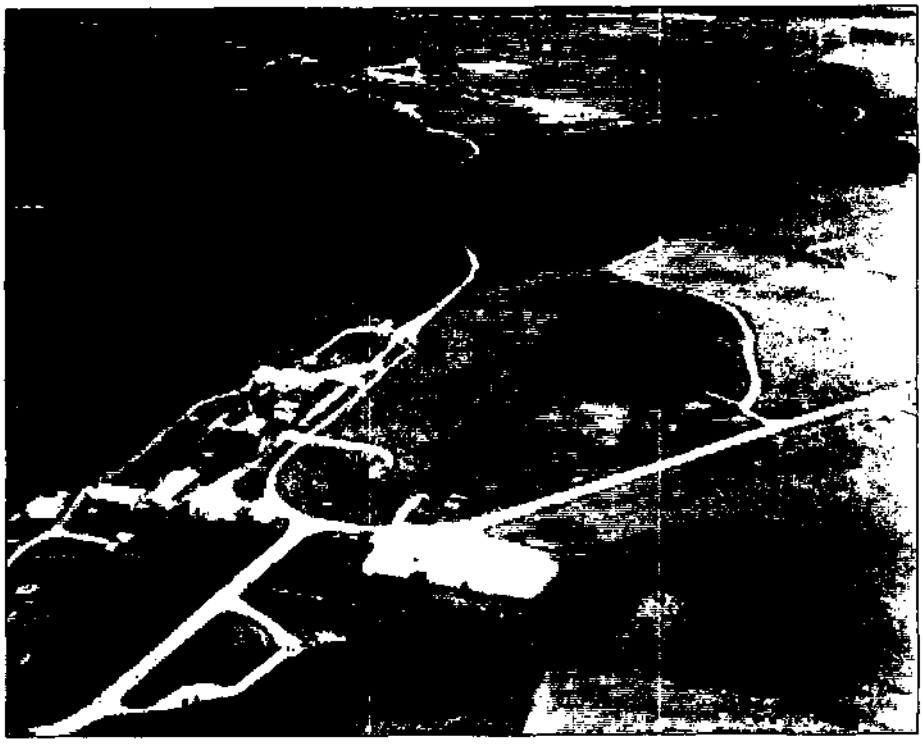
(Revised DRAFT FINAL)

Five-Year Review Report for Iowa Army Ammunition Plant Middletown, Iowa



February 2006

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APPENDICES

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ACRONYMS

AEC	Atomic Energy Commission
AMC	Army Materiel Command
amsl	Above Mean Sea Level
AO	American Ordnance
ARARs	Applicable, Relevant and Appropriate Requirements
BAECP	Burlington Atomic Energy Commission Plant
BERA	Baseline Ecological Risk Assessment
bgs	Below Ground Surface
CAMU	Corrective Action Management Unit
CEA	Cap Extension Area
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
COCs	Contaminants of Concern
CTA	Central Test Area
CWP	Contaminated Waste Processor
cy	Cubic Yards
DERA	Defense Environmental Restoration Account (currently called ER,A)
DERP	Defense Environmental Restoration Program
DNT	Dinitrotoluene
DOE	Department of Energy
DSERTS	Defense Site Environmental Restoration Tracking System
DU	Depleted Uranium
EBP	East Burn Pads
ECC	Environmental Chemical Corporation
EDA	Explosive Disposal Area
EE/CA	Engineering Evaluation/Cost Analysis
EPA	Environmental Protection Agency
ER,A	Environmental Restoration, Army (formerly called DERA)
ERC	Emergency Response Command Post
ESD	Explanation of Significant Differences
EWI	Explosive Waste Incinerator
FFA	Federal Facilities Agreement
FS	Feasibility Study
FUSRAP	Formerly Utilized Sites Remedial Action Program
FY	Fiscal Year
GAC	Granular Activated Carbon
GW	Groundwater
HMX	High Melting Explosives
HRS	Hazard Ranking Score
IAAAP	Iowa Army Ammunition Plant
IAG	Interagency Agreement
IDA	Inert Disposal Area
IDNR	Iowa Department of Natural Resources
IRA	Interim Remedial Action
IRP	Installation Restoration Program
LAP	Load, Assemble, Pack

LDR	Land Disposal Restriction
LTM	Long Term Monitoring
LTTD	Low Temp Thermal Desorption
MACS	Modular Artillery Charge System
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
ug/L	Micrograms per Liter
mg/Kg	Milligrams per Kilogram
MNA	Monitored Natural Attenuation
MW	Monitoring Well
NBP	North Burn Pads
NBPLF	North Burn Pads Landfill
NCP	National Contingency Plan
NFA	No Further Action
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Unit
PA	Preliminary Assessment
PCB	Polychlorinated Biphenyl
PCP	Pentachlorophenol
PEP	Pyrotechnic
POL	Petroleum, Oil & Lubricants
PP	Proposed Plan
ppb	Parts Per Billion
ppm	Parts Per Million
RA	Remedial Action
RA(C)	Remedial Action - Construction
RA(O)	Remedial Action - Operation
RAB	Restoration Advisory Board
RAD	Radionuclides
RC	Response Complete
RI	Remedial Investigation
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RDX	Royal Demolition Explosive
RGs	Remedial Goals
ROD	Record of Decision
RRSE	Relative Risk Site Evaluation
SARA	Superfund and Reauthorization Act
SECOM	Security Command
SI	Site Investigation
STP	Sewage Treatment Plant
SVE	Soil Vapor Extraction
SVOC	Semi-Volatile Organic Compound
SWMU	Solid Waste Management Unit
TBCs	To be Considered
TCE	Trichloroethene
TCLP	Toxicity Characteristics Leaching Procedure

TNT	Trinitrotoluene
USAEC	US Army Environmental Center
USACE	US Army Corps of Engineers
USACHPPM	US Army Center for Health Promotion and Preventive Medicine
USAEHA	US Army Environmental Hygiene Agency (currently called CHPPM)
USATHAMA	US Army Toxic and Hazardous Material Agency (currently USAEC)
UST	Underground Storage Tank
VOC	Volatile Organic Compounds
WAM	Wide Area Mine
WBPA	West Burn Pads Area
WBPLF	West Burn Pads Landfill

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EXECUTIVE SUMMARY

This Five-Year Review was performed for the Iowa Army Ammunition Plant (IAAAP) Superfund Site. The IAAAP facility has been divided into three Operable Units (OUs).

The scope of this review includes OUs 1, 3, and 4. OU-2 was originally established for soil removal actions, but was subsequently merged into OU-1. The primary focus of this review is OU-1. However, OU-3 and OU-4 are also addressed to provide current status and limited site summary information. The three OUs are summarized as follows:

- Soils OU-1 is intended to address the majority of the areas of contaminated soil at the IAAAP. It consists of an Interim Action to excavate contaminated soils from across the installation and consolidate them at the Inert Disposal Area (IDA), including the Soil Repository and Corrective Action Management Unit (CAMU), plus a Final Action to treat excavated soils, when required, and to address ultimate disposal of the soil. The Interim Action Record of Decision (ROD) for OU-1 was signed on March 4, 1998, to address remedial action to be taken at 15 areas throughout the IAAAP. The Final ROD for OU-1, was signed on September 29, 1998.

- Groundwater OU-3 is intended to address groundwater contamination on- and off-post resulting from IAAAP sources. The approach for addressing OU-3 currently entails two general response actions: 1) off-site groundwater; and 2) comprehensive on-site groundwater. The Army and EPA have signed an OU-3 ROD, effective in August 2005, for an off-site groundwater Interim Action. A separate ROD for comprehensive on-site Groundwater will be prepared to address groundwater contamination within IAAAP boundaries, where required.

- Installation-wide OU-4 was developed as a "miscellaneous" Operable Unit to address issues which were not fully evaluated in other OUs, and to ensure that all remaining necessary remedial actions at the IAAAP are carried out. OU-4 includes eco-risk issues, surface water/sediment issues, point source contamination, long-term monitoring requirements, land use restrictions, closure of the CAMU/IDA, miscellaneous soil contamination sites, and any other unacceptable risks not addressed in either OU-1 or OU-3. The ROD for OU-4 is currently scheduled for completion in late 2007.

The conclusion supported by this review is that since the remedial action at OU-1 is under construction and is not yet completed, the remedy at OU-1 is expected to be protective of human health and the environment upon completion. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

The remedy for OU-3 Off-Site Groundwater was selected during the preparation of this review and remedies for the remainder of OU-3 and OU-4 have not yet been selected. Therefore, protectiveness reviews for OU-3 and OU-4 are not included as a part of this Five-Year Review. Instead, OU-3 and OU-4 protectiveness issues will be addressed in future Five-Year Reviews.

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FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site name: Iowa Army Ammunition Plant		
EPA ID: IA7213820445		
Region: 7	State: IA	City/County: Middletown / Des Moines Co.
SITE STATUS		
NPL status: Currently on the Final NPL		
Remediation status (under construction, operating, complete): All apply		
Multiple OUs*: Yes	Construction completion date: Not yet complete	
Has site been put into reuse? Site currently used by Army for active production of ammunition, with operations dating back to 1941.		
REVIEW STATUS		
Lead agency (EPA, State, Tribe, Federal agency): U.S. Army		
Author name: USACE HTRW Center of Expertise (see report for review team members)		
Author(s) title: various	Author affiliation: U.S. Army Corps of Engineers HTRW Center of Expertise, Omaha, NE	
Review period: 01 April 2004 - 10 December 2004		
Date(s) of site inspection: 30 June 2004 - 01 July 2004		
Type of Review: Post-SARA		
Review Number: 1 (first)		
Triggering action event: Actual RA Start at OU #1.		
Trigger action date (from WasteLAN): 7/1/1999		
Due date: 7-1-2004		

* "OU" refers to operable unit.

Five-Year Review Summary Form, cont'd

Issues:

For OU-1:

1. Formalize current site controls.
2. Maintain minimum 6 inches of soil or other approved cover on Cap Extension Area at IDA.
3. Clear vegetation from drainage ditch near Cap Extension Area at the IDA.
4. Place signs or boundary markers delineating Trench 6 Boundaries at the IDA.
5. Maintain leachate levels in Trench 6 and the CAMU to no more than 1 foot above the primary liner system.
6. Monitor the condition of the sacrificial/temporary geosynthetic cover in the CAMU for continued deterioration, replace when necessary.
7. Clear brush from outlet at Line 800 Pinkwater Lagoon.
8. Remediation Goals for arsenic and beryllium may require re-evaluation.

Recommendations and Follow-up Actions:

Implement recommendations as shown in Paragraphs 3.7 of this report.

Protectiveness Statements:

OU-1:

Since the remedial action at OU-1 is under construction and is not yet completed, the remedy at OU-1 is expected to be protective of human health and the environment upon completion. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

OU-3:

The OU-3 ROD for Off-Site Groundwater was signed (in August 2005) during the preparation of this review, and the remedy for the remainder of OU-3 has not yet been determined. Therefore, a determination of protectiveness is not applicable at this time.

OU-4:

Since the OU-4 ROD has not been finalized, a determination of protectiveness is not applicable at this time.

STATEMENT OF PROTECTIVENESS

As required by CERCLA, the Army and EPA have completed the first Five-Year Review for the IAAAP. This Five-Year Review is required because hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unrestricted use/unrestricted exposure. This review evaluates the protectiveness of the OU-1 remedy.

Since the remedial action at OU-1 is under construction and is not yet completed, the remedy at OU-1 is expected to be protective of human health and the environment upon completion. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

The review indicates that while conditions at the IDA may be protective, conditions could be improved with relatively minor effort, consistent with the recommendations in this review, to ensure the safety and health of IDA workers and other potential exposure groups.

For the United States Army:

FEB 27 2006

Lt. Col. Jack T. Judy — Date
Commander
Iowa Army Ammunition Plant

For the United States Environmental Protection Agency:

3/23/06

Cecilia Tapia — Date
Director
Superfund Division
USEPA, Region VII

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1.0 INTRODUCTION

The purpose of the five-year review is to determine whether the remedy at a site is protective of human health and the environment. In addition, five-year review reports identify issues found during the review, if any, and include recommendations to address them.

Executive Order 12580 designates the United States Army (Army) as the lead agency under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) for responding to releases at or from Army facilities, such as the Iowa Army Ammunition Plant (IAAAP). The U. S. Environmental Protection Agency (EPA) and the Army signed a Federal Facility Agreement (FFA) for site cleanup, which became effective December 10, 1990. The FFA provides a framework for CERCLA response actions to be performed at the IAAAP, including the investigation and cleanup of contamination, and conducting five-year reviews. The EPA oversees the cleanup activities conducted by the Army to ensure that requirements of CERCLA/ Superfund Amendments and Reauthorization Act (SARA), the National Contingency Plan (NCP), and the FFA between the Army and the EPA have been met. The State of Iowa is not a signatory to the FFA, but has participated in the review of CERCLA clean-up activities at the IAAAP. The Army is preparing this five-year review pursuant to CERCLA §121 and the NCP. CERCLA §121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The agency interpreted this requirement further in the NCP; 40 CFR §300.430(f)(4)(ii) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

This is the first five-year review for the IAAAP. The triggering action for this statutory review is the initiation of remedial action on 7-1-1999 in Operable Unit 1 (OU-1). The five-year review is required because hazardous substances, pollutants, or contaminants remain at sites within the IAAAP above levels that allow for unlimited use and unrestricted exposure. This review evaluates protectiveness of the OU-1 remedy. The remedy for OU-3 off-post groundwater was selected during the preparation of this review, and remedies for the remainder of OU-3 and for OU-4 have not yet been selected. Therefore, a protectiveness review for OU-3 and OU-4 is not included as a part of this review.

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2.0 BACKGROUND

2.1 PHYSICAL CHARACTERISTICS

The IAAAP is a load, assemble, and pack (LAP) munitions facility located in Middletown, a rural area of eastern Iowa, 10 miles west of Burlington in Des Moines County and approximately nine miles northwest of the Skunk and Mississippi Rivers. The IAAAP is located on approximately 19,000 acres. The northern area of the IAAAP consists of gently undulating terrain; the central portion is characterized by rolling terrain dissected by a shallow drainage system, while the southern area of the site contains drainage ways with steep slopes down to the creek beds. Elevations within the IAAAP range from 730 feet above mean sea level (amsl) in the north to 530 feet amsl in the south.

The IAAAP contains five watersheds. The Brush Creek watershed comprises the central portion of the facility; Brush Creek exits at the southeastern boundary and flows into the Skunk River, which then flows into the Mississippi River. The Spring Creek watershed drains the eastern portion of the facility; Spring Creek exits at the southeastern corner and flows directly into the Mississippi River. The Long Creek watershed comprises the western portion of the IAAAP; Long Creek exits at the southwestern boundary and joins the Skunk River just south of the facility. Long Creek has been dammed near the center of the facility to create the 85-acre George H. Mathes Lake. Use of this lake by the plant as a water source was discontinued in January 1977. The Skunk River watershed comprises the southwest corner of the IAAAP; Skunk River borders the facility's perimeter on the southwest corner and provides year-round recreational use. The Little Flint Creek watershed comprises a small area in the north portion of the facility.

2.2 LAND AND RESOURCE USE

The IAAAP produced munitions for World War II from the plant's inception in September 1941 until August 1945, and munitions for military activities in southeast Asia in the 1960s and early 1970s. Activities at the IAAAP continued at a reduced level during peacetime. The plant was operated from 1941 to 1946 by Day & Zimmerman Corporation. Between 1946 and 1951, the IAAAP was operated by the Government for munitions storage and ammunition surveillance activities. The former Atomic Energy Commission (AEC) operated at Line 1 from 1947 through mid-1975, at which time operation reverted to Army control. The Army continues to own the IAAAP, which was operated by the private contractor Mason & Hanger Corporation between 1951 and 1998.

The IAAAP is currently an active U.S. Army Joint Munitions Command facility operated by the civilian contractor American Ordnance LLC. IAAAP's current mission is to LAP ammunition items, including projectiles, mortar rounds, warheads, demolition charges, and munitions components such as fuzes, primers, and boosters. Since the installation is an active production plant, inactive lines are maintained on a standby status or leased to other contractors.

On the IAAAP, approximately 8,000 acres are leased for agricultural use, about 7,500 acres are forested, and the remaining areas are used for administrative and industrial operations. Hunting and fishing is regulated at the IAAAP through the use of permits. The anticipated future land use at the IAAAP is expected to be of the commercial/industrial type. Public access to the installation is restricted due to perimeter fencing and IAAAP installation security staff.

The demographic setting of IAAAP surrounding area is characterized as rural. The most important population centers--in terms of size--are the towns of Burlington (~28,000), West Burlington (~3,000), Middletown (~400), and Danville (~900). The rural area south (downgradient) of IAAAP is sparsely populated. Approximately 50 people live in Augusta, an unincorporated town approximately 1 mile from the south-southwestern boundary along the Skunk River.

Croplands comprise about 60 percent of the county; the remaining area is composed of 10 percent urban use, eight percent pasture use, and 22 percent woodland or idle land. Crops grown in the area consist mostly of corn and soybeans.

The anticipated future land use surrounding the IAAAP is not expected to change significantly over time, and is expected to remain largely rural.

2.3 HISTORY OF CONTAMINATION

The primary source of contamination at the site is attributable to past industrial and laboratory operating practices involving various explosive-laden sludges, wastewaters and solids, lead-contaminated sludges, ashes from incineration and open burning of explosives, and waste solvents. Past operations also generated waste pesticides and incendiaries. Radioactive wastes may have been generated by the AEC weapons assembly and component testing operations.

The primary contaminants at the installation are the explosives royal demolition explosive (RDX) and trinitrotoluene (TNT). Other contaminants such as pesticides, fuel products, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals are also present in some on-site areas. Most of the contamination is contained within the industrial areas of the installation, although an explosive-related contamination plume has developed off-site near Brush Creek, south of the IAAAP. This plume is approximately 1.5 miles long by 1 mile wide. RDX levels of up to approximately 200 parts per billion (ppb) have been detected in the plume. Surface water drainage is the primary off-site migration pathway for IAAAP contaminants from three primary drainages: Brush Creek, Spring Creek, and Long Creek. The Brush Creek and Long Creek drainages are intercepted by the Skunk River, which flows east toward the Mississippi River. The Spring Creek drainage is intercepted by the Mississippi River. A small area in the northern part of the installation (Yard L) drains into the Little Flint Creek Watershed.

2.4 SUMMARY OF INITIAL RESPONSE

Pursuant to the Resource Conservation and Recovery Act (RCRA) Hazardous and Solid Waste Amendments (HSWA) of 1984, the USEPA completed an assessment of the facility in 1987

(USEPA 1987) and reported that releases had occurred. The IAAAP was subsequently proposed for the National Priorities List (NPL) in August 1989 and, in August 1990, the facility was placed on the NPL with a Hazard Ranking Score (HRS) of 29.73.

The Department of Defense (DOD) has established the Defense Environmental Restoration Program to address sites under CERCLA, as amended by the SARA that are within the responsibility of the DOD. The EPA and the Army negotiated a FFA for site cleanup, which became effective December 10, 1990. The FFA provides a framework for CERCLA response actions to be performed at the IAAAP, including the investigation and cleanup of contamination. The EPA oversees the cleanup activities conducted by the Army to ensure that requirements of CERCLA/SARA, the NCP and the FFA between the Army and the EPA have been met. The State of Iowa is not currently a party to the FFA, however, the State has expressed a desire to be included on the IRP FFA in the future.

In 1992, a facility-wide Preliminary Assessment/Site Investigation (PA/SI) of the 44 sites with potential contamination was completed. In 1993, off-post contamination of private drinking water wells with explosives [RDX and 2,6-dinitrotoluene (DNT)] was confirmed. The IAAAP offered to connect residents south of the installation to the Rathbun Regional Water Supply. One hundred and fifty-four residences accepted the Army's offer.

In 1996, a facility-wide Remedial Investigation (RI)/Risk Assessment (RA) for 35 of the 44 sites was completed. Two of the sites had ongoing RIs and were not addressed; the remaining seven sites were recommended for no further action.

The IAAAP facility was originally divided into four operable units (OUs- 1, 2, 3, and 4) to facilitate project management. OU-2, originally established for soil removal actions, has been subsequently merged into OU-1. The three remaining OUs are described as follows:

- Soils OU-1 is intended to address the majority of the areas of contaminated soil at the IAAAP. It consists of an Interim Action to excavate contaminated soils from across the installation and consolidate them at the Inert Disposal Area (IDA), including the Soil Repository and Corrective Action Management Unit (CAMU), plus a Final Action to treat excavated soils, when required, and to address ultimate disposal of the soil. The OU-1 Record of Decision (ROD) specified Low Temperature Thermal Desorption (LTTD) or biological treatment of explosive-contaminated soils. The Interim Action ROD for OU-1 was signed on March 4, 1998, to address the remedial action to be taken at 15 areas throughout the IAAAP. The interim remedial action was chosen in accordance with CERCLA, as amended by SARA, and to the extent practicable, the NCP. The Final ROD for OU-1 was signed on September 29, 1998.

- Groundwater OU-3 is intended to address groundwater contamination on- and off-post, resulting from IAAAP sources. The approach for addressing OU-3 currently entails two general response actions: 1) Off-Site Groundwater; and 2) Comprehensive On-Site Groundwater. The Army and EPA have signed an OU-3 ROD, effective in August 2005, for an Off-Site Groundwater Interim Action. A separate ROD for Comprehensive On-Site Groundwater will be prepared to address groundwater contamination within IAAAP boundaries, where required.

- Installation-wide OU-4 was developed as a "miscellaneous" OU to address issues which were not fully evaluated in other OUs, and to ensure that all remaining necessary remedial actions at the IAAAP are carried out. OU-4 includes eco-risk issues, surface water/sediment issues, point-source contamination, long-term monitoring requirements, land use restrictions, closure of the CAMU/IDA, miscellaneous soil contamination sites, and any other unacceptable risks not addressed in either OU-1 or OU-3. The OU-4 ROD is currently scheduled for completion by late 2007.

In 2001, IAAAP provided connection to 34 additional homeowners located south of the IAAAP who had rejected the Army's original offer for hook-up to the Rathbun Regional Water Supply in 1993. This brought the total number of homes connected to the Rathbun Regional Water Supply to 188.

On April 16, 2003, an Explanation of Significant Differences (ESD) for the OU-1 ROD was signed, with regards to updated soils treatment technologies, the discovery of a larger quantity of contaminated soil than was expected at the West Burn Pads Area (WBPA), and to include a remedy for soils contaminated with only metals. The ROD stated that 1,451 cubic yards (cy) of contaminated soil would be removed from the WBPA, however approximately 46,500 cy were actually removed.

2.5 GENERAL BASIS FOR TAKING ACTION

During the RI/ Feasibility Study (FS), an analysis was conducted to estimate the health or environmental problems that could result if the soil contamination at IAAAP was not cleaned up. This analysis is referred to as a Baseline Risk Assessment (BLRA). In conducting the BLRA, the focus was on the health effects that could result from direct exposure to contaminants as a result of the soil coming into contact with the skin or from direct ingestion of the soil. The analysis identified explosives as the major contaminants of concern. Metals and SVOCs were also identified as contaminants of concern at certain sites. The BLRA for the IAAAP identified unacceptable risk based on a future commercial/industrial land use setting due to possible incidental ingestion and dermal contact with contaminated soils. The BLRA also identified unacceptable risk associated with potential consumption of contaminated groundwater on-site. Site soils have been determined to be acting as a continuing source of groundwater contamination at unacceptable levels.

The BLRA provided the basis for the response actions that determined what soils were to be excavated and either disposed in the Soil Repository of the Inert Landfill or stockpiled in the CAMU for subsequent treatment. Under CERCLA, containment of low-level threats is acceptable while treatment of principal threats to permanently reduce contaminant toxicity, mobility, and volume is preferred. Principal threats are defined as the most highly contaminated, most toxic, and most mobile source materials. Under the Interim Action ROD, highly contaminated soils (cumulative risk between 10^{-5} and 10^{-6}) and lightly contaminated soils (cumulative risk less than 10^{-6}) were considered to present low-level threats and therefore were permanently disposed in the Soil Repository or under the Inert Landfill cap. Potential groundwater impacts as measured by the Summer's model and Land Disposal Restrictions (LDRs) were also considered in identifying principal threats and low-level threats.

2.6 FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM (FUSRAP) ACTIVITIES

2.6.1 General

Due to past AEC activity at the IAAAP, portions of the installation have been included in the U.S. Army Corps of Engineers (USACE) Formerly Utilized Sites Remedial Action Program (FUSRAP), a program that addresses environmental impacts associated with past AEC operations. The site was added to FUSRAP in 2002. As of January 2006, EPA and the State of Iowa were negotiating with the USACE to develop a FFA to specifically address FUSRAP actions at the IAAAP. Upon conclusion of the FUSRAP FFA negotiations, the parties may re-open the IRP FFA to also include the State of Iowa.

2.6.2 Status

Pursuant to FUSRAP, the USACE is tasked with responding to all releases and threats of releases of hazardous substances, pollutants or contaminants, with the exception of ground and surface water contamination [to be addressed by Army Installation Restoration Program (IRP)] for the following areas on the IAAAP:

- Line 1 (existing IRP OU-1 ROD addresses chemical remedial action requirements – remedy not implemented)
- Firing Site Area (ROD not complete)
- WBPA [south of the road] (existing IRP OU-1 ROD addresses chemical remedial action requirements – remedy not implemented)
- Warehouse 3-01 (ROD not complete)
- Yard G (ROD not complete)
- Yard C (ROD not complete)
- Yard L areas surrounding Warehouses L-1, L-2, and L-3 (ROD not complete).

In addition, the USACE has evaluated the following areas (currently under the authority of the IRP, administered by IAAAP) in accordance with a radiological screening plan:

- IDA (the IDA is integral to the IRP OU-1 ROD)
- Demolition Area/Deactivation Furnace (addressed in the IRP OU-1 ROD)
- Former Line 1 Impoundment (IRP OU-1 ROD addresses any future chemical remedial action requirements, a removal action has occurred in this area)

- North Burn Pads (NBP) and North Burn Pads Landfill (NBPLF) (addressed in the IRP OU-1 ROD, remedial action has been taken)
- WBPA (north of road) (addressed in the IRP OU-1 ROD, remedial action has been taken)
- East Burn Pads (EBP) (addressed in the IRP OU-1ROD, remedial action has been taken)

The results of the evaluation were under review at the time this Five Year Review was being prepared.

The purpose of the FUSRAP-funded screening at these areas is to determine if radiological contaminants from AEC activities at the IAAAP are present. If the Army, EPA, and State of Iowa determine that an area is free of radiological contamination from AEC activities, no further action will be taken in that area pursuant to FUSRAP, and the responsibility for any additional remediation will remain the responsibility of the IAAAP in accordance with the 1990 IAAAP FFA.

2.7 GENERAL FIVE-YEAR REVIEW INFORMATION AND DATA

2.7.1 Community Notification and Involvement

Initial community notification was accomplished by providing a Five-Year Review presentation at the May 13, 2004, Restoration Advisory Board (RAB) meeting held in Burlington, Iowa. Public comment and information survey forms were made available for anyone to provide input regarding their concerns and overall impressions of the clean-up progress at IAAAP. In addition, a public notice was placed in the local paper, *The Hawk Eye*, which ran from June 22 through June 30, 2004. A copy of the notice is in Appendix E. To date, there have been no survey forms returned or any verbal inquiries regarding this Five-Year Review. A follow-up presentation on the status of the Five-Year Review was provided at the November 16, 2004, RAB meeting held in Burlington, Iowa.

2.7.2 Document Review

A list of documents reviewed is contained in Appendix A.

2.7.3 Data Review

The summarized data and laboratory reports were reviewed, as available, from documents listed in Appendix A. For those areas where remedial action has been completed, data pertaining to current operations are included in Appendix B in this report.

2.7.4 Site Inspection

A site inspection was held at the IAAAP on June 30 and July 1, 2004. The purpose of the inspection was to visually assess the protectiveness of the completed remedies at IAAAP. Those participating on the inspection are as follows:

Rodger Allison	IRP Manager, IAAAP
Steve Bellrichard	FUSRAP IAAAP PM, IAAAP
Melenie Wonderlich	IAAAP IRP Support, MKM Engineers
Greg Mellema	USACE HTRW-CX
Ben Letak	USACE CENWO-ED
Debra Wallin	USACE CENWO-CD
Scott Marquess	EPA Project Manager, EPA Region 7
Daniel Cook	Senior Environmental Specialist, Iowa Dept. of Natural Resources

The site inspection began with a pre-inspection meeting held at the IDA conference room. Specific findings for the areas visited are provided in Chapters 3, 4 and 5 of this report. Site photos are provided in Appendix C, and a site inspection checklist is included in Appendix D.

2.8 NEXT FIVE-YEAR REVIEW

The next Five-Year Review is scheduled for completion no later than five years from the signature date of this report.

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3.0 OPERABLE UNIT 1 (OU-1)

3.1 GENERAL

OU-1 was established to address the majority of the areas of contaminated soil at the IAAAP. It consists of an Interim Action to consolidate contaminated soils from across the installation at the Soil Repository and the CAMU, and a Final Action to specify a treatment technology for soils stored in the CAMU. The OU-1 ROD specifies LTTD or biological treatment of explosive-contaminated soils. The Interim Action ROD for OU-1 was signed on March 4, 1998, to address the remedial action to be taken at 15 areas throughout the IAAAP. The interim remedial action was chosen in accordance with CERCLA, as amended by SARA, and to the extent practicable, the NCP. The Final ROD for OU-1 was signed on September 29, 1998.

Numerous response actions have been implemented to address soil contamination under OU-1. In the summer of 1995, the Army completed cleanup actions to address soil contamination at a former pesticide pit and at numerous explosive-wastewater sump locations.

In 1997, removal actions were completed at the Line 1 Impoundment and Line 800 Pinkwater Lagoon sites, where explosives-contaminated soils were excavated and subsequently segregated for disposal purposes at the IDA.

As of 2005, contaminated soils have been excavated from a number of areas at the IAAAP, including Lines 5A and 5B, Line 9, EBP, West Burn Pads Area (WBPA), NBP, NBPLF, Fire Training Pit (FTP), and other areas on the IAAAP.

Low-level contaminated soils were used as random fill material at the Inert Disposal Landfill, which was subsequently capped with a geosynthetic cover system in late 1997. Low-level contaminated soils are also located in the Cap Extension Area (CEA). Mid-level contaminated soils have been disposed in a RCRA-equivalent landfill, the Trench 6 Soil Repository, which is constructed adjacent to the Inert Disposal Landfill. The most highly contaminated soils have been temporarily stockpiled in a RCRA waste pile facility, designated by EPA as a CAMU, also adjacent to the Inert Disposal Landfill. The soils stockpiled in the CAMU will ultimately be treated as specified in the Soils OU-1 Final ROD. Construction of the Trench 6 Soil Repository and the CAMU was completed in November of 1996. Both facilities are constructed to RCRA Subtitle C standards, consisting of a double (synthetic) liner system, leachate collection, and leak detection features. The CEA is an unlined soil disposal area. These soil management cells will be closed at the completion of the site-wide remediation activities at IAAAP.

3.1.1 OU-1 Interim Action ROD Components

The remedy for the OU-1 Interim Action consists of the following primary elements:

- Excavation of soils contaminated at levels exceeding Remediation Goals (RGs) from 15 remediation areas.
- Verification sampling to ensure RGs are met in the 15 remediation areas. Restoration of excavated areas to original conditions.
- Segregation of the excavated soils according to contaminant type and concentration.

- Temporary storage of the most highly contaminated soils in the on-site CAMU. Treatment of soils stored in the CAMU as specified in the final ROD for the soils OU.
- Permanent disposal of soils contaminated at lesser levels in the on-site Soil Repository or in the on-site Inert Disposal Landfill.
- Solidification/stabilization of metals-contaminated soils at levels exceeding LDR criteria, and permanent disposal in the on-site Soil Repository.

The process for past soil excavations from the various sites at the IAAAP was generally performed in the following manner:

- An approved Excavation Plan was developed.
- A survey of existing conditions was performed.
- Each of the sites were cleared and grubbed and any wastes from this activity was disposed in the IDA.
- Surface-water control was established.
- A site reconnaissance was performed with the USACE to establish project sampling locations.
- Based on sample locations, a node-centered grid was established for each area.
- Based on characterization results, soil removals were performed. Each cell's excavated material was assigned to either the CAMU or the Trench 6 Soil Repository; the field analytical data coordinator was present on site to ensure that excavated material was assigned and disposed in the proper cells. Additionally, observations were made in the field where visibly contaminated soil or debris was removed and disposed. Horizontal and vertical survey controls were established for each area during the excavation phase.
- Where appropriate, waste water was collected and treated by the Granular Activated Carbon (GAC) units.
- Once the final soil excavation was completed at a site, verification samples were collected and analyzed.
- An as-excavated survey was performed.
- Clean fill soil was placed in the excavations; the soil was compacted to meet specification criteria. Fill was generally obtained from approved areas; chemical sampling and analysis of the clean soil was performed prior to its use as fill soil.
- Topsoil and erosion matting was added where appropriate.
- All roads in the work area were covered with gravel, shaped, and compacted. New culverts were added where appropriate.
- Vegetation was placed on the final grade.

3.1.2 OU-1 Interim Action ROD Remediation Goals

RGs for the IAAAP were established based on risk considerations (see Table 3-1). These include criteria associated with ingestion of and dermal contact with contaminated soils by the reasonably maximum exposed individual, as well as criteria to evaluate possible leaching of contaminants from soils to groundwater at unacceptable levels. For the IAAAP, RGs were established at a target carcinogenic risk of 10^{-6}, consistent with the NCP. Commercial/industrial land use is the current and reasonably anticipated future land use at the site upon which the RGs were based.

Table 3-1 Soil Remediation Goals at 10^{-6} Risk Level Based on Ingestion/Dermal Contact

Chemical	PRG (µg/g)
Antimony	816
Arsenic	30
Beryllium	5
Cadmium	1,000
Chromium VI	10,000
Lead	1,000
Thallium	143
Benzo(a)anthracene	8.1
Benzo(a)pyrene	0.81
Benzo(b)fluoranthene	8.1
Dibenz(a,b)anthracene	0.81
Total PCBs	10
1,3,5-Trinitrobenzene	102
2,4-Dinitrotoluene (2,4-DNT)	8.7
2,4,6-TNT	196
RDX	53
HMX	51,000
Radionuclides	**PRG (pCi/g)**
Actinium 228	0.014
Bismuth 214	0.008
Potassium 40	0.74

In addition to risk-based soil RGs for protection of human health, the impact to groundwater from residual soil contamination was evaluated. The Summers' model was utilized to estimate the level at which contaminant concentrations in soils will produce groundwater contamination at concentrations above acceptable levels. The Summers' model was used to determine acceptable levels for the explosives RDX and 2,4,6-TNT in soils. The model was not used for metals, as metals are relatively immobile in the clay soils found at the IAAAP. The site-specific "leaching" RGs for these explosives are presented in Table 3-2.

Table 3-2 Soil Remediation Goals: Leaching

Chemical	PRG (µg/g)
RDX	1
2,4,6-TNT	47

Currently, the FFA parties have discussed amending the ROD to revise the remediation goals for radiological constituents, shown in Table 3-1 that are commensurate with background radiation. This issue is currently being evaluated by the parties.

3.1.3 OU-1 Final ROD Components

The remedial action presented in the Final ROD is intended to provide for treatment and ultimate disposal of soils, which are being temporarily stockpiled in the CAMU as a result of the interim action. Soils stockpiled in the CAMU are managed based on the nature of the contamination: 1) explosives-contaminated soils; 2) explosives plus metals contaminated soils; and 3) SVOC-contaminated soils.

The major components of the remedy include:

Explosives-Contaminated Soils:

- Excavate explosives-contaminated soils from the CAMU and transport it to a temporary treatment facility on-site.
- Screen, shred and blend the soil to produce a uniform feed material.
- Process the blended soil through a mobile direct-fired LTTD unit (selected remedy) or a temporary Biological Treatment Unit (contingent remedy).
- Following confirmation sampling, dispose of treated soil according to the following criteria: 1) For soils with cumulative risks less that 10^{-6}, in compliance with LDRs, and exceeding *Summers' model remediation goals, dispose in the Soil Repository* or under another synthetic landfill cap on-site; and 2) For soils with cumulative risks less than 10^{-6}, in compliance with LDRs, and satisfying Summers' model remediation goals, dispose on IAAAP property in an appropriate manner protective of human health and the environment. For Biotreated soils, treatment residuals must also be shown to be non-toxic or not bioavailable at levels posing a threat to human health or the environment.

Explosives Plus Metals Contaminated Soils

- Excavate explosives plus metals contaminated soil from the CAMU and transport it to a temporary treatment facility on-site.
- Screen, shred and blend the soil to produce a uniform feed material.
- Process the blended soil through a temporary solidification/stabilization facility.

- Following sampling to confirm compliance with Toxicity Characteristics Leaching Procedure (TCLP) based remediation goals, dispose of treated soil on-site in the Soil Repository or under another synthetic landfill cap.

SVOC-Contaminated Soils

- Excavate SVOC-contaminated soil from the CAMU.
- Transport the soil to a commercial waste treatment and disposal facility off-site.

3.1.4 OU-1 Final ROD Remediation Goals

Chemical-specific remediation goals were established for treatment of soils stockpiled in the IAAAP CAMU. The treatment goals are based on risk considerations and have been established at the 10^{-6} risk level to the reasonably maximum exposed individual considering an industrial land use setting. Remediation goals presented in the OU-1 Final ROD are shown in Table 3-3. In addition, remediation goals were established for impacts to groundwater from residual soil contamination. The Summers' model was utilized to estimate the point at which contaminant concentrations in the soils will produce groundwater contamination at concentrations above acceptable levels. These goals are as presented in Table 3-4.

Table 3-3 Soil Remediation Goals at 10^{-6} Risk Level Based on Ingestion/Dermal Contact

Chemical	PRG (µg/g)
Antimony	816
Arsenic	30
Beryllium	5
Cadmium	1,000
Chromium VI	10,000
Lead	1,000
Thallium	143
Benzo(a)anthracene	8.1
Benzo(a)pyrene	0.81
Benzo(b)fluoranthene	8.1
Dibenz(a,b)anthracene	0.81
Total PCBs	10
1,3,5-Trinitrobenzene	102
2,4-Dinitrotoluene (2,4-DNT)	8.7
2,4,6-TNT	196
RDX	53
HMX	51,000

Table 3-4 Soil Remediation Goals: Based on Soil Leaching

Chemical	PRG (µg/g)
RDX	1.3
2,4,6-TNT	47.6

3.1.5 Explanation of Significant Differences for the OU-1 Final ROD

The Selected Remedy for the explosives-contaminated soils was on-site treatment using a mobile direct-fired LTTD unit. However, due to safety, performance, and cost considerations, a Contingency Remedy, using biological treatment for the explosives-contaminated soils, was also identified in the Final OU-1 ROD. In 2001, the Army determined it would be appropriate to implement the biological treatment Contingency Remedy in lieu of the LTTD Selected Remedy. This change required the preparation of an ESD. Site-specific treatability studies were performed on IAAAP soil to verify that biological treatment technology would be able to meet or exceed performance standards established in the ROD.

In addition, it became necessary for the Army to treat soil contaminated with metals only, a situation that was not directly addressed by the OU-1 Final ROD. This situation was encountered during the remediation of the WBPA in 2000. A large fraction of those soils required treatment for metals contamination only, due to high barium concentrations, and to a lesser degree, lead. The revised remedy proposed in the ESD was solidification/stabilization for metals contaminants.

As a result of these factors, the Army and EPA concluded that it was appropriate to revise the OU-1 Final ROD to address these changes, and to document them in an ESD.

3.2 OPERABLE UNIT 1 ROD SITES

3.2.1 General

A summary of past site actions for the OU-1 ROD sites is provided in Table 3-5. Site-specific details and discussion are provided in subsequent paragraphs.

3.2.2 Line 1 (IAAP-001)

3.2.2.1 Background

Line 1 is an ammunition production line that has been in operation since the inception of IAAAP in 1941. In 2000, the Line was split, thereby creating an active area called Line 1A. This area contains approximately 15.9 acres and 151 buildings. Activities in this area include Metrology and Chemical Labs, Tool & Die Shop, Electronic Shop, Ammunition Surveillance, DU Demil, Steam Plant, Research and Development, and production for MACS and WAM. All other areas of Line 1 are inactive and surrounded by perimeter fencing. In addition, the active area has been fenced off and secured from the inactive area. The entire site, Lines 1 and 1A combined, occupies approximately 188 acres. The majority of the contamination occurred as a result of building wash downs and sump failures.

Table 3-5 Summary of OU-1 Soil ROD Sites

Site	Past Site Actions and Current Schedule
Line 1	As part of a removal action, eleven sumps were removed in 1995. In accordance with the OU-1 Interim ROD, approximately 600 cy of soil were removed in 2000. Line 1 is listed as a site to be addressed by FUSRAP. FUSRAP will respond to all releases and threats of releases of hazardous substances, pollutants, or contaminants, with the exception of groundwater and surface water contamination.
Line 2	As part of a removal action, seven sumps were removed in 1995. Currently, remaining contaminated soils have not been excavated and placed in the IDA. The remedial actions to be implemented by the Army will consist of additional contaminant delineation and contaminated soil excavation and placement in the IDA for treatment and/or disposal. Remedial actions are to be completed in 2007 as part of Phase 8 activities.
Line 3	As part of a removal action, three sumps were removed in 1995. Currently, remaining contaminated soils have not been excavated and placed in the IDA. The remedial actions to be implemented by the Army will consist of additional contaminant delineation and contaminated soil excavation and placement in the IDA for treatment and/or disposal. Remedial actions are to be completed in 2007 as part of Phase 7 activities. Building 3-01 is to be addressed by FUSRAP.
Line 3A	Currently, soils have not been excavated and placed in the IDA. The remedial actions to be implemented by the Army will consist of additional contaminant delineation and contaminated soil excavation and placement in the IDA for treatment and/or disposal. Remedial actions are to be completed in 2007 as part of Phase 7 activites.
Lines 4A & 4B	As part of a removal action, one sump was removed from Line 4A in 1995. Currently, no other soils have been excavated and placed in the IDA. According to the Phase 4 Sites Supplemental Remedial Design Sampling done in 2003 and 2004, no contamination concentrations above remediation levels were found. It is anticipated that no additional actions will be required at this site.
Lines 5A & 5B	As part of a removal action, eighteen sumps were removed in 1995. In 1999, approximately 1,065 cy of contaminated soil were removed and placed in the IDA. It is anticipated that no additional actions will be required at this site.
Line 6	As part of a removal action, three sumps were removed in 1995. Currently, remaining contaminated soils have not been excavated and placed in the IDA. The remedial actions to be implemented by the Army will consist of additional contaminant delineation and contaminated soil excavation and placement in the IDA for treatment and/or disposal. Remedial actions are to be completed in 2007 as part of Phase 5 activities.
Line 8	According to the Phase 4 Sites Supplemental Remedial Design Sampling, done in 2003 and 2004, no contamination concentrations above remediation levels were found. It is anticipated that no additional actions will be required at this site.

Table 3-5 Summary of OU-1 Soil ROD Sites (continued)

Site	Past Site Actions and Current Schedule
Line 9	As part of a removal action, five sumps were removed in 1995. In 2003, Phase 4 Sites Supplemental Remedial Design Sampling indicated that contaminated soils above remediation levels were found. In the Phase 4 Sites Remedial Action, completed in 2004, 120 cy of soil was removed. No other areas were identified as requiring further excavation at that time. It is anticipated that no additional actions will be required at this site.
Line 800	In 1999, a sump at Building 800-192 and approximately 20 cy of soil were removed. The remedial action to be implemented by the Army will consist of additional contaminant delineation, contaminated soil excavation and placement in the IDA for treatment and/or disposal. Remedial actions are to be completed in 2007 as part of Phase 5 activities.
East Burn Pads	In 1998, approximately 12,670 cy of soil were removed from the EBP. This site is to be evaluated by FUSRAP. FUSRAP will determine if radiological contaminants from AEC activities are present. Should this area be found to be free of radiological contamination from AEC activities, no further action will be taken in that area pursuant to FUSRAP. It is anticipated that no additional actions will be required at this site.
Demolition Area/Deactivation Furnace	The Demolition Area/Deactivation Furnace area is a site being evaluated by FUSRAP. FUSRAP will determine if radiological contaminants from AEC activities are present at the site. Results from the screening have not been finalized to date. Should this area be found to be free of radiological contamination from AEC activities, no further action will be taken in that area pursuant to FUSRAP. The Interim ROD requires the removal of 753 cy of lead-contaminated soil from the Deactivation Furnace subsite. This site is currently permitted for continued use of the OB/OD area.
Burn Cages/West Burn Pads Area	In 1998, approximately 46,496 cubic yards of contaminated soil was removed from the WBPA (north of the road). The site is listed as a site to be addressed by FUSRAP. For the area south of the road, FUSRAP will respond to all releases and threats of releases of hazardous substances, pollutants or contaminants, with the exception of ground and surface water contamination.
North Burn Pads Area	In 1998, approximately 2990 cy of soil was excavated from the NBP Area, which was taken to the Trench 6 Soil Repository. The NBP Area is listed as a site to be evaluated by FUSRAP. FUSRAP will determine if radiological contaminants from AEC activities are present at the site. Should this area be found to be free of radiological contamination from AEC activities, no further action will be taken in that area pursuant to FUSRAP. It is anticipated that no additional actions will be required at this site.
Roundhouse Transformer Storage Area	According to the ROD, 599 cy of soil was estimated for excavation. According to the Phase 4 Sites Supplemental Remedial Design Sampling done in 2003 and 2004, no contamination concentrations above remediation levels were found. It is anticipated that no additional actions will be required at this site.

The AEC operated a portion of Line 1 between 1947 and 1975. In 1947, the IAAAP was selected as the first production facility for manufacturing of high explosives components for weapons under the AEC. Detailed information regarding the history of Line 1 activities can be found in the TN & Associates Historical Site Assessment (September 2001).

Figures of the Line 1 Site and related investigations are provided in Tab 1 of Appendix F.

3.2.2.2 Remedy Status

The PA/SI completed by JAYCOR in 1991 indicated that there was a potential for contamination at Line 1. As a result of the PA/SI, further investigation was conducted as part of the RI, which was completed in May 1996 (JAYCOR, 1996). Subsequent to the RI, an FS and a BLRA were performed.

The IAAAP Interim ROD required that contaminated soils be removed and taken to the IDA (IAAP-020) and sorted by contaminant level and type. The Interim ROD estimated this would involve the removal of approximately 7,410 cy (220 cy metals, 4,850 cy explosives, 1,480 cy explosives and metals, 590 cy VOCs, and 270 cy radionuclide) contaminated soil.

As part of a removal action, eleven sumps and associated soils were removed in 1995, as further described in Section 3.3.6 of this report. In 1997, a removal action at the Line 1 Impoundment occurred, as further described in Section 3.3.4 of this report.

The Remedial Action for Line 1, as required in the 1998 Interim ROD has not been completely implemented. However, in May 2000, a total of 600 cy of material was removed from the Line 1 North Sump area, located at Building 1-05-2. All of this material was placed in the Trench 6 Soil Repository for final disposition. Sampling and testing showed that all material was excavated to below excavation criteria with the exception of one area. This area is between the metal support frame holding up the escape slide and Building 1-05-2. This area was not excavated due to the confinement of the area and logistical problems encountered. The excavated area was backfilled with clean soil and revegetated.

Explosives, metals, and SVOC contamination was identified at the Line 1 South Sump area, located at Building 1-05-2. A Phase II sampling plan was submitted by Environmental Chemical Corporation (ECC) that outlined further characterization and subsequent removal of contaminated soil at this site. Within the document the logistical problems and the feasibility of a cost-effective approach to remediation was discussed. The USACE determined that because of the logistical problems associated with this site, extra sampling or soil removal at the time would not be cost effective.

A Supplemental RI (TN & Associates, 2002) was completed in 2002 to further characterize contamination from explosives, metals, VOCs, and SVOCs, but did not include radiological constituents. Explosives found above RGs at Line 1 are RDX and 2,4,6-TNT. Explosives were also found above RGs in basements of Buildings 1-05-1 and 1-05-2. Metals found above RGs at Line 1 are arsenic and lead. Barium and silver were found above PRGs. The SVOC found above PRGs at Line 1 was indo(1,2,3-cd)pyrene. The explosives, metals and SVOC contaminants were found above PRGs in drainage ways and around the doorways of Line 1 (TN & Associates, 2002).

Additional site characterization will be necessary to define the nature and extent for all COCs so that the Remedial Action can be implemented and completed.

Line 1 is listed as a site to be addressed by FUSRAP, administered by the USACE. The USACE will respond to all releases and threats of releases of hazardous substances, pollutants or contaminants, with the exception of groundwater and surface water contamination at Line 1. Surface and groundwater issues will be addressed by the Army.

3.2.3 Line 2 (IAAP-002)

3.2.3.1 Background

This IRP site consists of the contamination from past munitions production. The past contamination has resulted from the practice of washing spilled explosives from floors and equipment and sump failures. Line 2 is a production line that has been in operation since the inception of IAAAP, except for a brief hiatus from 1947 to 1949, and occupies nearly 140 acres, including 31 buildings and covered walkways. It is used to LAP 120mm ammunition and blank ammunition. The melt building appears to be where the highest volumes of wastes were produced. The buildings include equipment rooms, explosives magazines and nine sump buildings.

Figures of the Line 2 site and related investigations are provided in Tab 2 of Appendix F.

3.2.3.2 Remedy Status

The PA/SI was completed in 1991, and an initial RI was completed in May 1996. Low levels of metals were reported in all of the SI samples, with the highest concentrations reported in soil west of Filter House 2-70-2, at the southeast corner of Filter House 2-70-1, and at an area adjacent to a support pillar northeast of Building 2-80-1. One sample, collected near Building 2-08-2, contained low levels of HMX and RDX. Several SVOCs and VOCs were reported in soil samples collected throughout Line 2. According to the RI, contamination appears to be constrained to surficial soils (JAYCOR, 1996).

Seven wastewater sumps were removed at Line 2 in 1995, as further described in Section 3.3.6 of this report.

The Interim ROD requires the removal of an estimated 1,950cy (885cy of metals only, 770cy of explosives only, and 295cy of metals and explosives) of soil contaminated with metals and explosives. The remedial actions implemented by the Army will consist of additional contaminant delineation and contaminated soil excavation and placement in the IDA for treatment and/or disposal. Remedial actions are to be completed in 2007 as part of Phase 8 activities.

3.2.4 Line 3 (IAAP-003)

3.2.4.1 Background

This IRP site consists of the contamination from past munitions production. The practice during the early years of production was to dispose of wastewater at the Line 800 Pink Water Lagoon.

This line was upgraded to include self-contained Pinkwater Reroute Systems in July 1995 and September 1998.

Line 3 is a production line that has been in operation since 1941, except for a short time between 1945 and 1949. This line fills and assembles artillery projectiles, occupies about 150 acres, and consists of 26 buildings and covered walkways. The buildings include equipment rooms, explosives magazines, and nine sump buildings for explosive waste processing. The two melt buildings appear to be the areas where the highest volumes of wastes were produced during operations.

From 1977 to 1984, metal cleaning operations were conducted at Line 3. This process consisted of several stainless steel dip tanks where ammunition casings were immersed in a sulfuric/hydrochloric acid bath, followed by a chromic acid rinse, then a water rinse. Sludge that accumulated in the bottom of the sulfuric acid tank was removed, treated with sodium hydroxide, and reportedly disposed in the Line 3A Pond.

Figures of the Line 3 site and related investigations are provided in Tab 3 of Appendix F.

3.2.4.2 Remedy Status

The PA/SI was completed in 1991, and an initial RI was completed in May 1996. During the RI, soils exhibiting the highest concentrations of explosives were located at wastewater sumps, foundations of buildings where wastewater is generated, and loading docks. Sampling indicated explosives were confined to surficial soils and did not extend beyond approximately 10 to 20 feet from the most impacted soils. Elevated metals concentrations were more widespread throughout the building areas at Line 3 and were not concentrated at a particular building. Lead is the primary contaminant, and to a lesser degree, chromium (near Building 3-01). Several SVOCs were reported in soil samples collected throughout Line 3, with only one sample reporting levels greater than 10ug/g (JAYCOR, 1996).

Three wastewater sumps were removed at Line 3 in 1995, as further described in Section 3.3.6 of this report.

The Interim ROD requires the removal of an estimated 3,500 cy of contaminated soil including 120cy of soil that the Army now believes to contain radionuclides at background levels. It should be noted that Building 3-01 related contamination has been designated to be addressed by FUSRAP.

Currently, soils have not been excavated and placed in the IDA (IAAP-020) for treatment. The remedial actions implemented by the Army will consist of additional contaminant delineation and contaminated soil excavation and placement in the IDA for treatment and/or disposal. Remedial actions are to be completed in 2007 as part of Phase 7 activities.

3.2.5 Line 3A (IAAP-004)

3.2.5.1 Background

Line 3A was constructed in 1941 and began operations in 1943. The line was shut down from 1945 to 1949. Metal cleaning operations were also conducted here from 1977 to 1985. The

process included several stainless steel dip tanks where ammunition casings were immersed in a sulfuric/hydrochloric acid bath, followed by a chromic acid bath, and water rinse. Line 3A encompasses 119 acres and is currently active. The line is a LAP operation for 155mm artillery rounds. The melt building appears to be the area where the highest volumes of wastes were produced during operations. Line 3A was upgraded to include a self-contained Pinkwater Reroute System in December 1996.

Figures of the Line 3A site and related investigations are provided in Tab 4 of Appendix F.

3.2.5.2 *Remedy Status*

The PA/SI was completed in 1991, and an initial RI was completed in May 1996. During the RI, the majority of explosives were detected around Building 3A-05-1 and its associated buildings. Other buildings reported lower levels of explosives contamination. RDX and HMX were the explosives with the highest reported values. The levels of detectable contaminants were observed to decrease with distance from the identified source areas such as sumps and loading areas. The areas with the highest metals are the Building 3A-05-1 area and the area northwest of Building 3A-05-2 (JAYCOR, 1996).

The Interim ROD requires the removal of an estimated 2,040 cy (1350cy of explosives only, and 690 cy of metals and explosives). This soil will be taken to the IDA and sorted by contaminant level and type.

Currently, soils have not been excavated and placed in the IDA for treatment. The remedial actions implemented by the Army will consist of additional contaminant delineation and contaminated soil excavation and placement in the IDA for treatment and/or disposal. Remedial actions are to be completed in 2007 as part of Phase 7 activities.

3.2.6 Line 4A and 4B (IAAP-005)

3.2.6.1 Background

Lines 4A and 4B are located in the north-central portion of the plant and are approximately 1,000 feet apart. Line 4A encompasses 20 acres, and Line 4B encompasses 17 acres. Both lines were constructed in 1941 for component assembly.

Line 4A produced detonators and was in operation between 1942 and 1945; it was reopened in 1982. It is currently leased to a private corporation (ICI), who reworked the line to make air-bag initiators; operations have ceased. There are 12 buildings in the area which consists of an assembly building, mixer buildings, lead azide magazine, detonator service magazine and change houses. Hazardous substances at Line 4A include lead azide, RDX, lead styphnate, tetracene, barium nitrate, TNT, HMX, and metals. Fourteen in-ground sumps (treatment tanks) underwent RCRA closure in 1995.

Line 4B is an assembly facility for components manufactured elsewhere. Operations began in 1941 and ceased in 1945. Production resumed in 1962 and the line was used for missile assembly in the late 1960's. Line 4B consists of a fuze assembly and equipment building, detonator service magazine, rest

houses and change houses. Hazardous substances of concern are TNT, RDX, Composition B, HMX, and LX-14. Previous materials included tetryl, booster pellets and fuze ingredients.

Figures of the Line 4A and 4B sites and related investigations are provided in Tab 5 of Appendix F.

3.2.6.2 Remedy Status

The PA/SI was completed in 1991, and the initial RI was completed in May 1996. One wastewater sump was removed at Line 4A in 1995, as further described in Section 3.3.6 of this report. The Interim ROD requires the removal of an estimated 153cy of contaminated soil from Line 4A and none from Line 4B. Remedial Design Sampling was conducted at Lines 4A and 4B in 2003 and 2004, which found no contaminant concentrations above remediation levels, further described below:

Line 4A:
As part of the Phase 4 Remedial Design Sampling, conducted in 2003 and 2004, a total of 12 distinct building groups were evaluated at Line 4A. Of these 12 areas, three areas were evaluated through a historical document reviews only, and no additional samples were collected. The three areas evaluated through historical documents reviews only were Building 4A-04, Buildings 4A-137-1 through 4A-137-4, and the spray evaporation pond. Based on the findings of the historical review, it was concluded that the soils associated with these three areas were not likely to have been adversely impacted by previous site activities. The remaining nine areas were sampled. Soil samples were taken from 55 locations at Line 4A. Samples were analyzed for explosives, VOCs, SVOCs, PCBs, total metals, and mercury. Analytical results from the surface and subsurface samples collected at these locations showed no contaminant concentrations above remediation levels. Details regarding sample results and conclusions are provided in the USACE Draft Final Data Summary Report, Supplemental Remedial Design, Phase 4 Soil Sites, OU-1, dated May 20, 2004. In the conclusion of this report, the following sites were recommended for no further Remedial Design/Remedial Action activities and for CERCLA closure:

- Building 4A-03-01 and 4A-03-02
- Building 4A-04
- Building 4A-07
- Building 4A-22
- Building 4A-54
- Buildings 4A-58-1 through 4A-58-4
- Building 4A-63
- Building 4A-68
- Buildings 4A-137-1 through 4A-137-4
- Line 4A Tank Farm
- Spray Evaporation Pond
- Transformer Substations 4A-169-1 through 4A-169-4

Line 4B:
As part of the Phase 4 Remedial Design Sampling, conducted in 2003 and 2004, a total of five distinct buildings or building groups were evaluated at Line 4B. Of these five areas, three were evaluated through a historical document review and an evaluation of previous environmental

sampling results, and no additional samples were collected. The three areas evaluated through historical reviews were Building 4B-21, Building 4B-54 and Buildings 4B-137-1 through 4B-137-3. Buildings 4B-21 and 4B-54 were sampled by USACE, Omaha District in April 2001 and subsequently confirmed free of contamination above remediation levels. As part of the Phase 4 Remedial Design Sampling, a total of 12 sample locations were established at Building 4B-22 and at Transformer Substation 4B-169-1. Samples were analyzed for explosives, VOCs, SVOCs, PCBs, total metals, and mercury. Analytical results from the surface and subsurface samples collected at these locations showed no contaminant concentrations above remediation levels. Details regarding sample results and conclusions are provided in the USACE Draft Final Data Summary Report, Supplemental Remedial Design, Phase 4 Soil Sites, OU-1, dated May 20, 2004. In the conclusion of this report, the following sites were recommended for no further Remedial Design/Remedial Action activities and for CERCLA closure:

- Building 4B-21
- Building 4B-22
- Building 4B-54
- Buildings 4B-137-1 through 4B-137-3
- Transformer Substation 4B-169-1.

3.2.7 Line 5A and 5B (IAAP-006)

3.2.7.1 Background

This IRP site consists of the contamination from past munitions production. In the past, both lines were component lines for pelletizing and assembly of explosive components. The Central Test Area (CTA) (IAAP-047), which included a testing platform and a firing pit, are located within the site boundary. Principal explosives used at these lines were TNT, RDX and Tetryl.

Lines 5A and 5B were booster and grenade lines situated in the north-central portion of the installation. Line 5A is approximately 33 acres in size, and Line 5B is 41 acres. Both lines were constructed in 1941 and operated from 1942 to 1945. Production resumed in 1949 during the Korean War and intensified in 1961 during the Vietnam War.

Lines 5A and 5B are currently in a modified caretaker status; there are no plans to activate these lines in the future.

Figures of the Line 5A and 5B sites and related investigations are provided in Tab 6 of Appendix F.

3.2.7.2 Remedy Status

The PA/SI was completed in 1991, and an initial RI was completed in May 1996.

Eighteen wastewater sumps were removed at Line 5A and 5B in 1995, as further described in Section 3.3.6 of this report. In October 1999, approximately 1,065 cy of contaminated soil were removed from Lines 5A and 5B and placed in the IDA.

Line 5A:
Excavation at various locations at Line 5A began on 20 October 1999 and continued through 6 November 1999. These locations include: (1) the north and east sides of Building 5A-26; (2) the north, west, and south sides of Building 5A-140-2; (3) an area between Buildings 5A-28 and 5A-140-3; (4) the south, east and west sides of Building 5A-140-3; (5) the east side of Building 5A-99-2; (6) the west side of Building 5A-99-1; and (7) the south side of Building 5A-140-1. Approximately 590 cy was excavated. All of the soil excavated was transferred to the IDA for proper disposition. Verification sampling and testing showed that after excavation, contamination remaining in these areas were below excavation criteria. These areas were then backfilled and revegetated.

Line 5B:
Excavation at various locations at Line 5B began on 5 October 1999 and continued through 15 October 1999. The locations include (1) the south, east, and west sides of Building 5B-26, (2) the north and south sides of Building 5B-28, and (3) the east and west sides of Building 5B-140-3. Approximately 475 cy of soil was excavated. All of the soil excavated was transferred to the IDA for proper disposition. Excavation was performed at all locations, laterally and to depth, until confirmation sampling and testing indicated that contamination was below cleanup criteria.

3.2.7.3 Site Inspection

The excavated areas at Lines 5A and 5B were inspected and found to be in excellent condition. There was no evidence of erosion or ponded areas. Vegetation over the backfilled areas is in good condition.

3.2.8 Line 6 (IAAP-007)

3.2.8.1 Background

Line 6 is a detonator production area encompassing 30 acres and located in the center of the installation. Constructed in 1941 and operated until 1981, this line is currently inactive. Line 6 consists of 34 buildings for the production, storage, and shipping of detonators, relays, and hand grenade fuzes.

The primary waste stream was related to the production of detonators and included lead azide, lead styphnate, tetracene, RDX, barium nitrate and mercury fulminate.

Figures of the Line 6 area and related investigations are provided in Tab 7 of Appendix F.

3.2.8.2 Remedy Status

The PA/SI was completed in 1991, and an initial RI was completed in May 1996.
Treatment of black powder was performed in Building 6-68 as a RCRA permitted unit. This unit underwent RCRA closure in 1995 and will no longer be maintained or used by the Army (modified caretaker status). As part of the RCRA closure, 800cy of contaminated soil was removed in 1994.

Three wastewater sumps were removed at Line 6 in 1995, as further described in Section 3.3.6 of this report.

The Interim ROD requires the removal of approximately 445 cy of contaminated (metals) soil that was not addressed under the RCRA closure. The remedial action to be implemented by the Army will consist of additional contaminant delineation and contaminated soil excavation and placement in the IDA for treatment and/or disposal. Remedial actions are to be completed in 2007 as part of Phase 5 activities.

3.2.9 Line 8 (IAAP-009)

3.2.9.1 Background

Line 8 was a production Line that was constructed in 1941 and was used during World War II to produce Amatol. The Emergency Export Co. utilized the ammonium nitrate crystallization equipment to produce fertilizer to support the Marshall Plan. Subsequent activities were fuze and rocket igniter LAP operations. Prior to closing of the production activities around 1950, Line 8 consisted of four process buildings, a gatehouse, and tank farm to store ammonium nitrate liquor. Ammunition inspection activities took place from 1976 to 1993. Only two buildings remain and will no longer be maintained or used by the Army (modified caretaker status).

Figures of the Line 8 area and related investigations are provided in Tab 8 of Appendix F.

3.2.9.2 Remedy Status

The PA/SI was completed in 1991, and an initial RI was completed in May 1996. The Interim ROD requires the removal of approximately 476 cy of lead contaminated soil.

Remedial Design Sampling for Phase 4 Soil Sites was conducted at Line 8 in 2003 and 2004. As part of the Phase 4 Remedial Design Sampling, eight distinct buildings or building groups were evaluated. Of these eight areas, one was evaluated through historical document reviews and no additional soil samples were collected. The areas evaluated through historical document reviews were the Line 8 storm sewer, untreated water, and sanitary sewage pipelines. No historical information was found stating that Line 8 used these pipelines for operational wastewater purposes. For the remaining areas, soil samples were taken from 56 locations at Line 8. Samples were analyzed for explosives, VOCs, SVOCs, PCBs, total metals, and mercury. Analytical results from the surface and subsurface samples collected at these locations showed no contaminant concentrations above remediation levels, except at the Line 8 Tank Farm. For the Line 8 tank farm area, benzo(a)anthracene and benzo(a)pyrene were detected in two locations exceeding the corresponding RG values of 8.1 and 0.81 mg/kg. The maximum detected concentrations were 15 and 13 mg/kg, respectively. However, field observations indicated that these areas are covered with degraded asphalt, and benzo(a)anthracene and benzo(a)pyrene are compounds commonly found in asphalt. As a result, it was concluded that these elevated compound concentrations are due to the presence of asphalt and are not products of past processes conducted at Line 8. Details regarding sample results are provided in the USACE Draft Final Data Summary Report, Supplemental Remedial Design, Phase 4 Soil Sites, OU-1,

dated May 20, 2004. In the conclusion of this report, the following sites were recommended for no further Remedial Design/Remedial Action activities and for CERCLA closure:

- Buildings 8-83 and Transformer Station 8-169-1
- Building 8-137-1
- Buildings 8-80-1 through 8-80-4
- Buildings 8-81-1 through 8-81-4
- Line 8 Tank Farm
- Buildings 8-79
- Line 8 Pipelines
- Line 8 Drainage Ditches

3.2.10 Line 9 (IAAP-010)

3.2.10.1 Background

Line 9 is approximately 9 acres in size and was built in 1942 for use as a production facility and produced mine and mine fuzes during the Vietnam War. The site was later operated as a LAP facility, but is no longer in use. Wastes produced at this facility include sump scrap, acetone, xylene, lacquer thinner, and 1,1,1-trichloroethane. During Line 9 activities, waste solvents were generated at Buildings 9-59 and 9-60. Building 9-58 served as the 90-day waste solvent accumulation area for this line. Waste solvents were then taken to Building 600-86, where they may have stayed for nine months. This Line is currently in modified caretaker status.

Figures of the Line 9 area and related investigations are provided in Tab 9 of Appendix F.

3.2.10.2 Remedy Status

The PA/SI was completed in 1991, and an initial RI was completed in May 1996.

Five wastewater sumps were removed at Line 9 in 1995, as further described in Section 3.3.6 of this report.

Remedial Design Sampling for Phase 4 Soil Sites was conducted at Line 9 in 2003 and 2004. In the Phase 4 Sites Remedial Action, completed in 2004, 120 cy of soil was removed. A Remedial Action Report for the Phase 4 efforts is not yet complete.

As part of the Phase 4 Remedial Design Sampling, conducted in 2003 and 2004, nine distinct buildings or building groups were evaluated. For these areas, 57 sample locations were established at the nine areas within Line 9. Samples were analyzed for explosives, VOCs, SVOCs, PCBs, total metals, and mercury. Analytical results from the surface and subsurface soils showed contaminant concentrations above remediation levels at the Building 9-57 and 9-61 areas only. The other seven Line 9 areas addressed under Phase 4 had no contaminant concentrations that exceeded remediation levels in any of the soil samples collected. Details regarding sample results are provided in the USACE Draft Final Data Summary Report, Supplemental Remedial Design, Phase 4 Soil Sites, OU-1, dated May 20, 2004. In the conclusion

of this report, the following sites were recommended for no further Remedial Design/Remedial Action activities and for CERCLA closure:

- Building 9-14
- Building 9-58
- Building 9-59
- Building 9-59-1
- Building 9-60
- Building 9-64
- Buildings 9-72-1, 9-72-2, and 9-72-3.

As a result of this sampling, contaminated soils were excavated at Buildings 9-57 and 9-61 in July 2004. For the Building 9-57 area, approximately 84 cubic yards of soil were excavated and placed in the Trench 6 Soil Repository. For the Building 9-61 area, approximately 36 cubic yards of soil were excavated and placed in the Trench 6 Soil Repository. It is anticipated that no additional actions will be required at this site.

3.2.11 Line 800 (IAAP-011)

3.2.11.1 Background

Line 800 is nearly 18 acres in size and has been in operation intermittently since plant inception. From 1943 to present, the primary function of the line was ammunition renovation, where the explosives filler is washed from the projectiles and 75mm blank salute ammunition is loaded.

Wastes were generated by metal cleaning operations at Line 800, which were identical to the metal cleaning operations at Line 3. Waste sludge from the metal cleaning bath was disposed of at the former Blue Sludge Lagoon at the IDA from 1979 through 1980. Prior to having the Line 3 Treatment Facility, untreated metal cleaning effluent was discharged to the ditches at Line 3 and Line 800.

Figures of the Line 800 area and related investigations and activities are provided in Tab 10 of Appendix F.

3.2.11.2 Remedy Status

The PA/SI was completed in 1991 and found explosives concentrations which exceed cleanup criteria in the northwest corner of the site and the area adjacent to the east end of Building 800-04, and lead concentrations in excess of cleanup criteria along the west side of Building 800-191.

The RI work was finished in May 1996. During the RI, three sample locations west of Building 800-191 and four samples southeast of Building 800-192 contained explosives above detection limits. Metals contamination was confined to depths of less than 2 feet, except in three areas surrounding Buildings 800-61, 900-04, and 800-193, which have metals contamination up to three feet deep immediately adjacent to the loading doors and sumps (JAYCOR, 1996).
In 1999, a sump at Building 800-192 was excavated and removed. Approximately 20 cy of contaminated soil was removed and placed in Trench 6 at the IDA.

The Interim ROD requires the removal of 1,325 cy of contaminated soil. The remedial actions to be implemented by the Army will consist of additional contaminant delineation and contaminated soil excavation and placement in the IDA for treatment and/or disposal. Remedial actions are to be completed in 2007 as part of Phase 5 activities.

3.2.12 East Burn Pads (IAAP-012)

3.2.12.1 Background

The EBP, located in the northeast corner of IAAAP, consisted of 8 raised earthen burning pads enclosed in a fenced area of approximately 12 acres. Activities included open burning of explosives-contaminated metals, propellant explosive and pyrotechnic (PEP) contaminated materials. Each pad was bermed on three sides to restrict horizontal movement of metal projectiles. The pads were in operation from 1941 until 1982, when the Explosive Waste Incinerator (EWI) was built.

Figures of the EBP and related investigations or activities are provided in Tab 11 of Appendix F.

3.2.12.2 Remedy Status

The PA/SI was completed in 1991, and an initial RI was completed in May 1996. The Interim ROD required the removal of contaminated soil.

In 1998, ECC excavated contaminated soil from the EBP area, the NBP area, and the NBPLF. The approximate quantity of material excavated from the EBP area is 12,670 cubic yards. The soil was taken to the IDA and sorted by contaminant level and type.

In general, excavation activities for the EBP area were performed according to the procedures outlined in Section 3.1.1 of this report.

The EBP area is listed as a site to be evaluated by FUSRAP, administered by the USACE. In August 2004, FUSRAP conducted a screening survey of this site to determine if radiological contaminants from AEC activities are present at the site. Results from the screening have not been finalized to date. Should this area be found to be free of radiological contamination from AEC activities, no further action will be taken in that area pursuant to FUSRAP.

It is anticipated that no additional actions will be required at this site.

3.2.12.3 Site Inspection

The EBP were inspected and found to be in excellent condition. There was no evidence of erosion or ponded areas. Vegetation over the backfilled areas is in good condition.

3.2.13 Demolition Area/Deactivation Furnace (IAAP-021)

3.2.13.1 Background

The Deactivation Furnace (IAAP-023) was incorporated into this site due to their close proximity.

The Demolition Area encompasses 10 acres of land and consists of a fenced field with six shallow craters. Open detonation of rejected ammunition items at this site began in the 1940s on a regular basis, with extensive use from 1966 to 1970. Current practices are limited to an emergency-only basis. The Iowa DNR does allow open detonation of ammunition items that require an immediate method of disposition due to safety considerations such as ammunition rounds that become armed during the assembly process. The Iowa DNR is required to be notified of an open detonation event.

In 1997, EPA approved a change in the RCRA Subpart X interim status. This change allowed for the movement of the open burning of propellant with faulty stabilizer (performed in pans) from the EBP (IAAP- 012) to the Detonation Area. This accommodated the cleanup of former open burning pads at the EBP in 1998. In 1985, the Iowa IDNR allowed open burning of propellant determined by the Army to have a faulty stabilizer on a case-by-case basis with an expedited (within 48 hours) approval.

The Deactivation Furnace subsite was used from 1971 until RCRA closure in 1995. The Deactivation Furnace consists of a feed area, furnace system and air pollution control system. The feed area is housed within a building that provides access to a conveyor system. The furnace was used to destroy small explosive-loaded components such as detonators, primers, and fuzes. The furnace incinerated the explosive/propellant content of the munitions and thermally treated the metal casings, which were recovered and sold as scrap metal. The ash from these operations were placed in drums and stored as hazardous waste. The Deactivation Furnace has undergone RCRA closure and is now in a temporarily inactive (TIA) status.

Figures of the Demolition Area and Deactivation Furnace Area and related investigations are provided in Tab 12 of Appendix F.

3.2.13.2 Remedy Status

The PA/SI was completed in 1991, and an initial RI was completed in May 1996. During the RI, explosives in the soils were not considered to be a concern at the site. All soil samples reported detectable levels of arsenic, barium, chromium, and lead; and 12 samples reported detectable levels of mercury. In other locations, lead and chromium were the metals with the highest reported values, but high levels of antimony, cadmium, copper, silver, and zinc were also reported (JAYCOR, 1996). The Interim ROD requires the removal of 753 cy of lead-contaminated soil from the Deactivation Furnace subsite.

The Demolition Area/Deactivation Furnace area is listed as a site to be evaluated by FUSRAP, administered by the USACE. In August 2004, FUSRAP conducted a screening survey of this site to determine if radiological contaminants from AEC activities are present at the site. Results

from the screening have not been finalized to date. Should this area be found to be free of radiological contamination from AEC activities, no further action will be taken in that area pursuant to FUSRAP.

3.2.14 Burn Cages, Burn Cage Landfill, West Burn Pads, West Burn Pads Landfill (IAAP-032)

3.2.14.1 Background

Due to the complexity in defining site boundaries, sites IAAP-032 (Burn Cages), IAAP-033 (Burn Cage Landfill), IAAP-034 (West Burn Pads), and IAAP-035 (West Burn Pads Landfill), are managed as one site, the WBPA, by the Army.

Burn cages, consisting of three cages, were used for the incineration of inert and explosives-contaminated packaging. The flashing of metals parts also was performed here. The site was used from 1949 to 1982 when the cages were removed. Metal parts, munitions casings and staining on the ground surface were observed during the site inspection in 1991.

The West Burn Pads were used for metals flashing from 1949 to 1982. Ash from the Burn Cages and West Burn Pads were disposed of at the Burn Cage Landfill (1949 to 1982) and the West Burn Pads Landfill (WBPLF) (1950 to 1975). The WBPLF also received waste from the East Burn Pads as well as various sanitary and industrial solid wastes. The landfills were approximately three acres in size and heavily vegetated.

Historical documents indicate the WBPA was used concurrently by the AEC and the Army from 1949 to 1975.

Figures of the WBPA and related site investigations and activities are provided in Tab 13 of Appendix F.

3.2.14.2 Remedy Status

The PA/SI was completed in 1991, and the RI was completed in May 1996. The RI confirmed metals and explosives contamination and indicated low levels of SVOCs and VOCs. The depth of explosives, metals, SVOCs, and VOCs contamination during the RI appeared to be limited to 3 or 4 feet below ground surface (bgs) (JAYCOR, 1996). The Interim ROD required the removal of an estimated 1451 cy of contaminated soil to be taken to the IDA and sorted by contaminant level and type. However, during pre-design characterization of soils in 1998, significant levels of barium contamination that was not previously known were located.

In 1998, ECC excavated contaminated soil from the WBPA, which was performed as outlined in Section 3.1.1 of this report.

A total of approximately 46,496 cubic yards of contaminated soil was removed from the WPBA(north of the road). The Trench 6 Soil Repository received 5,112 cubic yards, 4,032 cubic yards was temporarily stored at the CAMU, and 37,352 cubic yards was disposed of as Random Fill in the CEA. Several thousand cubic yards of metals-contaminated soil were stabilized at the

time of placement in the CEA and the Trench 6 Soil Repository. In addition, approximately 6,000 cy of the soil placed within Trench 6 and the CAMU was treated for metals and explosives and subsequently disposed in the Trench 6 Soil Repository. Treatment involved stabilization of metals followed by bioremediation of explosives.

Following the IRP remedial action in the area north of the road, an area of soil contamination was discovered south of the road.

Groundwater monitoring began in 1994. Annual groundwater monitoring did not show an expected decline in explosive concentrations downgradient of the site. Groundwater sampling and historical documentation indicate further soil removal may be necessary. Groundwater results, historical records, and a site walk-over in 2001 indicate further soil investigation is warranted in an area that lies across the road to the south of the soil removal area, as explosive chunks were found on the surface. The USACE notified American Ordnance for a safety review, and some explosive chunks were removed and sampled.

The area is listed as a site to be addressed by FUSRAP, administered by the USACE. For the area south of the road, FUSRAP will respond to all releases and threats of releases of hazardous substances, pollutants, or contaminants, with the exception of groundwater and surface water contamination. Surface water and groundwater issues will be addressed by the Army.

3.2.14.3 Site Inspection

The WBPA was inspected and found to be in good condition. Vegetation has been established, and tree plantings appear to be healthy. A few small barren areas (15' by 15') are present at the site. Deer apparently use these areas as a mineral lick. Minor soil erosion has been noted. The Army will evaluate and address this erosion, as necessary.

3.2.15 North Burn Pads (IAAP-036)

3.2.15.1 Background

The NBP consists of Pads 1-N and 2-N. Each pad measures about 20 feet by 50 feet and was operational from 1968 to 1972. Lead azide and gunpowder were burned here. A 275-gallon diesel fuel station was located at the base of Pad 2-N. The station had an above-ground tank used to refuel equipment operating in the area.

Historical documents indicate that the AEC conducted activities at the NBP Area.

Figures of the NBP and related site investigations and activities are provided in Tab 14 of Appendix F.

3.2.15.2 Remedy Status

The PA/SI was completed in 1991, the RI was completed in May 1996 and found metals and small amounts of explosives.

In 1998, ECC excavated contaminated soil from the NBP Area performed as outlined in Section 3.1.1. The approximate quantity of material excavated from the NBP is 2,990 cy, which was taken to the Trench 6 Soil Repository.

The NBP Area is listed as a site to be evaluated by FUSRAP, administered by the USACE. In August 2004, FUSRAP conducted a screening survey of this site to determine if radiological contaminants from AEC activities are present at the site. Results from the screening have not been finalized to date. Should this area be found to be free of radiological contamination from AEC activities, no further action will be taken in that area pursuant to FUSRAP.

3.2.15.3 Site Inspection

The NBP Area was inspected and found to be in good condition. Vegetation has been established, and there were no signs of erosion observed.

3.2.16 Roundhouse Transformer Storage Area (IAAP-040)

3.2.16.1 Background

This area was used since the 1940s to store transformers pending use or disposal; this site is no longer used for PCB storage. The storage yard is a flat, graded area with crushed stone on a hard base. Transformers found to contain greater than 50 ppm PCBs were moved to Building L-37-34, the old storage site. Those transformers having less than 50 parts per million (ppm) PCBs were moved to an outside storage concrete pad at Yard L, between buildings L-3 and L-4, new storage site E-18.

Figures of the Roundhouse Transformer Storage Area and related site investigations are provided in Tab 15 of Appendix F.

3.2.16.2 Remedy Status

The PA/SI was completed in 1991, the RI was completed in May 1996. The RI results indicated that PCBs were present in surface soils in the drainage ditch to the east of the yard and in the soils west and south of the yard, which are periodically disturbed during agricultural planting activities (JAYCOR, 1996). The Interim ROD estimated the removal of approximately 600 cy of PCB-contaminated soil.

In 2003 and 2004, Supplemental Remedial Design Sampling for Phase 4 Soil Sites was conducted at the Roundhouse Transformer Storage Area. As part of this effort, a total of 50 sample locations were established at the site where historical documentation and/or previous sampling indicated a potential for contamination. Samples were analyzed for PCBs, total metals, and mercury. Analytical results from these samples showed no contaminant concentrations above remediation levels within any of the Phase 4 soil samples. Details regarding sample results are provided in the USACE Draft Final Data Summary Report, Supplemental Remedial Design, Phase 4 Soil Sites, OU-1, dated May 20, 2004. No further Remedial Design/Remedial Action activities and CERCLA closure were recommended in the report for this area. It is anticipated that no additional actions will be required at this site.

3.3 REMOVAL ACTIONS AND OTHER SITE INVESTIGATIONS

3.3.1 General

A summary of removal actions taken and other past soil site investigations is provided in Table 3-6. Site-specific details and discussion are provided in subsequent paragraphs.

Decisions regarding final actions for all of these sites will be documented within the OU-4 ROD.

3.3.2 Line 7 (IAAP-008)

3.3.2.1 Background

Line 7 was a production Line that was built in 1941 and has been inactive since 1970. It encompassed 9 acres. It was a fuze and blank LAP operation where artillery primers, rocket igniters and time fuzes were assembled for World War II and the Korean War. Line 7 will no longer be maintained or used by the Army (modified caretaker status).

Figures of the Line 7 area and related investigations are provided in Tab 16 of Appendix F.

3.3.2.2 Remedy Status

The PA/SI was completed in 1991, and an initial RI was completed in May 1996. No contaminants above action levels were found.

Ten wastewater sumps were removed at Line 7 in 1995, as further described in Section 3.3.6 of this report. No additional actions are currently planned at this site.

3.3.3 Boxcar Unloading Area (IAAP-014)

3.3.3.1 Background

This site consists of two areas located adjacent to the railroad tracks in Yard B, situated approximately 750 feet west of the southwestern most corner of the Explosive Disposal Area (EDA) (comprised of the WBPA, EBP, NBP, NBPLF, FTP, and EWI). The site was utilized as an unloading and temporary storage area for dunnage lumber. The rail cars at times also transported boxes of explosives; therefore, minute amounts of explosives may have come into contact with the dunnage. The area began receiving shipments in the 1940s and continues to do so. However, in recent years, explosives have been transported primarily by trucks. Minute amounts of TNT and RDX may have come into contact with the soil in the area.

Figures of the Boxcar Unloading Area and related investigations are provided in Tab 17 of Appendix F.

Table 3-6 Summary of Removal Actions and Other Site Investigations

Site	Past Site Actions and Current Schedule
Line 7	Ten wastewater sumps were removed at Line 7 in 1995. No additional actions are currently planned at this site.
Boxcar Unloading Area	No additional actions are currently planned at this site.
Line 1 Impoundment	In 1997, approximately 8,270 cy of explosives-contaminated soil was excavated from the Line 1 Impoundment area. The excavated soil was segregated and disposed at the CAMU, the Trench 6 Soil Repository, and under the Inert Landfill cap. The Line 1 Impoundment is listed as a site to be evaluated by FUSRAP. FUSRAP will determine if radiological contaminants from AEC activities are present at the site. Should this area be found to be free of radiological contamination from AEC activities, no further action will be taken in that area pursuant to FUSRAP.
Pesticide Pit	In 1995, 144 cy of soils were excavated at this site. No additional actions are currently planned at this site.
Misc. Sumps (57)	In 1995, a total of 57 sumps, located throughout the IAAAP, were removed, and the associated contaminated soils were excavated. For this removal project, approximately 950 cy of contaminated soil and other sump related materials were removed.
Inert Disposal Area	The IDA is a component of the IAAAP Interim ROD. A removal action was taken in 1997 to cover the Inert Landfill Area and to create the Trench 6 Soil Repository and a CAMU at the IDA. To date, approximately 190,000 cy of soil have been taken to the IDA. The IDA is listed as a site to be evaluated by FUSRAP. FUSRAP will determine if radiological contaminants from AEC activities are present at the site. During the August 2004 radiological screening of the IDA conducted by FUSRAP, one isolated area of radiological contamination was identified on the CEA. This area was limited to a small object and the soils around the object (approximately 1 square yard). Preliminary analysis indicates this object contains Cesium-137. Final analysis of confirmatory soil samples and a dose estimate for IDA workers is under way. Additional investigation of the object will be performed in an attempt to identify it and determine its origin. Should the remaining areas of the IDA be found to be free of radiological contamination from AEC activities, no further action will be taken pursuant to FUSRAP. After all contaminated soil has been treated, Trench 6, the CAMU and the CEA will be capped with a final cover. The OU-4 ROD, when completed, will address the final closure of the IDA. A draft ROD for closure of the CAMU, Trench 6, and the IDA is expected for completion according to the FFA schedule.
Unidentified Substance (oil) Waste Site	No additional actions are currently planned at this site.

Table 3-6 Summary of Removal Actions and Other Site Investigations (continued)

Site	Past Site Actions and Current Schedule
Firing Site Area	The Firing Site Area is listed as a site to be addressed by FUSRAP. FUSRAP will respond to all releases and threats of releases of hazardous substances, pollutants or contaminants, with the exception of ground and surface water contamination at the Firing Site. Surface water and groundwater issues will be addressed by the Army.
Yard B Ammo Box Chipper Disposal Pit	No additional actions are currently planned at this site.
North Burn Pads Landfill	In 1998, approximately 6,482 cy of material was excavated and placed in the IDA. The NBPLF is listed as a site to be evaluated by FUSRAP. FUSRAP will determine if radiological contaminants from AEC activities are present at the site. Should this area be found to be free of radiological contamination from AEC activities, no further action will be taken in that area pursuant to FUSRAP.
Building 600-86 Septic System	No additional actions are currently planned at this site.
Fire Training Pit	In 1998, a soil cleanup effort removed 4,250 cy of contaminated soil. Approximately half of the excavated soils were thermally treated. In 2003, 616 cy of contaminated soil and debris was removed and disposed of in the IDA. It is anticipated that no additional actions will be required at this site.
Abandoned Coal Storage Yard	No additional actions are currently planned at this site.
Fly Ash Disposal Area	No additional actions are currently planned at this site.
Line 800 Pinkwater Lagoon	In 1997, approximately 74,736 cy of explosives-contaminated soils was excavated from the Pinkwater Lagoon and placed in the IDA. A remedial action is to be implemented by the Army and will consist of additional contaminant delineation and contaminated soil excavation and placement in the IDA for treatment and/or disposal. Remedial actions are to be completed in 2007 as part of Phase 5 activities.
Former Fuel Station USTs	In June 2002, approximately 520 cy of petroleum-contaminated soil was excavated from the former fueling station in accordance with guidelines from the Leaking UST Section of the Iowa DNR. A "No Further Action" certificate has been received from the State of Iowa.

3.3.3.2 Remedy Status

In 1987, a contamination assessment of the Boxcar Unloading Area was performed as part of a RCRA facility assessment (RFA). A PA/SI was conducted by JAYCOR in 1991. Analytical results from the samples collected during the SI indicated that no significant contamination was present in the wide area encompassed by the sampling locations. Based on the SI results, this site was not advanced to the RI stage (JAYCOR, 1996).

No additional actions are currently planned at this site.

3.3.4 Line 1 Former Wastewater Impoundment (IAAP-016)

3.3.4.1 Background

This site consists of the Line 1 Former Wastewater Impoundment and up-gradient settling basins. The Line 1 Former Wastewater Impoundment was formed by damming a portion of the upper reaches of Brush Creek. The primary function of the impoundment was to allow settling of particulate matter from explosives-contaminated wastewater before it was discharged downstream. This impoundment received large volumes of discharge from 1948 to 1957. The wastes included TNT, coal pile runoff, and condensate from the coal-fired power plant. Fly ash would be added to the impoundment liquid to absorb the explosives and reduce the color. It was estimated that the impoundment was 3.6 acres in size and as large as 7.5 acres (1,300 to 2,400 feet long) during periods of high flow. The embankment was breached after 1957; Brush Creek flowed through the breach, and the former impounded area was allowed to re-vegetate naturally.

Figures of the Line 1 Impoundment and related investigations and site activities are provided in Tab 18 of Appendix F.

3.3.4.2 Remedy Status

RI work for the Impoundment area was completed in 1991. In 1995, an Army Decision Document was approved, and the Action Memo was approved in 1996.

The elements of the removal action are presented in the *Action Memorandum for the Pinkwater Lagoon and Former Line 1 Impoundment at the Iowa Army Ammunition Plant, Middletown, Iowa* [U. S. Army Environmental Center (USAEC), October 1996] (Action Memorandum). Based on the Action Memorandum, the purpose of the removal action was to prevent soil contamination from leaching into groundwater resources and subsequently cause unacceptable human health risks. The removal action described in the Action Memorandum is summarized below:

- Excavate explosives-contaminated sediment and soil from the former Line 1 Impoundment and other ancillary areas. Soil and sediment were to be disposed in trenches at the IDA based on the contaminant concentration.

- Excavations created by the removal of contaminated soil and sediment in the Line 1 impoundment were to be left open after completion. The purpose in leaving the excavations open is to create wetland areas. Vegetation will be planted in appropriate portions of the wetlands and in upland areas that is capable of accomplishing phytoremediation.

- Construction of a diversion dam and parallel channel to divert Brush Creek from flowing in its current path to a parallel path on the west side. The hydraulic structure will also be used to control flow into the wetland.

- Development of borrow sources for clay, random fill, select fill, topsoil, and wetland seed bank. Stump Lake and the wetlands borrow area were to be the primary borrow sites.

- Water treatment was to be performed during most of the project phases. The following types of water were treated during the project: surface water in the Line 1 impoundment and effluent from the Line 1 impoundments.

(Final Remedial Action Report, Iowa Army Ammunition Plant, Multiple Remedial Actions, Middletown, Iowa, April 2001)

In 1997, approximately 8,270 cubic yards of explosives-contaminated soil was excavated from the Line 1 Impoundment area. The excavated soil was segregated and disposed at the CAMU, the Trench 6 Soil Repository, and under the Inert Landfill cap. The excavated soil was segregated into three categories according to the "level of risk" associated with the level of soil contamination. The contaminated soil was excavated from the lagoon in one-foot layers on 50 foot grids.

The excavated area was restored as an off-stream linear wetland. Hydraulic control structures were constructed to regulate the water surface elevation of the wetland. The excavated area was blanketed with organic rich seedbank material derived from Brush Creek sediments and imported from the Stump Lake borrow. Wetland plants established naturally from the seedbank. The wetland vegetation provides a local ecological enhancement and is phytoremediating residual contaminants in both soil and surface water. Low levels of residual explosives remain in surface water within the impoundment, and they are treated with granular activated carbon prior to discharge into Brush Creek.

The Line 1 Impoundment is listed as a site to be evaluated by FUSRAP, administered by the USACE. In August 2004, FUSRAP conducted a screening survey of this site to determine if radiological contaminants from AEC activities are present at the site. Results from the screening have not been finalized to date. Should this area be found to be free of radiological contamination from AEC activities, no further action will be taken in that area pursuant to FUSRAP.

3.3.4.3 System Operation and Maintenance

Water Control and Treatment. The Army is to monitor the water surface elevation on a monthly basis and during periods of heavy surface runoff to assure that there are no spills of contaminated water from the lagoon. The discharge criteria for surface water is 2 microgram per liter (ug/L) for RDX. When the RDX levels are below 2 ug/L, the Army may discharge water from the lagoon by opening the slide gate on the lower hydraulic control structure and by positioning the stop logs to maintain the water surface elevation in the impoundment at elevation 671.5 feet amsl. The Army is to comply with State discharge requirements when discharging water from the impoundment. The Army coordinates State discharge requirements and also reports discharges to EPA and the Iowa DNR. To date, there has been only one known release of untreated water from the Line 1 Impoundment, with concentrations potentially exceeding discharge criteria. A staff gage is located

in the impoundment near the lower hydraulic control structure to identify water surface elevations. During the periods that the RDX levels are above 2 ug/L, the slide gate remains closed preventing releases of contaminated water. An electric pump, GAC, and sand filter are located in the pre-engineered metal building located near the lower hydraulic control structure. Contaminated surface water in the impoundment is pumped and treated when the water surface elevation exceeds 671.0 feet amsl and RDX levels exceed 2 ug/L, discharging into Brush Creek. In 2001, approximately 3,188,000 gallons were treated, and in 2002, approximately 24,809,880 gallons were treated prior to discharge into Brush Creek. Samples taken on July 1, 2004 from the Line 1 impoundment indicate that 0.72 ug/L of HMX and 1.5 ug/L of RDX were present.

Mowing and Reseeding. The Army mows the grass on the upper and lower hydraulic control structures three times during the growing season, if needed. All seeded areas are inspected for vegetation growth, and areas with sparse vegetative growth are reseeded.

Project Signs. The Army maintains the project signs.

Road Rock Surfacing. The Army maintains the rock-surfaced access road for the upper and lower hydraulic control structures and the monitoring wells.

Upper and Lower Hydraulic Control Structures. The Army operates and lubricates the slide gates in the concrete upper and lower hydraulic control structures on a regular basis. Note that these structures are confined spaces, and all staff must be trained and follow confined-space entry requirements when performing O&M activities within the structures. The Army also repairs any displaced riprap and removes silt from both the inlet and outlet of the upper and lower hydraulic control structures if needed.

Grouted Rock Drop Structure, and Texas Crossing. The Army is to replace any displaced riprap to the original lines and grades as shown on the design drawings.

Brush Creek Diversion Channel. The Army is to replace any displaced riprap to the original lines and grades as shown on the design drawings.

(Iowa Army Ammunition Plant, Site Operations & Maintenance Plan, 2001)

3.3.4.4 Site Inspection

The Line 1 Impoundment was inspected and found to be in good condition. Access to the site was well maintained, and the warning sign at the site was recently updated. There were no areas of erosion or sparse vegetation noted. The water control structure was also noted to be in good condition. Aside from a single isolated incident, no releases of water exceeding discharge criteria have occurred.

3.3.5 Pesticide Pit (IAAP-017)

3.3.5.1 Background

The Pesticide Pit was in operation between 1968 and 1974 for the disposal of small quantities of

insecticides and herbicides. This site is located approximately 25 feet west of the Winnebago

School House (Bldg 500-30-6) on an upland terrace surrounded by agricultural fields. The School House is currently vacant. The Pesticide Pit was a small plywood structure (8 feet x 8 feet x 3 feet) lined with limestone and polyester resin geomembrane. However, the integrity of the structure that contained these wastes was questionable. The pit was capped with clay of unknown thickness during the late 1970s to early 1980s.

Figures of the Pesticide Pit and site activities are provided in Tab 19 of Appendix F.

3.3.5.2 Remedy Status

The PA/SI was completed in 1991, and the RI in May 1996.

In 1995, based on preliminary RI results, the Pesticide Pit was excavated as part of a removal action. The removal action involved excavation of soil from an approximately 20-foot x 20-foot x 4.5-foot deep excavation with approximately 144 cubic yards of contaminated soil removed. This material was placed in nine, 20-yard roll-off containers at the Inert Disposal Area, and subsequently sampled. The stockpiled soil was disposed of at an approved off-site waste disposal facility by 1997. Confirmation sampling indicated that the excavation was clean. Due to the excessive amounts of rain encountered throughout the project, it proved infeasible to keep the excavation free of water. Near the completion of the project, a sump was installed in the pesticide pit to allow for the future treatment of the water in the excavation. The excavation was then backfilled with washed pea gravel and clean soil.

Sampling at the sump has been regularly attempted, but the sump is normally dry. However, Spring 2001 and June 2004 groundwater sampling indicated slightly elevated levels of chromium. Evaluation of this data is required to determine if any action must be taken. It should be noted that the Pesticide Pit has not yet been addressed in any IAAAP RODs, but it will be addressed in the OU-4 ROD. It is anticipated that no additional actions will be required at this site.

3.3.5.3 Site Inspection

The pesticide pit was inspected and found to be in generally good condition. Vegetation was noted to be quite overgrown, however, access to the sump riser was not obstructed. Fencing surrounds the old school house to limit access to the deteriorating structure.

3.3.6 Miscellaneous Sumps Removal Action

3.3.6.1 Background

In 1995, as part of the Pesticide Pit Removal Action Contract, a total of 57 sumps located throughout the IAAAP were removed, the associated contaminated soils were excavated, and the excavations were backfilled and seeded. Additionally, a sump at Line 4A was backfilled and seeded; and the West Recirculation Tank, located adjacent to Line 2, was removed. For this removal project, approximately 507 cy of soil was removed. Confirmation samples for all sumps were collected and analyzed prior to backfilling. A temporary storage cell, consisting of a clay

and geomembrane liner and covered with a geomembrane cover was constructed to contain approximately 950 cy of material, including concrete sumps, contaminated soil, and other miscellaneous materials. The temporary storage cell was later removed and the materials were subsequently placed in the Trench 6. Table 3-7 provides a list of the sumps removed.

Table 3-7 IAAAP Sumps Removal Summary

Line No.	Sump	Line No.	Sump	Line No.	Sump
1	1-40	3	3-05-1U	5	5B-140-2
1	1-05-1N	3	3-50S	6	6-19
1	1-05-1NE	5	5A-21	6	6-98
1	1-05-1S	5	5A-25	6	600-86-2
1	1-05-1SE	5	5A-56	7	7-18
1	1-05-1U	5	5A-140-1	7	7-19-2
1	1-08-1	5	5A-28SW	7	7-54-1
1	1-50N	5	5A-28SE	7	7-19-1
1	1-50S	5	5A-28N	7	7-54-2
1	1-05-2U	5	5A-140-2	7	7-64C
1	1-12	5	5B-21	7	7-64S
2	2-05-2U	5	5B-25	7	7-66
2	2-05-1U	5	5B-27	7	7-67
2	2-05-1NM	5	5B-55N	7	7-36
2	2-05-1W	5	5B-55S	9	9-14A
2	2-05-1S	5	5B-56	9	9-14B
2	2-06-1	5	5B-140-3W	9	9-57
2	2-50S	5	5B-140-3E	9	9-58A
3	3-05-1N	5	5B-140-1	9	9-58B

3.3.7 Inert Disposal Area (IAAP-020)

3.3.7.1 Background

The IDA is an area of approximately 20 acres that formerly included an Inert (sanitary) Landfill, a burning ground, a metal salvage operation, the Former Blue Sludge Lagoon, wastewater sludge drying bed, and an earthen holding area formerly used to store sludge from Line 3 and Line 800. The IDA is located west of C Road, north of Line 3A in the west central part of the Installation.

The Inert Landfill was in operation from 1941 to September 1992 and employed the trench and fill operation technique. Trenches 1 through 5 were filled primarily with sanitary landfill materials such as unsalvageable or unrecoverable materials (cafeteria and residential refuse and garbage, broken pallets, plastic, tin cans, scrap wood/lumber, paper, cardboard, and asbestos insulation in double-lined plastic bags). Ash from open burnings and incinerations was also placed in the landfill.

In 1980, a Part A Permit was received for the Inert Landfill and the Blue Sludge Lagoon. Interim status was granted that same year. The lagoon holding area was excavated, backfilled and closed in 1984 following the transfer of the blue sludge to a concrete-lined sludge drying bed, where it remained until January 1997.

The north end of Trench 5 contains "special waste", such as ash from the Contaminated Waste Processor (IAAP-024), EWI (IAAP-025), and open burning of explosives and explosives-contaminated wastes. This area was capped, and the RCRA closure plan was completed in April 1988; this plan was amended in February 1997 to address sampling issues. Radionuclides were found in groundwater samples during 1997 routine sampling and were determined to be "within normal background levels for IAAAP" and within safe limits.

Figures of the Inert Disposal Area and related site activities are provided in Tab 20 of Appendix F.

3.3.7.2 Remedy Status

The IDA is a component of the IAAAP Interim ROD. A removal action was taken to cover the Inert Landfill Area and to create Trench 6/CAMU at the IDA. The EPA designated "Trench 7" as a CAMU on March 8, 1996.

Soils from other restoration sites are transported to the IDA for segregation according to health risk. Soils classified as a high health risk are placed in the CAMU to be held for treatment. Those classified as a medium health risk are placed in Trench 6 (a RCRA-type lined cell) and soils that are classified as low health risk are placed in the CEA, which will be underneath the final overall cap at the IDA.

Soil removal actions at the Line 1 Impoundment Area and the Line 800 Pinkwater Lagoon were initiated in 1996 and completed in 1997. As part of this effort, "low-level" contaminated soils, primarily from the Line 1 Impoundment and the Line 800 Pinkwater Lagoon were used as "random fill" in covering Trenches 1-5 of the Inert Landfill prior to placement of the synthetic cap in 1997 (approximately 17 acres). This area was seeded in 1998.

Soil and debris from the burning grounds were placed underneath the Inert Landfill cap or in Trench 6, whichever was appropriate based upon contamination levels. Soils from the EBP, NBP, NBPLF, and FTP were placed into Trenches 6 or the CAMU. VOC-contaminated soils from the FTP were removed and treated via the LTTD unit at Trench 6. In addition, the "blue sludge materials" were excavated from the sludge drying bed and deposited into Trench 6 in 1997.

To date, approximately 190,000 cy of soil have been taken to the IDA. Four percent has undergone biological treatment for soils, 1.5 percent has undergone thermal treatment, and nine percent has undergone stabilization for metals. It should be noted that a portion of this volume came from FUSRAP screening areas (IAAAP-012, 032, 036, and 037).

The IDA is listed as a site to be evaluated by FUSRAP, administered by the USACE. In August 2004, FUSRAP conducted a screening survey of this site to determine if radiological contaminants from AEC activities are present at the site. During the August 2004 radiological screening of the IDA conducted by FUSRAP, one isolated area of radiological contamination

was identified on the CEA. This area was limited to a small object and the soils around the object (approximately 1 square yard). Preliminary analysis indicates this object contains Cesium-137. Final analysis of confirmatory soil samples and a dose estimate for IDA workers is underway. Additional investigation of the object will be performed in an attempt to identify it and determine its origin. The soil where the object was found originated from remediation activities at the WBPA (IAAAP-032). Final results from the overall site screening have not been finalized to date. Should the remaining areas of the IDA be found to be free of radiological contamination from AEC activities, no further action will be taken pursuant to FUSRAP.

After all contaminated soil has been treated, Trench 6, the CAMU, and the CEA will be capped with a final cover. The OU-4 ROD, when completed, will address the final closure of the IDA. A draft ROD for closure of the CAMU, Trench 6, and the IDA is expected for completion according to the FFA schedule. A final Remedial Action Report for soil treatment at the IDA will be submitted in 2039.

3.3.7.3 Remedy Design Summary

The interim remedial action for the Soils OU-1, as specified in the Interim ROD, called for the temporary stockpiling, for future treatment, of the most highly contaminated soils and the permanent disposal of the remaining contaminated soils from various sites at the IAAAP. The Interim Action ROD specified that the most highly contaminated soils be stockpiled in an on-site CAMU, constructed to specifications that meet RCRA Subtitle C landfill requirements. The remaining contaminated soils will be permanently disposed in either the on-site Trench 6 Soil Repository, constructed to RCRA Subtitle C landfill specifications, or the on-site Inert Landfill. A cover system will be installed over contaminated soils placed in the Soil Repository. Soils in both the Soil Repository and the Inert Landfill will remain on-site for long-term management.

Trench 6, which consists of an open trench, is utilized as a soils repository similar to a RCRA Subtitle C Landfill. Trench 6 was designed to have a capacity of approximately 80,000 cubic yards, with the capability for expansion. The bottom of the trench was lined to minimize releases of leachate generated from the storage of contaminated material in the soils repository. After the capacity of Trench 6 is exhausted, a RCRA subtitle C cover will be placed over the contaminated material in Trench 6.

The remedial action at the Inert Landfill was accomplished through containment as part of a presumptive remedy. The proposed action involved capping the existing five trenches and Trench 6 Soil Repository in accordance with 40 CFR 264, Subpart N requirements.

The cover system is designed to:

- Isolate waste materials
- Eliminate direct human and animal contact
- Contain waste materials in a controlled environment
- Allow management and safe release of gasses generated by decaying organic matter

(Action Memorandum for the Inert Landfill at the Iowa Army Ammunition Plant, Middletown, Iowa, September 1997)

3.3.7.4 Remedy Implementation

The major features of the IDA are the Inert Landfill cover system, Trench 6 Soil Repository, the CAMU, and the CEA. Three sedimentation dams have been installed downstream of the CAMU, Trench 6, and the CEA. Contaminated soils were also removed from the Burning Grounds and the Blue Sludge Storage Area, both located at the IDA. Additional details regarding the construction of the primary features at the IDA and other site activities are summarized as follows:

Inert Landfill Cover System. The Inert Landfill Cover System, covers an area of 17 acres and was completed in the Fall 1997. This includes the north end of Trench 5, which was previously capped as a RCRA closure. The cover system components over areas with 3 percent and 1V:4H slopes, from top to bottom include:

- Four inches Topsoil (with shallow-rooted vegetation)
- 20 inches Select Fill
- Geotextile
- Geonet Drainage Layer
- 40 mil Smooth Geomembrane
- 6 inches minimum clean Random Fill

The cover system components for areas with 1V:3H slopes, from top to bottom include:

- Four inches Topsoil (with shallow-rooted vegetation)
- 20 inches Select Fill
- Double-sided Geocomposite Drainage Layer
- 40 mil Double-sided Textured Geomembrane
- 6 inches minimum clean Random Fill

The random fill layer was required to bring the landfill surface to proper grade to provide for adequate drainage. Since large volumes of fill was required in the random fill layer, lightly contaminated soil from Lines 1 and 800 was used. Other significant features of the landfill cover system include four perimeter gas probes, and eight passive gas vents, which were dual designed to allow for leachate removal from the original landfill trenches.

The CAMU Soils Stockpile. The CAMU was designed as a temporary storage area for highly contaminated soil from various sites within the IAAAP, waiting for treatment. The CAMU was designed per RCRA Stockpile Requirements, which are similar to "Subtitle C" (hazardous waste) Landfill Cell. The bottom liner system components, from top to bottom:

- A 12-inch Soil Cover
- Geotextile
- Geonet
- 60 mil Geomembrane
- Cushion Geotextile (In the sump areas only)
- Geonet
- 60 mil Geomembrane
- Geosynthetic Clay Liner (GCL)

This system incorporates sump areas for leachate collection, and a leak detection system. GAC Units are established onsite to treat the collected leachate.

Trench 6 Soil Repository - The Trench 6 Soil Repository is located adjacent to the landfill and was designed for permanent storage of moderately contaminated soil from various sites within the IAAAP, without any further treatment to be performed. Trench 6 was designed per RCRA Stockpile Requirements, which are similar to "Subtitle C" (hazardous waste) Landfill Cell. The bottom liner system components, from top to bottom:

- A 12-inch Soil Cover (Side slopes only)
- Geogrid (Side slopes only)
- Double-sided Geocomposite Drainage Layer (Side slopes only)
- Granular Filter Material Layer (Trench bottom only)
- Open-graded drainage material (Trench bottom only)
- Cushion Geotextile (Trench bottom only)
- 60 mil Geomembrane
- Cushion Geotextile (Trench bottom only)
- Open-graded drainage material (Sump areas only)
- Double-sided Geocomposite Drainage Layer
- 60 mil Geomembrane
- GCL (Trench bottom only)

This system incorporates sump areas for leachate collection, and a leak detection system. GAC Units are established onsite to treat the collected leachate. Upon complete filling of Trench 6, the landfill cover system will be extended over Trench 6, which will totally encapsulate this material.

CEA. The CEA is located southeastern side of the Inert Landfill and is used to store materials considered to be "lightly contaminated." The CEA has soil berms on three sides of the soil pile to ensure runoff from the CEA is directed to the downstream sedimentation dam.

Burning Grounds Area. Approximately 1,700 cy of metals contaminated soil from the former Burning Grounds area, located within the IDA, was excavated and placed as random fill under the Inert Landfill cap.

Blue Sludge Area. Approximately 300 cy of metals contaminated soil from the former Blue Sludge area, located within the IDA, was excavated and placed in Trench 6.

CAMU, Trench 6, and CEA Sediment Control Dams. The CAMU sediment control dam is located south of the CAMU. This dam was constructed to capture sediment carried downstream from clean areas around the CAMU area. The drainage basin for this dam is approximately six acres. The Trench 6 sediment control dam is located south of Trench 6 and the Inert Landfill. This dam was constructed to capture sediment carried off the landfill cover and surrounding areas from precipitation events. The drainage basin for this dam is approximately 20 acres. The CEA sediment control dam is located south of the CEA. The drainage basin for this dam is approximately 9 acres. Due to the mobility of RDX, water stored behind the dams is treated through GAC units prior to downstream release.

3.3.7.5 System Operation and Maintenance

IDA Contaminated Water Treatment Building. A water treatment building was constructed in 1999 near the south end of the Trench 6 Soil Repository. The building is equipped with sand filters and GAC units. Contaminated water originates from the following sources: 1) surface water from the CAMU and the Trench 6 Soil Repository; 2) Trench 6 and 7 Sedimentation Dams; 3) the CAMU and Trench 6 Soil Repository leachate collection and leak detection systems; and 4) groundwater pumped from the Inert Landfill gas vents/dewatering wells. GAC discharges are sampled after every seven days of use. Sampling data and operational records are kept on file at the IAAAP.

Inert Landfill Cap. The operation and maintenance activities required for the project features of the Inert Landfill Cap include the following:

- Maintaining the project signs.
- Mowing of the grass on the cap and the perimeter three times during the growing season.
- Inspecting and repairing any cap surface erosion or settled areas.
- Maintaining the rock surfacing of the access roads.
- Survey the settlement markers twice a year.
- Maintaining surface drainage control features, including: diversion berms, ditches, culverts, and riprap protection.
- The gas vents/dewatering wells are to be pumped for a period of one year in order to dewater contaminated groundwater (leachate) trapped in the existing landfill Trenches 1 through 6. The extracted leachate is to be pumped to the contaminated water treatment building located near the south end of the Trench 6 Soil Repository.
- The gas vents/dewatering wells and the perimeter gas monitoring probes are to be tested for landfill gases twice a year. The probes and wells are to be monitored for lower explosive limits (LEL), hydrogen sulfide, methane, organic vapor and air pressure.
- Inspecting the two seepage collection outlet pipes that drain the subgrade below the Trench 6 Soil Repository and Detail G of the Inert Landfill Cap (quarterly). If leachate is discharging through the pipes, the leachate is to be sampled for explosives (SW-846 8330).
- Maintaining the integrity and effectiveness of the chain link security fence
- Routine maintenance and sampling of the monitoring wells is to be done by others in association with the quarterly monitoring requirements.

CEA. A six-inch layer of clean fill or other approved cover is to be maintained over the CEA. The purpose of the cover is to minimize the amount of contaminated surface runoff that discharges into the sedimentation dam.

Trench 6 Soils Repository. The primary operation and maintenance requirements for the Trench 6 Soils Repository is the care of contaminated surface water and leachate. The Army is required to pump, convey, and treat contaminated water from the Trench 6 Soil Repository leachate collection and leak detection systems as well as ponded storm surface water runoff located within the trench. Water that is pumped and treated from both the leachate and leak detection systems is monitored. The rate of recharge of water into both the leachate collection and leak detection systems is monitored and recorded.

CAMU Soils Stockpile. The primary operation and maintenance requirements at the CAMU are similar to the Trench 6 Soils Repository, regarding the care of contaminated surface water and leachate. As previously stated, the infrastructure for treating the contaminated water is located at the contaminated water treatment building located near the south end of the Trench 6 Soil Repository. The Army is to pump, convey, and treat contaminated water from the CAMU leachate collection and leak detection systems as well as ponded storm surface water runoff located within the trench. The amount of water that is pumped and treated from both the leachate and leak detection systems is monitored and recorded. The rate of recharge of water into both the leachate collection and leak detection system is also monitored and recorded. Maintenance of the geosynthetic protective cover is also required.

Trench 6, CAMU, and CEA Sediment Dams. The operation and maintenance activities for each dam are limited to mowing the grass on the earthen embankment three times during the growing season. Any displaced riprap in the stilling basins below the dam is repaired to the original lines and grades. The inlet is kept clear of debris. No maintenance of the outlet works is anticipated. The sideslopes of the dam embankments are to be inspected for erosion. The water in the reservoir areas is sampled and tested quarterly.

3.3.7.6 Site Inspection

The review indicates that while conditions at the IDA may be protective, conditions could be improved with relatively minor effort, consistent with the recommendations in this review, to ensure the safety and health of IDA workers and other potential exposure groups.

IDA Site Access and Security. The 6-foot fence on the east site of the IDA was in good condition, and warning signs were in place. Other access roads were gated, signed, and locked. It should be noted however that fencing around other areas of the IDA consists of 3-strand barbed wire. Since contaminated soils are generally uncovered and exposed in the CAMU and Trench 6, site access controls for unauthorized access must continue to be maintained at all times. It was reported during the site inspection that in the summer of 2003, the National Guard entered the IDA, and a vehicle drove on a portion of the Inert Landfill Cover, causing minor rutting damage. The rutted area was repaired.

CEA. The CEA was inspected and found to be in poor condition. A temporary geosynthetic cover, used to reduce contaminated surface water runoff into the sedimentation dam, was found

to be torn and in many areas missing. As noted in Paragraph 3.3.7.5, a minimum 6-inch soil cover or other approved cover material is to be maintained over the CEA. Some repairs to the temporary cover have been conducted since the time of the site inspection. In addition, in September 2004, additional soil was placed near the southern end of the CEA. Perimeter and downstream drainage channels, lined with riprap, were found to have weedy growth becoming established. There was no erosion or displaced riprap noted. It is recommended that a temporary cover system be maintained over the CEA and the perimeter ditches be cleared of vegetation.

Inert Landfill Cap. In general, the Inert Landfill Cap was found to be in excellent condition. There were no signs of settlement, erosion, or areas of sparse vegetation. The perimeter drainage ditches and cover system drains were in good condition. Settlement monuments and gas vent/dewatering wells were found to be well maintained. It was reported that the cap is mowed three times per year. Water levels under the cap have been decreasing over time, as shown in Figures B-1 and B-2 in Appendix B. This indicates the cap is performing as intended and groundwater pumping rates are adequate. Overall settlement of the cap is less than 6 inches, as shown on Figure B-3 in Appendix B.

Trench 6 Soils Repository. In general, the Trench 6 Soils repository was found to be in good condition; however, there are several issues that warrant further attention. Additional soils are planned to be placed in the repository, therefore soils already placed in the repository remain uncovered with a final cap. The location of the repository is not readily apparent at the site, especially in the northern areas of the repository. It is recommended that markers be installed to clearly delineate the boundaries of the repository in the field. A small covered stockpile of soils from various sources is located near the northern end of the Trench 6 repository. Although they are not directly in Trench 6, surface water runoff from this stockpile drains into the Trench 6 repository. This stockpile is planned to be included under the final cap system.

Surface water management in the repository has proven to be difficult, especially during periods of high precipitation. Runoff in the cell collects near the south end of the repository, creating high ponding levels over the primary liner, and small leaks in the primary liner result in corresponding high levels in the leak detection sump. Water levels in the repository are to be limited to no higher than one foot over the primary liner. Figure B-4 in Appendix B shows that water levels in the past have at times been higher than 1 foot over the primary liner for extended periods of time. In 2002, water levels in the repository have been within 5.1 feet (22.9 feet over the primary liner, elevation 689.9 msl) of the top of the "plug" (elevation 695.0 msl) located at the south end of the repository. Water collected in the repository must be treated prior to discharge. During times of high precipitation, additional GAC units must be utilized to increase treatment capacity. It was also discussed that as the repository is filled with soils, corresponding water storage capacity is reduced. As a result, it is highly recommended that surface water be managed to maintain water levels to within one foot over the primary liner. In addition, treatment capacity may need to be increased to prevent potential scenario of overtopping of the "plug" resulting in an uncontrolled release into the Trench 6 Sedimentation Dam. Samples taken on July 1, 2004, indicate that there is 62 ug/L of HMX, and 13 ug/L of RDX in the ponded surface water in the Trench 6 repository.

CAMU. In general, the CAMU was found to be in good condition; however, there are several issues that warrant further attention. A protective geosynthetic cover was installed to provide protection of the primary liner system. The protective geosynthetic cover has been exposed for

several years and is showing signs of continued deterioration. It is recommended that the condition of the protective geosynthetic cover be closely monitored and replaced as necessary.

As in Trench 6, surface water management in the CAMU has also proven to be difficult, especially during periods of high precipitation. Runoff in the unit collects near the south end of the CAMU, creating high ponding levels over the primary liner, and small leaks in the primary liner result in corresponding high levels in the leak detection sump. Water levels in the repository are to be limited to no higher than one foot over the primary liner. Figure B-5 in Appendix B shows that water levels have been consistently been higher than one foot over the primary liner for extended periods of time. In 2002, water levels in the repository were within three feet (5.3 feet over the primary liner, elevation 692.0 feet amsl) of the top of the "plug" (elevation 699.5 feet amsl) located at the south end of the CAMU. Water collected in the repository must be treated prior to discharge. During times of high precipitation, additional GAC units must be utilized to increase treatment capacity. As a result, it is highly recommended that surface water be managed to maintain water levels to within one foot over the primary liner. In addition, treatment capacity may need to be increased to prevent potential scenario of overtopping of the "plug" resulting in an uncontrolled release into the Trench 7 Sedimentation Dam. Samples taken on July 1, 2004, indicate that there is 45 ug/L of HMX and 44 ug/L of RDX in the ponded surface water in the CAMU.

IDA Contaminated Water Treatment Building. The water treatment building was found to be in excellent condition. The building is equipped with sand filters and GAC units. When originally constructed, the water treatment was fully automated. However, due to operational problems, the treatment facility is now operated manually. Water enters the facility in batches, from the following sources: 1) surface water from the CAMU and the Trench 6 Soil Repository; 2) water from the Trench 6 and 7 Sedimentation Dams; 3) contaminated water from the CAMU and Trench 6 Soil Repository leachate collection and leak detection systems; and 4) contaminated groundwater pumped from the Inert Landfill gas vents/dewatering wells. Since water is treated in batches from mixed sources, specific quantities of water treated from each source has not been recorded; however, in 2002, approximately 19,552,000 gallons were treated by the Phase I unit, and 22,123,000 gallons were treated by the Phase II unit. It was noted that as surface water is drawn from the Trench 6 repository and CAMU, sediment loads can quickly clog the filters. This results in increased filter maintenance, thus reducing treatment short-term capacity. GAC discharges are sampled after every seven days of use. It is recommended that surface water pumping practices be further evaluated to reduce sediment load into the treatment facility, thus increasing overall treatment capacity.

Trench 6, CAMU and CEA Sediment Dams. The sedimentation dams were inspected and found to be in excellent condition. There were no signs of erosion, settlement or slides observed. The outlet control structures were open and not constricted by debris. The outfalls and downstream channels were also found to be in good condition. The water in the sedimentation dams is sampled and tested quarterly. Samples taken from the sedimentation dams on July 1, 2004, indicate the following data: 0.39 ug/L of HMX and below quantitation limits (BQL) for RDX in the Trench 6 Sedimentation Dam; 1.3 ug/L of HMX and BQL for RDX in the Trench 7 Sedimentation Dam; and 10 ug/L of HMX and 6.7 ug/L of RDX in the CEA Sedimentation Dam. Water stored behind the sedimentation dams is managed to prevent releases of water with RDX concentrations exceeding 2 ug/L. During a few isolated storm events, uncontrolled releases of

water have occurred. The concentrations of contaminants in those stormwater releases is unknown. However, considering contaminant concentrations in captured water before the storm events and high volume flows of stormwater during the events, it is likely that contaminant concentrations in released water was diluted to below action levels within a short distance downgradient from the sedimentation dams.

3.3.8 Unidentified Substance (oil) Waste Site (IAAP-022)

3.3.8.1 Background

This site covered an area approximately 20 by 20 feet. The site is situated in the central portion of the IAAAP, northwest of Yard O along the south side of the railroad track, approximately 150 yards west of Plant Road I. The spill area is located 15 to 20 feet south of the railroad track bed.

The unidentified substance thought to be road surfacing oil was discovered on July 16, 1985 (IAG, 1990). The source of the oil spill is thought to have been a leaking railroad tank car (RI/FS Task Order, 1990).

According to the on-site personnel, this area has been covered with approximately 10 feet of fill material which has created a small incline sloping up and away from the railroad track bed.

Figures of the Unidentified Substance Waste Site area and related site activities are provided in Tab 21 of Appendix F.

3.3.8.2 Remedy Status

The SI sampling was completed in 1991, and no significant contamination was found. No additional actions are currently planned at this site.

3.3.9 Firing Site Area (IAAP-030)

3.3.9.1 Background

The Firing Site area has been in use since the 1940s for testing of static warheads. The fenced site encompasses about 450 acres and is about one mile from the nearest installation boundary.

There are a number of distinct test sites in the Firing Site Area, and the complex is currently in use by the Army. In 1947, the IAAAP was selected as the first production facility for manufacturing of high explosives components for weapons under the AEC. Portions of the Firing Site were under the control of the AEC from 1948 to 1974. The AEC operated Sub-Area FS-12 from December 1965 to December 1973. FS-12 was used for destructive testing of ordnance containing depleted uranium and high explosives. Area FS-12 was surveyed for radioactivity by the AEC in 1974, and some contaminated soil was shipped off-site to Sheffield, IL in that same year. In May 2001, a survey conducted by FUSRAP detected numerous fragments of depleted uranium. An aerial radiological survey of the entire plant was conducted in October 2002, and detectable emissions from man-made radiological sources were found at Firing Site 12. Currently, Firing Site 12 is fenced off and is not used by the Army for testing purposes.

Figures of the Firing Site Area and related site investigations are provided in Tab 22 of Appendix F.

3.3.9.2 Remedy Status

The PA/SI was completed in 1991, and the RI in May 1996, and found radionuclides and metals in soil and groundwater. A Supplemental RI was completed in 2002 (TN & Associates, 2002), and in the samples collected there were no contaminants above RGs observed. Samples were taken at Buildings FS- 1 through 7, FS-9 through 12, and FS-14 and 15. It should be noted that samples were not analyzed for radiological constituents.

The Firing Site Area is listed as a site to be addressed by FUSRAP, administered by the USACE. The USACE will respond to all releases and threats of releases of hazardous substances, pollutants or contaminants, with the exception of groundwater and surface water contamination at the Firing Site. Surface water and groundwater issues will be addressed by the Army.

3.3.10 Yard B Ammo Box Chipper Disposal Pit (IAAP-031)

3.3.10.1 Background

The Yard B Ammunition Box Chipper Disposal Pit has been estimated to measure 120 feet by 40 feet by 8 feet, and is reportedly located approximately 2,000 feet west of the FTP and 500 feet south of Plant Road O. The pit was used for a three-month period sometime between 1972 and 1975. Wastes consisted of shredded ammunition boxes treated with the wood preservative pentachlorophenol (PCP). Figures of the Yard B Ammo Box Chipper Disposal Pit and related site investigations are provided in Tab 23 of Appendix F.

3.3.10.2 Remedy Status

The PA/SI performed by JAYCOR in 1991 indicated that there was a potential for contamination at this site. During the RI, no explosives were reported, nor did the soil investigation indicate pervasive metals contamination in the area of the disposal pit. However, investigations conducted during 1997 did not substantiate the former existence of this site. Bis-2-ethylhexylphthalate has been found in GW. No additional actions are currently planned at this site.

3.3.11 North Burn Pads Landfill (IAAP-037)

3.3.11.1 Background

The NBPLF measures approximately 75 feet by 475 feet and was used to receive the remnants (reported to be flashed cans and containers) from the NBP. Landfill activities occurred from 1968 to 1972.

A cleanup operation was performed in 1980, during which some of the contents of the landfill were taken to the IDA, and the landfill was capped with a compacted clay layer. This closure was not a RCRA closure.

Figures of the NBPLF and related site investigations and activities are provided in Tab 24 of Appendix F.

3.3.11.2 Remedy Status

Results from the SI in 1991 did not indicate significant contamination; however, RI work was initiated to fill data gaps. RI work completed in May 1996 found metals in soil and groundwater.

Pre-design sampling in 1997/1998 found high levels of explosives in soil and leachate. In 1998, approximately 6,482 cy of contaminated soils and debris were removed and placed it in the appropriate areas at the IDA, which was conducted as outlined in Section 3.1.1. The Trench 6 Soil Repository received approximately 2583 cubic yards, 551 cubic yards was taken to the CAMU, and 3348 cubic yards was used as Random Fill.

The NBPLF is listed as a site to be evaluated by FUSRAP, administered by the USACE. In August 2004, FUSRAP conducted a screening survey of this site to determine if radiological contaminants from AEC activities are present at the site. Results from the screening have not been finalized to date. Should this area be found to be free of radiological contamination from AEC activities, no further action will be taken in that area pursuant to FUSRAP.

3.3.11.3 Site Inspection

The NBPLF was inspected and found to be in excellent condition, with no signs of erosion, settlement, or areas with sparse vegetation.

3.3.12 Building 600-86 Septic System (IAAP-038)

3.3.12.1 Background

Building 600-86, also referred to as the Central Chemical Lab, is located in the north-central portion of the installation. This building has served in several roles since its construction in 1941. It was an analytical laboratory from 1941 to 1953. The function of the laboratory was to perform drinking water and wastewater analyses, as well as analysis of primer mixes containing lead azide in quantities of 10 to 20 milligrams. The waste from the primer tests was deactivated with ceric ammonium nitrate and the resultant waste solution was disposed of in the Explosive Disposal Area.

In 1985, two rooms in the building were used to store RCRA hazardous wastes. Room A is used to store spent solvents with a permitted capacity of 2640 gallons. Room B is used to store waste liquids containing cyanide salts. Both rooms have concrete curbing around the perimeter. Small amounts of solvents that may be contaminated with explosives are accumulated in Room C, then filtered through a carbon filter column before being taken off-site.

The laboratory building was constructed with its own septic tank and drain. Sometime after 1983, sludge was removed from the septic tank ,and the tank was filled with sand.

Figures of the Building 600-86 Septic System related site investigations are provided in Tab 25 of Appendix F.

3.3.12.2 Remedy Status

The PA/SI was completed in 1991, the RI was completed in May 1996. The RI concluded that no significant levels of metals, SVOCs, or VOCs were reported in samples obtained from the site (JAYCOR, 1996). No additional actions are currently planned at this site.

3.3.13 Fire Training Pit (IAAP-039)

3.3.13.1 Background

The former FTP is located in the southwestern portion of the EDA, southwest of the WBPA. The FTP was an unlined pit that measured approximately 40 feet by 16 feet by 2 feet used from 1982 to 1987. During training sessions, 55-gallon drums of solvents and petroleum products were set ablaze and then extinguished by fire fighters. Waste solvents were used for this purpose from 1982 to 1984, and fuels were used from 1984 through 1987. Wastewater from fire extinguishing practices was directed to the FTP. A crescent shaped berm approximately 3 feet high was present around the northern and western boundaries of the pit.

Figures of the FTP and related site investigations and activities are provided in Tab 26 of Appendix F.

3.3.13.2 Remedy Status

The PA/SI was completed in 1991; the RI was completed in May 1996. Investigations found localized soil and groundwater contamination consists of significant quantities of VOCs (including chlorinated solvents), SVOCs, metals, and low levels of dioxins and furans. It should be noted that the FTP is not currently addressed by any IAAAP RODs.

An Engineering Evaluation/Cost Analysis (EE/CA) and an ESD & Action Memorandum were prepared for this site. The elements of this removal action are presented in the ESD and Action Memorandum (ECC, December 1997). In general, the primary elements of the removal action include the following:

- Excavation of VOC, SVOC and lead contaminated soils exceeding RGs.
- Segregation of metals-contaminated soil from VOC and SVOC contaminated soil in separate stockpiles.
- Perform verification sampling of the excavation to ensure the RGs are attained.
- Treatment of the contaminated soil utilizing LTTD to the treatment criteria.
- Prior to release, treat the off-gas from the LTTD system using a secondary treatment unit consisting of a thermal oxidizer operating at approximately 1,800 degrees Fahrenheit with a two second retention time, rapid quench evaporative cooling chamber, and acid gas scrubber.
- Stabilize metals contaminated soil that fails TCLP criteria.

- Sample stockpiles of treated soil to assure that treatment criteria has been achieved.
- Dispose of the treated soil at the Trench 6 Soil Repository.
- Restore the site by backfilling with clean soil and turf establishment.

This 1998 soil cleanup effort removed 4,250 cy of contaminated soil and was accomplished in three phases. Approximately half of the excavated soils were thermally treated.

Phase I excavation started on August 20, 1998. The Phase I excavation area was based on the data obtained from the characterization sampling event conducted between November 1996 and March 1997. The excavation area had a surface area of approximately 2,500 square feet. Approximately 900 cy of soil was removed. The soil was segregated into two categories based on lead content and transported to the IDA treatment area.

Phase II excavation was performed on September 2, 1998 as the result of two sidewall confirmation samples exceeding the excavation criteria. Approximately 350 cy of soil was removed in Phase II. Additional soil was removed from the east wall, and the entire southern side-wall was excavated an additional 25 feet to the south. The upper 7 feet of material was clean and used for backfill. Additional soil was removed from the west wall due to the presence of debris. The remaining material was excavated to approximately 9 feet bgs and placed in Trench 6 Soil Repository for LTTD treatment.

Phase III of the excavation was conducted in December 1998 because high VOC levels were detected below the previous excavation elevations at 9 feet bgs. The third phase of the excavation was not due to soil confirmation samples exceeding the excavation criteria, but was performed as a cost-efficient means for removal of residual contamination. Excavation was terminated at a depth of 22 feet bgs in the absence of ponded water in the excavation. Approximately 3,000 cy of soil was removed from the FTP during Phase III. Approximately 1,400 cy was designated for treatment in the LTTD unit, and 1,600 cy of soil was placed directly into Trench 6 for landfarming. Twenty-five confirmation samples and two QC samples were collected from the bottom of the excavation on December 4, 1998, and analyzed for VOCs to determine residual contaminant levels in the excavation. All sample results were below the excavation criteria. During the Phase III excavation, monitoring well JAW-69, located in the southern portion of the Phase III excavation area, was abandoned and completely removed.

In 2001, approximately 500 to 1,000 cy of contaminated soil and debris was found in secondary locations. This material contained high levels of metals and/or VOCs. In 2003, 616 cy of contaminated soil and debris was removed and disposed of in the IDA (ECC, 2003).

3.3.13.3 Site Inspection

The site was inspected and found to be in excellent condition. There were no signs of erosion, settlement, or areas of sparse vegetation observed.

3.3.14 Abandoned Coal Storage Yard (IAAP-042)

3.3.14.1 Background

During the operation of the Steam Generating Plant at Line 1, coal was the primary fuel used. The Coal Pile is bounded on the north and east by railroad tracks and on the southeast by the head of Brush Creek. The coal is now scattered around an area about 4 acres. Runoff from the coal pile, augmented by water brought into the area by the three culverts below the rail tracks could have caused the widespread dispersal of the coal pile.

The coal pile was established in 1950 and used through 1968. Currently, it is not in use because the fuel for the heating plant was changed to No. 2 Oil. When the use of coal for heating plant was discontinued in 1968, the stockpiled coal was left in place. There was no cover for the pile to reduce infiltration of precipitation, therefore it can be expected that leaching and runoff have occurred since 1950.

Although the coal pile covers an area of approximately 3 to 4 acres, runoff may have spread to a greater area. There has been severe erosion of the pile resulting in furrows several feet deep as evidenced by vegetation stress observed on the adjacent storage yards.

Figures of the Abandoned Coal Storage Yard and related site investigations are provided in *Tab 27 of Appendix F.*

3.3.14.2 Remedy Status

The SI sampling was completed in 1991 and no significant contamination was found.

The Abandoned Coal Storage Yard was eliminated from RI consideration because the installation completed a State of Iowa DNR Removal Activity. This removal activity was summarized in a Finding of No Significant Impact dated 26 October 1992. The RCRA Branch of EPA Region 7 agreed to this removal action. The removal was completed in late 1993, and the area was covered with clean soil and re-vegetated with native grasses. No additional actions are currently planned at this site.

3.3.15 Fly-Ash Disposal Area (IAAP-043)

3.3.15.1 Background

In operation from the 1940's to the 1950's, this area was used for disposal of fly ash, residual coal, clinkers, and other residue from the coal-fired power plant and is nearly 5 acres in size. The site is abandoned and covered with natural vegetation, but has no soil or clay cover.

Figures of the Fly-Ash Disposal Area and related site investigations are provided in Tab 28 of Appendix F.

3.3.15.2 Remedy Status

The PA/SI was completed in 1991, the RI was completed in May 1996. The PA/SI indicated there was a potential for contamination at this site. Metals were detected in soil samples collected from the disposal area above SI evaluation criteria; however, no metals were found in sediment samples collected from the streambed. No explosives were found in any samples taken at the site. Surface water and sediment samples collected during the RI confirmed off-site migration of contamination has not occurred at the Fly-Ash Disposal Area due to surface runoff to the intermittent stream (JAYCOR, 1996). No additional actions are currently planned at this site.

3.3.16 Line 800 Pinkwater Lagoon (IAAP-044)

3.3.16.1 Background

Due to the complexity in defining site boundaries, sites IAAP-0044 (Line 800 Pinkwater Lagoon) and IAAP-011 (Line 800) are currently managed as one site by the Army.

The Line 800 Pinkwater Lagoon consisted of an unlined, 5-acre impoundment, four feet deep, surrounded by an earthen berm. This lagoon was located adjacent to Line 800 (IAAP-011) and an intermittent tributary to Brush Creek. The Pinkwater Lagoon was constructed in 1943 for the disposal of pink water effluent from adjacent Line 800 production facilities and sludges trucked in from other line operations within the installation. In 1943, leaching fields associated with the lagoon to include evaporation furrows were constructed. The lagoon also received metal cleaning sludge from Line 3 operations. In the early 1970s this lagoon ceased to be used.

The primary activity at Line 800 was ammunition renovation from 1943 to 1980. From 1980 to the present, primary activities at Line 800 include remote disassembly of projectiles and assembly of 75 mm and 105 mm blanks.

Figures of the Line 800/Pinkwater Lagoon Area and related site investigations and activities are provided in Tab 10 of Appendix F.

3.3.16.2 Remedy Status

Studies conducted in 1991 through 1998 indicated that primary waste disposed at the Pinkwater Lagoon included explosives-contaminated wash water and heavy metals from operations at Line 800 and other production lines. Carbon and fly-ash disposal may also have occurred at the site. As a result of the RI sampling, a removal action to excavate explosives-contaminated soils occurred in 1997. The elements of the removal action are presented in the *Action Memorandum for the Pinkwater Lagoon and Former Line 1 Impoundment at the Iowa Army Ammunition Plant, Middletown, Iowa* [USAEC, October 1996]. The removal action described in the Action Memorandum includes the elements that are summarized in Section 3.3.4.2.

In 1997, the Line 800 Lagoon was excavated as a component of the environmental clean-up of the Line 800 Lagoon and the Line 1 Impoundment and other contaminated soil removal sites. The primary feature of the cleanup was to excavate contaminated soil from the Line 1 Impoundment and the Line 800 Lagoon, segregate the soil according to level of contamination

and transport the material to the Inert Landfill Disposal Area. At the IDA, the material with the highest level of contamination was placed into a temporary stockpile where it will be treated at a later date. The remainder of the material was permanently placed into the Trench 6 Soils Repository or used as random fill under the geosynthetic cap that was placed over Trenches 1 through 5 of the Inert Landfill. Approximately 74,736 cy of explosives-contaminated soils were excavated from the Pinkwater Lagoon.

When cleanup activities began, the lagoon consisted of an unlined 5-acre impoundment, four feet deep, surrounded by an earthen berm. The lagoon was dewatered with the water being discharged into a Brush Creek tributary after being processed through a carbon treatment system. The contaminated soil was excavated from the lagoon in one-foot layers on 50 foot grids.

The excavated area was reclaimed as an engineered wetland area. The excavated area was blanketed with organic rich seedbank material imported from the Stump Lake borrow source. Wetland plants were allowed to naturally establish from the Stump Lake seedbank.

Two additional areas of explosives soil contamination were found in 1998. One area in the southwest portion of the lagoon was found to require no action. The other area, in Settling Basin #1, requires additional contaminant delineation and excavation. A remedial action implemented by the Army will consist of additional contaminant delineation, contaminated soil excavation and placement in the IDA for treatment and/or disposal. Remedial actions are to be completed in 2007 as part of Phase 5 activities.

3.3.16.3 System Operation and Maintenance

Line 800 Pinkwater Lagoon. After contaminated soils were excavated from the Pinkwater Lagoon, the excavated area was lined with sediment from Stump Lake and other topsoil sources. The excavated area has since filled with water originating from precipitation. This water is contaminated primarily with RDX. The RDX levels varied during the 1999 sampling season from approximately 30 ug/L in the winter to less than 2 ug/L in the summer. Wetland vegetation that naturally establishes from the imported seedbank is intended to phytoremediate the contaminated residual surface water. There are two wetland cells comprising the Line 800 Lagoon. The shallow southwestern end was separated from the deeper main lagoon by constructing a berm across the lagoon in 1998. The southwestern end was segregated from the main lagoon because hot spots of explosives were detected in both the surface water and soil. An overflow pipe is located in the berm separating the two wetlands. The water in the deeper main lagoon can be regulated down to elevation 678.6 feet amsl using a six-inch diameter valved structure that is located on the north end of the lagoon. The primary activities at the Line 800 Lagoon are monitoring chemical water quality and controlling water discharges from the lagoon.

- **Water Control.** The water surface elevation is to be measured on a monthly basis and during periods of heavy surface runoff to assure that there are no spills of contaminated water from the lagoon. The discharge criteria for surface water is 2 ug/L for RDX. When the RDX levels are below 2 ug/L, water may be discharged from the lagoon by opening the valve allowing the water to stabilize at elevation 678.6 feet amsl. Releases from the lagoon are to comply with State requirements when discharging water. A staff gage is located in the lagoon to identify water surface elevations. During the periods that the RDX levels are above 2 ug/L, the valve is

to remain closed preventing releases of contaminated water.

- **Mowing.** There are no mowing requirements.
- **Project Signs.** Signs are to be maintained.
- **Rock Surfacing.** The access road rock surfacing for the water control valve and the monitoring wells is to be maintained.
- **Water Control Structure.** The water control structure and outfall channel are to be maintained, and any displaced riprap located in the outfall channel is to be replaced.

(Iowa Army Ammunition Plant, Site Operations & Maintenance Plan, Year 2001)

3.3.16.4 Site Inspection

The site was inspected and found to be in excellent condition. The wetlands are well established and appear to be thriving, and largemouth bass were observed to be present. Signs are posted which restrict fishing in the pond. No releases of water exceeding discharge criteria have occurred. The water control outlet was found and has vegetation growing around it that could impact flows. It is recommended that this vegetation be cleared. A new warning sign has been installed at the start of the access road.

3.3.17 Former Fuel Station USTs (IAAP-045)

3.3.17.1 Background

The Fuel Station was located directly east of Texas Avenue north of the Fire Station. The Fuel Station was used from 1941 until 1997. In 1988, three leaking USTs were removed and replaced; some contaminated soil was left in place. This site consists of the contaminated soil and groundwater. The new tanks were active from 1988 to 1997 and were removed in 1999.

3.3.17.2 Remedy Status

In June 2002, 460 cy of petroleum-contaminated soil were excavated from the Former Fueling Station in accordance with guidelines from the Leaking UST Section of the DNR. In July 2002, an additional 60 cy of soil was removed (Trileaf, 2002). Regular groundwater monitoring has been conducted at the site, and the compound with the highest concentration reported in 2003 was benzene, but the concentration was below the action level. In October 2003, Trileaf Corporation requested no further action for this site from the Iowa DNR (Trileaf, 2003), which has been approved, and a "No Further Action" certificate has been received from the State of Iowa.

3.4 PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

This is the first Five-Year Review.

3.5 TECHNICAL ASSESSMENT

3.5.1 Question A: Is the Remedy functioning as intended by the Decision Documents?

Since the remedial action at OU-1 is under construction and is not yet completed, the remedy at OU-1 is expected to function as intended by the Decision Documents.

Based upon a review of the documents, Applicable, Relevant and Appropriate Requirements (ARARs), risk assumptions, and the results of the on-site inspection, it has been determined that the actions taken to date have been implemented as intended by the OU-1 ROD, as modified by the ESD. However, as described in Section 3.6, there are operational issues that will require follow-up actions.

3.5.2 Question B: Are the exposure assumptions, toxicity data, clean-up levels and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Changes in Standards and To Be Considered:

As the remedial work has been completed, the ARARs for soil contamination in the ROD have been met. ARARs that still must be met at this time of the remedial action, include surface water and ground water ARARs and the closure and post-closure requirements for the soils repository. A list of these ARARs is included in Table 3-8. There have been no changes in these ARARs and no new standards or standards to be considered (TBCs) affecting the protectiveness of the remedy.

Changes in Exposure Pathways, Toxicity, and other Contaminant Characteristics:

All exposure assumptions appear to remain valid. Many COCs have had changes in toxicity information since the ROD. A comparison of acceptable reference doses (RfDs) and cancer slope factors (SFs) was made and is shown in Table 3-9. A discussion of the significance of those changes follows, including evaluation of how the changes in toxicity would effect the soil remediation levels.

Discussion of changes in toxicity values:

Arsenic. Based on the cancer endpoint, the PRG for arsenic was calculated in the BLRA as 3.4 mg/Kg. The soil remediation goal, however, was set at 30 mg/Kg, the maximum value observed in background soil samples. The SF_o for arsenic was revised on April 10, 1998. Using the revised SF_o, the PRG calculates to 2.6 mg/Kg, compared to the original PRG of 3.4 mg/Kg. However, since the remediation goal was set approximately one order of magnitude higher, it should be assumed that the remedy for arsenic remains protective.

Beryllium. Based on the cancer endpoint, the PRG for beryllium was calculated in the BLRA as 1.4 mg/Kg. The soil remediation goal, however, was set at 5 mg/kg. The PRG is in the process of being re-evaluated and may be revised to reflect the maximum observed value in background soils (2.1 mg/Kg). The oral RfD, inhalation RfC and carcinogenicity assessment in IRIS were revised 04/03/1998. Per IRIS, "Confidence in this assessment is improved over the earlier version on IRIS because of the inclusion of additional chronic studies in rats and dogs." The RfD_o was reduced; however, there was no change in the SF_o for beryllium. The remediation goal for beryllium was set at approximately a factor of 4 times the 1E-6 PRG, and should be protective. However, the basis for this remediation goal is being further reviewed.

Table 3-8 Applicable, Relevant and Appropriate Requirements

ARARs Citation	Explosives Contaminated Soils/Explosives plus Metals Contaminated Soils Biological Treatment/ Solidification/Stabilization with Activated Carbon
Fish and Wildlife Coordination Act, 16 U.S.C. 661 et seq. 40 CFR 6.302	Surface water removed from excavated areas of decontamination water may be discharged to Brush, Long, or Spring Creeks. If so, the water will be treated as necessary to avoid modifying the creeks and affecting fish or wildlife.
Federal Water Pollution Control Act (FWPCA), 33 U.S.C. Section 402 (National Pollution Discharge Elimination (NPDES) permit conditions	This alternative may involve the discharge of surface water removed from excavated areas, or decontamination water, into Brush, Long, or Spring Creeks. Appropriate treatment will ensure that discharges comply with standards in the NPDES permit issued to IAAAP.
IEQA, I.A.C., Division 567, Title III, Chapter 62, Effluent and Pretreatment Standards: Other Effluent Limitations or Prohibitions (I.A.C.62.1(455B)(1) [NPDES Permit conditions]	This alternative may involve the discharge of surface water removed from excavated areas, or decontamination water, into Brush, Long, or Spring Creeks. Appropriate treatment will ensure that discharges comply with standards in the NPDES permit issued to IAAAP.
IEQA, I.A.C., Division 567, Title IV, Chapter 61, Surface Water Quality Criteria (I.A.C.61.2(455B)(2) [Antidegradation Policy]	This alternative may involve the discharge of surface water removed from excavated areas, or decontamination water, into Brush, Long, or Spring Creeks. Appropriate treatment will ensure that discharges comply with the State antidegradation policy.
IEQA, I.A.C., Division 567, Title IV, Chapter 61, Surface Water Quality Criteria (I.A.C.61.3(455B) [Water Quality Criteria for general use segments, and for designated use water segments]	This alternative may involve the discharge of surface water removed from excavated areas, or decontamination water, into Brush, Long, or Spring Creeks. The discharge will be treated appropriately to ensure compliance with the State water quality criteria for Class B(LR)waters.
Solid Waste Disposal Act, as amended by the Resource Conservation Recovery Act, 42 U.S.C. 6901 et seq. 40 CFR 258.40(1)(1), and Table 1 [Groundwater Protection Standards for solid waste disposal facilities]	This alternative may include the on-site disposal of treatment residuals into an on-site landfill. This may present a potential for leaching of contaminants into the groundwater, which is a potential source of drinking water. Groundwater monitoring will ensure compliance with the groundwater protection standards.
Solid Waste Disposal Act as amended by the Resource Conservation Recovery Act, 42 U.S.C. 6901 et seq. 40 CFR 264.92 – 264.94, and Table 1 [Groundwater Protection Standards for permitted hazardous waste facilities]	This alternative may include the on-site disposal of treatment residuals into an on-site landfill. This may present a potential for leaching of contaminants into the groundwater, which is a potential source of drinking water. Groundwater monitoring will ensure compliance with the groundwater protection standards.
IEQA, I.A.C., Division 567, Title X, Chapter 133, Iowa Responsible Parties Cleanup Regulations (I.A.C.133.4(455B,455E)(2) and (3)(b)(1) [Action levels for groundwater cleanup actions]	This alternative may include the on-site disposal of treatment residuals into an on-site landfill. This may result in a point source contamination presenting a significant risk to groundwater, through leaching of contaminants. Groundwater monitoring will ensure compliance with the State action levels.
IEQA, I.A.C., Division 567, Title X, Chapter 141, Hazardous Waste 40 CFR Part 264, Subpart G (I.A.C.141.5[455B]) [Closure and Post-Closure Requirements]	This alternative involves the disposal of treated and untreated contaminated soils into a landfill. The alternative will comply with the closure requirements when the soil repository is closed.

Table 3-9. Comparison of ROD (1996 RI) and Five-Year Review Toxicity Values.

Chemical	1996 RI RfD_o	1996 RI SF_o	July 2004 RfD_o[a]	July 2004 SF_o[a]
Antimony	4E-04		4E-04	
Arsenic	3E-04	**1.8E+00**	3E-04	**1.5E+00**
Beryllium	**5.0E-03**	4.3E+00 2.4E-03 (Inhalation Unit Risk)	**2E-03 (RfD)** **2E-02 (RfC)**	2.4E-03 (Inhalation Unit Risk)
Cadmium	5.0E-04 (Water) 1.0E-03 (Food)	1.8E-03 (Inhalation Unit Risk)	5E-04 (Water) 1E-03 (Food)	1.8E-03 (Inhalation Unit Risk)
Chromium VI	**5.0E-03**	1.2E-02 (Inhalation Unit Risk)	**3E-03 (RfD)** **1E-04 (RfC, particulate)**	1.2E-02 (Inhalation Unit Risk)
Lead	NA	NA	NA	NA
Thallium	**7.0E-05**[c]		**8E-05**[h] **9E-05**[h]	
Benzo(a)anthracene[d]	3.0E-02[b]	7.3E-01	3.0E-02[b]	7.3E-01
Benzo(a)pyrene	3.0E-02[b]	7.3E+00	3.0E-02[b]	7.3E+00
Benzo(b)fluoranthene[d]	3.0E-02[b]	7.3E-01	3.0E-02[b]	7.3E-01
Dibenz(a,h)anthracene[d]	3.0E-02[b]	7.3E+00	3.0E-02[b]	7.3E+00
Total PCBs **Aroclor 1254** **Aroclor 1260**	**7.0E-05** **7.0E-05** **7.0E-05**	**7.7E+00** 7.7E+00 **7.7E+00**	**NA**[e] **2E-05** **NA**[f]	**2.0E+00**[g] **2.0E+00**[g]
1,3,5-Trinitrobenzene	**5.0E-05**		**3E-02**	
2,4-Dinitrotoluene (2,4-DNT)	2.0E-03	6.8E-01 (Mixture)	2E-03	6.8E-01 (Mixture)
2,4,6-Trinitrotoluene (2,4,6-TNT)	5.0E-04	3.0E-02	5E-04	3.0E-02
RDX	3.0E-03	1.1E-01	3E-03	1.1E-01
HMX	5.0E-02		5E-02	

BOLD indicates where toxicity values have changed.

a. June 2004 RfDs and SF_os taken from the USEPA IRIS database.

b. 1996 and 2004 RfD values for pyrene.

c. Value taken from HEAST, 1992.

d. Slope factor taken for benzo(a)pyrene, adjusted using TEF approach.

e. Per IRIS, RfD for total PCBs no longer calculated. RfDs calculated for individual Aroclors.

f. RfD not available for Aroclor 1260.

g. The cancer potency of PCB mixtures is determined using a three tiered approach that depends on the information available. Criteria for use of the High Risk and Persistence Tier include: food chain exposure; sediment or soil ingestion; dust or aerosol inhalation; dermal exposure if an absorption factor has been applied; any early-life exposure; and the presence of dioxin-like, tumor-promoting, or persistent congeners. This value, 2.00e+00 per (mg/kg)/day, is the upper-bound slope factor for the High Risk and Persistence Tier. The central-estimate slope factor for this tier is 1.00+00 per (mg/kg)/day.

h. RfD values for thallium range from 8E-05 (thallium carbonate, thallium chloride, thallium(I)sulfate) to 9E-05 (thallium acetate, thallium nitrate). RfD for thallium selenite withdrawn from IRIS 7/22/93.

Chromium VI. There was no PRG for chromium calculated in the BLRA. Using the information from the BLRA and the oral RfD, the PRG would have been 10,204 mg/Kg. In the FFS, the PRG was established at 10,000 mg/kg. The oral RfD, inhalation RfC and carcinogenicity assessment in IRIS were revised September 3, 1998. Per IRIS, "The RfD is similar to the previous value on IRIS but now incorporates a threefold uncertainty factor to account for the less-than-lifetime exposure in the principal study and a threefold modifying factor to account for uncertainties related to reports of gastrointestinal effects following drinking water exposures in a residential population in China." Utilizing the revised RfD_o, the PRG calculates to 6,122 mg/Kg. Therefore, if actual levels of chromium VI remain above 6,122 mg/Kg, and exposures occur as assumed in the BLRA, the protectiveness of the remedy for chromium VI is questioned. It is not clear from the documents reviewed why a PRG for chromium VI was calculated in the FFS, as chromium was not selected as a COC in the BLRA. Additionally, this review was unable to find information on confirmation samples for metals taken after remediation. Therefore, a review of the analytical data from the RI was conducted to determine pre-remedial concentrations. The highest detected concentration was 2,110 mg/Kg at IAAP-032. Also, chromium was not speciated, so all concentrations were total chromium, and chromium VI typically makes up no more than 20 percent of the total. Therefore, it must be concluded that the remedy for chromium VI remains protective.

Thallium. The oral RfD for thallium used in the BLRA was taken from HEAST, 1992. As noted in Table 3-9, the current RfD_o values for thallium range from 8E-05 (thallium carbonate, thallium chloride, thallium(I)sulfate) to 9E-05 (thallium acetate, thallium nitrate). The RfD_o for thallium selenite was withdrawn from IRIS July 22, 1993. Using the lower value of the RfD_o (range), the PRG calculates to 163 mg/Kg, compared to the remediation goal of 143 mg/Kg. Therefore, the remedy for thallium remains protective.

Polychlorinated biphenyls (PCBs). As noted for Table 3-9, an oral RfD is no longer calculated for total PCBs, but is assessed for each Aroclor. The RfD_o for Aroclor 1254 was revised on November 1, 1996. An RfD_o is no longer available for Aroclor 1260. The change in RfD_o calculates a lower non-cancer PRG, whereas the change in SF_o calculates a higher cancer PRG. Since the soil remediation goal for Total PCBs (10 mg/Kg) was based on OSWER 9355.4-01, *Guidance on Remedial Actions for Superfund Sites with PCB Contamination*, the changes in RfD_o and SF_o do not affect the protectiveness of the remedy for PCBs.

1,3,5-Trinitrobenzene. The oral RfD for 1,3,5-Trinitrobenzene was revised on October 1, 1997. Per IRIS, "The RfD is based on a well-conducted 2-year study that includes interim sacrifices at 3, 6 and 12 months and is supported by subchronic reproductive and developmental toxicity data in rats and subchronic data in mice. High confidence is recommended for the study. The database contains adequate subchronic studies in rats and mice, reproductive, developmental and chronic studies in rat and lacks additional developmental studies in other species. Medium confidence is therefore recommended for the database and the RfD." Using the revised RfD_o, the PRG calculates to 61,224 mg/Kg, compared to the remediation goal of 102 mg/Kg. Therefore, the remedy for 1,3,5-TNB remains protective.

3.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Formalized Land Use Controls will be addressed in the OU-4 ROD. In the interim, procedures for maintaining site controls at the IAAAP used to protect plant workers, contractors, and other site visitors from site contaminant, are in place but have not yet been completely formalized. Currently, coordination of digging permits, utility repairs, maintenance, or other site work is accomplished through internal coordination between American Ordnance and the IAAAP Staff to ensure workers are aware of and are protected from potential environmental hazards. A meeting was held on November 17, 2004, to discuss current site controls and as a result, it was decided to formally review and document these procedures (American Ordnance to take the lead) and distribute to appropriate staff at the IAAAP and at EPA. The documented procedures should address general site controls, routine maintenance and repair activities, new construction, and emergency work. In addition, questions arose regarding how hunting and fishing at the IAAAP is managed. Hunting and fishing is allowed on the IAAAP and is controlled through an in-place permit system. Hunting and fishing is allowed only in designated areas. Hunters must attend a hunter safety briefing prior to each year's hunting season.

A facility-wide baseline ecological risk assessment (BERA) is currently being conducted (Draft, MWH, 2004). The Indiana Bat, a special status species, is known to utilize the facility and feeds within the aquatic and terrestrial environments. The results of the BERA will be used to determine if the remedies within OU-1 are protective of the environment in general and this species of bat, in particular. If it is shown that the remedy is not protective, additional remediation will occur. This aspect should be revisited at the next five-year review.

3.6 ISSUES

Issue	Currently Affects Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
1. Formalize current site control procedures (para 3.5.3)	N	N
2. Maintain minimum 6" soil or other approved cover on Cap Extension Area at the IDA (para. 3.3.7.6).	N	N
3. Clear vegetation from drainage ditch near Cap Extension Area at the IDA (para. 3.3.7.6).	N	N
4. Place signs and/or boundary markers delineating Trench 6 Boundaries at the IDA, particularly on the northern side (para. 3.3.7.6).	N	N
5. Maintain leachate levels in Trench 6 and the CAMU to no more than 1 foot above the primary liner system (para. 3.3.7.6).	N	N
6. Monitor the condition of the sacrificial/temporary geosynthetic cover in the CAMU for continued deterioration, replace when necessary (para. 3.3.7.6).	N	N
7. Clear brush from outlet at Line 800 Pinkwater Lagoon (para. 3.3.16.4).	N	N
8. This review could not determine how the Remediation Goal (RG) for Beryllium was derived. The RG for this constituent may need revision as future site work warrants (para. 3.5.2).	N	N
9. Barren soil areas at the West Burn Pads Area (para. 3.2.14.3).	N	N

3.7 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Issue	Recommendations and Follow-Up Actions	Party Responsible	Oversight Agency	Recommended Schedule	Affects Protectiveness? (Y/N)	
					Current	Future
1. Formalize current site control procedures	Prepare written procedures and distribute to IAAAP staff	IAAAP	IAAAP	June 2005	N	N
2. Maintain minimum 6-inch soil or other approved cover on CEA at the IDA	Place approved cover over uncovered areas	IAAAP	EPA	Oct 2005 and Monitor Quarterly	N	N
3. Clear vegetation from drainage ditch near CEA at the IDA	Remove vegetation, inspect ditches quarterly	IAAAP	EPA	June 2005 and Clean as Necessary	N	N
4. Place boundary markers delineating Trench 6 Boundaries at the IDA.	Place appropriate signs and/or markers along road	IAAAP	EPA	December 2005	N	N
5. Maintain leachate levels in Trench 6 and the CAMU to no more than 1 foot above the primary liner system.	Evaluate current practices and implement SOPs to maintain minimum water levels in the liner systems	IAAAP	EPA	June 2005 and Monitor Monthly	N	N
6. Monitor the condition of the sacrificial/temporary geosynthetic cover in the CAMU for continued deterioration, replace when necessary.	Monitor and replace cover as necessary	IAAAP	EPA	Monitor Quarterly	N	N
7. Clear brush from outlet at Line 800 Pinkwater Lagoon	Remove Brush	IAAAP	IAAAP	June 2005 and Monitor Quarterly	N	N
8. Monitor water levels in sedimentation ponds to minimize overtopping of dam	Evaluate current practices and implement SOPs to maintain minimum water levels in the ponds	IAAAP	EPA	June 2005 and Monitor Monthly	N	N
9.RGs for Beryllium	Re-evaluate RG if future work warrants	IAAAP	EPA	Upon needs of future RA	N	N
10.Barren soil areas at the WBPA (para. 3.2.14.3).	Evaluate/address erosion	IAAAP	EPA	Spring 2006	N	N

Note: All actions with dates prior to January 2006 have been completed.

3.8 PROTECTIVENESS STATEMENT

Since the remedial action at OU-1 is under construction and is not yet completed, the remedy at OU-1 is expected to be protective of human health and the environment upon completion. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

The review indicates that while conditions at the IDA may be protective, conditions could be improved with relatively minor effort, consistent with the recommendations in this review, to ensure the safety and health of IDA workers and other potential exposure groups.

4.0 OPERABLE UNIT 3 (OU-3)

4.1 GENERAL

Groundwater OU-3 is intended to address groundwater contamination on- and off-post resulting from IAAAP sources. OU-3 entails two general response actions: 1) off-post groundwater; and 2) comprehensive on-site groundwater. The OU-3 ROD for the off-post groundwater Interim Action was signed by the Army and EPA in August 2005. A separate ROD for comprehensive on-site groundwater will be prepared to address groundwater contamination within IAAAP boundaries, where required.

The remedy for OU-3 off-post groundwater was selected during the preparation of this review and remedies for the remainder of OU-3 have not yet been selected. Therefore, a protectiveness review for OU-3 is not included as a part of this review. Instead, an update on the status of OU-3 is provided.

4.2 OFF-POST GROUNDWATER RESPONSE ACTION

4.2.1 Background

The off-post groundwater area occupies the Brush Creek watershed south of the IAAAP and portions of the Skunk River floodplain where groundwater is contaminated by RDX at levels exceeding 2 ug/L. Explosives used at IAAAP have been transported in Brush Creek surface water to the off-post area. The contaminants infiltrated into groundwater near U.S. Highway 61 and created the plume that has impacted and is threatening private drinking water wells. The plume has an average width of approximately 4,000 feet and extends approximately 7,800 feet downgradient (south).

A figure of the off-post groundwater area is provided in Tab 39 of Appendix F.

4.2.2 Past Investigations and Studies

In 1993, the presence of RDX above 2 ug/L in off-post groundwater was confirmed after an initial round of private drinking water well sampling completed by the Army. IAAAP connected private residences located south of the IAAAP to the regional water supply in 1994 and in 2001, as part of an interim action. This interim action was designed to eliminate the risk of exposure to possible contaminated drinking water until a remedial action could be completed.

Utilizing data from previous groundwater sampling events in the off-post area, an RI was conducted and a report prepared in 2003 (URS, 2003). The RI defined the extent of RDX contaminated groundwater and assessed the potential risks to human exposure to the RDX under a variety of exposure scenarios.

The exceedance of the target risk range and hazard index by off-post RDX groundwater concentrations triggered the development and evaluation of remedial alternatives in a FS. The FS was completed in March 2004 (URS, 2004a).

The draft-final Proposed Plan was issued to the public in July 2004. The Proposed Plan identified in-situ biodegradation in combination with monitored natural attenuation and institutional/land-use controls as the preferred remedial alternative. The preferred alternative is intended to be protective of potential exposures to RDX in groundwater to a level of 2 ug/L, which is a State ARAR. The Proposed Plan also concluded that a field-scale treatability study evaluating in-situ biodegradation should be conducted to determine the most effective means to implement this technology.

The *OU-3 ROD for the Off-Post Groundwater Interim Action* was signed by the Army and EPA in August 2005. The preferred alternative from the Proposed Plan was selected.

4.2.3 Current Status

In November 2004, a *Treatability Study Test Plan for In Situ Biodegradation of RDX in Off-Post Groundwater* was submitted for EPA review (Tetra Tech, 2004b). The treatability study will provide data useful for designing the in-situ biotreatment component of the remedy. Field-work for this study was initiated in early 2005.

Work has begun on the Remedial Design for the off-post response action.

4.3 COMPREHENSIVE ON-SITE GROUNDWATER RESPONSE ACTION

4.3.1 Background

There are numerous areas of groundwater contamination located on the IAAAP that will be addressed within the comprehensive on-site groundwater response action. Treatability studies to evaluate enhanced biotreatment at four of these areas were started in early 2005. Depending upon results, these treatability studies may be expanded. Currently, groundwater is not used or accessed on the IAAAP.

Areas of groundwater contamination to be addressed in the forthcoming OU-3 FS include, but are not necessarily limited to:

- Line 1
- Former Line 1 Pinkwater Impoundment
- Line 2
- Line 3
- Line 3A
- Line 5A/5B
- Line 9
- Line 800 / Pinkwater Lagoon
- Fire Training Pit
- East Burn Pads
- West Burn Pads Area
- Inert Disposal Area
- Firing Site
- Demolition Area / Deactivation Furnace

Other areas subject to further investigation include:

- Line 3A Sewage Treatment Plant Sludge Drying Beds
- Line 3A Pond
- Central Test Area
- Construction Debris Landfill
- Main Sewage Treatment Plant Sludge Drying Beds
- Fly Ash Waste Pile
- Ammunition Box Chipper Disposal Pit
- Incendiary Disposal Area
- Contaminated Clothing Laundry
- Possible Demolition Site

The results of those investigations, which include soil and limited groundwater sampling [detailed in the *Draft Final OU-4 Supplemental Remedial Investigation Work Plan* (Tetra Tech 2005), the *Draft Final Brush Creek, Spring Creek, Long Creek, and Skunk River Watershed Evaluation and Supplemental Data Collection Work Plan* (Tetra Tech 2005), and the *Draft Final Supplemental Remedial Investigation Work Plan and Regulatory Path Forward for Six Non-ER,A Eligible Sites* (Tetra Tech, 2005)], will be used to evaluate the possibilities of any groundwater contamination which will be addressed in the forthcoming OU-3 FS.

4.4 AREAS OF GROUNDWATER CONTAMINATION

The following brief descriptions summarize the groundwater contaminant data at each site. Treatability studies have been initiated at Line 9, the Former Line 800 Pinkwater Lagoon, the FTP, and the WBPA.

4.4.1 Line 1 and Line 1 Impoundment

Elevated concentrations of metals and explosives were detected in groundwater samples collected from monitoring wells installed in Line 1 during the RI (JAYCOR, 1996).

As of 2002, RDX was reported above its PRG in only two wells in the shallow till, one at Line 1 proper and one adjacent to the former Line 1 impoundment (now a pond). Arsenic slightly above its PRG was detected in one intermediate till well (HydroGeologic, 2003). Subsequent sampling in 2003 yielded similar results. The analytical results for the well adjacent to the former impoundment (SL-81) indicate a decrease in RDX concentrations since Spring 2001 (HydroGeologic, 2004). In a well near the former impoundment that had not been sampled for nineteen years (Fall 1985), an elevated concentration of RDX was reported in 2004. That well will be resampled to verify the concentration.

4.4.2 Line 2

As of 2002, RDX and HMX were reported above PRGs in six shallow till wells, the majority of which are located in Line 2 with the exception of one shallow till/alluvium well located on the west side of Brush Creek (opposite side from Line 2). Arsenic was reported above its PRG in two intermediate till wells, located in the southern portion of Line 2 (HydroGeologic, 2003).

During the field activities in support of the Remedial Alternative Analysis (RAA) (Fall 2002 and Spring 2003), direct push samples collected along Brush Creek in the vicinity of Line 2 fully delineated the contamination in the vicinity of the till/alluvium well (G-15), and indicated the plume at that location is distinct from the plumes at Line 2. The explosives concentrations in well G-15 adjacent to Brush Creek increased in Spring 2003. With that exception, RDX levels in groundwater generally were stable between Spring 2002 and Spring 2003 (HydroGeologic, 2004).

4.4.3 Line 3

During the RI, concentrations of explosive-related compounds were identified in shallow groundwater in a swale area immediately downgradient of a permitted effluent discharge and the former wastewater treatment sumps near Building 3-05-1. The explosive compounds observed in the shallow groundwater and in surface water in nearby drainage ditches are near the discharges. The extent of groundwater contamination was defined as the area between Buildings 3-05-1, 3-05-2, and 3-50 in the RI (JAYCOR, 1996). Groundwater tends to flow towards Brush Creek.

As of 2002, RDX was detected above its PRG in one shallow till well (HydroGeologic, 2003). During the field activities in support of the RAA (Fall and Spring 2003) and the annual monitoring program (Spring 2003), groundwater samples (direct push and monitoring wells) collected at Line 3 and along the tributary to Brush Creek indicated a small plume near the western portion of Line 3, which did not intersect the Line 3 tributary. Contaminant concentrations in this area decreased between Fall 2000 and Spring 2003 (HydroGeologic, 2004).

4.4.4 Line 3A

During the RI, explosives were reported in five wells. The RI concluded that probable sources included wastewater discharges and percolation of surface contaminants confirmed to exist in soils around production buildings and loading dock areas. Metals above detection limits, including lead and chromium, were reported in all wells. Neither lead nor chromium were detected in the two bedrock wells during the follow-on sampling (JAYCOR, 1996). The VOCs trichloroethene (TCE) and chloroform also were reported at the site during the RI.

In Spring 2002, RDX was detected above the PRG at four shallow till wells and one shallow bedrock well. Similar RDX concentrations have been previously detected above the PRG at the same well locations, with the exception of the bedrock well. No metals were detected above their respective PRGs in samples collected from the shallow till wells or basal till/upper bedrock wells (HydroGeologic, 2003).

In Spring 2003, RDX was detected above the PRG at the same shallow till wells. RDX concentrations indicated a general increase in all wells except one. The shallow bedrock well that had contained RDX in 2002 was not sampled because it was dry (HydroGeologic, 2004).

4.4.5 Line 5A

No explosives, SVOCs, or VOCs were detected during the PA/SI or RI in the well pair installed south of Line 5A (JAYCOR, 1996). The 1999 Supplemental RI (Harza, 2001) indicated RDX and TNT above PRGs in the shallow groundwater (30 feet bgs) within Line 5A proper. Spring 2002 monitoring data also indicated TNT and RDX in these wells. By Spring 2003, TNT concentrations

had decreased to below detection limits, and RDX concentrations had decreased to below PRGs in one well in Line 5A (HydroGeologic, 2004). Groundwater was likely contaminated as a result of percolation of water through contaminated soil, which has since been removed.

4.4.6 Line 5B

During the RI, no explosives, SVOCs, or VOCs were detected, though low levels of metals were detected. The 1999 Supplemental RI (Harza, 2001) indicated levels of RDX and 2,4,6-TNT above PRGs in the shallow groundwater (30 feet bgs) within Line 5B proper.

In Spring 2002, RDX was detected above the PRG in one of the two Line 5B wells (HydroGeologic, 2003). In Spring 2003, RDX was detected above the PRG in the same well. No compounds were detected above PRGs in the other well (HydroGeologic, 2004).

4.4.7 Line 9

During the RI, metals detected in the shallow groundwater were attributed to the historical use of the wastewater sump located east of Building 9-57. The extent of metals was localized in the shallow groundwater surrounding the sump at Building 9-57. VOCs were reported in samples collected during the Phase II RI near Building 9-57 (JAYCOR, 1996). According to the 1998 Interim Groundwater FS Report, Freon 113 and VOCs were present at Line 9, and free product was observed in the subsurface.

As of 2002, Freon 113 was detected above the PRG in three shallow till wells, and 1,1-dichloroethene (DCE) was detected above the PRG in one shallow till well. Freon 113 concentrations appear to be changing little over time (HydroGeologic, 2004).

4.4.8 Line 800 and Former Line 800 Pinkwater Lagoon

During the RI, the highest concentrations of explosives and greatest number of chemicals exceeding PRGs were reported in wells along the southeast side of the former Pink Water Lagoon. In addition, ppm-level concentrations of RDX and HMX were detected in wells northwest of the lagoon. RDX was also reported to the southwest (JAYCOR, 1996).

As of 2002, explosives (primarily RDX, TNT, and HMX) were detected above PRGs in the shallow till in the vicinity of the former Pink Water Lagoon. Concentrations of explosives in groundwater range as high as ppm levels. In the intermediate till, explosives were detected above PRGs in two isolated areas, one northwest of the former lagoon and one due south. No compounds exceeded PRGs in the shallow bedrock, although explosives were detected (HydroGeologic, 2003). The wells were not sampled during the Spring 2003 sampling event (HydroGeologic, 2004). Data for June 2004 indicate a similar concentration distribution relative to 2002.

4.4.9 Fire Training Pit

During the RI, elevated metals and methylene chloride concentrations were detected in one piezometer upgradient of the Fire Training Vault. The three downgradient piezometers also detected chlorinated volatile compounds, with the one located southwest of the FTP exhibiting the highest levels.

In Spring 2002, RDX exceeded the PRG at a well far downgradient of the former FTP. Historically, similar RDX concentrations have been observed in the same well. The shallow till VOC plume primarily consisted of a large number of compounds above PRGs, including chlorinated solvents and fuel related VOCs. The maximum VOC concentrations, which have ranged into ppm-levels, were typically reported in the well within the former FTP excavation, with the exceptions of tetrachloroethene and TCE detected in a shallow till well southwest of the FTP. The upper bedrock VOC plume is defined by similar though fewer VOCs than those in the shallow till. Arsenic was detected above the PRG at the former FTP, a decrease from Spring 2001 (HydroGeologic, 2003).

During the field activities in support of the RAA (Fall 2002 and Spring 2003) and annual monitoring program (Spring 2003), the extent of contamination was further defined. It indicated two limited areas of RDX contamination between the FTP and the tributary, and impacts of VOCs across the site, with the highest concentrations being located near the FTP.

Impacts in wells adjacent to the tributary were also noted. In the monitoring wells, RDX was detected above the PRG in the same well as in 2002 and indicated a decrease in concentration. The same VOCs were detected as in 2002. In the new monitoring wells, VOCs above their PRGs were detected in two till/bedrock wells along the tributary southeast of the FTP site. Arsenic in the well in the former FTP increased relative to 2002 concentrations (HGL, 2004).

4.4.10 East Burn Pads

During the RI, the explosives RDX, 2,4-DNT, 2,6-DNT, and HMX were reported in the groundwater at the EBP. Arsenic, lead, and chromium were also detected during the RI. Chloroform was reported in the groundwater sample collected from the same well in which VOCs were detected during the SI, and toluene was detected in two wells in or near drainages (JAYCOR, 1996).

In Spring 2002, RDX was detected above the PRG in two shallow till wells and three upper bedrock wells. TCE was detected in one shallow till well.

During the field activities in support of the RAA (Fall 2002 and Spring 2003) and annual monitoring program (Spring 2003), the extent of contamination was further defined, and indicated groundwater impacts in the shallow bedrock near Spring Creek and one of its intermittent tributaries. RDX was detected above the PRG in three shallow till wells and five upper bedrock wells. Concentrations in both shallow till wells and one shallow bedrock well decreased relative to 2002, and increased in two shallow bedrock wells. The TCE concentration detected in one shallow till well remained below the PRG (HydroGeologic, 2004).

FUSRAP will evaluate potential radiological contamination in the groundwater using existing wells. If no radiological contamination is found, the responsibility for groundwater will remain with Environmental Restoration, Army (ER,A). If radiological contamination is found at levels requiring action, FUSRAP will assume responsibility for groundwater (USAEC, 2003).

4.4.11 West Burn Pads Area

During the RI, detections of explosives and metals were reported in groundwater samples. RDX was the explosive with the highest reported value, and chromium was the metal with the highest reported value. VOCs were also detected, primarily TCE, 1,2-DCE, and carbon disulfide (JAYCOR, 1996).

In Spring 2002, RDX was detected above the PRG in three shallow till wells and five upper bedrock wells. Contaminants in two shallow till wells and three upper bedrock wells increased relative to Spring 2001 concentrations. In one shallow till well west of the WBPLF, 1,1-DCE exceeded its PRG and increased relative to Spring 2001, when it was first detected. Freon 113 was detected above the PRG at two bedrock well locations along the tributary and increased relative to 2001 concentrations. TCE was detected in one shallow bedrock well along Spring Creek and had increased in concentration relative to 2001. Arsenic above the PRG was detected in two shallow bedrock wells, and barium was detected above the PRG in one shallow bedrock well. Historically, similar arsenic and barium concentrations have been detected above the PRG in these wells (HydroGeologic, 2003).

During the field activities in support of the RAA (Fall 2002 and Spring 2003) and the annual monitoring program (Spring 2003), the extent of contamination was further defined and indicated two areas with high concentrations of RDX, one along the northern tributary adjacent to the former WBP and WBPLF, and one in the southeastern portion of the site south of the Burn Cages. An area with high concentrations of Freon 113 was identified at the northern end of the WBP.

In the monitoring wells, RDX exceeded the PRG in one shallow till well and eight till/shallow bedrock wells. RDX concentrations generally decreased relative to previous concentrations, with the exception of one well. The VOC 1,1-DCE was not detected in shallow till groundwater, and TCE was not detected in shallow bedrock groundwater. Freon 113 was detected above the PRG in two shallow bedrock well locations along the tributary and indicated an increase relative to 2002 concentrations. Arsenic exceeded the PRG in one shallow bedrock well along Spring Creek, and barium exceeded the PRG in one shallow bedrock well along the tributary (HydroGeologic, 2004).

June 2004 data indicate a similar distribution of contamination. RDX concentrations decreased in some wells, though concentrations increased in three till/shallow bedrock wells. Freon 113 concentrations generally increased in all wells except two bedrock wells.

4.4.12 Inert Disposal Area

The RI concluded that elevated metals and VOC concentrations reported in the shallow aquifer most likely originated from landfill activities at the IDA.

Radionuclides were found in groundwater samples during 1997 routine sampling and were determined to be "within normal background levels for IAAAP" and within safe limits (USACE, 2003).

Neither of the shallow wells sampled during the annual sampling event at the IDA had contaminant detections above PRGs in Spring 2002. During the May 2002 Trench 5 RCRA sampling event,

1,1-DCE, 1,2-dichloroethane (DCA), and TCE were detected above PRGs in shallow monitoring wells south of the inert landfill. Similar 1,1-DCE, 1,2-DCA, and TCE concentrations had been detected at levels above PRGs at the same well locations in May 2001. RDX and 2,4,6-TNT were detected in one shallow well. Similar RDX and 2,4,6-TNT concentrations were detected above PRGs at the same well location in May 2001 (HydroGeologic, 2003).

Pentachlorophenol was detected above the PRG in an intermediate till well downgradient of Trench 5 (ash disposal cell), where similar pentachlorophenol concentrations had been detected previously. RDX was detected above its PRG in the same well, where it was first detected during the May 2001 sampling event. Additional explosive detections above PRGs in this well included 2,4-DNT, 2,6-DNT, and nitrobenzene. None of these explosives were detected in the well during the Fall 2000 or Spring 2001 sampling events. Vinyl chloride was detected above the PRG in the same well. Vinyl chloride was first detected in this well during the May 2001 sampling event. Arsenic was detected above the PRG, but was lower than it was in Fall 2000 and Spring 2001 (HydroGeologic, 2003).

Bis(2-ethylhexyl)phthalate was detected above the PRG in a shallow bedrock well west of the CAMU in Spring 2002. Historically, similar concentrations have been detected above the PRG at this well (HydroGeologic, 2003).

Spring and Fall 2003 monitoring results indicate similar concentrations in shallow monitoring wells as were detected in Spring 2002. The intermediate well south of Trench 5 (ET-3) indicated generally decreasing concentrations of RDX, VOCs, and arsenic, with RDX being non-detect in Fall 2003. Pentachlorophenol concentrations increased in Spring 2003 in this well and decreased in Fall 2003. No bis(2-ethylhexyl)phthalate was detected in shallow bedrock in both Fall and Spring 2003 (HydroGeologic, 2004).

The 2004 annual sampling data indicate continued decreasing or relatively unchanging concentrations in June 2004. RDX was detected at ET-3 above the PRG. No bis(2-ethylhexyl) phthalate was detected.

4.4.13 Firing Site

During the RI, detectable levels of metals, primarily chromium, lead, and arsenic, were reported in the shallow till wells at the north test site. Radionuclides were also reported, primarily potassium 40, with the highest levels reported in the shallow wells and a bedrock well at the north test site.

No shallow till wells were sampled in Spring 2002 at the Firing Site. The two shallow till wells proposed for sampling were dry during the event. Uranium (metal) was detected slightly above its PRG in a deep well screened in the glacial outwash, where it had been detected at similar levels. Gross alpha concentrations decreased to below the PRG at the same well where it had been above the PRG in Spring 2001 (HydroGeologic, 2003).

In 2003, only two wells were sampled because other shallow till wells at this site are dry. Uranium decreased to below its PRG in the well in which it was present in 2002, and radionuclides remained below PRGs (HydroGeologic, 2004).

The 2004 annual sampling data indicate that no contaminants (including radionuclides) were detected above PRGs.

4.4.14 Demolition Area / Deactivation Furnace

Groundwater was sampled at the site periodically between 1984 and 1987; during this time 2,4,6-TNT was reported above the detection limit. Chloroform was found above evaluation criteria in 1985, though in 1987 chlorinated solvents were not detected (JAYCOR, 1996). During the RI, it was reported that explosive contamination in soil extended to approximately 2 feet below grade. The explosives RDX, 2,4-DNT, 2,6-DNT, and HMX were reported in the upper bedrock groundwater.

During the Spring 2002 sampling event, no explosives or metals were detected above their respective PRGs in the sample collected from a shallow till well. RDX was detected above the PRG at all upper bedrock well locations. In general, the observed RDX concentrations were consistent with those observed during previous sampling events, and indicated slightly increasing concentrations. The plume is migrating radially from the demolition pits (HydroGeologic, 2003).

During the Spring 2003 sampling event, no compounds were detected above PRGs in the shallow till groundwater. Four of the shallow bedrock wells were not sampled, because they were dry. Both shallow bedrock wells sampled contained RDX concentrations above the PRG. One well indicated a slight increase relative to 2002 concentrations, and the other indicated a decrease (HydroGeologic, 2004).

4.4 Other Areas of Groundwater Contamination or Potential Contamination

The following areas at the IAAAP are subject to further investigation. The results of those investigations will be used to evaluate the possibilities of any associated groundwater contamination.

- Line 3A Sewage Treatment Plant Sludge Drying Beds
- Line 3A Pond
- Central Test Area
- Construction Debris Landfill
- Main Sewage Treatment Plant Sludge Drying Bed
- Fly Ash Waste Pile
- Ammo Box Chipper Disposal Pit
- Incendiary Disposal Area
- Contaminated Clothing Laundry
- Possible Demolition Site

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5.0 OPERABLE UNIT 4 (OU-4)

5.1 GENERAL

Installation-wide OU-4 was developed as a "miscellaneous" Operable Unit to address issues which were not fully evaluated in other OUs, and to ensure that all remaining necessary remedial actions at the IAAAP are carried out. OU-4 includes eco-risk issues, surface water/sediment issues, point source contamination, long-term monitoring requirements, land use restrictions, closure of the CAMU/IDA, miscellaneous soil contamination sites, and any other unacceptable risks not addressed in either OU-1 or OU-3. The OU-4 ROD is currently scheduled for completion by late 2007.

Because the ROD for OU-4 is not finalized, a determination of protectiveness is not required for this five-year review. Instead, an update on the status and approach for completing work relative to OU-4 is provided for this review.

5.2 OU-4 BACKGROUND INFORMATION

Sites outside the scope of the Record of Decision for OU-1 have been tracked within this operable unit. The Army tracks the disposition of these sites in two separate programs: Installation Restoration (eligible for ER,A funds) and Compliance-Related Cleanup (ineligible for ER,A funds). The following sites were determined to be eligible for ER-A funding and are subject to a supplemental OU-4 RI [*Draft Final OU-4 Supplemental Remedial Investigation Work Plan* (Tetra Tech, 2005)].

- Incendiary Disposal Area (IAAP-013)
- Fly Ash Waste Pile (IAAP-015)
- Possible Demolition Site (IAAP-018)
- Explosive Waste Incinerator (IAAP-025)
- Construction Debris Landfill (IAAP-028)
- Line 3A Pond (IAAP-041)
- Central Test Area (IAAP-047)

Soil contamination at these sites will be addressed in the same manner as soil contamination described in the OU-1 ROD. Any groundwater contamination associated with these sites will be addressed along with the other groundwater sites of OU-3 (see Section 4.5).

Some sites were previously determined by the Army to be ineligible for ER, A funding. Six sites determined to be ineligible for ER,A funds will be managed under the Army's Compliance-Related Cleanup Program, according to the February 19, 2004, Resolution of Dispute. The requirements for these sites will be submitted via the Army's Environmental Program Requirements (EPR) report. This is currently in progress and activities will be coordinated with the EPA Region 7 RCRA Division or the State of Iowa, depending on regulatory jurisdiction. These sites are as follows:

- Contaminated Clothing Laundry (IAAP-019)
- Demolition Area/Deactivation Furnace (IAAP-021)
- Contaminated Waste Processor (IAAP-024)
- Sewage Treatment Plant Sludge Drying Beds (IAAP-026)
- Fly Ash Landfill (IAAP-027)
- Line 3A Sewage Treatment Plant Sludge Drying Beds (IAAP-029)

Details of proposed investigations at these sites are presented in the *Draft Final Supplemental Remedial Investigation Work Plan and Regulatory Path Forward for Six Non-ER,A Eligible Sites* (Tetra Tech, 2005).

Any future Institutional Controls and/or Land Use Controls, not otherwise addressed, are to be formalized via CERCLA documents prepared for OU-4.

APPENDIX A

REFERENCES

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APPENDIX B

INERT DISPOSAL AREA (IDA) DATA PLOTS

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FIGURE B-1
IDA - Gas Vents - Water Elevation

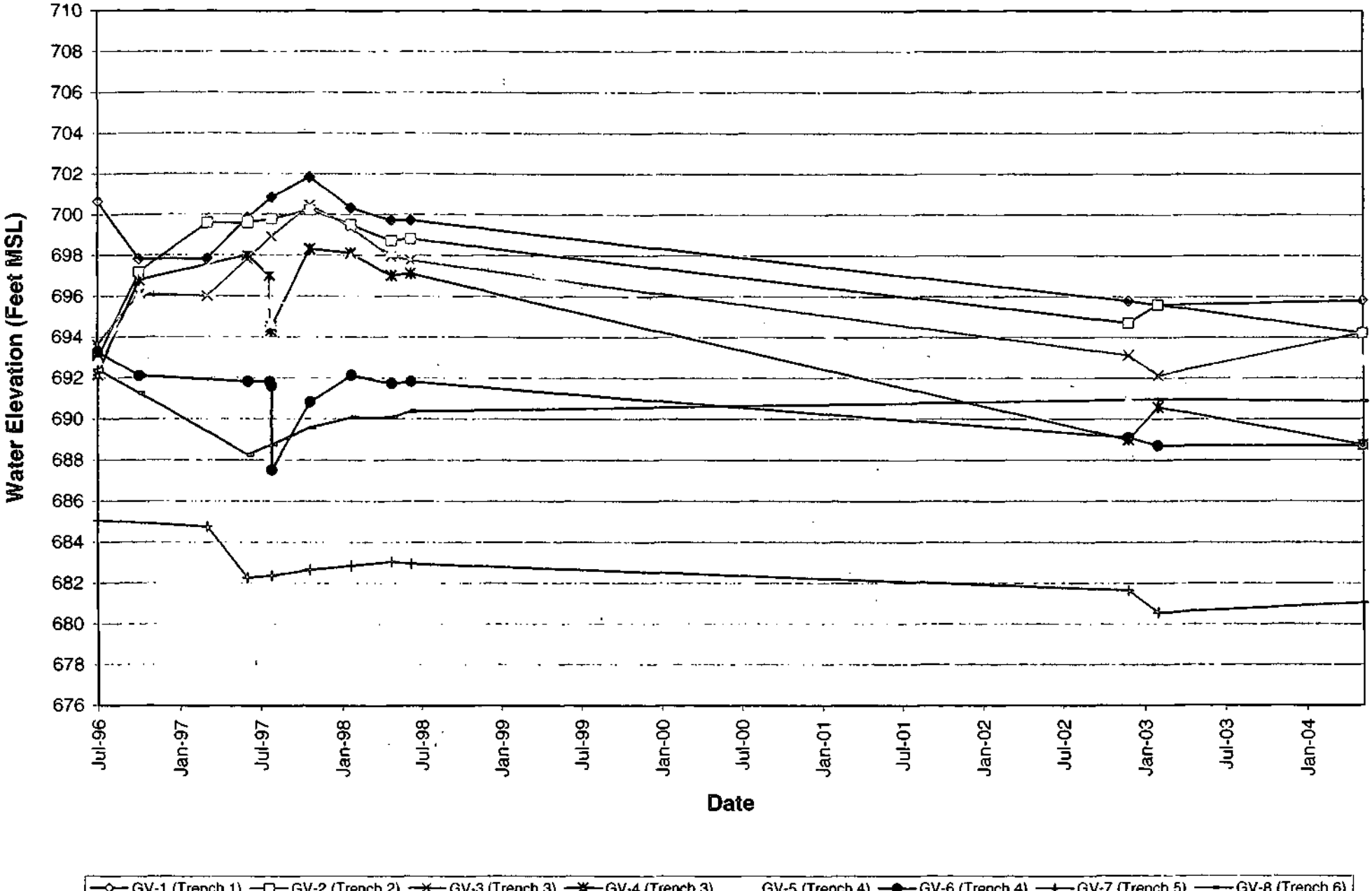


FIGURE B- 2

IDA - Gas Vents - Water Level above Bottom of Trash

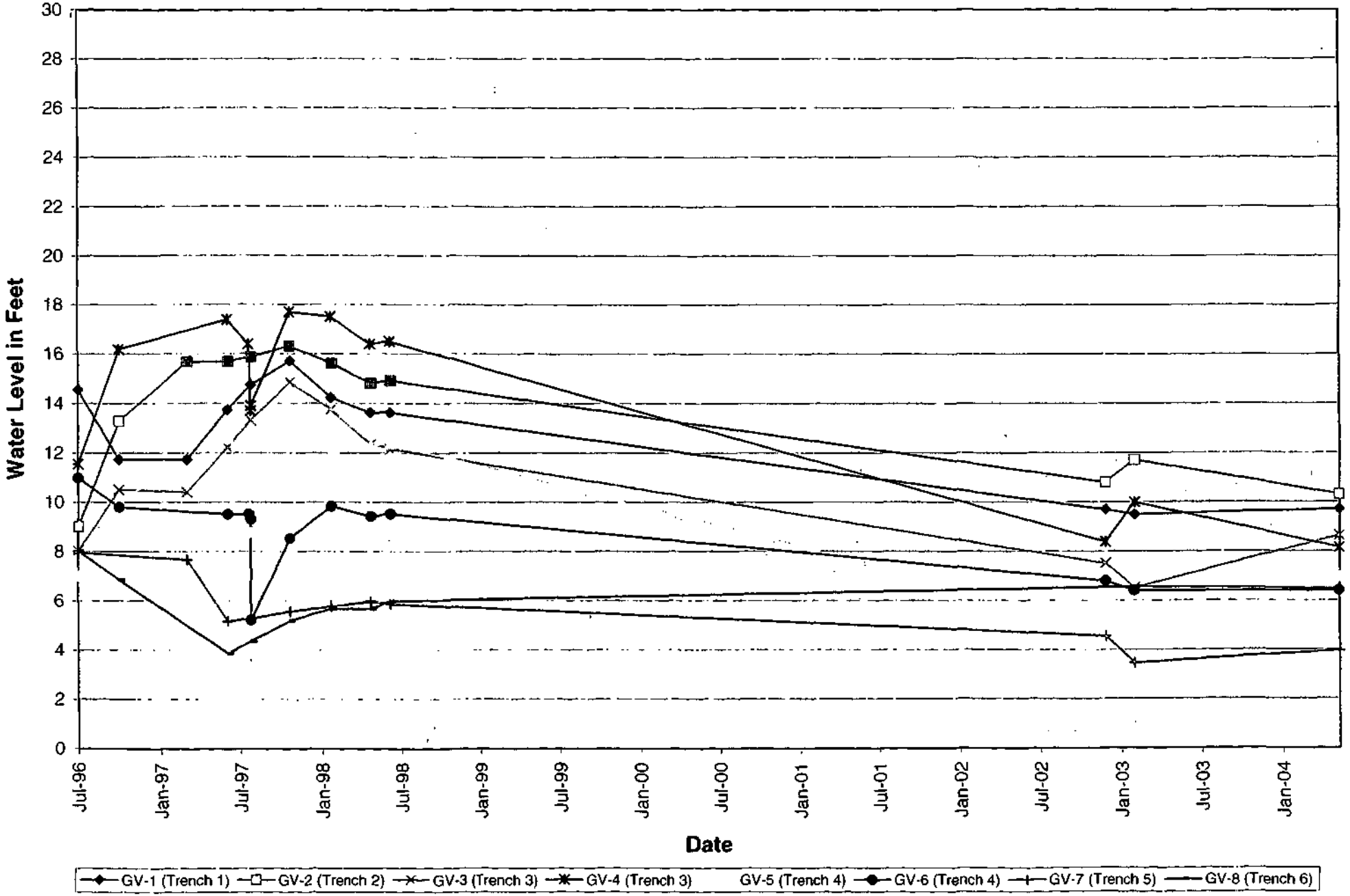


FIGURE B- 3
Inert Landfill Cap Settlement Monuments
Time vs. Movement Histories

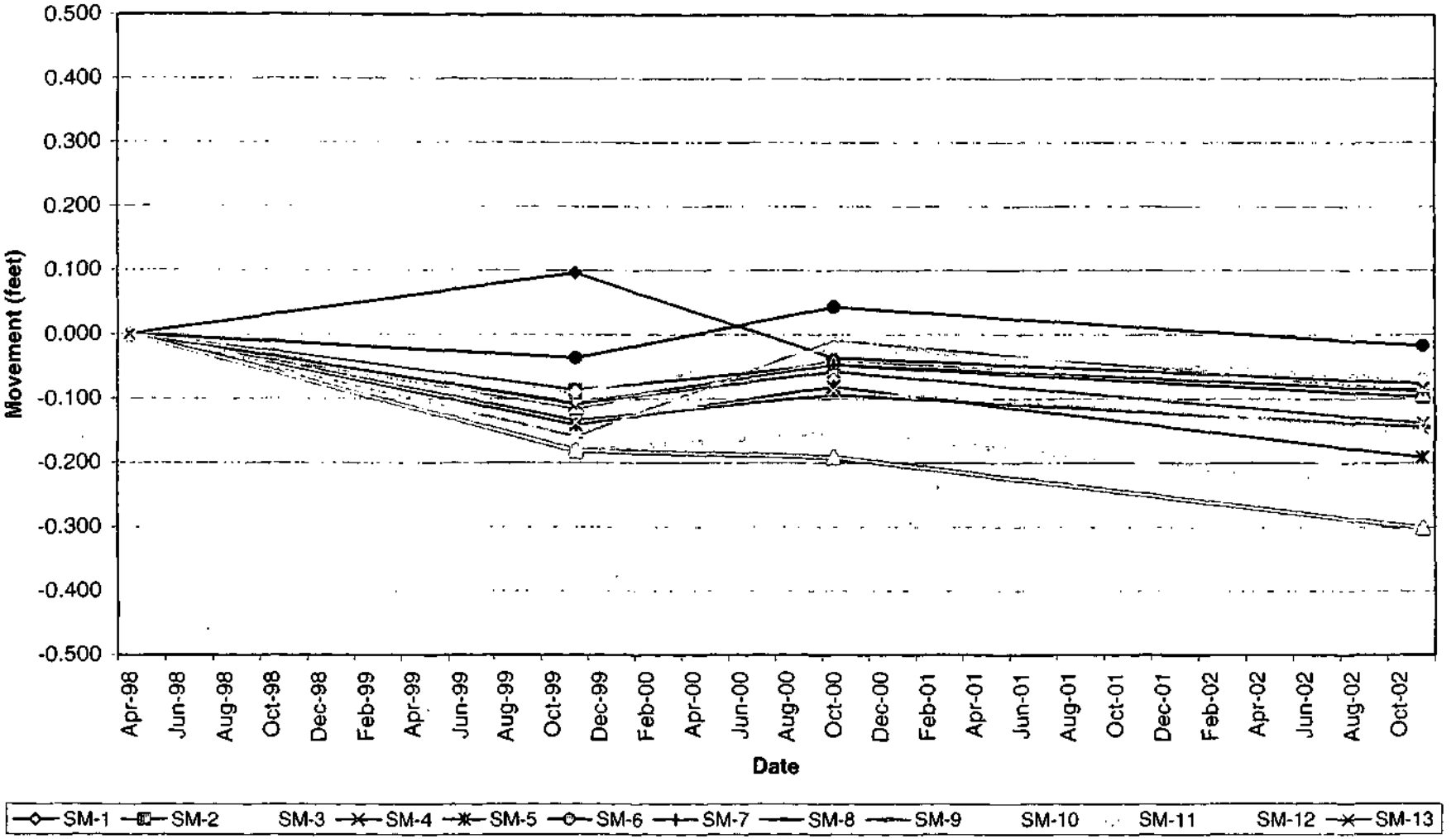


FIGURE B- 4
Trench 6 Soils Repository
Leachate Collection and Leak Detection Riser Pipe Water Levels

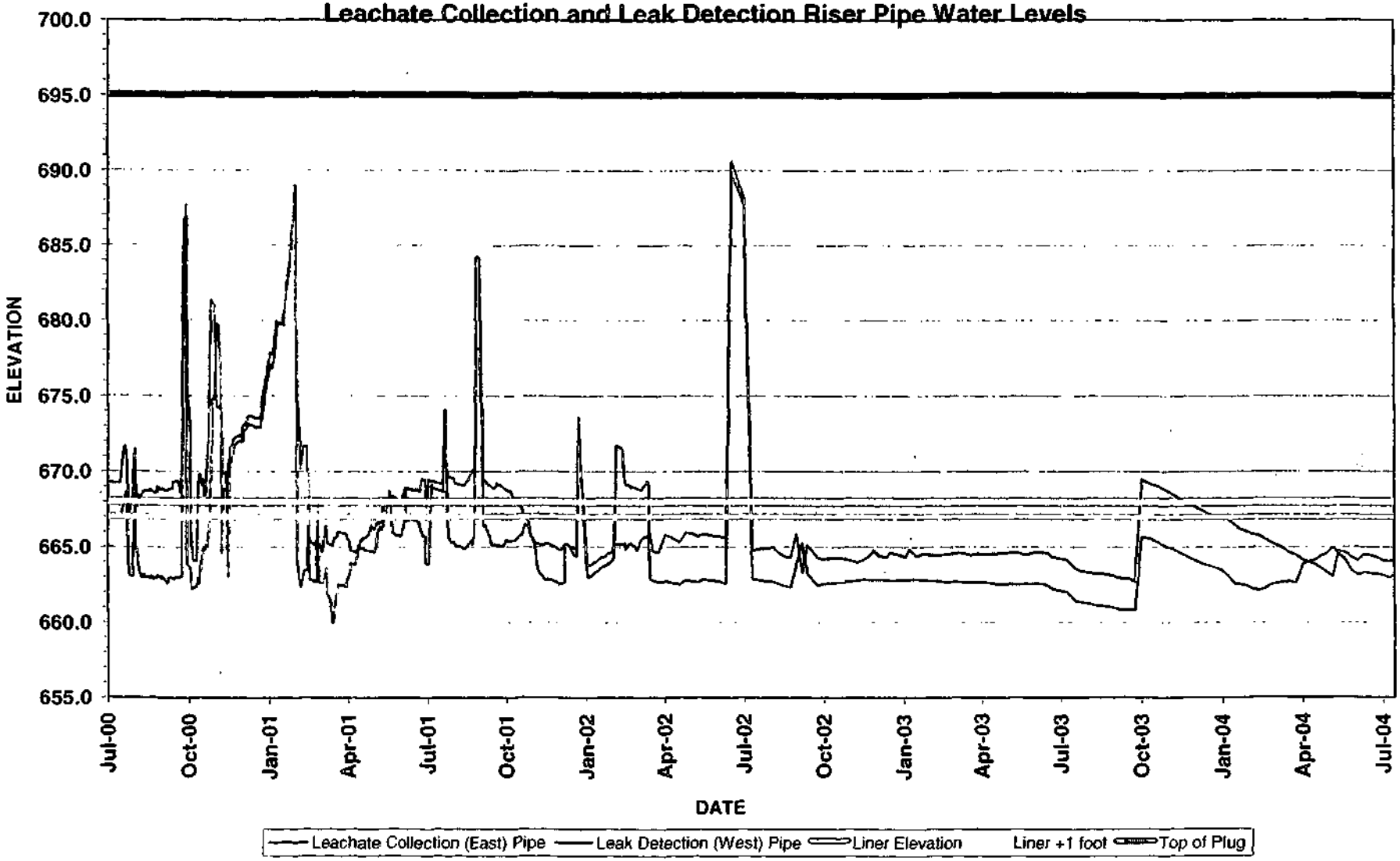
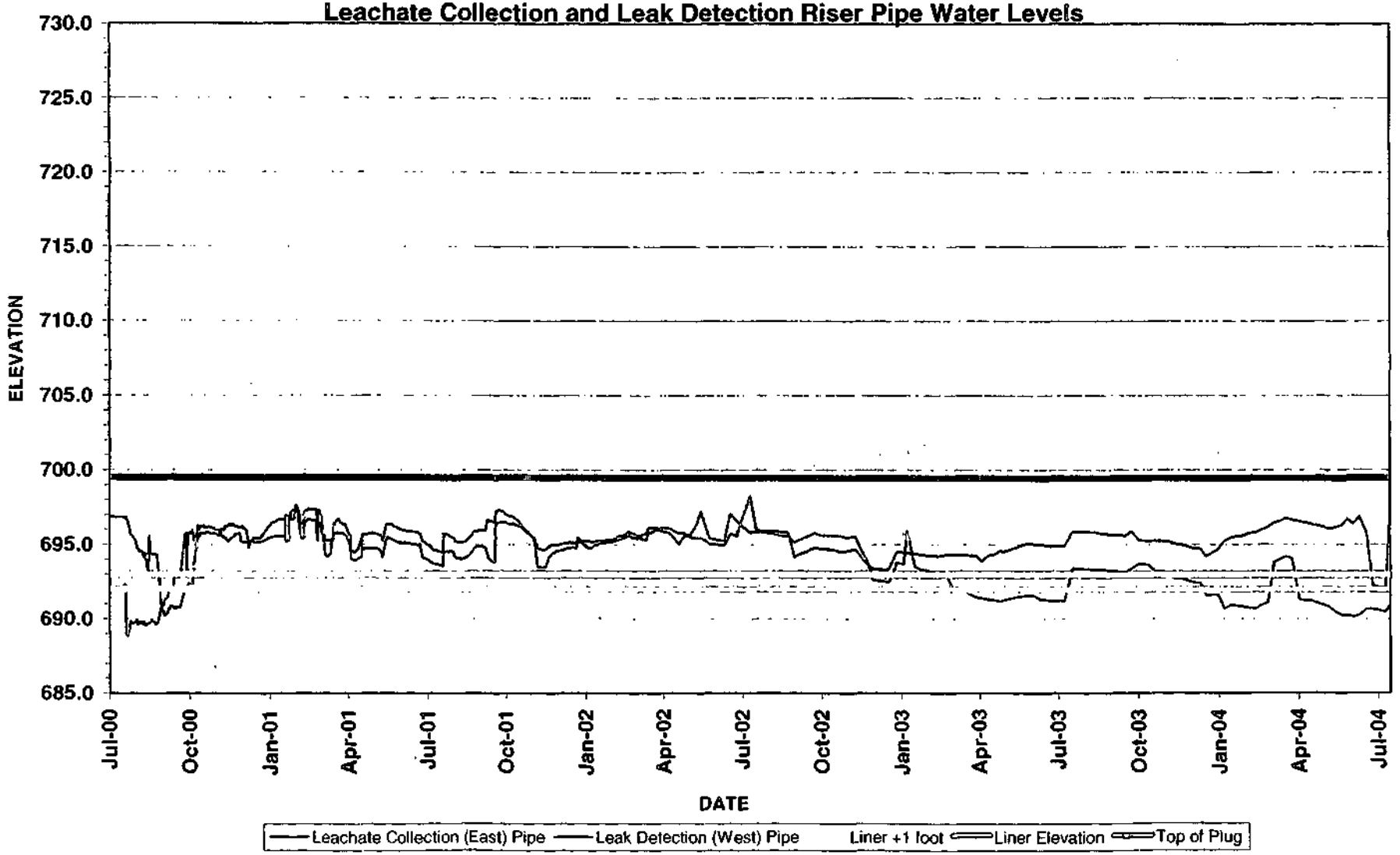


FIGURE B- 5
CAMU (Trench 7)
Leachate Collection and Leak Detection Riser Pipe Water Levels



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APPENDIX C

SITE PHOTOS

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IAAAP Five-Year Review
Site Inspection Photos

View of Random Fill/Cap Extension Area - Note Poor Condition of Temporary Cover

Perimeter Drainage Channel South of Random Fill/Cap Extension Area - Note Establishment of Weedy Growth

Inert Disposal Landfill Cover Perimeter Drain

Inert Landfill Cover - Note Good Condition of Vegetation

View of Inert Landfill Cover: Gas Vent 6 and Settlement Monument 9

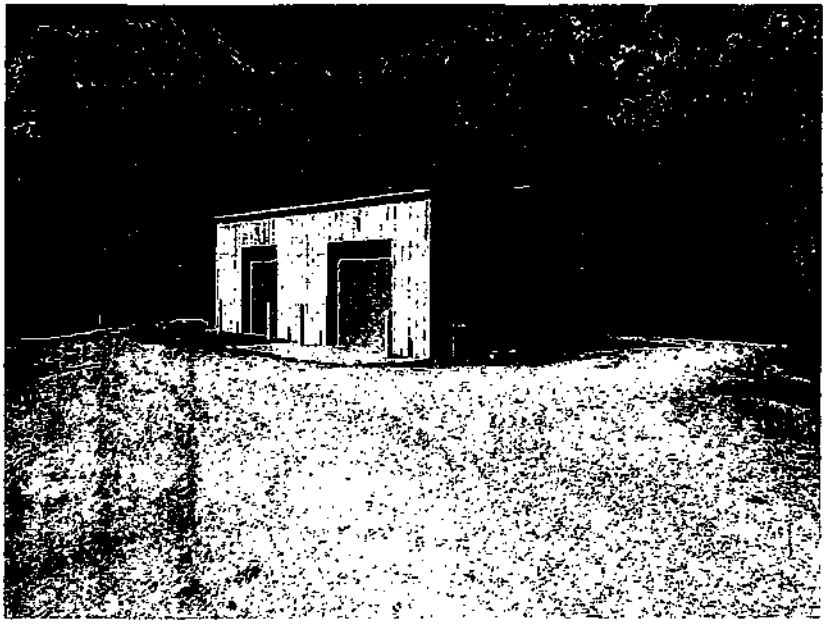
Trench 6 Soils Repository, Looking East near Sumps

View of Uncovered Soils in Trench 6 Soils Repository

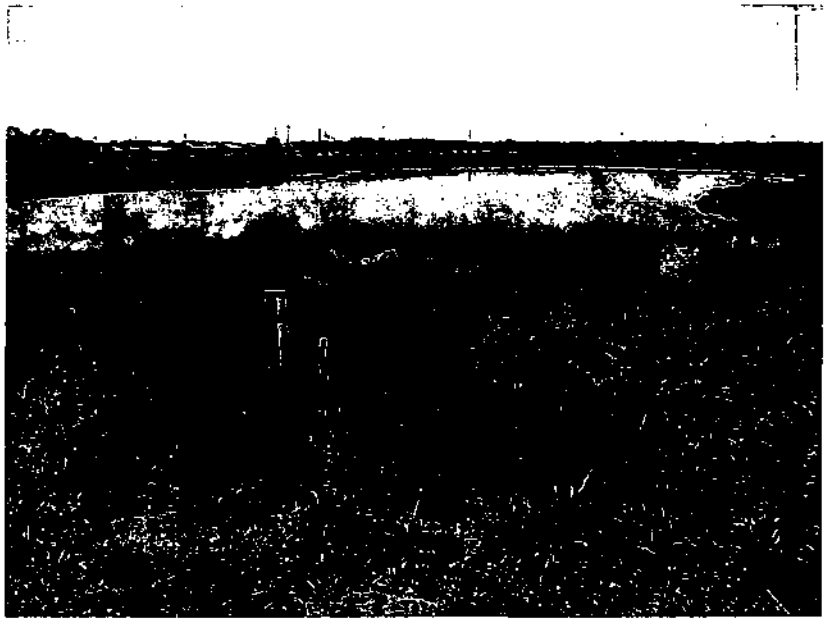
View of CAMU (Trench 7) - Note Ponding on Liner and Temporary Protective Geosynthetic Materials.

View of Sedimentation Dam Downstream of Trench 6

View of Sedimentation Dam Downstream of the CAMU (Trench 7)

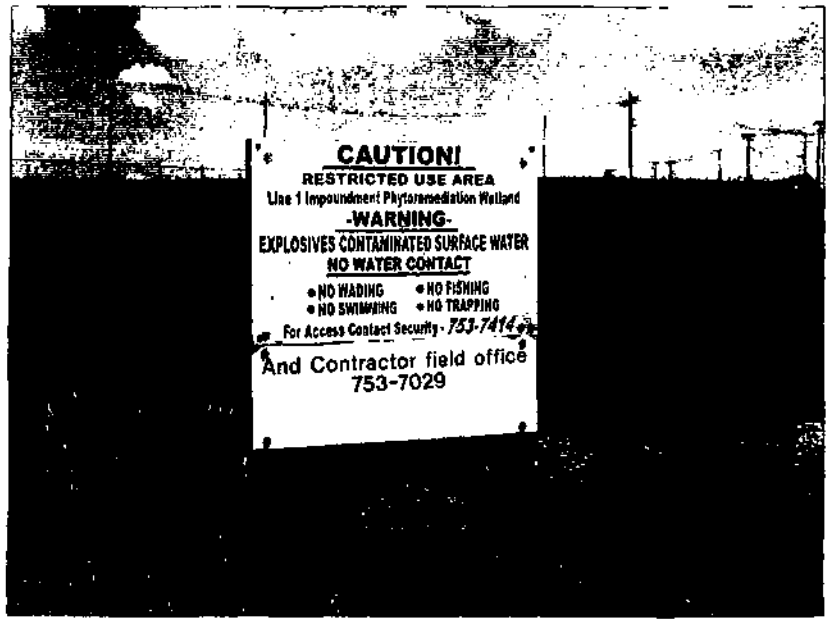


View of Treatment Building at the IDA



View of Line 800 Pinkwater Lagoon - Looking South

View of Line 1 Impoundment



View of Warning Sign at Line 1 Impoundment

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APPENDIX D

SITE INSPECTION CHECKLIST

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Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: IAAAP	**Date of inspection: June 30 - July 1, 2004**
Location and Region: Middletown, IA	**EPA ID: IA7213820445**
Agency, office, or company leading the five-year review: USACE	**Weather/temperature: Mostly Sunny, 80 to 85 degrees**

Remedy Includes: (Check all that apply)

- ■ Landfill cover/containment
- ■ Access controls
- ■ Institutional controls
- ☐ Groundwater pump and treatment
- ■ Surface water collection and treatment
- ■ Other: *excavation and removal actions*
- ☐ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ■ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** *Rodger Allison* (Name) *IRP Mgr* (Title) *6-30-04* (Date)
   Interviewed ■ at site ■ at office ■ by phone Phone no. *319-753-7130*
   Problems, suggestions: *summarized in the report*

2. **O&M staff** *Debra Wallin* (Name) *Construction Div., USACE* (Title) *6-30-04* (Date)
   Interviewed ■ at site ■ at office ■ by phone Phone no. *319-753-7846*
   Problems, suggestions: *summarized in the report*

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency *US EPA*				
Contact *Scott Marquess*	*EPA Region 7 RPM*	*6-30-04*	*913-551-7131*	
Name	Title	Date	Phone no.	

Problems; suggestions: *summarized in the report*

Agency *Iowa DNR*				
Contact *Dan Cook*	*Senior Environmental Spec.*	*6-30-04*	*515-281-4171*	
Name	Title	Date	Phone no.	

Problems; suggestions: *summarized in the report*

Agency _____				
Contact _____	_____	_____	_____	
Name	Title	Date	Phone no.	

Problems; suggestions: ☐ Report attached _____

Agency _____				
Contact _____	_____	_____	_____	
Name	Title	Date	Phone no.	

Problems; suggestions; ☐ Report attached _____

4. **Other interviews** (optional) ☐ Report attached.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

■ O&M manual	■ Readily available	☐ Up to date	☐ N/A
■ As-built drawings	■ Readily available	☐ Up to date	☐ N/A
■ O&M logs	■ Readily available	■ Up to date	☐ N/A

Remarks: *O&M plans and manuals are available, however, they are currently planned to be updated. As-built drawings are available in the installation's document repository. Recommend updating/formalizing water treatment SOPs. O&M logs are currently hand-written.*

2. **Site-Specific Health and Safety Plan** ■ Readily available ☐ Up to date ☐ N/A
■ Contingency plan/emergency response plan ■ Readily available ☐ Up to date ☐ N/A
Remarks

3. **O&M and OSHA Training Records** ■ Readily available ☐ Up to date ☐ N/A
Remarks

4. **Permits and Service Agreements**

☐ Air discharge permit	☐ Readily available	☐ Up to date	■ N/A
■ Effluent discharge	☐ Readily available	☐ Up to date	☐ N/A
☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	■ N/A
☐ Other permits_____	☐ Readily available	☐ Up to date	■ N/A

Remarks: *Line 1 Impoundment discharges meet NPDES requirements, although the permit is not required. Discharges from the IDA treatment facility meet ROD requirements.*

5. **Gas Generation Records** ■ Readily available ☐ Up to date ☐ N/A
Remarks: *No detects for some time.*

6. **Settlement Monument Records** ■ Readily available ☐ Up to date ☐ N/A
Remarks: *A new survey is planned for the entire IDA area, including settlement monuments in 2004.*

7. **Groundwater Monitoring Records** ■ Readily available ☐ Up to date ☐ N/A
Remarks: *GW monitoring continues in support of OU3 ROD finalization.*

8. **Leachate Extraction Records** ■ Readily available ☐ Up to date ☐ N/A
Remarks: *Surface water from IDA Trench 6, CAMU, and sedimentation dams, along with water from the leak detection sumps and Inert Landfill Gas vents is treated in combined batches prior to discharge. Recommend installing flow meters so that quantities from the various sources can be recorded.*

9. **Discharge Compliance Records**

☐ Air	☐ Readily available	☐ Up to date	■ N/A
■ Water (effluent)	■ Readily available	☐ Up to date	☐ N/A

Remarks

10. **Daily Access/Security Logs** ■ Readily available ☐ Up to date ☐ N/A
Remarks: *All visitors to the IDA are required to sign in. All access to the installation is provided by installation security office.*

IV. O&M COSTS

1. **O&M Organization**
   ☐ State in-house ☐ Contractor for State
   ☐ PRP in-house ☐ Contractor for PRP
   ☐ Federal Facility in-house ■ Contractor for Federal Facility
   Remarks: *O&M will be provided by recently awarded Performance Based Contractor.*

2. **O&M Cost Records**
   ■ Readily available ☐ Up to date
   ■ Funding mechanism/agreement in place
   Original O&M cost estimate_____ ☐ Breakdown attached

   Total annual cost by year for review period if available

From Oct 1, 1998 To Sep 30, 1999	$692,000	☐ Breakdown attached
Date Date	Total cost	
From Oct 1, 1999 To Sep 30, 2000	$596,000	☐ Breakdown attached
Date Date	Total cost	
From Oct 1, 2000 To Sep 30, 2001	$513,000	☐ Breakdown attached
Date Date	Total cost	
From Oct 1, 2001 To Sep 30, 2002	$ 486,000	☐ Breakdown attached
Date Date	Total cost	
From Oct 1, 2002 To Sep 30, 2003	$ 456,000	☐ Breakdown attached
Date Date	Total cost	

3. **Unanticipated or Unusually High O&M Costs During Review Period**
   Describe costs and reasons: *None*

V. ACCESS AND INSTITUTIONAL CONTROLS ■ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ■ Gates secured ☐ N/A
   Remarks: *Fencing was noted to be in good condition. Gates are locked and signed to restrict access to IDA. It should be noted that fencing on the eastern side of the IDA is a 6' 3 strand barbed wire fence, but fencing on the remaining perimeter consists of 3 strand barbed wire fencing.*

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A
   Remarks: *Signs have been updated at the IDA, Line 1 Impoundment, and Line 800 Pinkwater Lagoon to provide current phone numbers and contact information, and to say, "No Fishing Allowed." Hunting is allowed on designated areas of the installation, some of which borders the IDA area. In general, hunters are not allowed to cross any fenced or marked areas.*

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented ■ Yes ☐ No ☐ N/A
Site conditions imply ICs not being fully enforced ■ Yes ☐ No ☐ N/A

Type of monitoring: *self-reporting, drive by*
Frequency: *daily*
Responsible party/agency: *IAAAP*
Contact: *Rodger Allison* (Name) *IRP Mgr* (Title) *6-30-04* (Date) *319-753-7130* (Phone no.)

Reporting is up-to-date ☐ Yes ■ No ☐ N/A
Reports are verified by the lead agency ■ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ■ N/A
Violations have been reported ■ Yes ☐ No ☐ N/A

Remarks: *Institutional Controls are to be addressed by the OU-4 ROD, which has not been finalized to date. However, there is a need to develop a comprehensive land use restriction plan at IAAAP to alleviate potential hazards associated with future construction, digging, repairs, or other intrusive activities by others on the installation. In addition, coordination with state and local county officials is needed to address the potential for new wells being installed in the off-post ground water plume area.*

2. **Adequacy** ☐ ICs are adequate ■ ICs are inadequate ☐ N/A
Remarks: *See #1 above.*

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ■ No vandalism evident
Remarks

2. **Land use changes on site** ■ N/A
Remarks

3. **Land use changes off site** ■ N/A
Remarks

VI. GENERAL SITE CONDITIONS

A. Roads ■ Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map ■ Roads adequate ☐ N/A
Remarks

B. Other Site Conditions

Remarks _____

_____

_____

_____

_____

_____

VII. LANDFILL COVERS ■ Applicable ☐ N/A

A. Landfill Surface

1. **Settlement** (Low spots) ☐ Location shown on site map ■ Settlement not evident
   Areal extent_____ Depth_____
   Remarks: *Total settlement is less than 6 inches at the settlement monuments since construction completion.*
   _____

2. **Cracks** ☐ Location shown on site map ■ Cracking not evident
   Lengths_____ Widths_____ Depths_____
   Remarks_____
   _____

3. **Erosion** ☐ Location shown on site map ■ Erosion not evident
   Areal extent_____ Depth_____
   Remarks_____
   _____

4. **Holes** ☐ Location shown on site map ■ Holes not evident
   Areal extent_____ Depth_____
   Remarks_____
   _____

5. **Vegetative Cover** ■ Grass ■ Cover properly established ■ No signs of stress
   ☐ Trees/Shrubs (indicate size and locations on a diagram)
   Remarks_____
   _____

6. **Alternative Cover (armored rock, concrete, etc.)** ■ N/A
   Remarks_____
   _____

7. **Bulges** ☐ Location shown on site map ■ Bulges not evident
   Areal extent_____ Height_____
   Remarks_____
   _____

8. **Wet Areas/Water Damage** ■ Wet areas/water damage not evident
- ☐ Wet areas ☐ Location shown on site map Areal extent_____
- ☐ Ponding ☐ Location shown on site map Areal extent_____
- ☐ Seeps ☐ Location shown on site map Areal extent_____
- ☐ Soft subgrade ☐ Location shown on site map Areal extent_____

Remarks_____

9. **Slope Instability** ☐ Slides ☐ Location shown on site map ■ No evidence of slope instability
Areal extent_____
Remarks_____

B. Benches ☐ Applicable ■ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

1. **Flows Bypass Bench** ☐ Location shown on site map ☐ N/A or okay
Remarks_____

2. **Bench Breached** ☐ Location shown on site map ☐ N/A or okay
Remarks_____

3. **Bench Overtopped** ☐ Location shown on site map ☐ N/A or okay
Remarks_____

C. Letdown Channels ☐ Applicable ■ N/A
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

1. **Settlement** ☐ Location shown on site map ☐ No evidence of settlement
Areal extent_____ Depth_____
Remarks_____

2. **Material Degradation** ☐ Location shown on site map ☐ No evidence of degradation
Material type_____ Areal extent_____
Remarks_____

3. **Erosion** ☐ Location shown on site map ☐ No evidence of erosion
Areal extent_____ Depth_____
Remarks_____

4. **Undercutting** ☐ Location shown on site map ☐ No evidence of undercutting
Areal extent_____ Depth_____
Remarks_____

5. **Obstructions** Type_____ ☐ No obstructions
☐ Location shown on site map Areal extent_____
Size_____
Remarks_____

6. **Excessive Vegetative Growth** Type_____
☐ No evidence of excessive growth
☐ Vegetation in channels does not obstruct flow
☐ Location shown on site map Areal extent_____
Remarks_____

D. Cover Penetrations ■ Applicable ☐ N/A

1. **Gas Vents** ☐ Active ■ Passive
■ Properly secured/locked ■ Functioning ■ Routinely sampled ■ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance
☐ N/A
Remarks: *The gas vents serve a dual purpose. Passive gas venting and leachate collection within the Inert Landfill.*

2. **Gas Monitoring Probes**
■ Properly secured/locked ■ Functioning ■ Routinely sampled ■ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____

3. **Monitoring Wells** (within surface area of landfill)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ■ N/A
Remarks_____

4. **Leachate Extraction Wells (dual purpose: same as gas vent wells)**
■ Properly secured/locked ■ Functioning ■ Routinely sampled ■ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____

5. **Settlement Monuments** ■ Located ■ Routinely surveyed ☐ N/A
Remarks: *Settlement monuments will be surveyed in 2004, monuments do not penetrate the barrier layer of the cover system.*

E. Gas Collection and Treatment ☐ Applicable ■ N/A

1. **Gas Treatment Facilities**
   ☐ Flaring ☐ Thermal destruction ☐ Collection for reuse
   ☐ Good condition ☐ Needs Maintenance
   Remarks_____

2. **Gas Collection Wells, Manifolds and Piping**
   ☐ Good condition ☐ Needs Maintenance
   Remarks_____

3. **Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings)
   ☐ Good condition ☐ Needs Maintenance ☐ N/A
   Remarks_____

F. Cover Drainage Layer ■ Applicable ☐ N/A

1. **Outlet Pipes Inspected** ☐ Functioning ■ N/A
   Remarks_____

2. **Outlet Rock Inspected** ■ Functioning ☐ N/A
   Remarks: *Drainage rock is in good condition.*

G. Detention/Sedimentation Ponds ■ Applicable ☐ N/A

1. **Siltation** Areal extent_____ Depth_____ ☐ N/A
   ■ Siltation not evident
   Remarks_____

2. **Erosion** Areal extent_____ Depth_____
   ■ Erosion not evident
   Remarks_____

3. **Outlet Works** ■ Functioning ☐ N/A
   Remarks_____

4. **Dam** ■ Functioning ☐ N/A
   Remarks_____

H. Retaining Walls ☐ Applicable ■ N/A

1. **Deformations** ☐ Location shown on site map ☐ Deformation not evident
   Horizontal displacement_____ Vertical displacement_____
   Rotational displacement_____
   Remarks_____

2. **Degradation** ☐ Location shown on site map ☐ Degradation not evident
   Remarks_____

I. Perimeter Ditches/Off-Site Discharge ■ Applicable ☐ N/A

1. **Siltation** ☐ Location shown on site map ■ Siltation not evident
   Areal extent_____ Depth_____
   Remarks_____

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A
   ■ Vegetation does not impede flow
   Areal extent_____ Type_____
   Remarks: *Weeds and small trees are appearing in some of the perimeter ditches at the Inert Landfill.*

3. **Erosion** ☐ Location shown on site map ■ Erosion not evident
   Areal extent_____ Depth_____
   Remarks_____

4. **Discharge Structure** ☐ Functioning ■ N/A
   Remarks_____

VIII. VERTICAL BARRIER WALLS ☐ Applicable ■ N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident
   Areal extent_____ Depth_____
   Remarks_____

2. **Performance Monitoring** Type of monitoring_____
   ☐ Performance not monitored
   Frequency_____ ☐ Evidence of breaching
   Head differential_____
   Remarks_____

IX. GROUNDWATER/SURFACE WATER REMEDIES ■ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ■ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
☐ Good condition ☐ All required wells properly operating ☐ Needs Maintenance ☐ N/A
Remarks_____

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☐ Good condition ☐ Needs Maintenance
Remarks_____

3. **Spare Parts and Equipment**
☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks_____

B. Surface Water Collection Structures, Pumps, and Pipelines ■ Applicable ☐ N/A

1. **Collection Structures, Pumps, and Electrical**
■ Good condition ☐ Needs Maintenance
Remarks_____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
■ Good condition ☐ Needs Maintenance
Remarks_____

3. **Spare Parts and Equipment**
☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks: *Can be easily obtained if needed.*

C. Treatment System ■ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
   ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
   ☐ Air stripping ■ Carbon adsorbers
   ■ Filters_____
   ☐ Additive (*e.g.*, chelation agent, flocculent)_____
   ☐ Others_____
   ■ Good condition ☐ Needs Maintenance
   ■ Sampling ports properly marked and functional
   ■ Sampling/maintenance log displayed and up to date
   ■ Equipment properly identified
   Remarks:
   _____

2. **Electrical Enclosures and Panels** (properly rated and functional)
   ☐ N/A ■ Good condition ☐ Needs Maintenance
   Remarks_____
   _____

3. **Tanks, Vaults, Storage Vessels**
   ☐ N/A ■ Good condition ☐ Proper secondary containment ☐ Needs Maintenance
   Remarks_____
   _____

4. **Discharge Structure and Appurtenances**
   ☐ N/A ■ Good condition ☐ Needs Maintenance
   Remarks_____
   _____

5. **Treatment Building(s)**
   ☐ N/A ■ Good condition (esp. roof and doorways) ☐ Needs repair
   ☐ Chemicals and equipment properly stored
   Remarks_____
   _____

6. **Monitoring Wells** (pump and treatment remedy)
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ All required wells located ☐ Needs Maintenance ■ N/A
   Remarks_____
   _____

D. Monitoring Data

1. Monitoring Data
   ■ Is routinely submitted on time ☐ Is of acceptable quality

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ All required wells located ☐ Needs Maintenance ■ N/A
   Remarks_____

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. *For Trench 6 and the CAMU, surface water management has proven to be difficult, especially during periods of high precipitation. The cells are not covered, so all precipitation builds up and creates high ponding levels over the primary liner. Water levels should be pumped out to limit the head on the primary liner to less than 12 inches. During periods of high precipitation, pumping rates are not able to maintain these recommended levels for some period of time. There have been periods reported where water levels have been as close as 5 feet from the top of the berm in Trench 6 and 2 feet from the top of the CAMU berm. Overtopping of the berms would result in an uncontrolled release of contaminated water into the sedimentation dams below, which if filled, would release water uncontrolled downstream. This scenario should be addressed.*
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

APPENDIX E

PUBLIC NOTICE

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The Hawk Eye · Friday · June 25, 2004 7C

NOTICE OF FIVE-YEAR REVIEW
Iowa Army Ammunition Plant (IAAAP)
Middletown, Iowa
Superfund Site

The U.S. Army, in conjunction with the U.S. Environmental Protection Agency (EPA), is currently conducting a five-year review of the Iowa Army Ammunition Plant (IAAAP) Superfund Site. The purpose of a five-year review is to evaluate the implementation and performance of remedies in order to determine if the remedies are, or will be, protective of human health and the environment. The site was placed on the National Priorities List (NPL) in August 1990 and includes soil and groundwater contamination attributable to past operating practices. For soil, remedies were selected through an Interim Soils Record of Decision (ROD), signed in March 1998, the Final Soils ROD, signed in September 1998, and the Explanation of Significant Differences, signed January 2003. A ROD addressing groundwater has not yet been finalized. It is anticipated that the final five-year review report will be completed in December 2004. For more information, contact:

Greg Mellema
U.S. Army Corps of Engineers
12565 W. Center Rd.
Omaha, Nebraska 68144
402-697-2658
gregory.j.mellema@usace.army.mil
June 22, 23, 24, 25, 28, 29, 30, 2004_7t

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APPENDIX F

FIGURES

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Appendix F
Figures

Tab	Contents	Tab	Contents
1	Line 1 (IAAP-001)	21	Unidentified Substance Waste Site (IAAP-022)
2	Line 2 (IAAP-002)	22	Firing Site Area (IAAP-030)
3	Line 3 (IAAP-003)	23	Yard B Ammo Box Chipper Disposal Pit (IAAP-031)
4	Line 3A (IAAP-004)	24	North Burn Pads Landfill (IAAP-037)
5	Lines 4A and 4B (IAAP-005)	25	Building 600-86 Septic System (IAAP-038)
6	Lines 5A and 5B (IAAP-006)	26	Fire Training Pit (IAAP-039)
7	Line 6 (IAAP-007)	27	Abandoned Coal Storage Yard (IAAP-042)
8	Line 8 (IAAP-009)	28	Fly-Ash Disposal Area (IAAP-043)
9	Line 9 (IAAP-010)	29	Incendiary Disposal Area (IAAP-013)
10	Line 800 and Line 800 Pinkwater Lagoon (IAAP-011 and 044)	30	Old Fly-Ash Waste Pile (IAAP-015)
11	Explosive Disposal Area/East Burn Pads (IAAP-012)	31	Possible Demolition Site (IAAP-018)
12	Demolition Area/Deactivation Furnace (IAAP-021)	32	Explosive Waste Incinerator (IAAP-025)
13	Burn Cages, Burn Cage LF, West Burn Pads, West Burn Pads LF (IAAP-032)	33	Construction Debris Landfill (IAAP-028)
14	North Burn Pads (IAAP-036)	34	Line 3A Pond (IAAP-041)
15	Roundhouse Transformer Area (IAAP-014)	35	Central Test Area (IAAP-047)
16	Line 7 (IAAP-008)	36	Contaminated Clothing Laundry (IAAP-019)
17	Boxcar Unloading Area (IAAP-014)	37	Sewage Treatment Plant/Drying Beds (IAAP-026)
18	Line 1 Former Wastewater Impoundment (IAAP-016)	38	Line 3A Sewage Treatment Plant (IAAP-029)
19	Pesticide Pit (IAAP-017)	39	All Groundwater Figures
20	Inert Disposal Area (IAAP-020)		

Note: Recommend referring to enclosed CD for detailed viewing of the enclosed figures. Many figures have coloration, which is visible on the CD.

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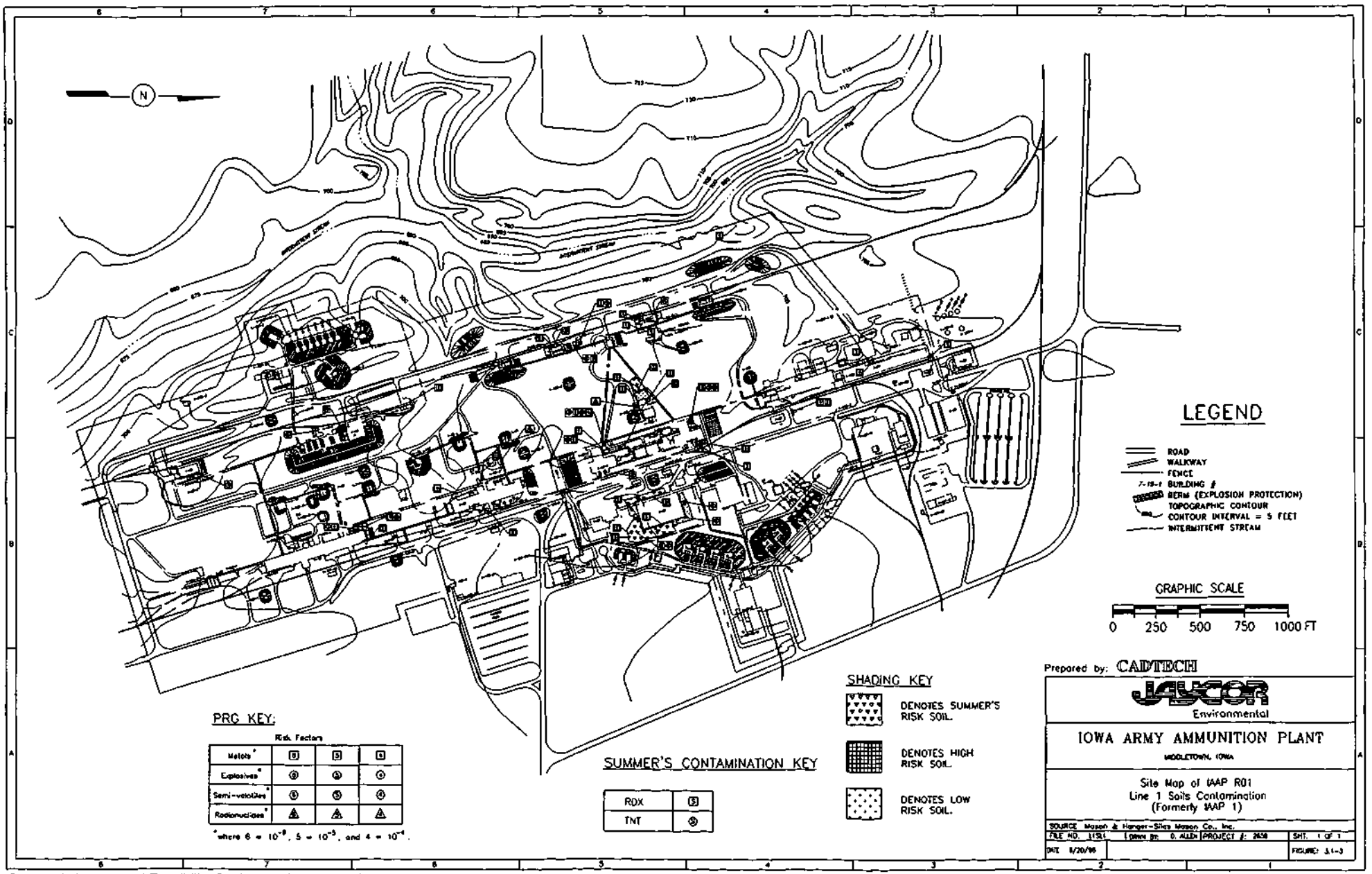
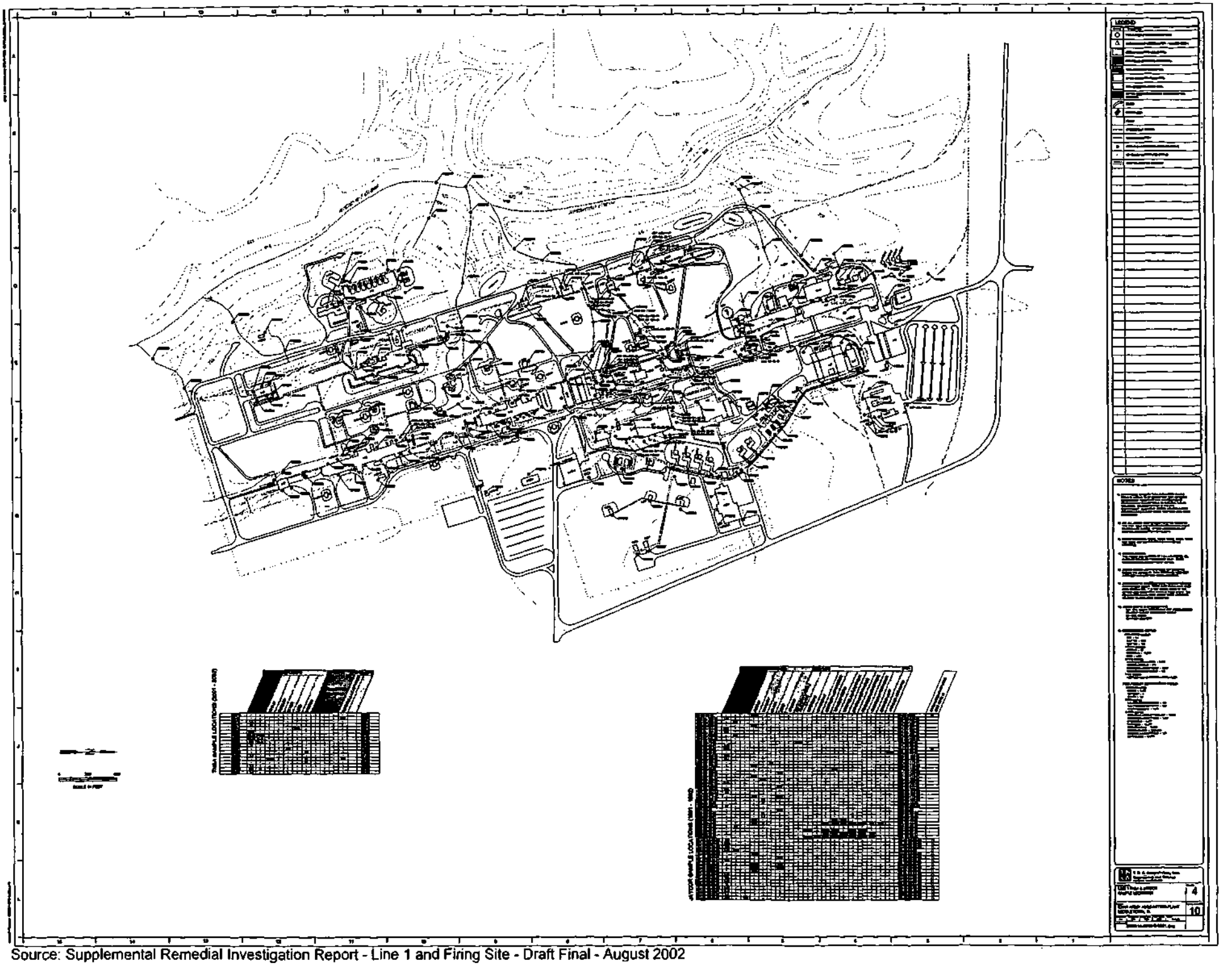
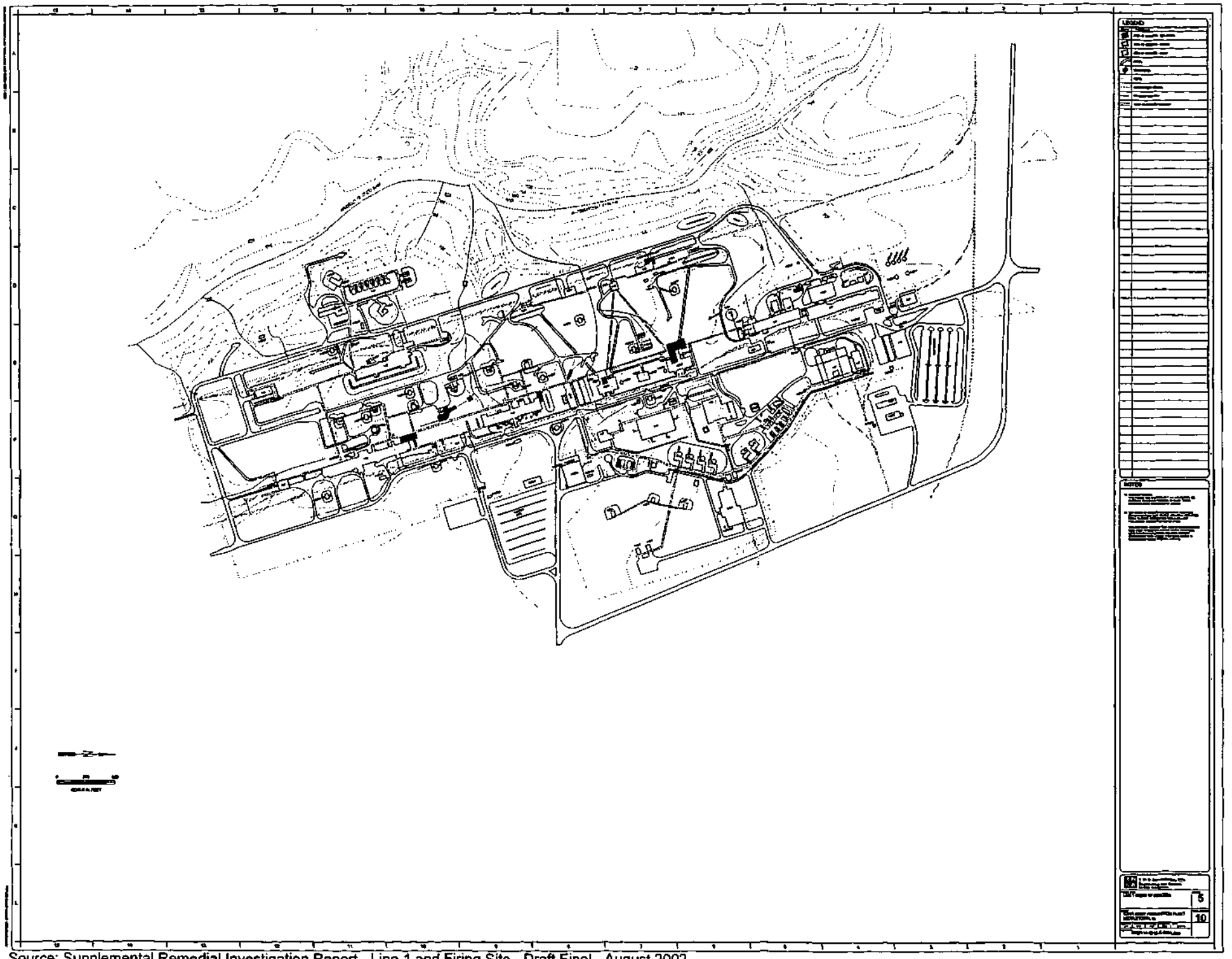


Source: Soils Focused Feasibility Study - Draft Final - 08 May 1997



Source: Supplemental Remedial Investigation Report - Line 1 and Firing Site - Draft Final - August 2002



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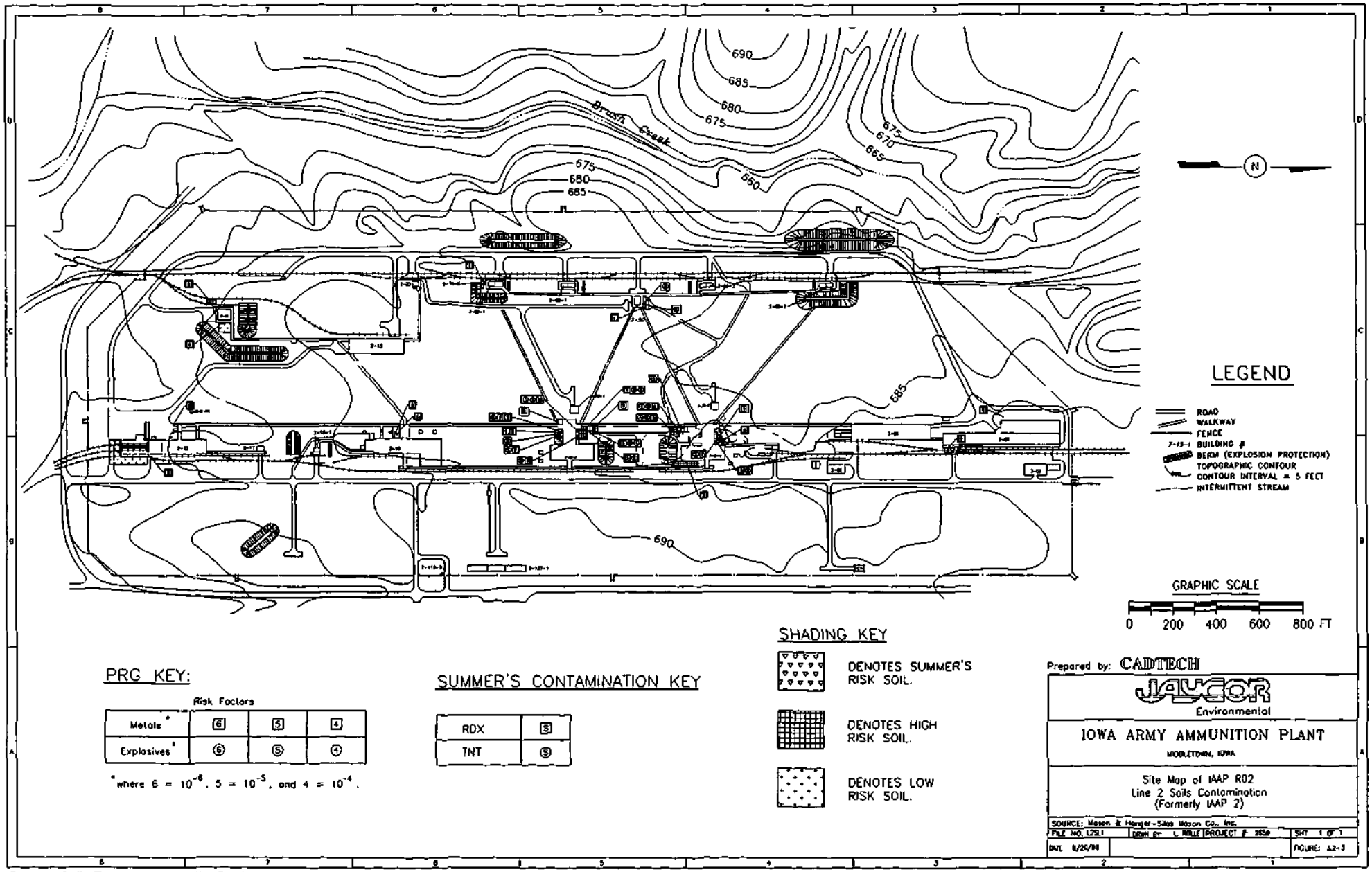

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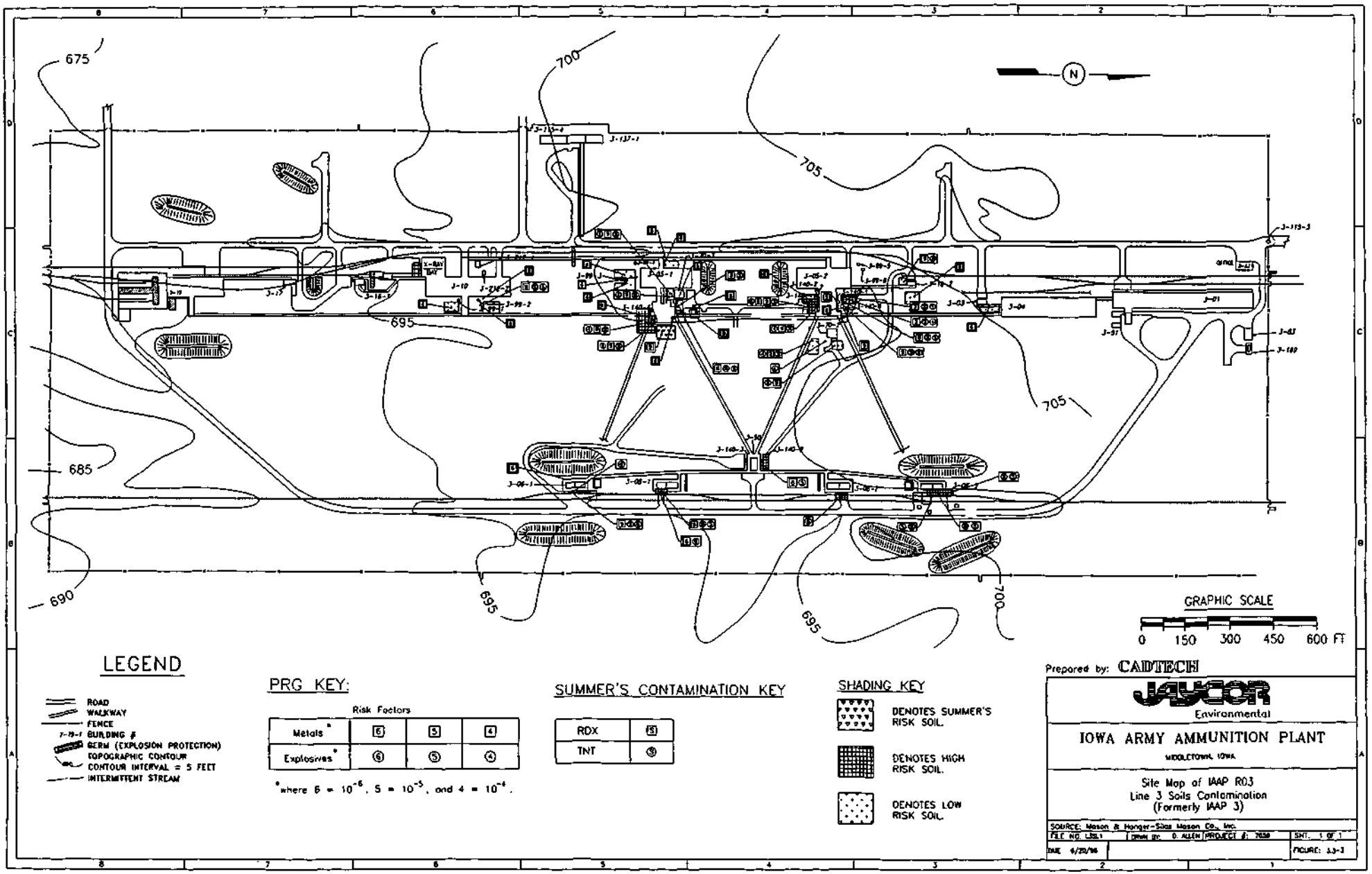

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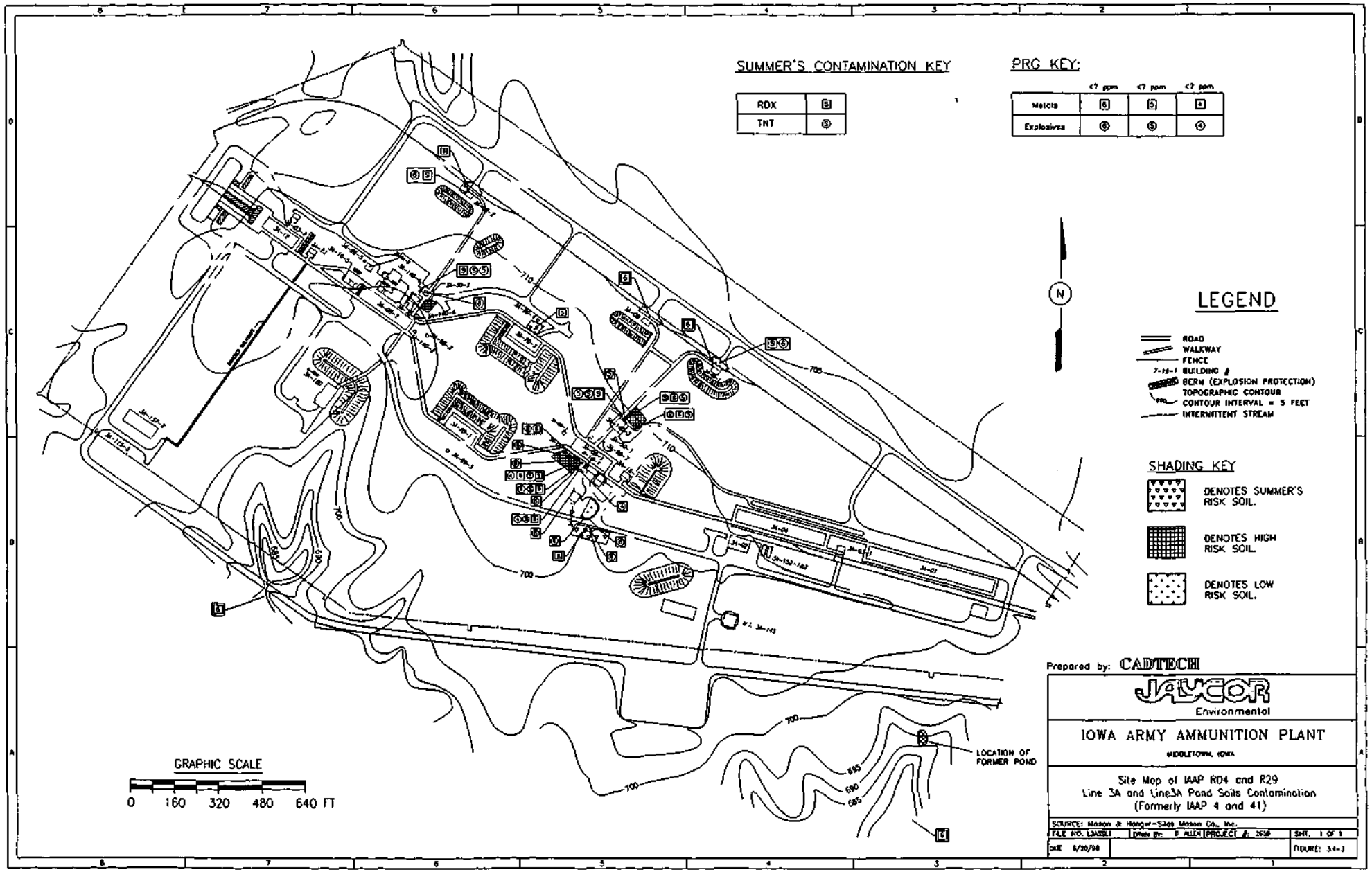

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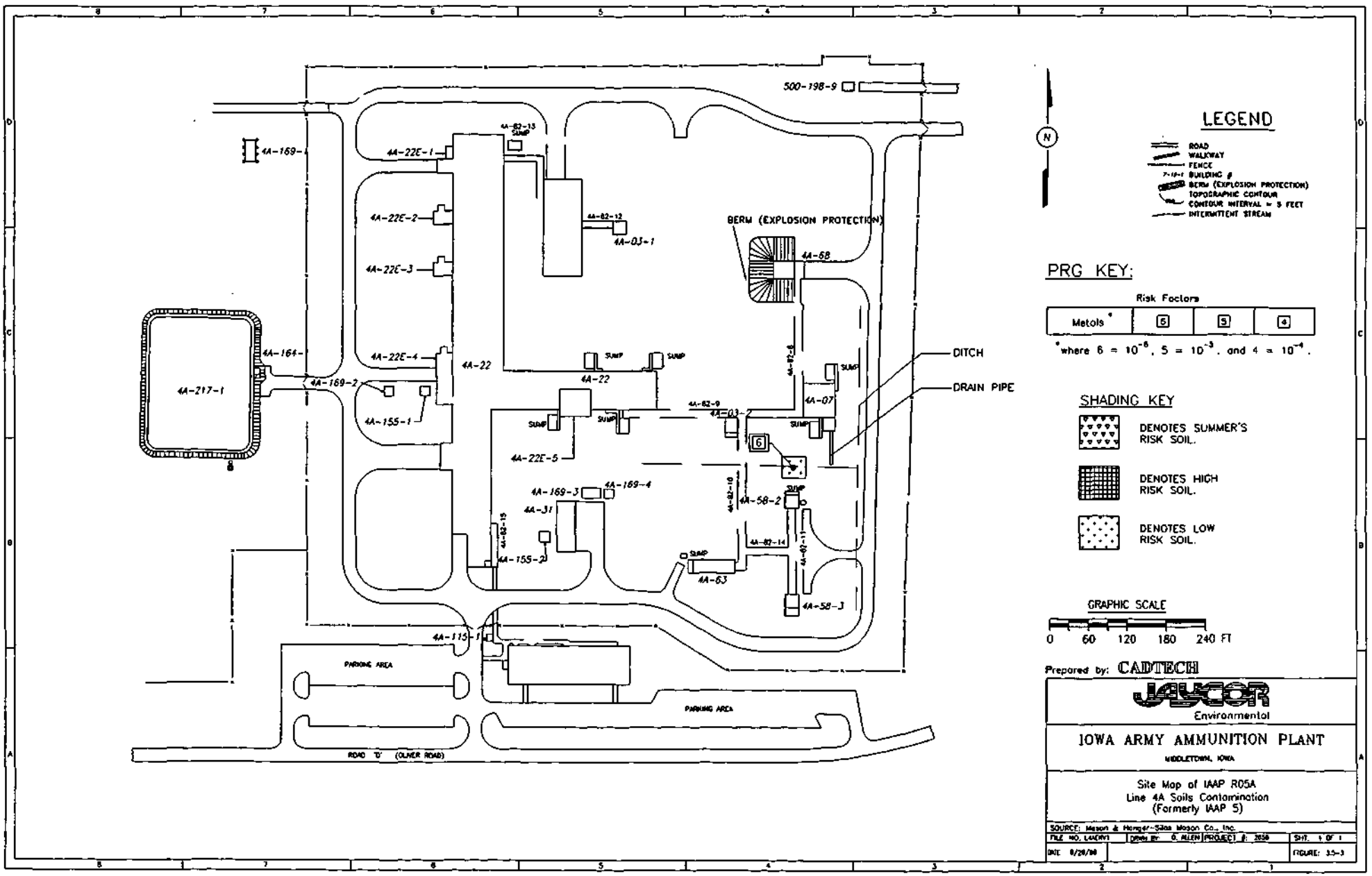

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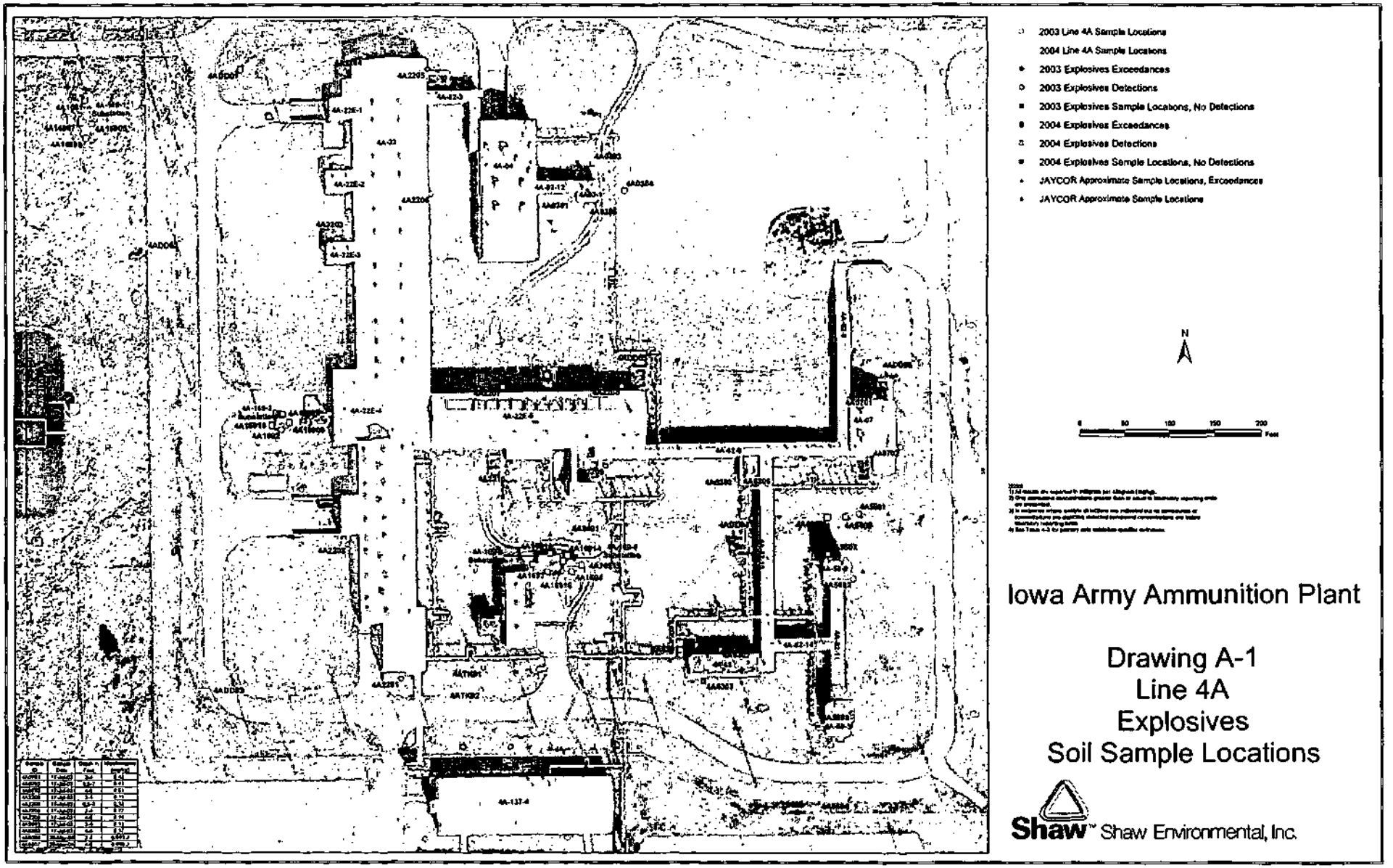
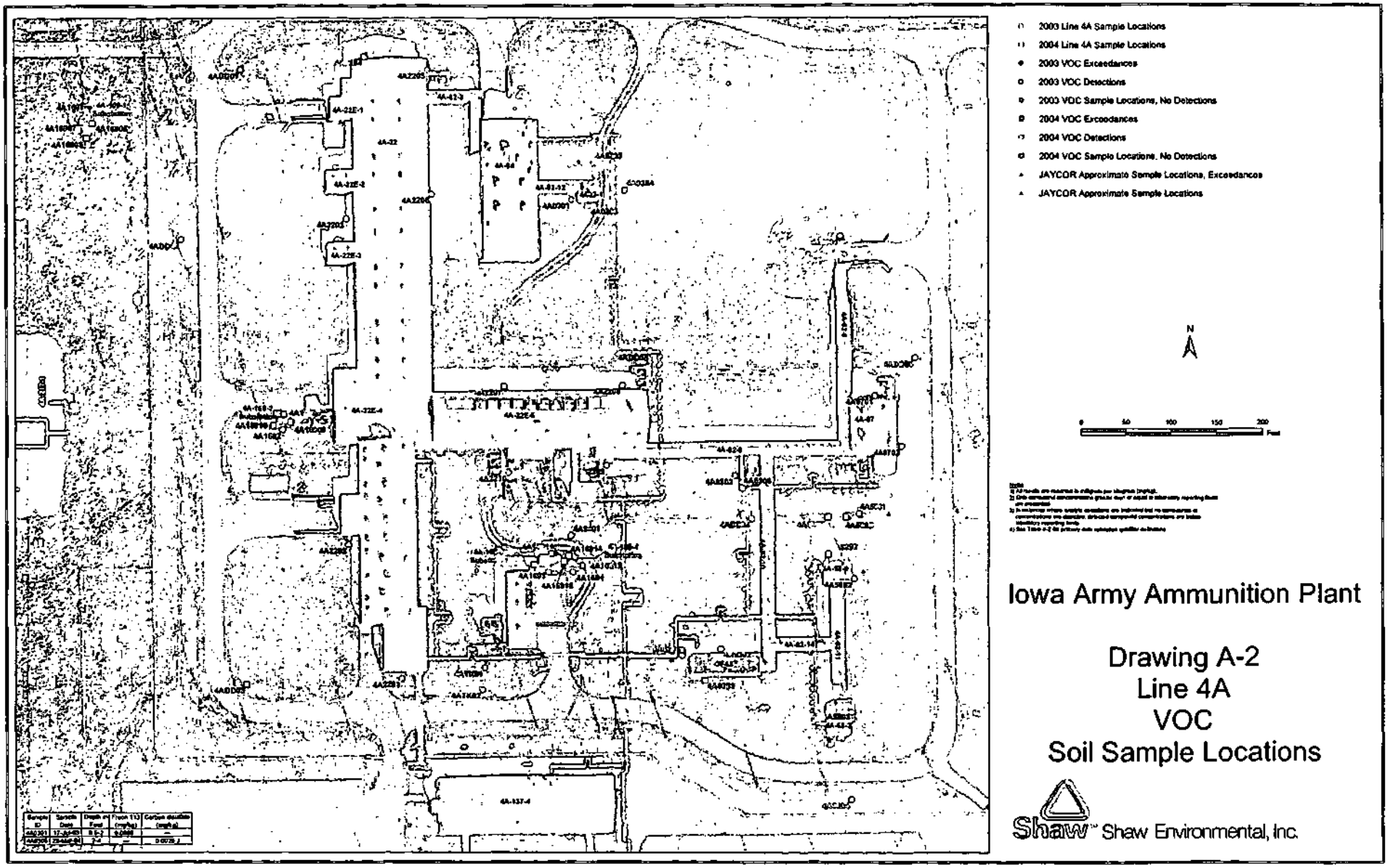


Source: Remedial Action Work Plan Addendum for Soil Excavation - Phase 4 Soil Sites - Draft Final - 20 May 2004



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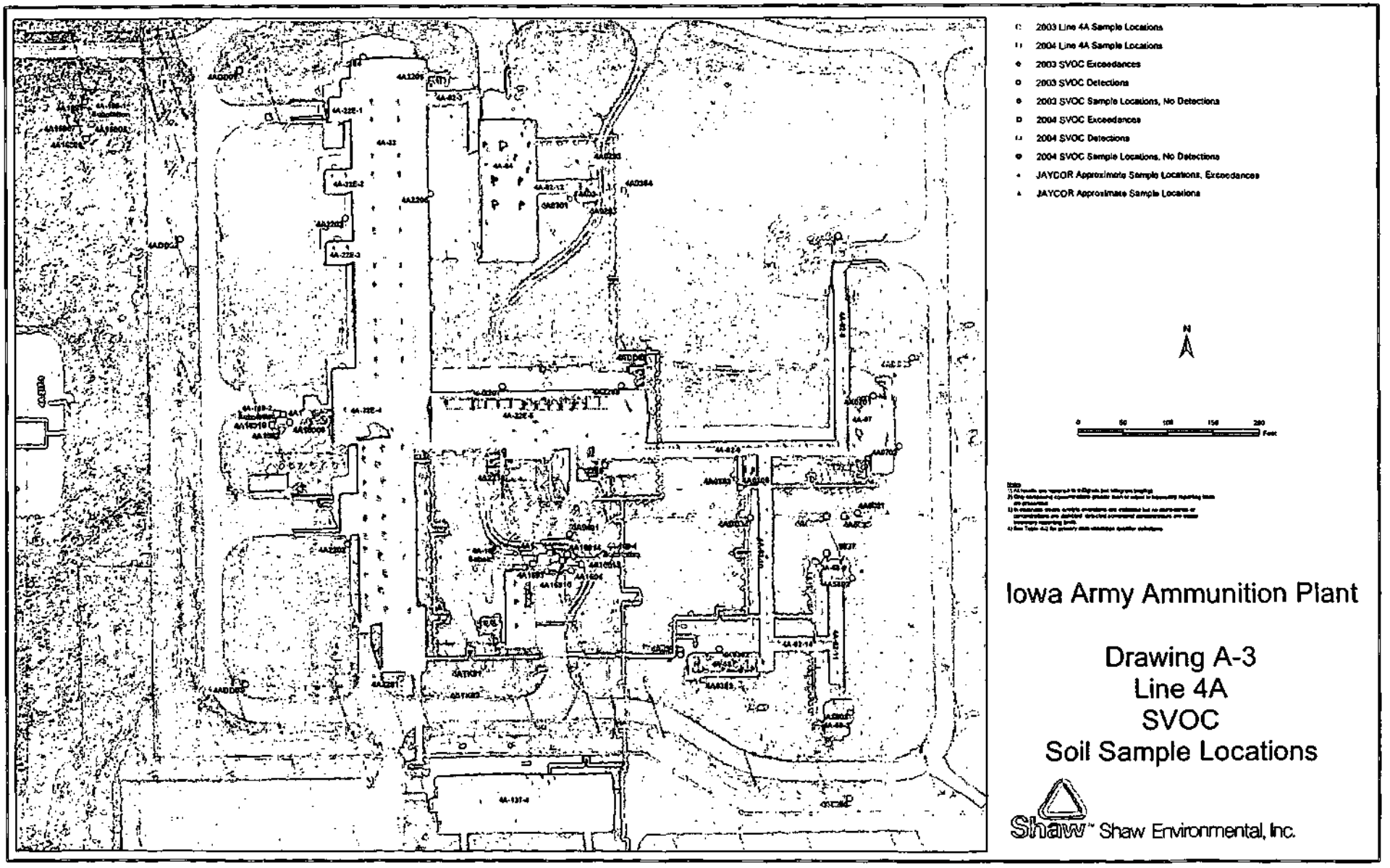

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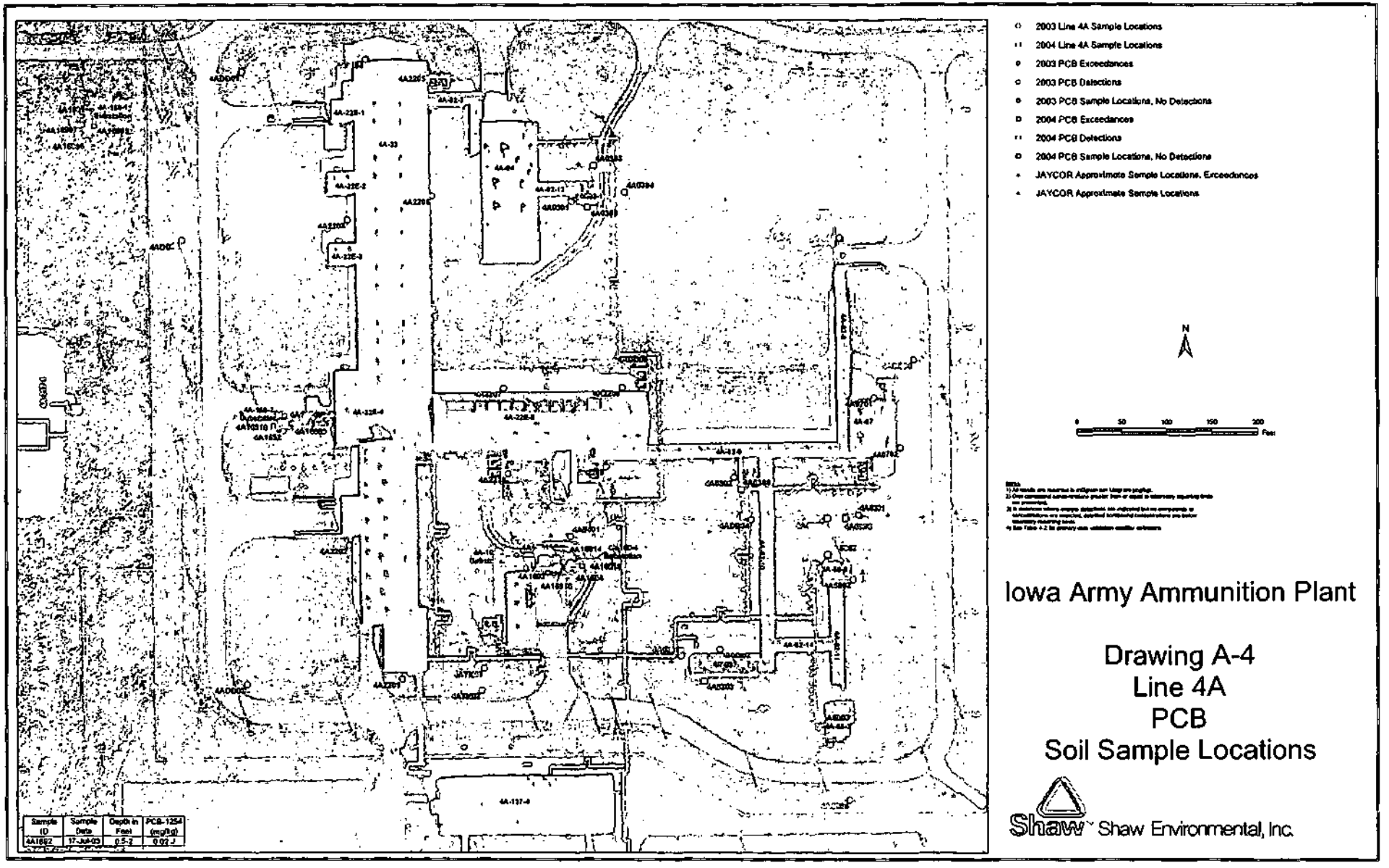

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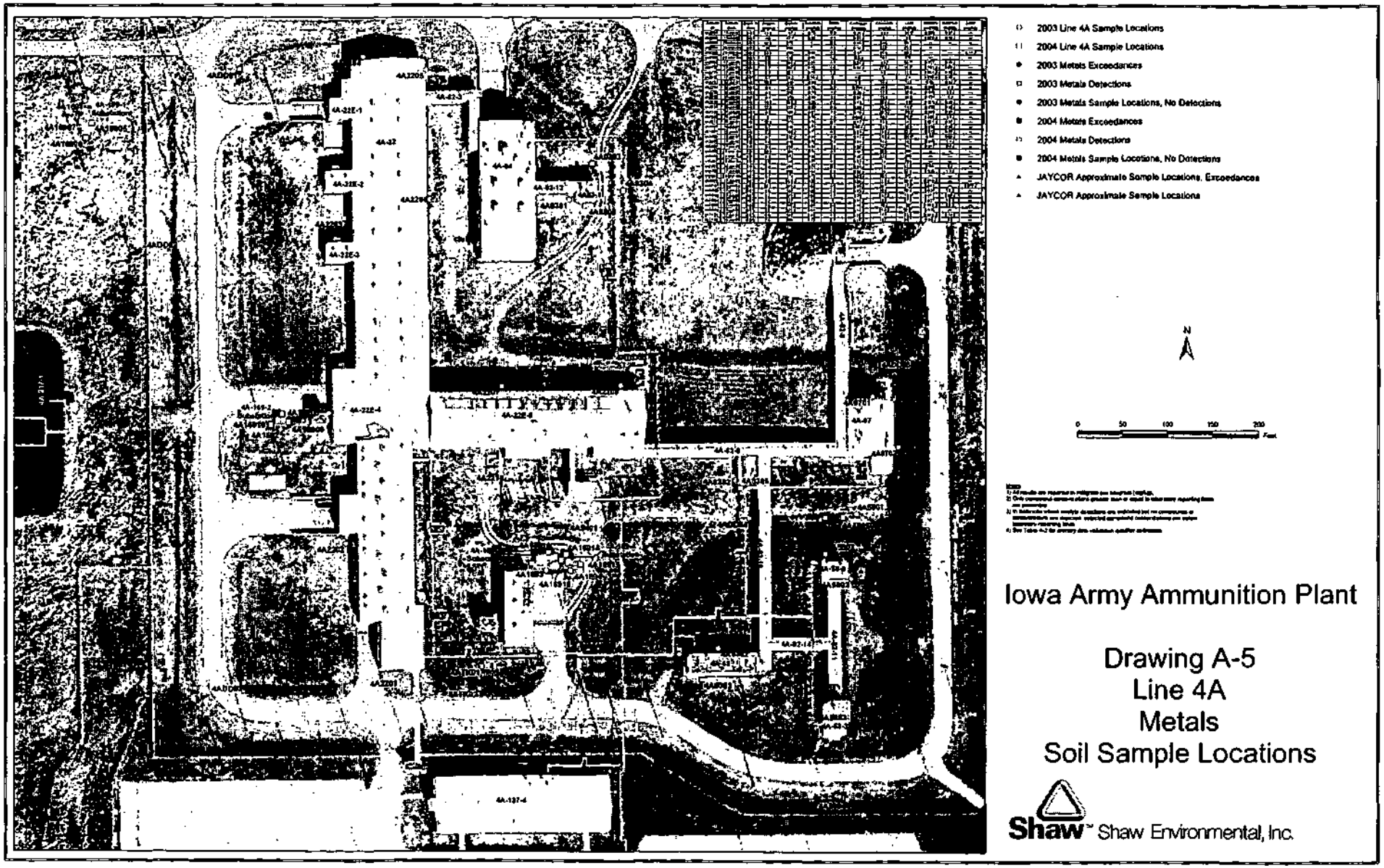

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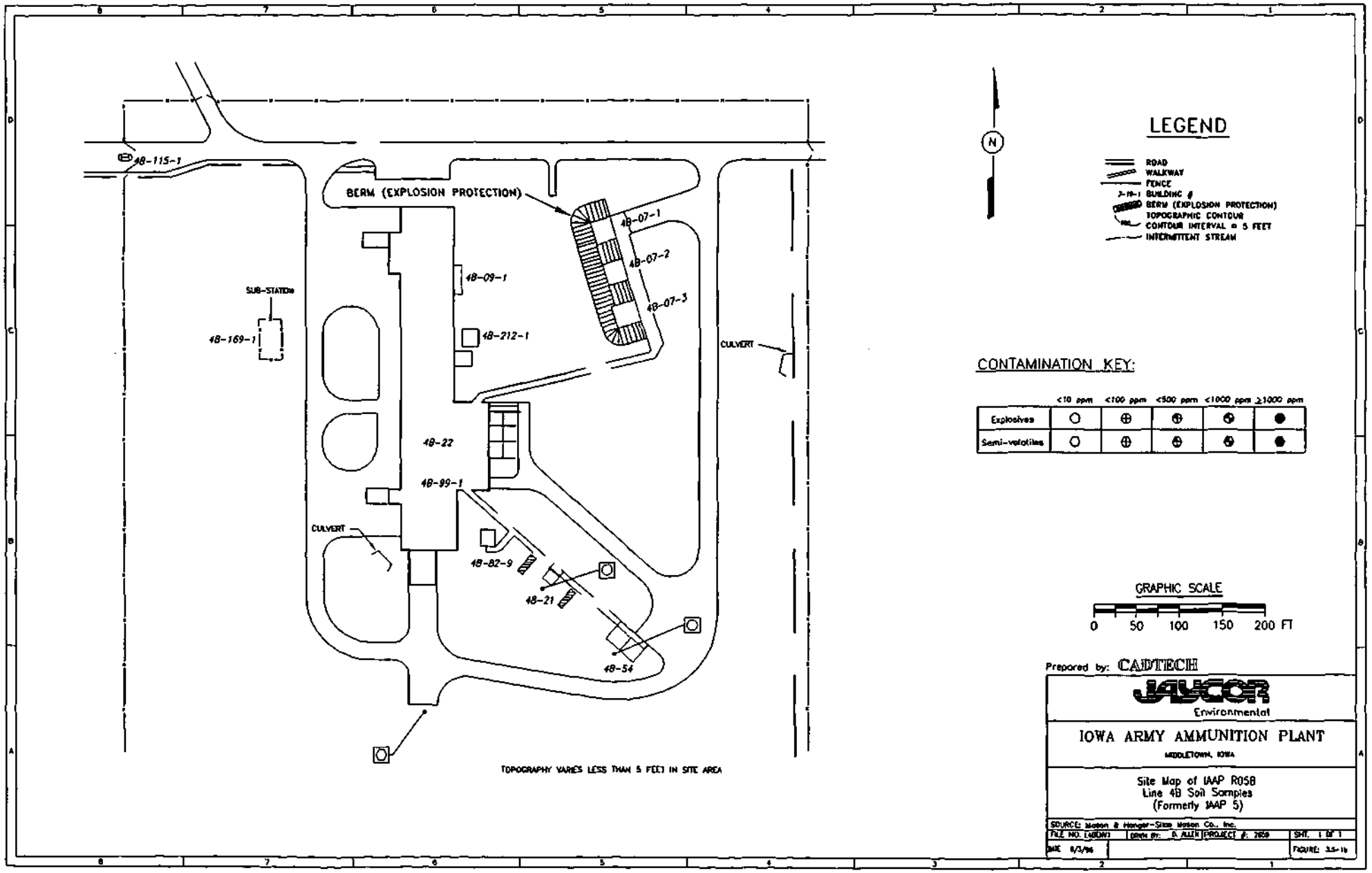
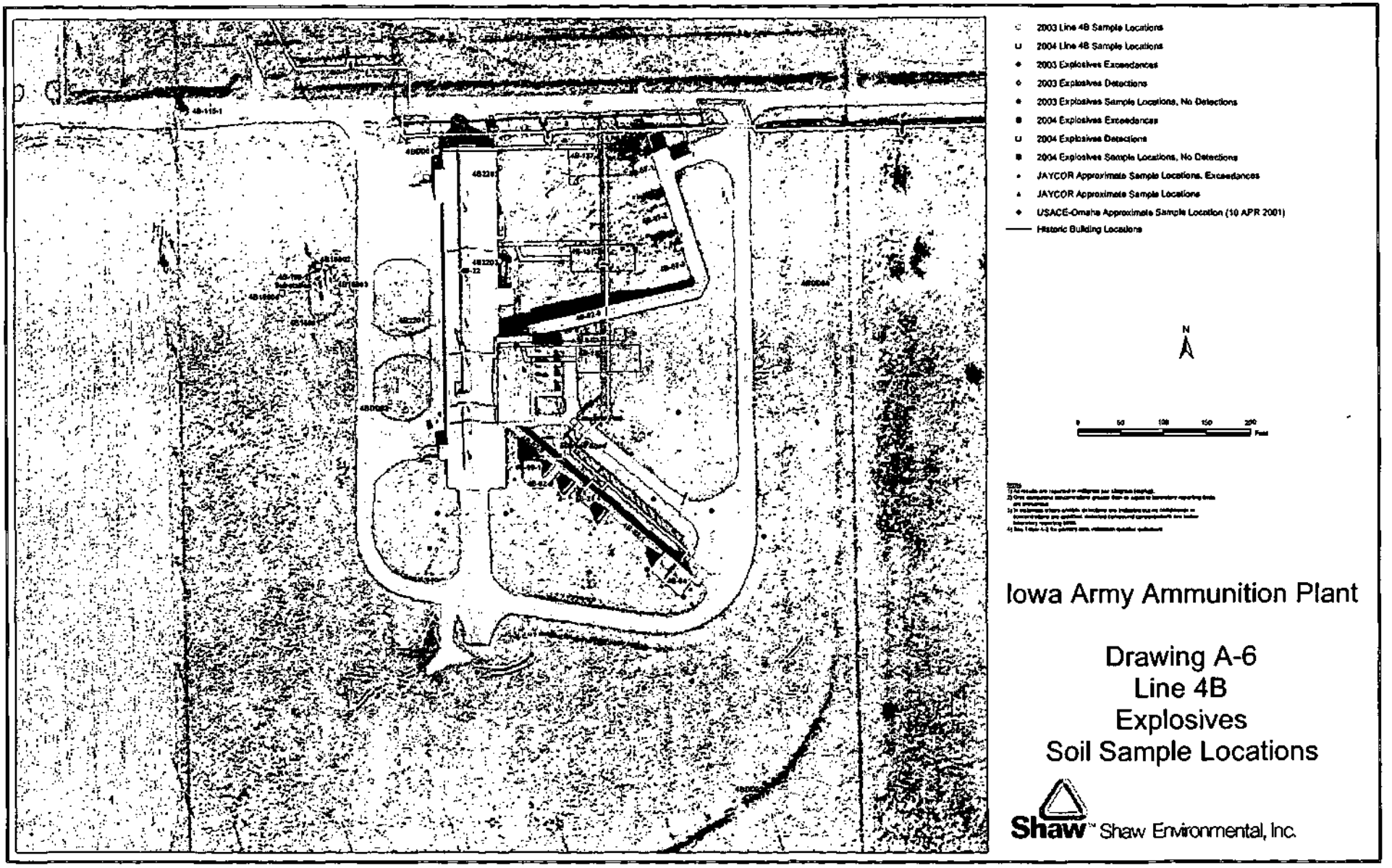


Source: Remedial Investigation/Risk Assessment - Revised Draft Final - 21 May 1996



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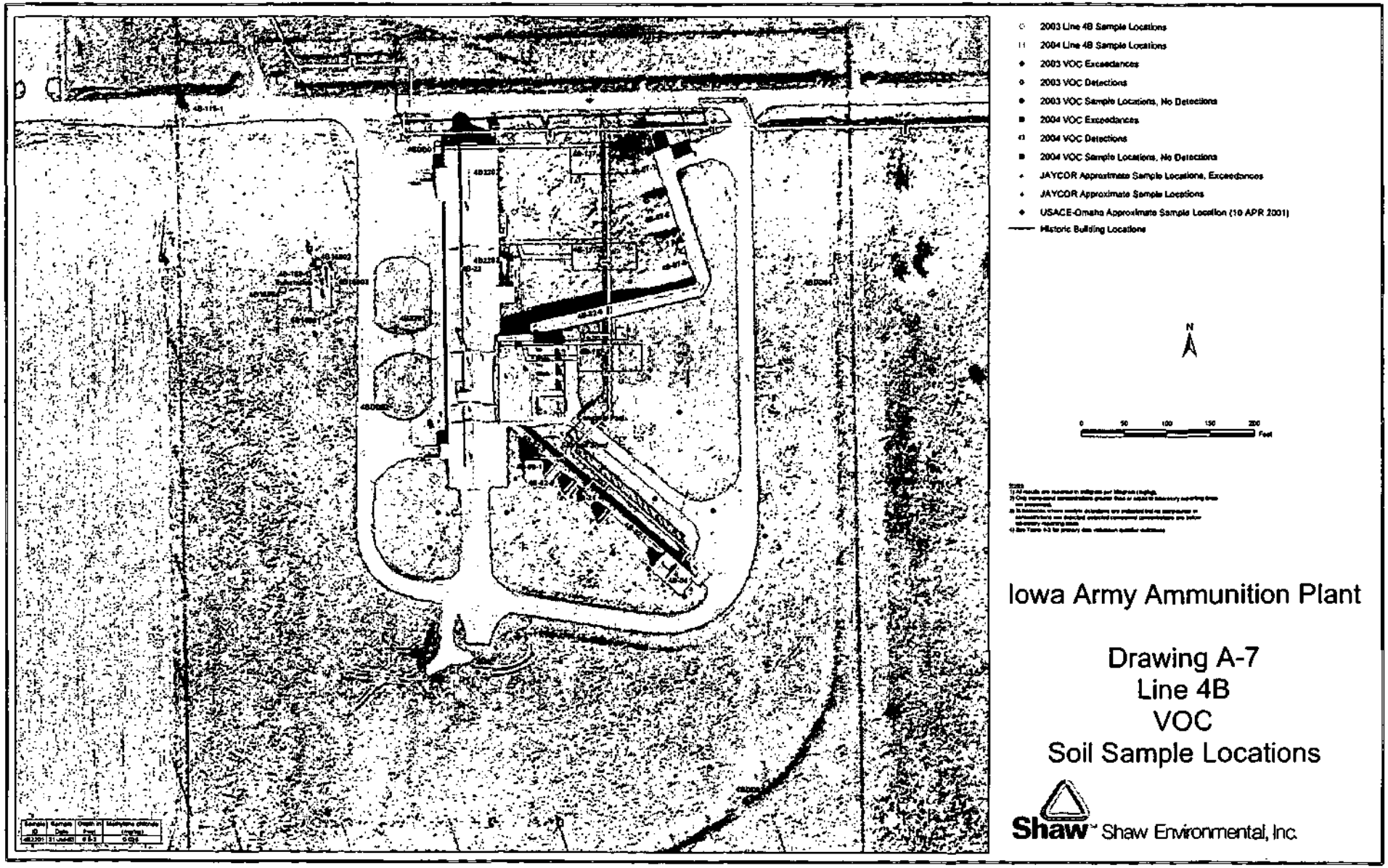

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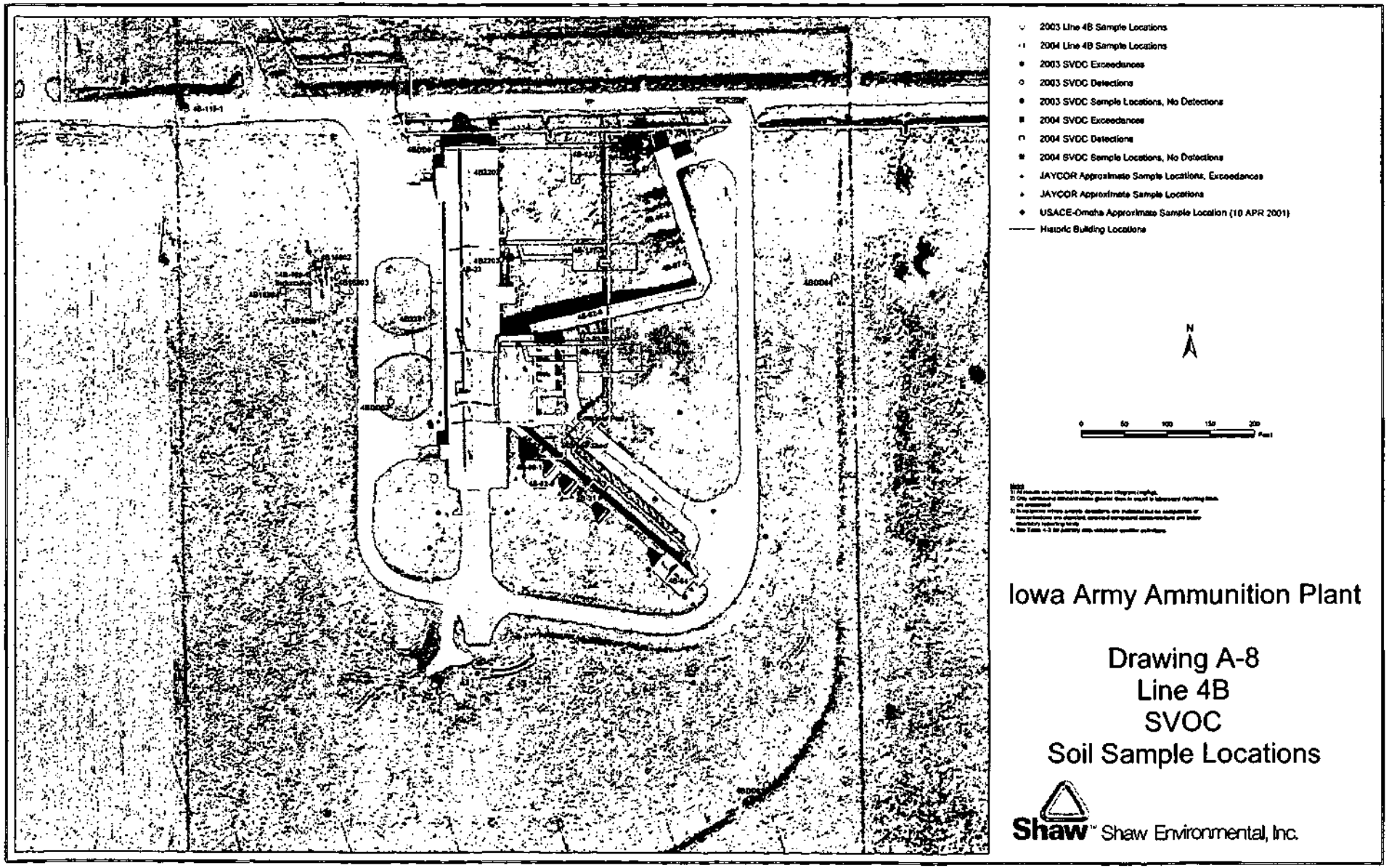

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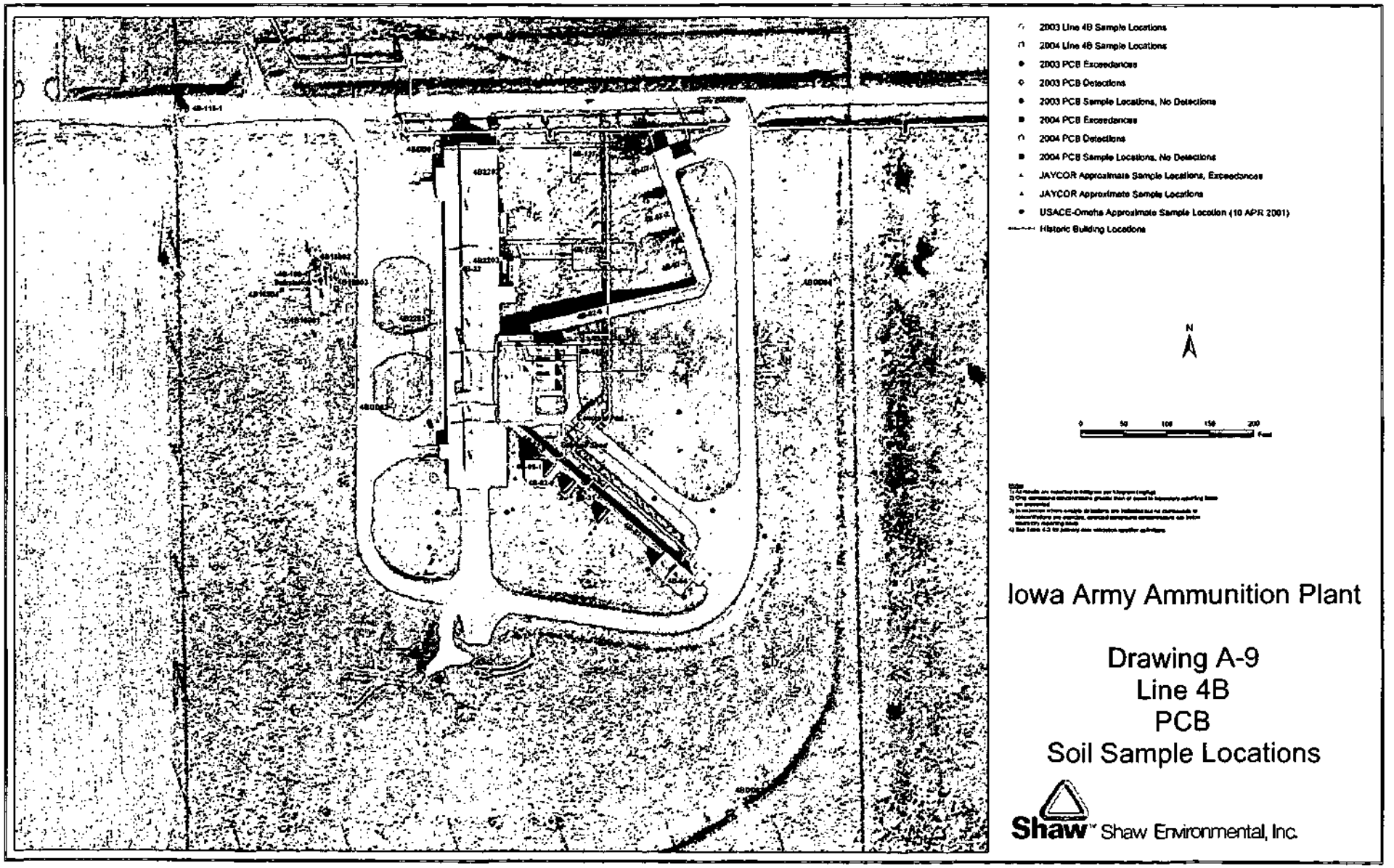

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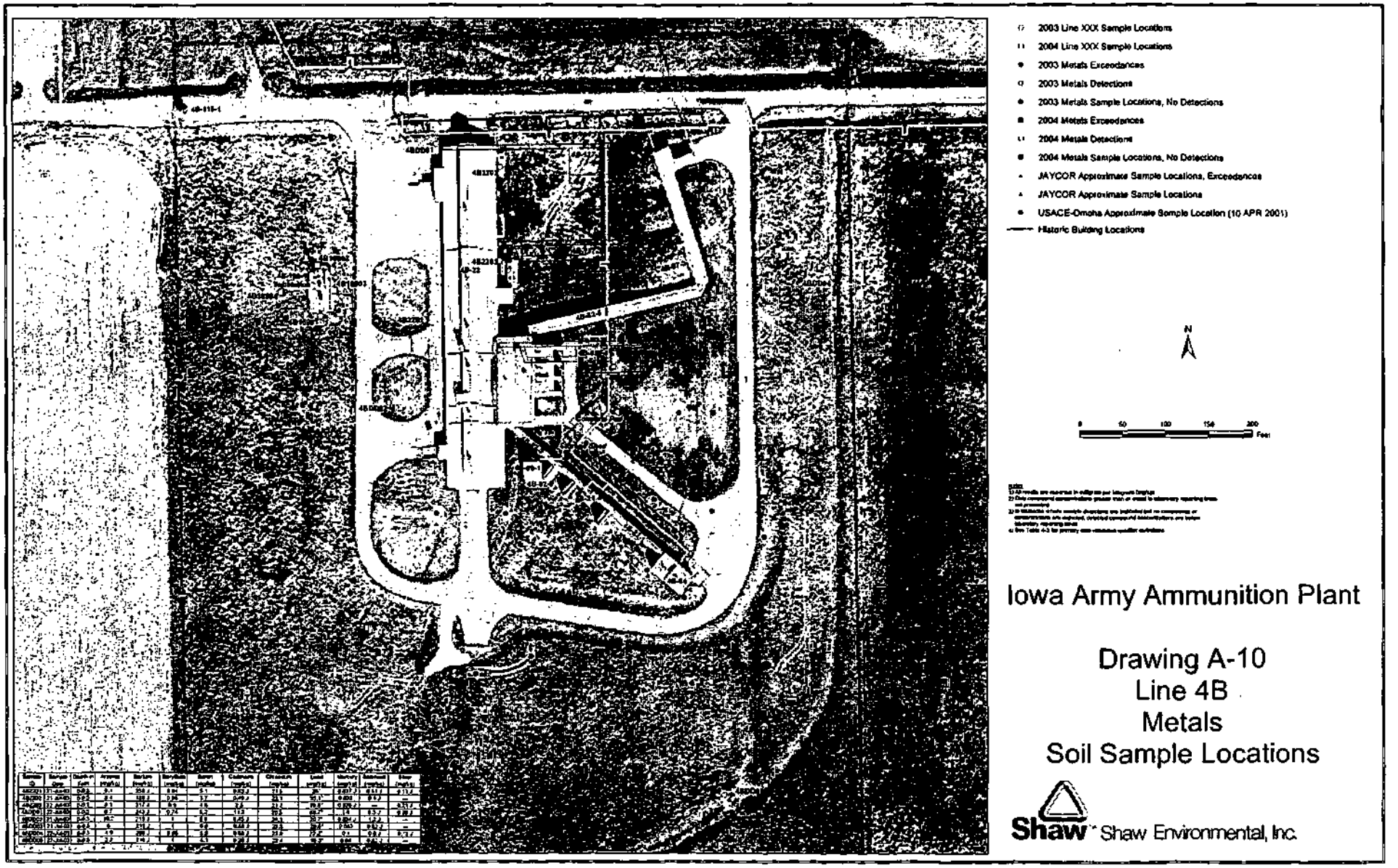

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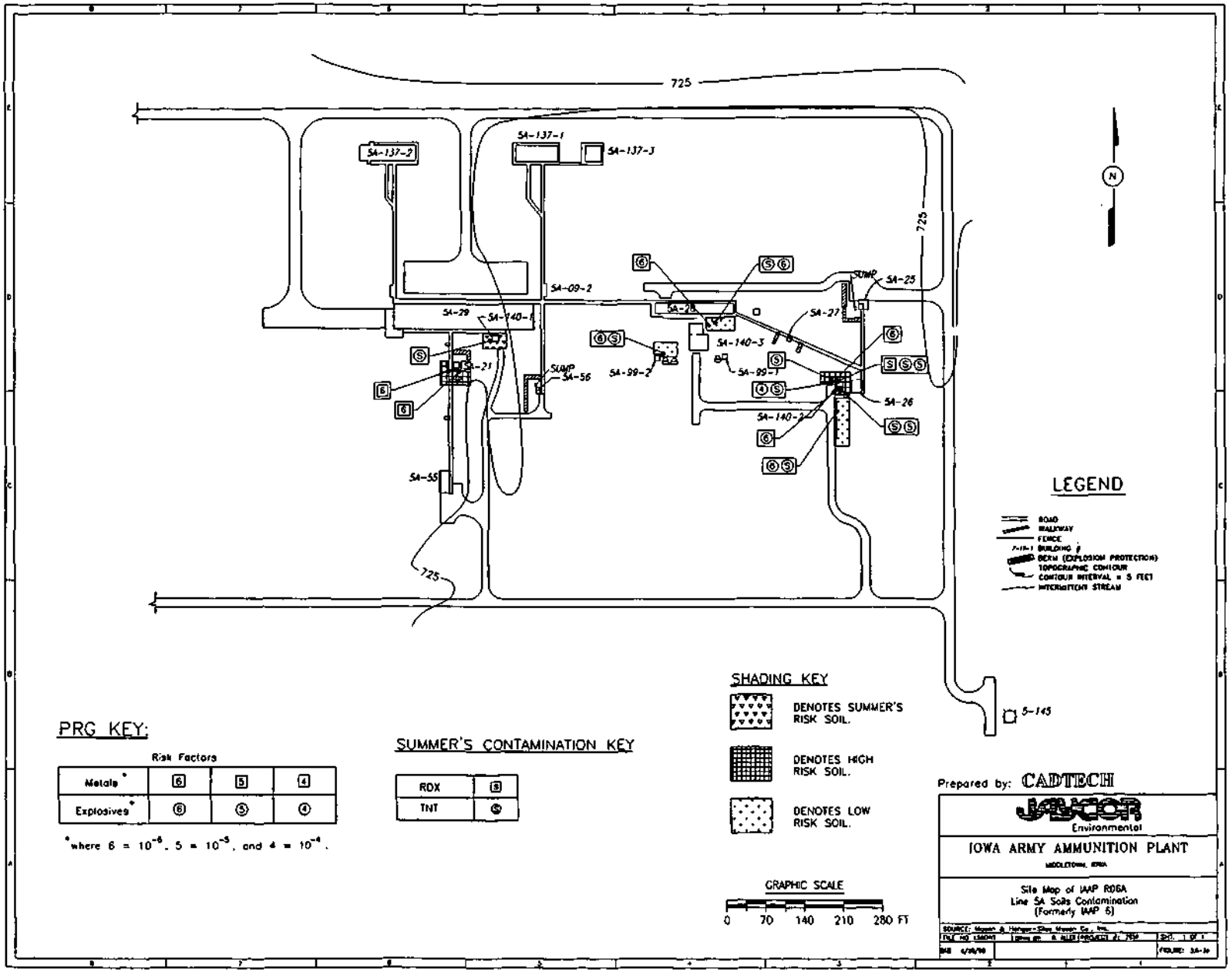
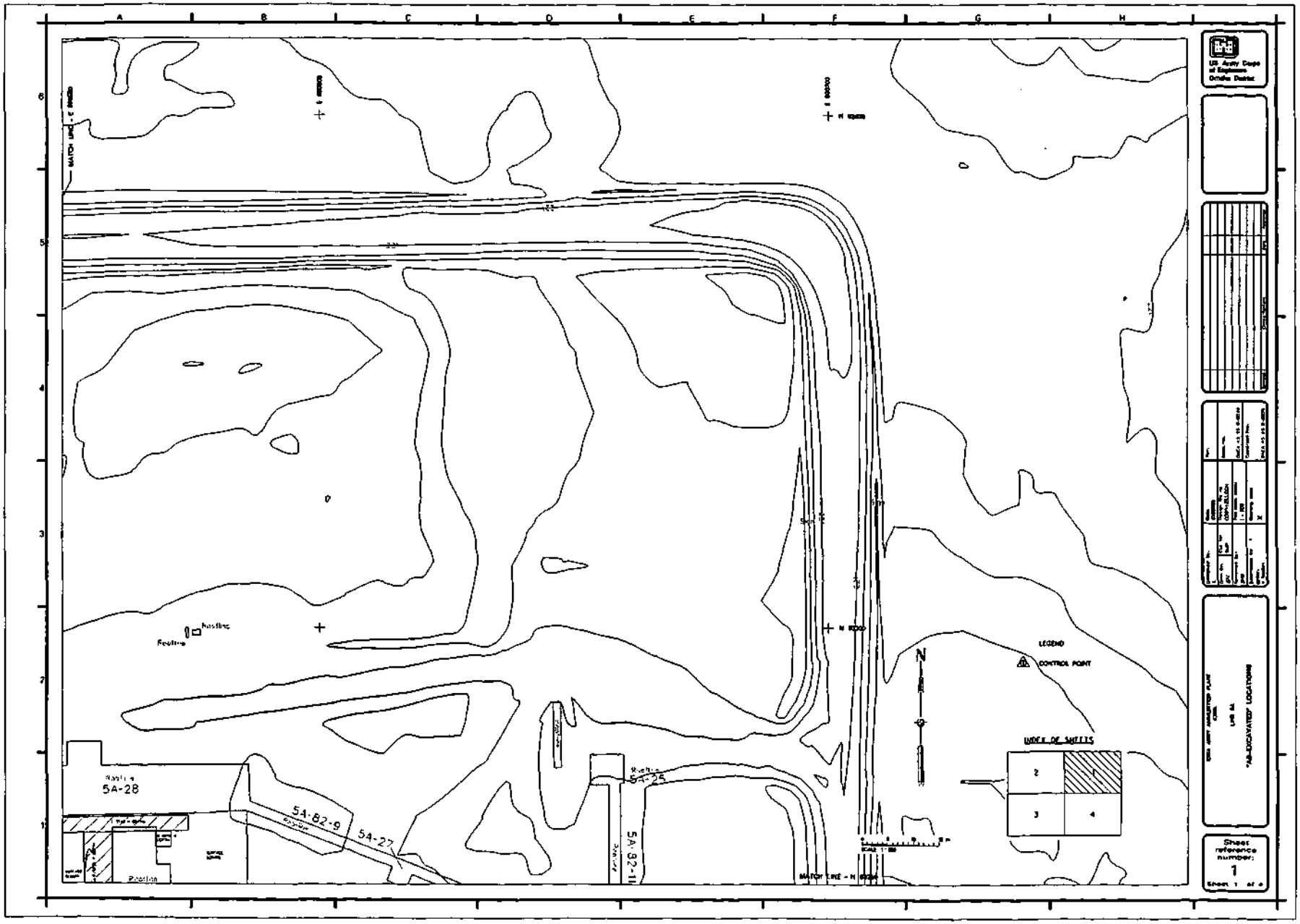
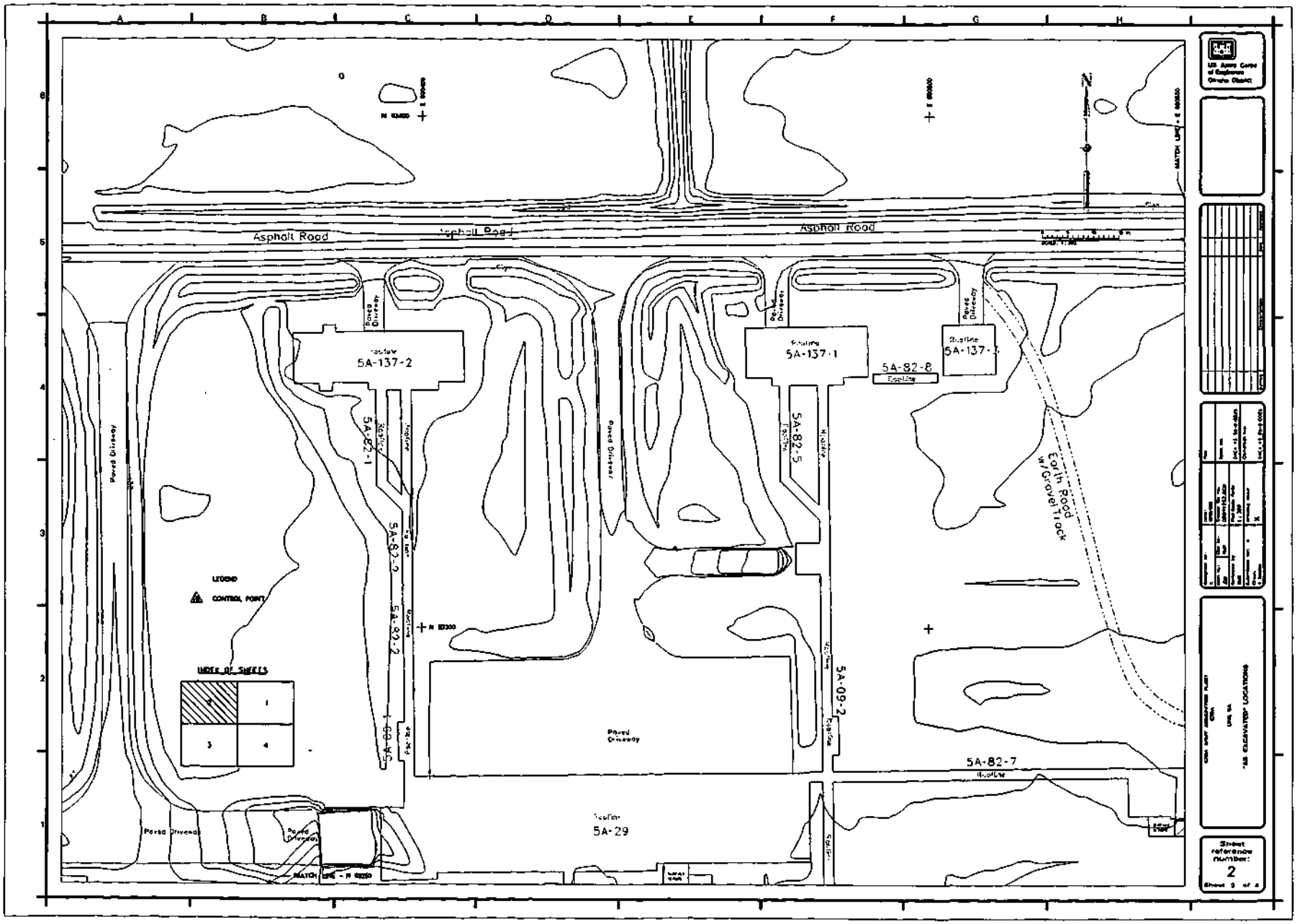


Source: Soils Focused Feasibility Study - Draft Final - 08 May 1997



Source: Remedial Action Report - FFS Sites - Phase II - Final- Apr 2001



Source: Remedial Action Report - FFS Sites - Phase II - Final- Apr 2001

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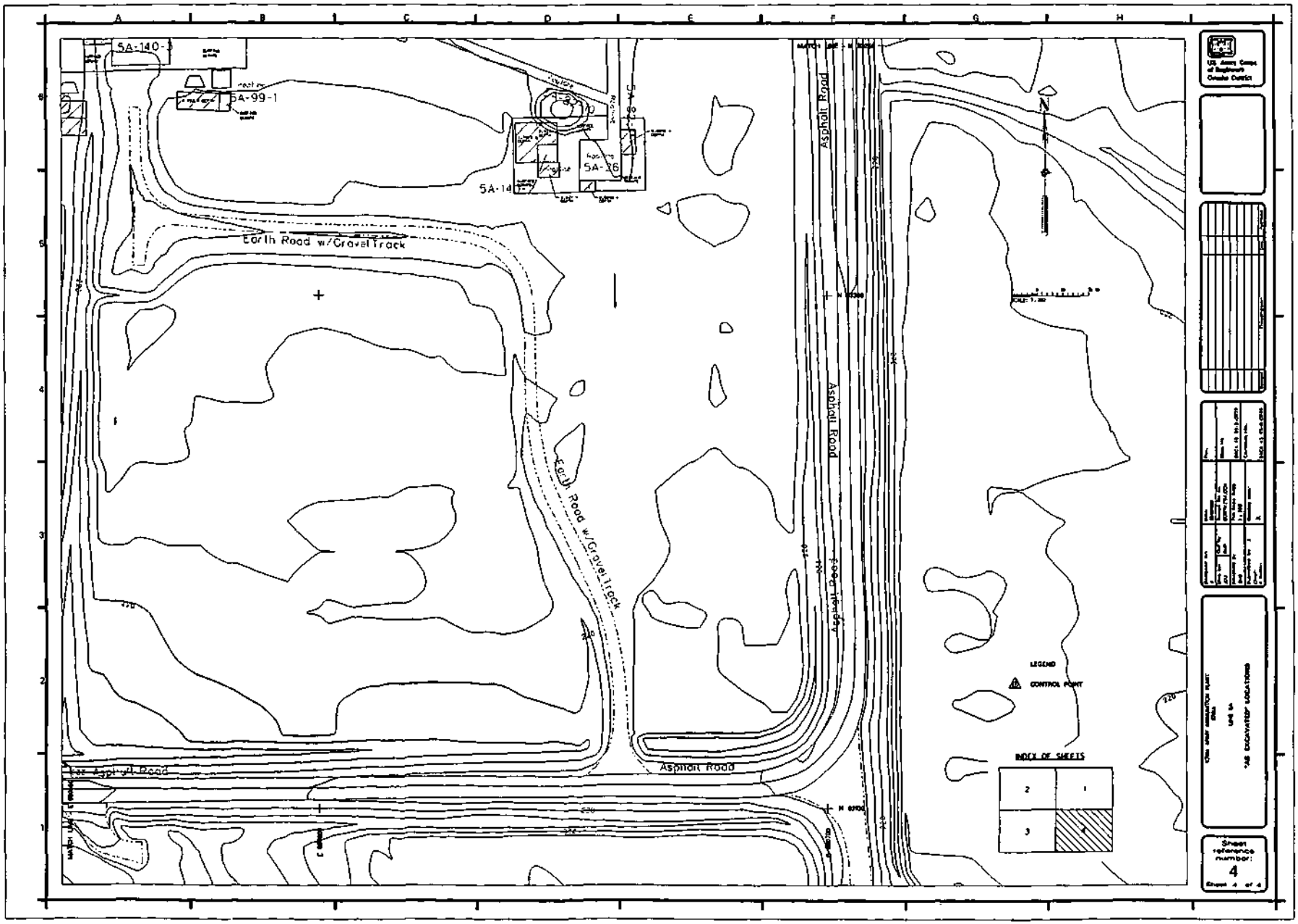

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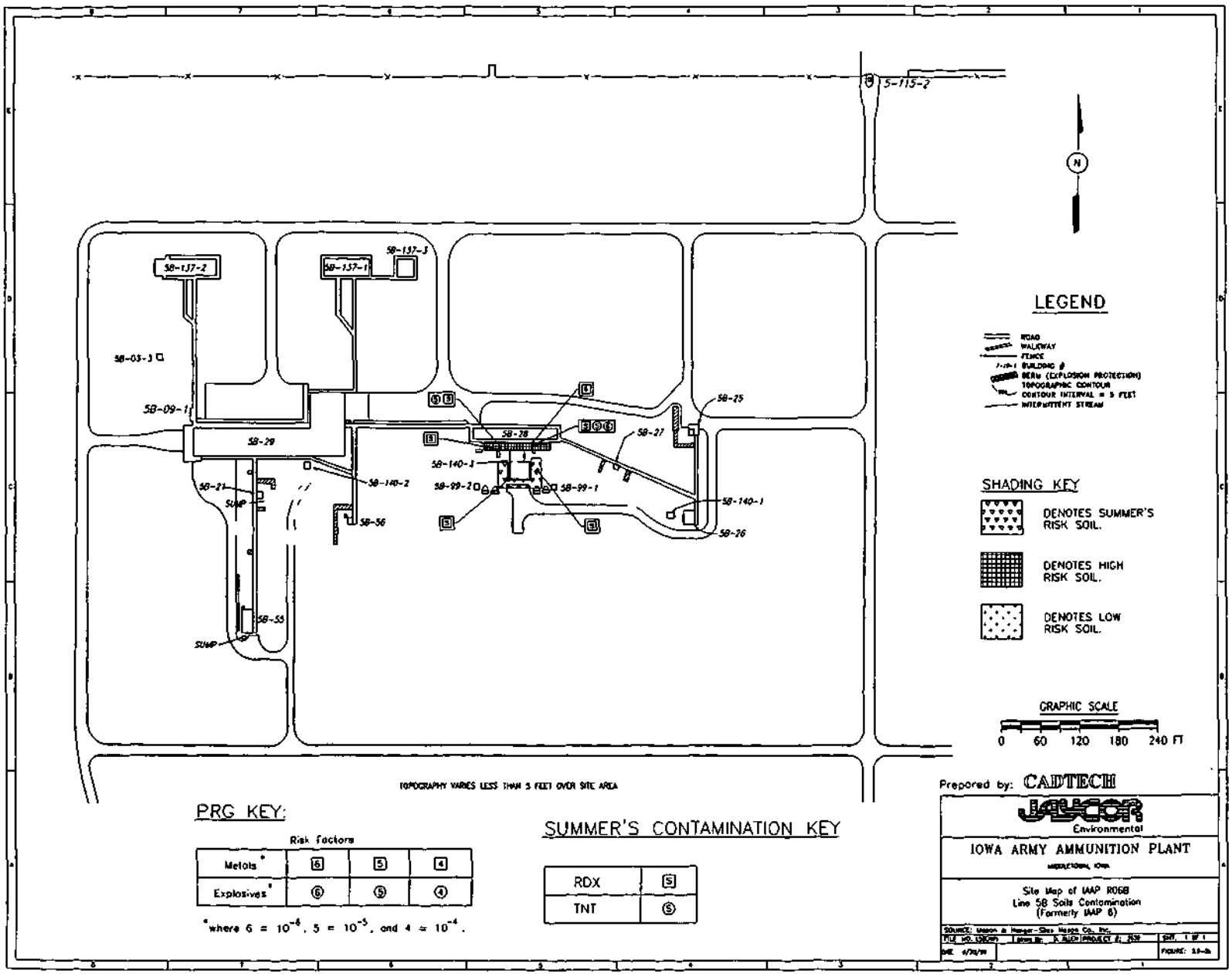
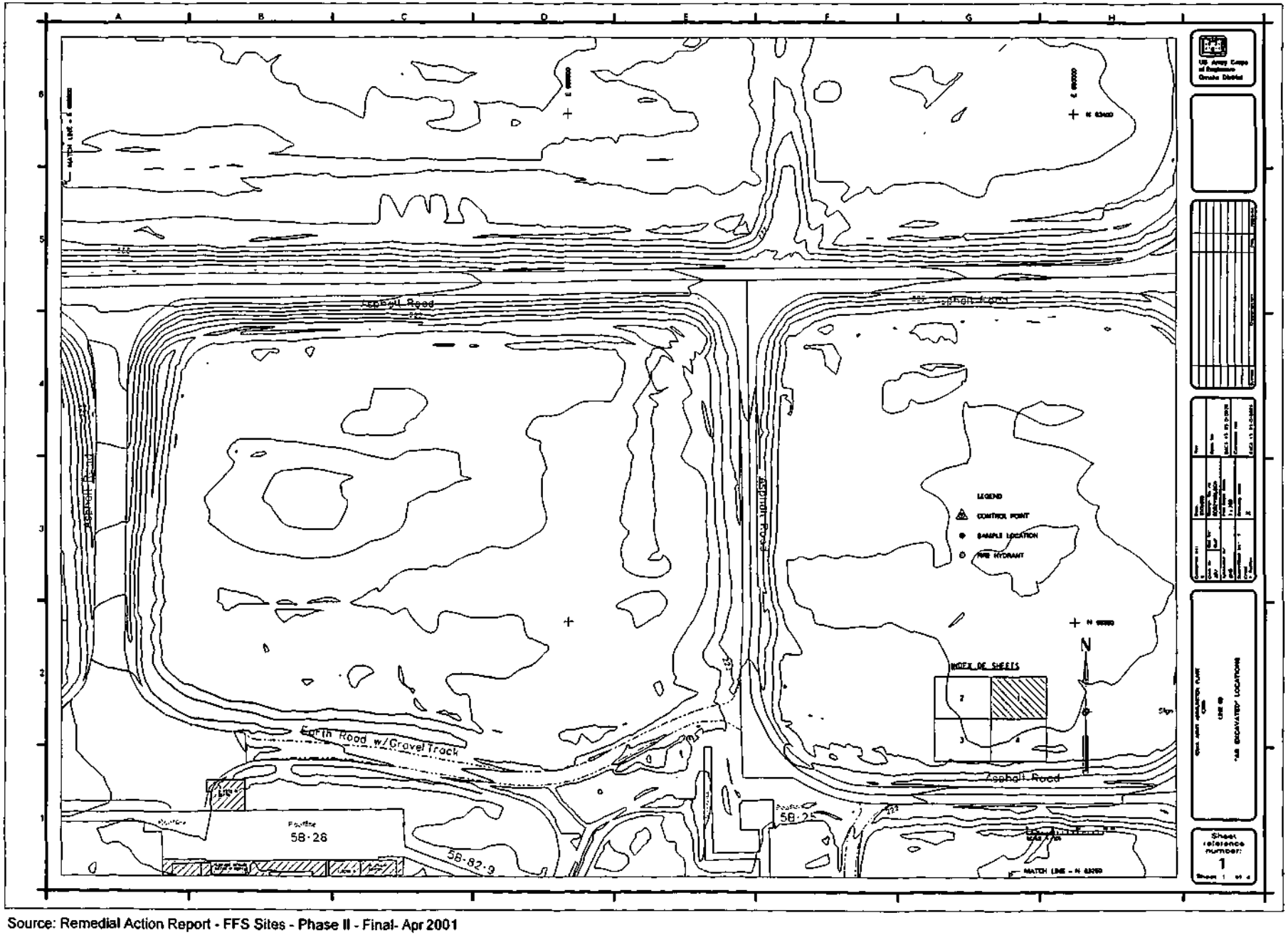
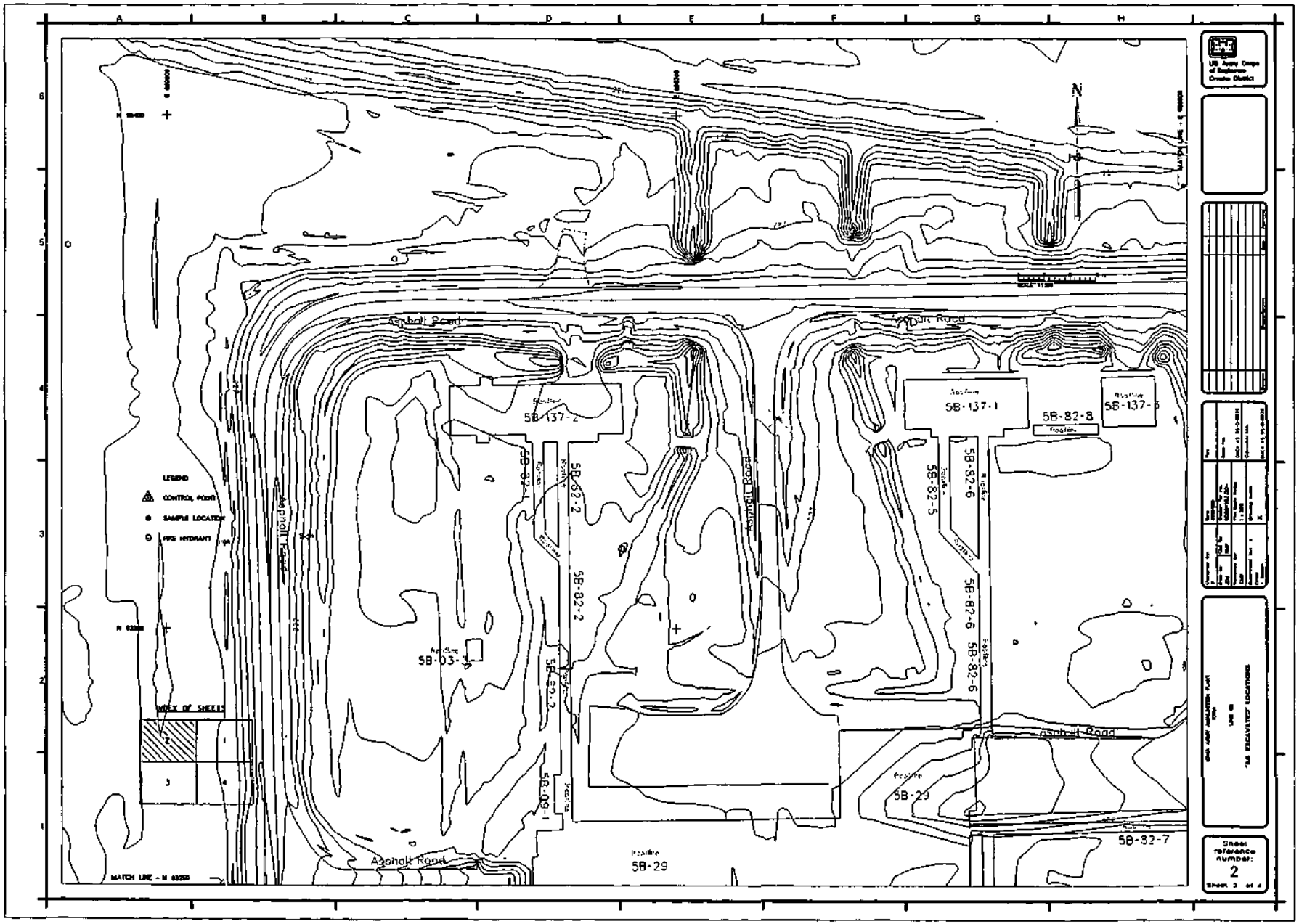


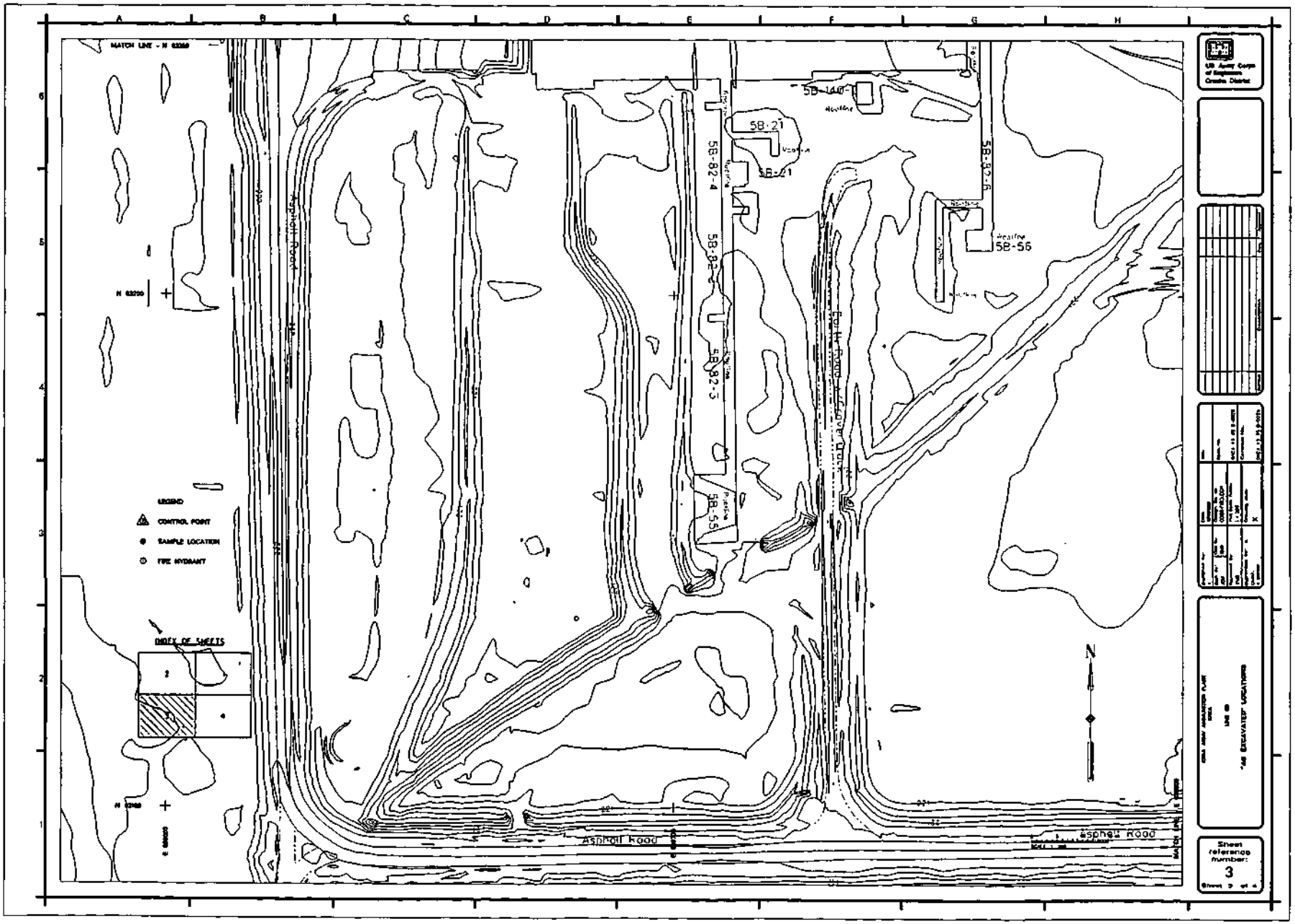
Source: Soils Focused Feasibility Study - Draft Final - 08 May 1997



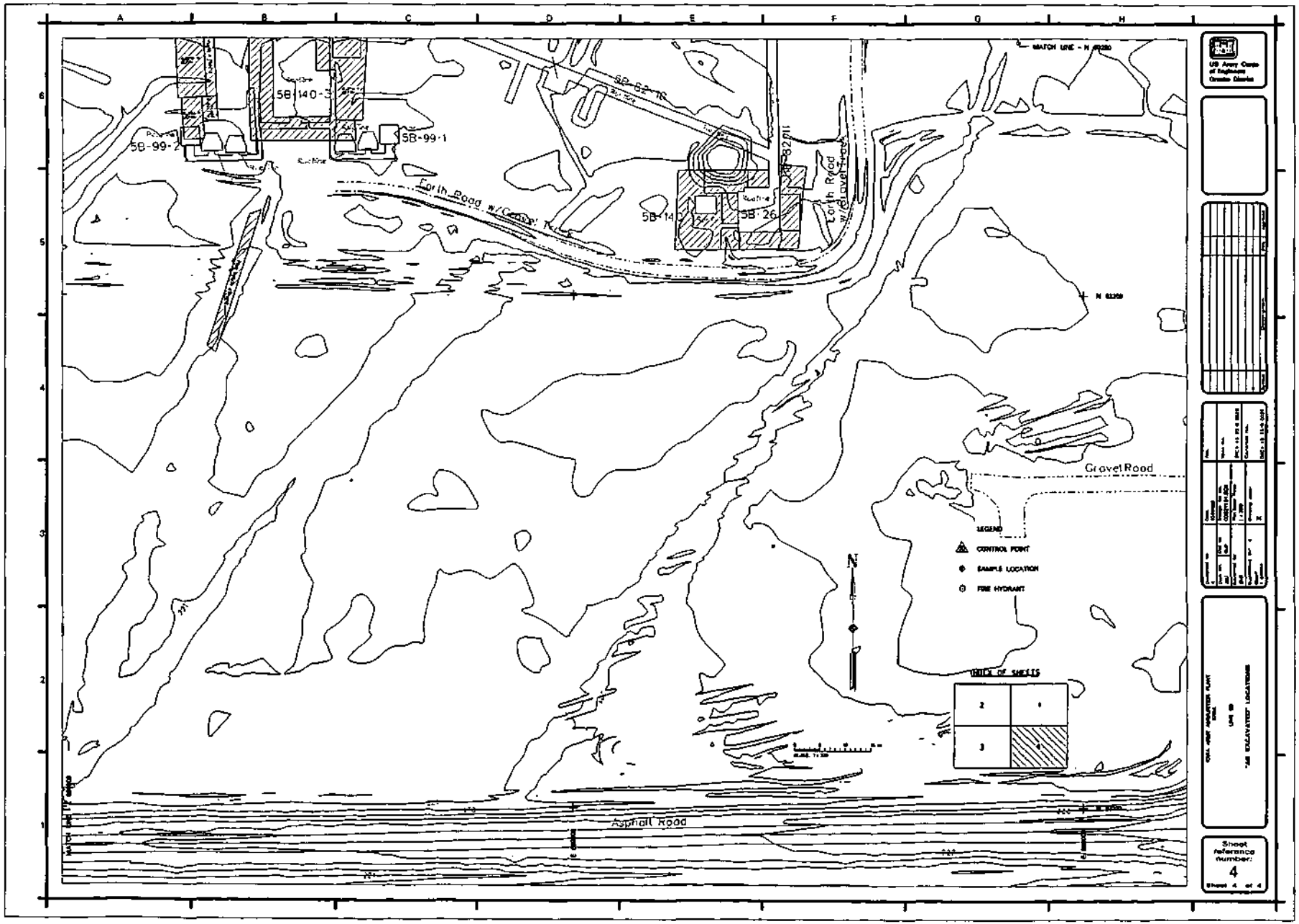
Source: Remedial Action Report - FFS Sites - Phase II - Final- Apr 2001



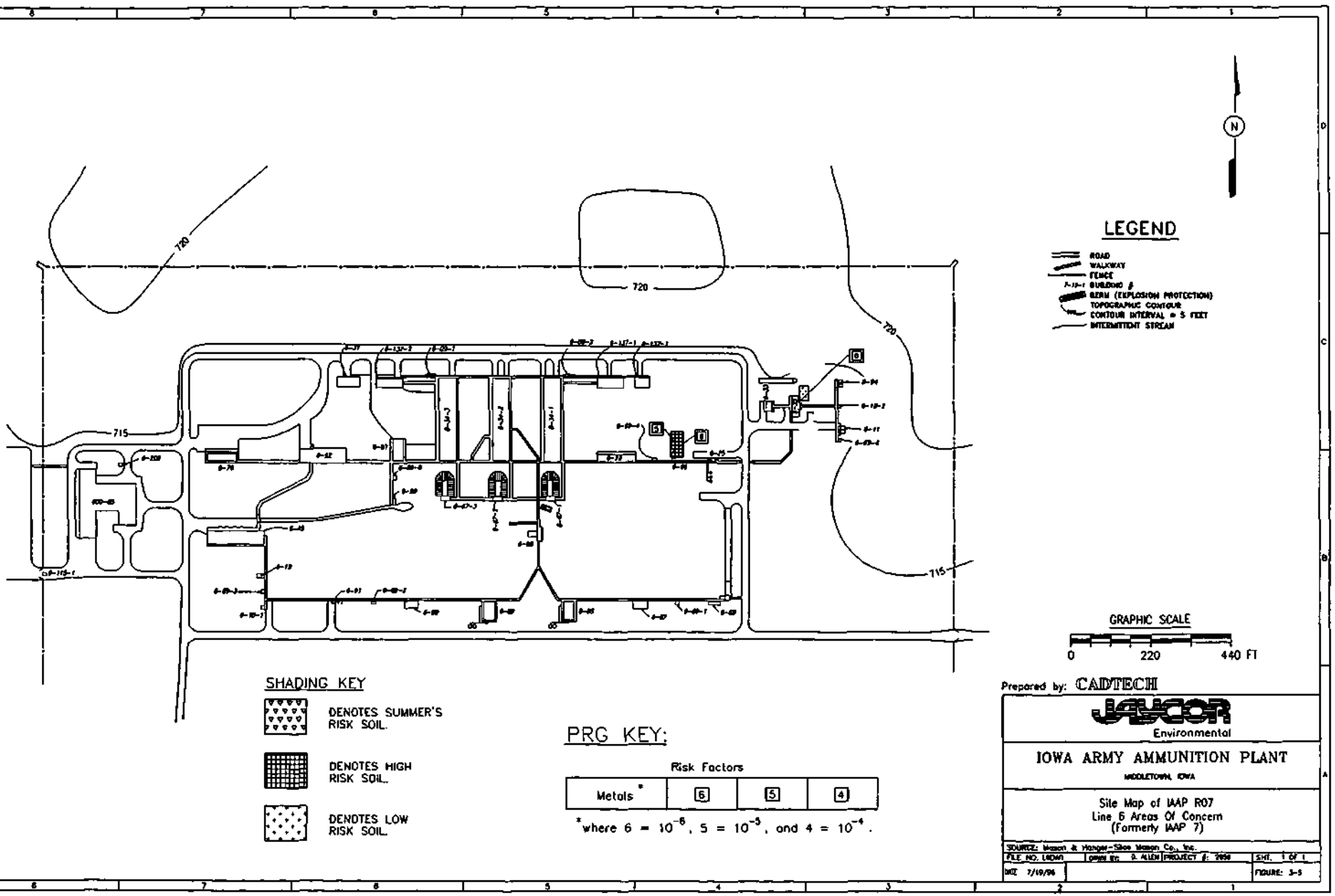
Source: Remedial Action Report - FFS Sites - Phase II - Final- Apr 2001



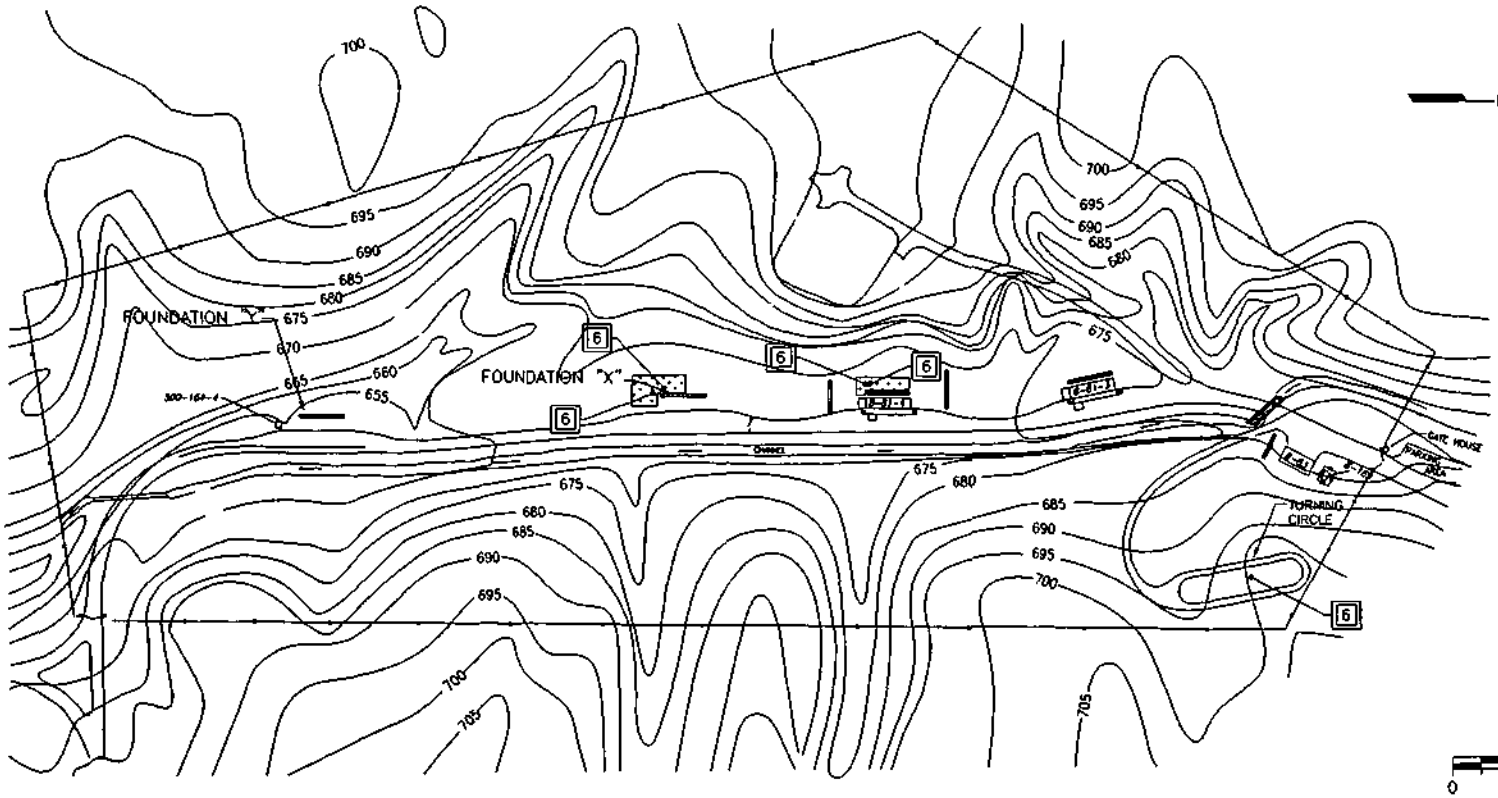
Source: Remedial Action Report - FFS Sites - Phase II - Final- Apr 2001



Source: Remedial Action Report - FFS Sites - Phase II - Final- Apr 2001



Source: Soils Focused Feasibility Study - Draft Final - 08 May 1997



GRAPHIC SCALE

0 100 200 300 400 FT

LEGEND

- ROAD
- WALKWAY
- FENCE
- 7-19-1 BUILDING #
- BERM (EXPLOSION PROTECTION)
- TOPOGRAPHIC CONTOUR
- CONTOUR INTERVAL = 5 FEET
- INTERMITTENT STREAM

PRG KEY:

Risk Factors			
Metals *	6	5	4

*where 6 = 10^{-6}, 5 = 10^{-5}, and 4 = 10^{-4}.

SHADING KEY

- DENOTES SUMMER'S RISK SOIL.
- DENOTES HIGH RISK SOIL.
- DENOTES LOW RISK SOIL.

Prepared by: CADTECH

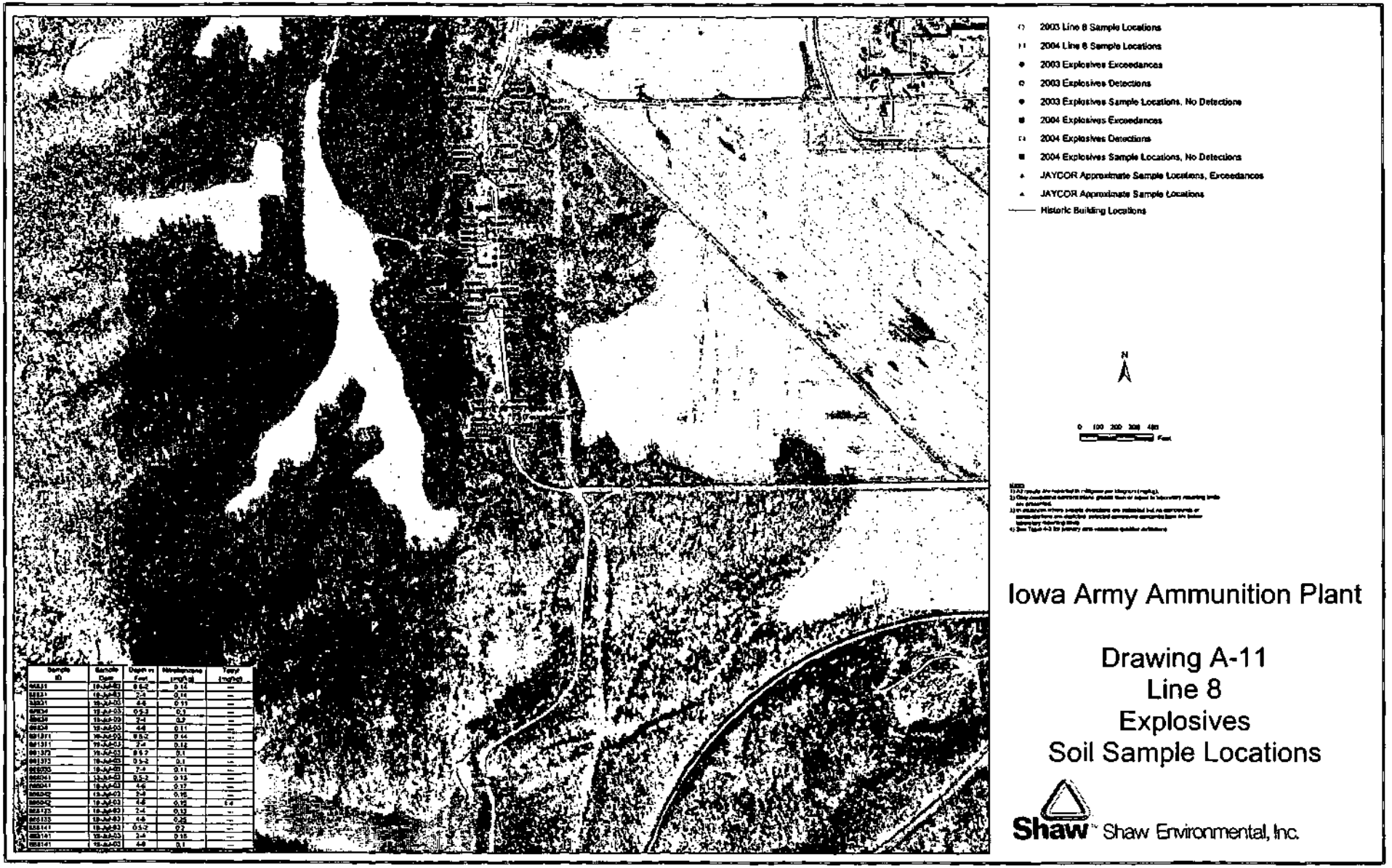
JAYCOR Environmental

IOWA ARMY AMMUNITION PLANT
MIDDLETOWN, IOWA

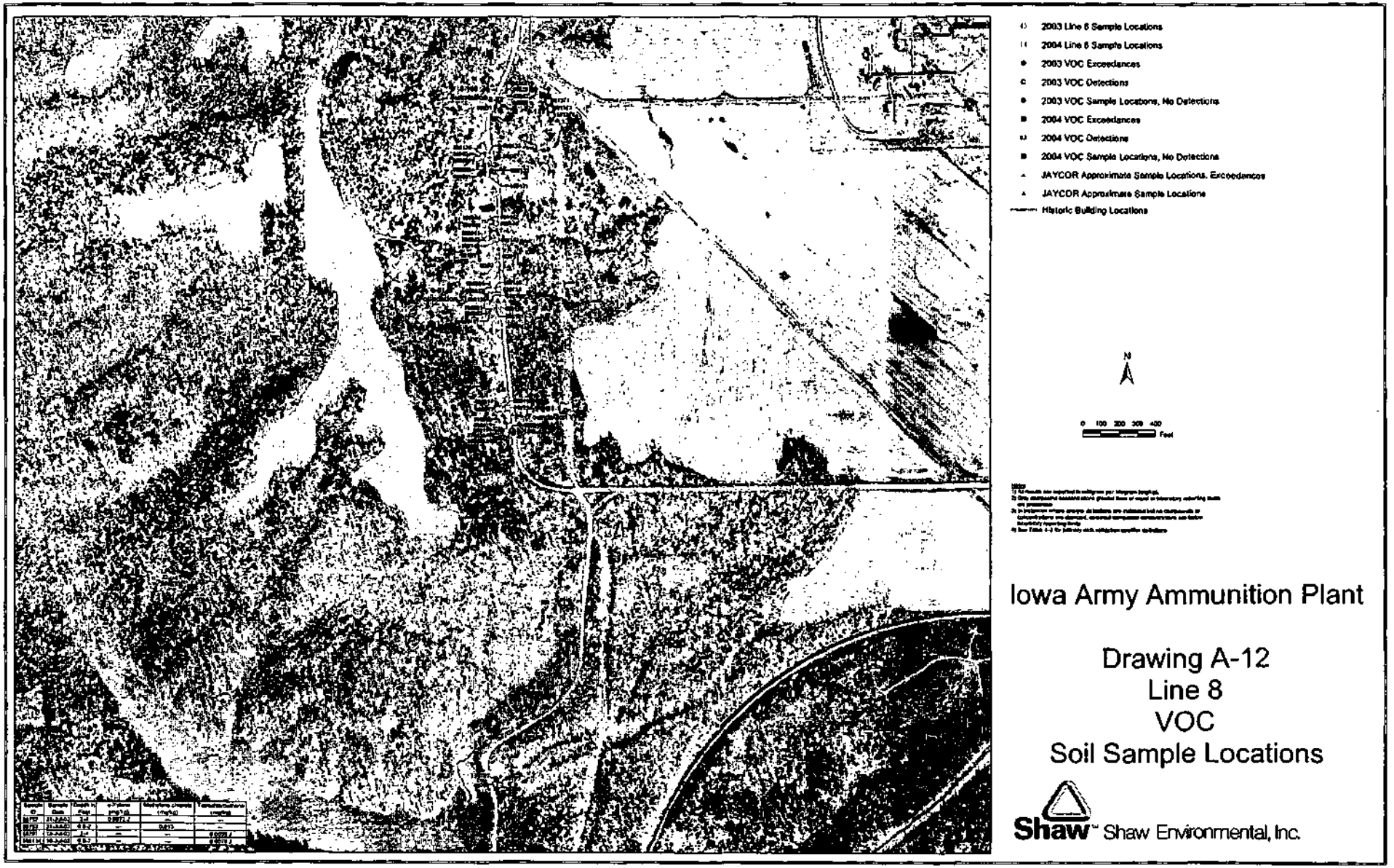
Site Map of IAAP R09
Line 8 Soils Contamination
(Formerly IAAP 9)

SOURCE: Mason & Hanger-Silas Mason Co., Inc.
FILE NO. LBUKY | DRWN BY: D. ALLEN | PROJECT #: 2650 | SHT. 1 OF 1
DATE 6/20/96 | FIGURE: 5.8-3

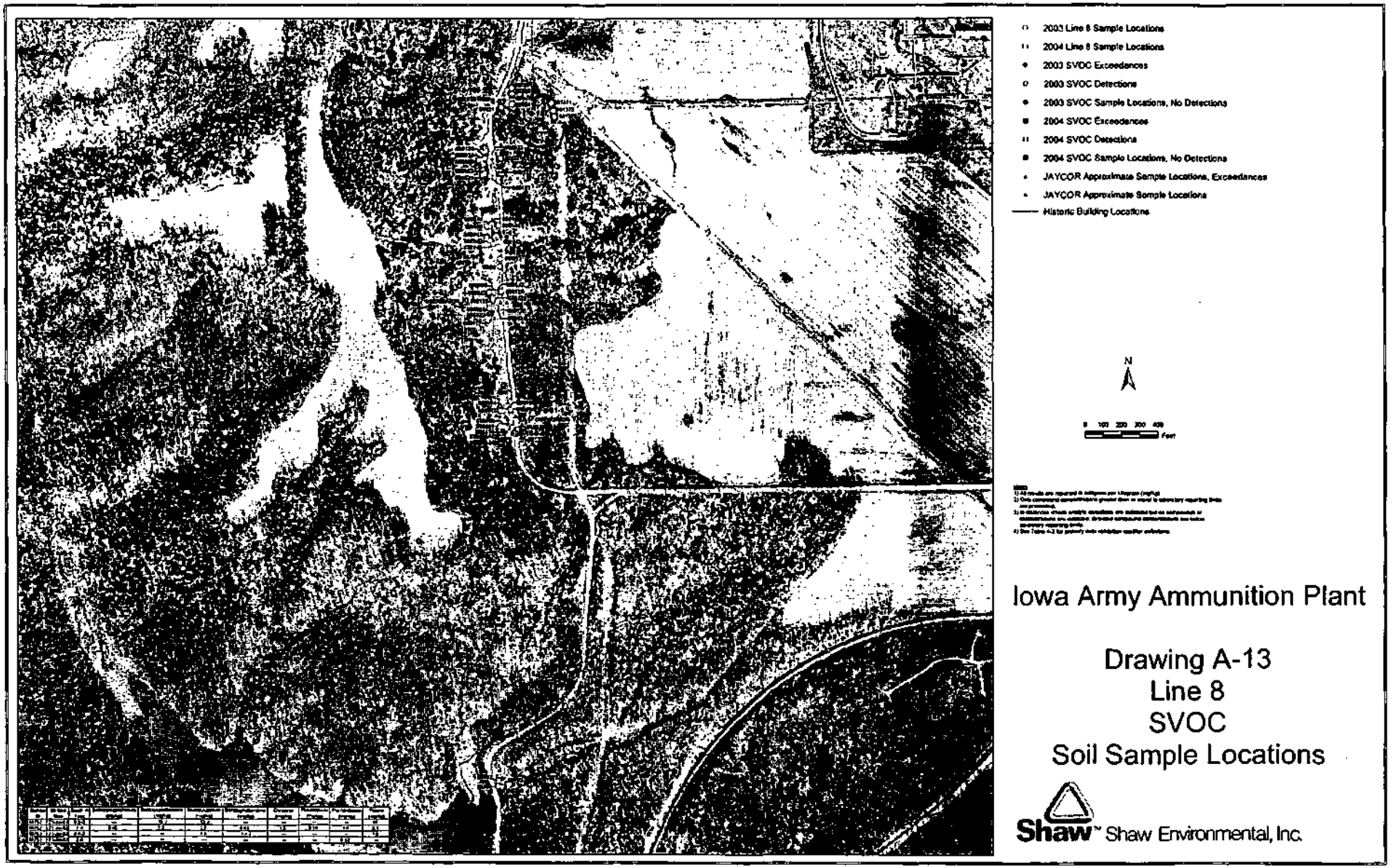
Source: Soils Focused Feasibility Study - Draft Final - 08 May 1997



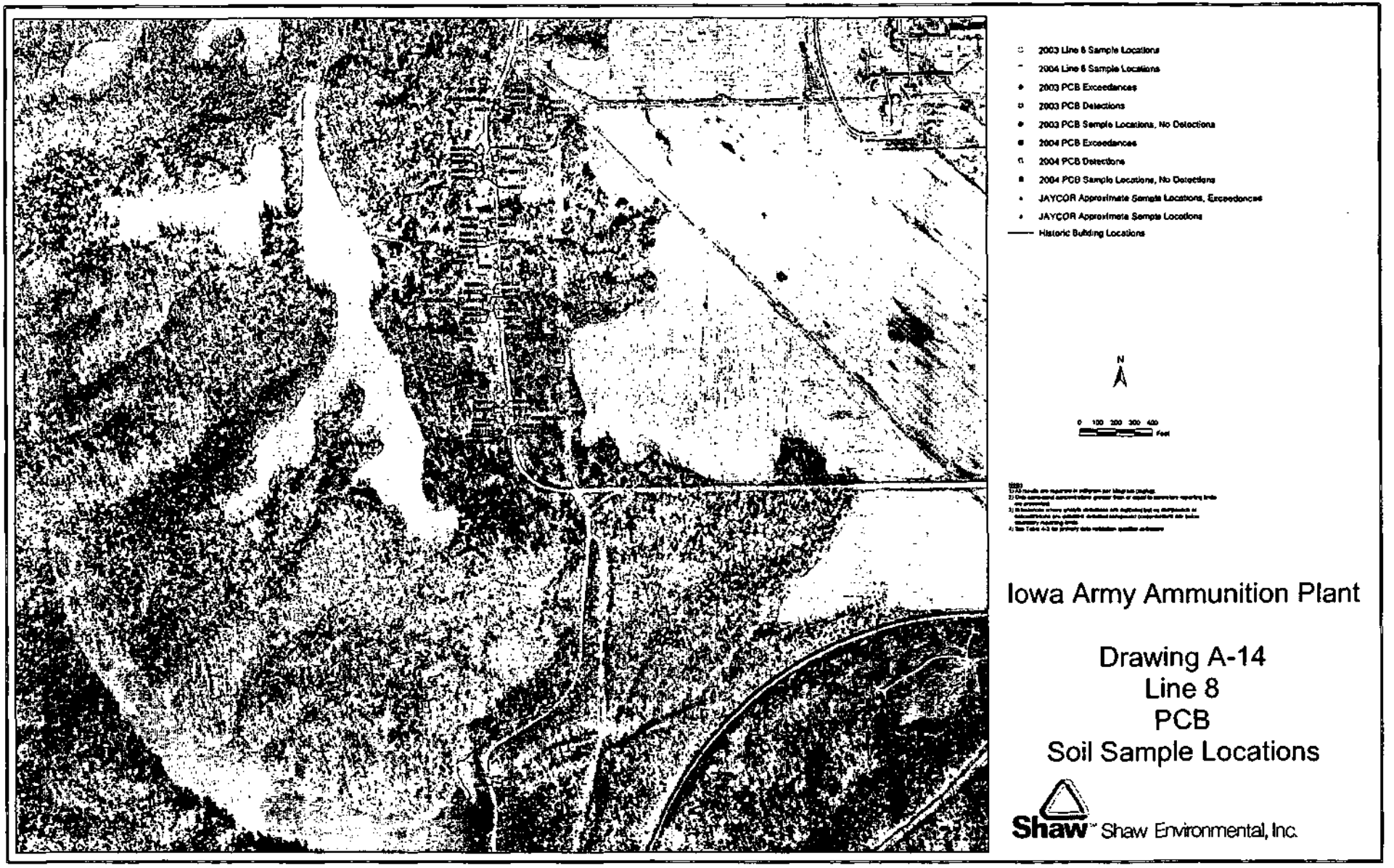
Source: Remedial Action Work Plan Addendum for Soil Excavation - Phase 4 Soil Sites - Draft Final - 20 May 2004



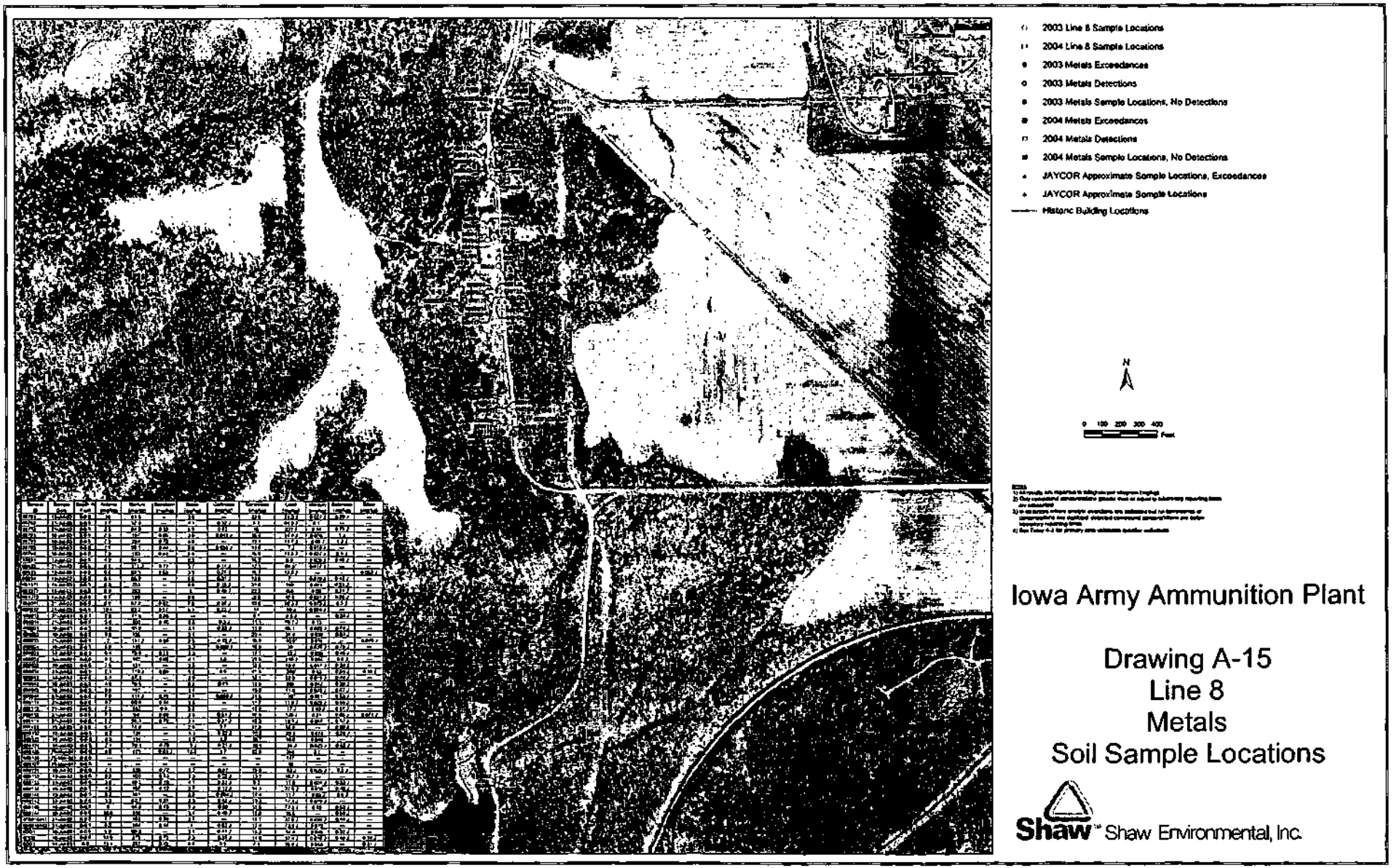
Source: Remedial Action Work Plan Addendum for Soil Excavation - Phase 4 Soil Sites - Draft Final - 20 May 2004



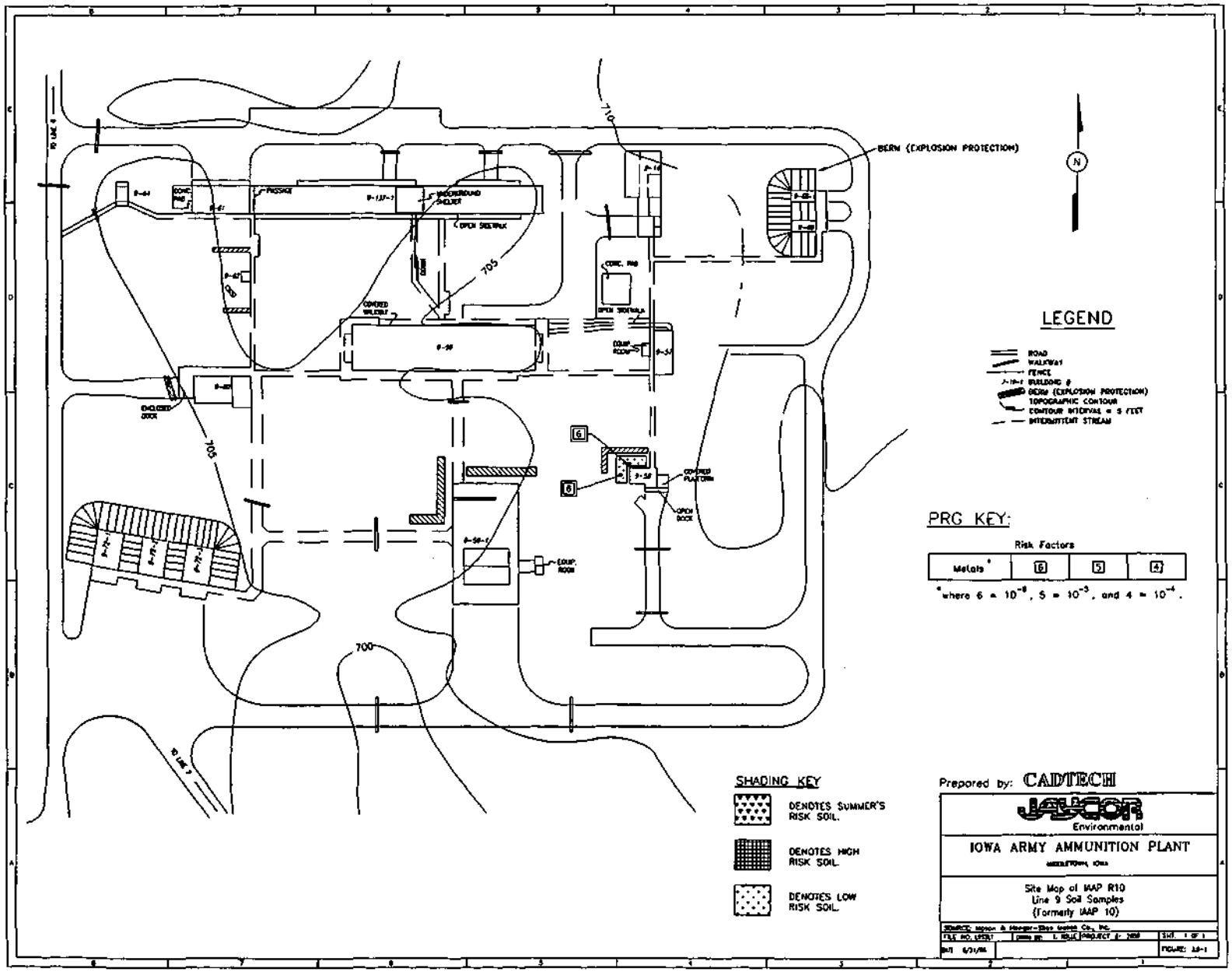
Source: Remedial Action Work Plan Addendum for Soil Excavation - Phase 4 Soil Sites - Draft Final - 20 May 2004



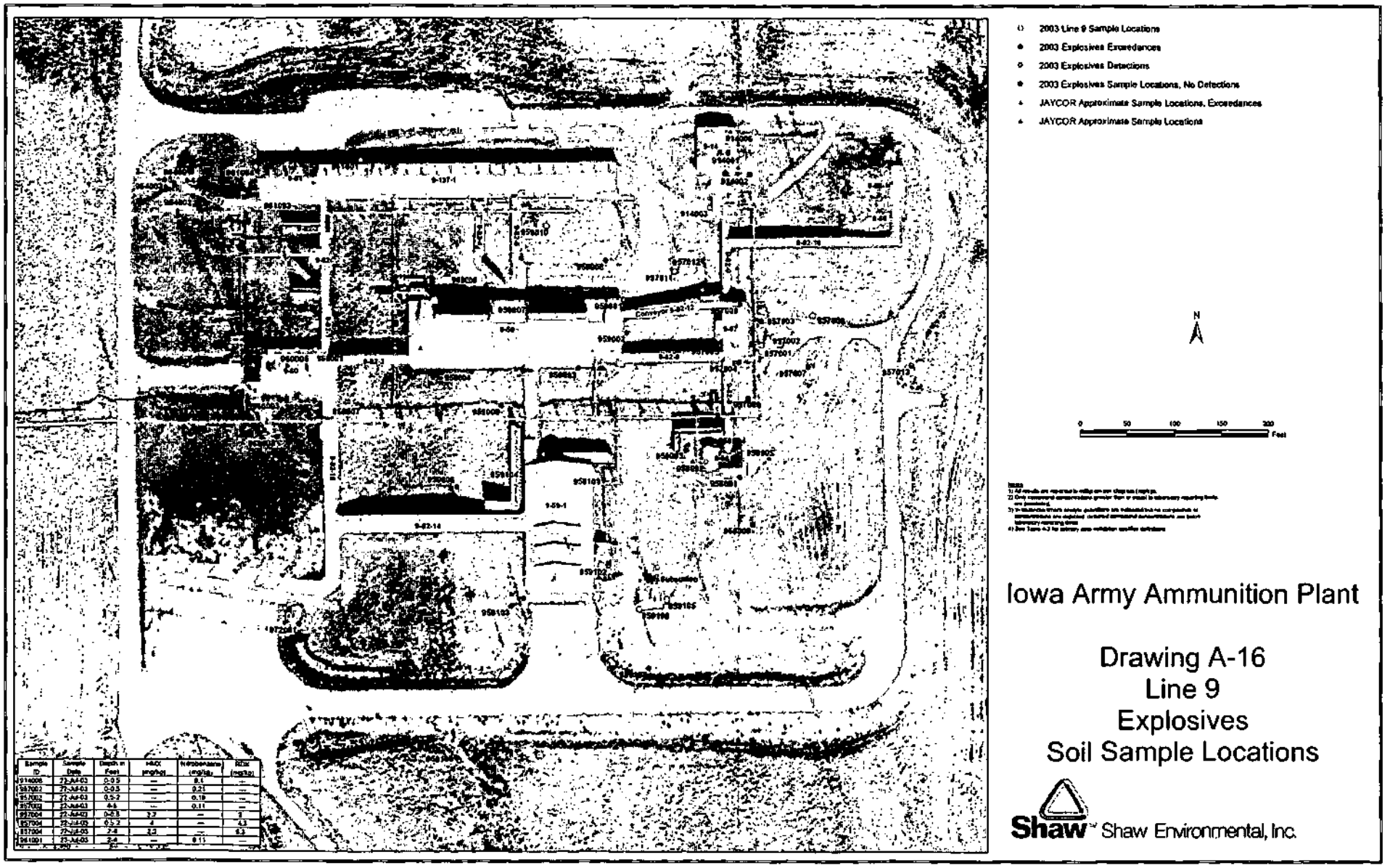
Source: Remedial Action Work Plan Addendum for Soil Excavation - Phase 4 Soil Sites - Draft Final - 20 May 2004



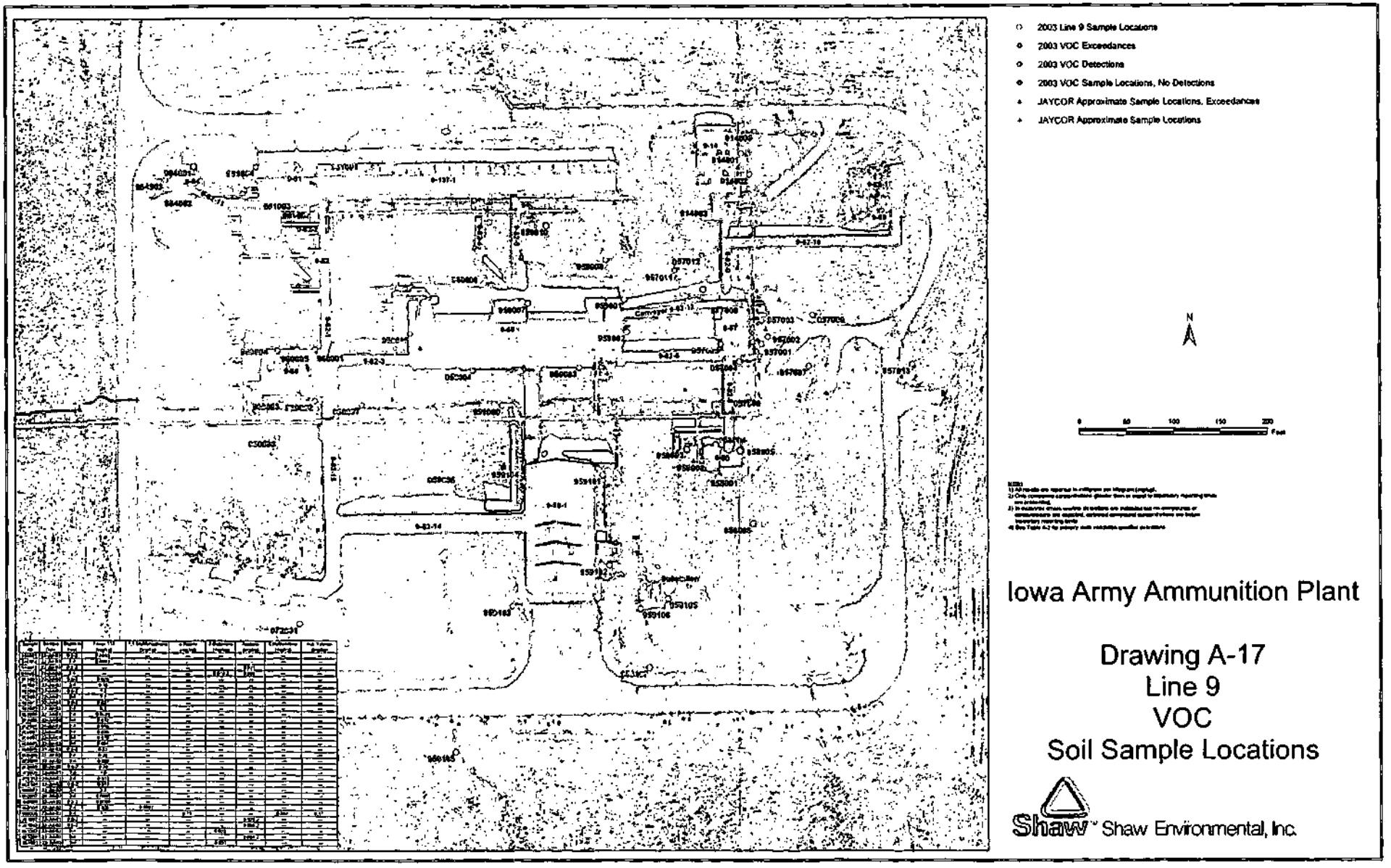
Source: Remedial Action Work Plan Addendum for Soil Excavation - Phase 4 Soil Sites - Draft Final - 20 May 2004



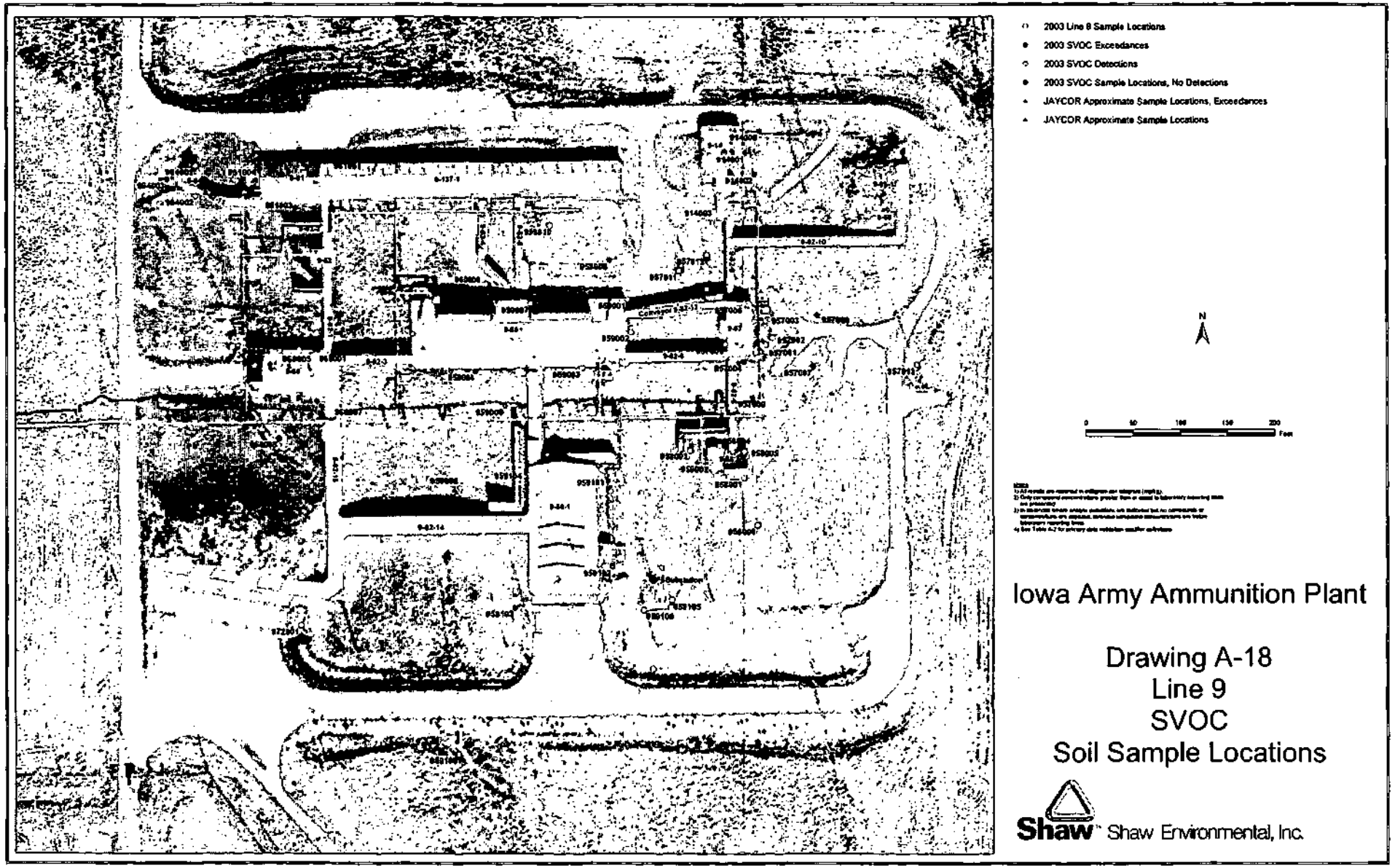
Source: Soils Focused Feasibility Study - Draft Final - 08 May 1997



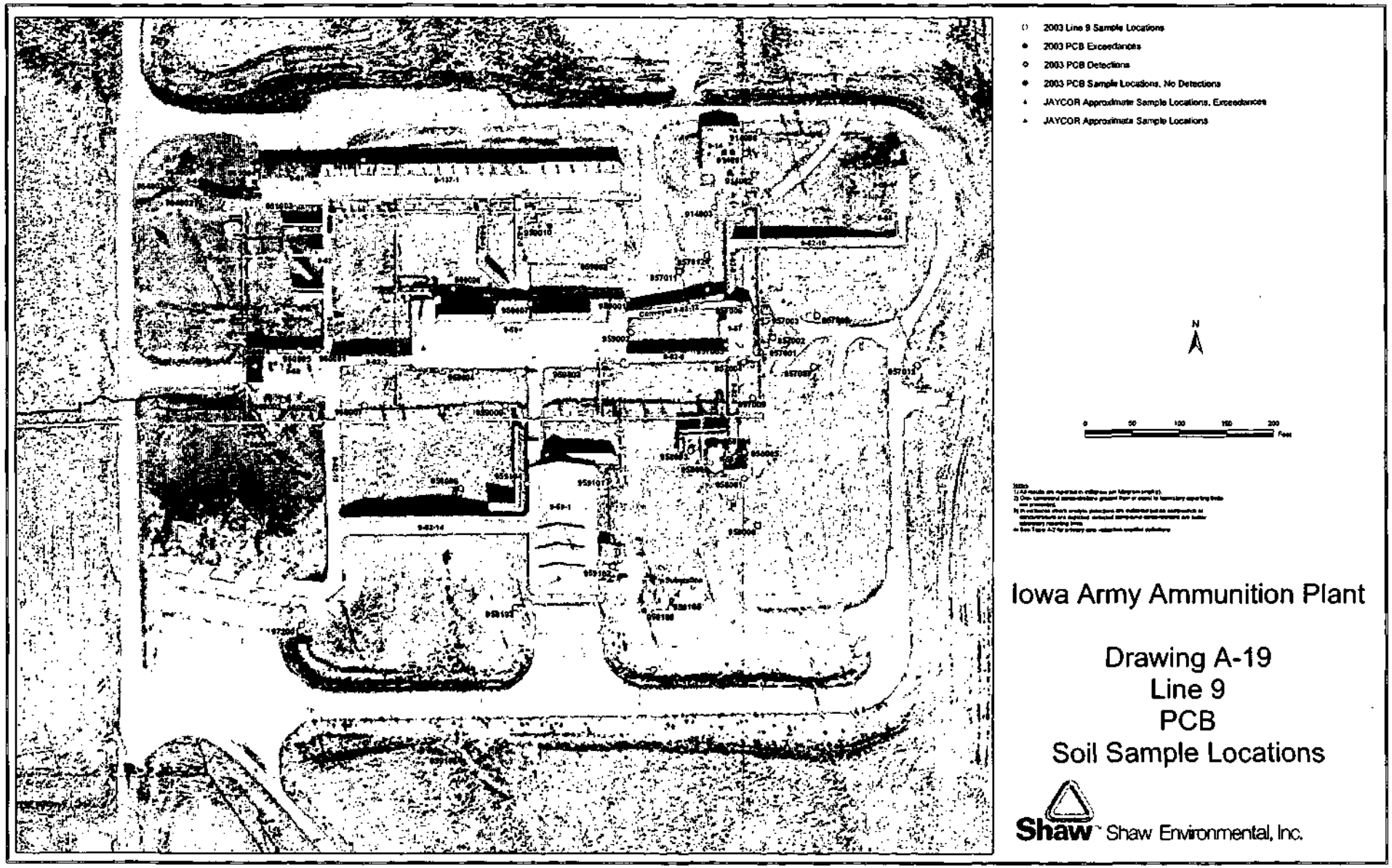
Source: Remedial Action Work Plan Addendum for Soil Excavation - Phase 4 Soil Sites - Draft Final - 20 May 2004



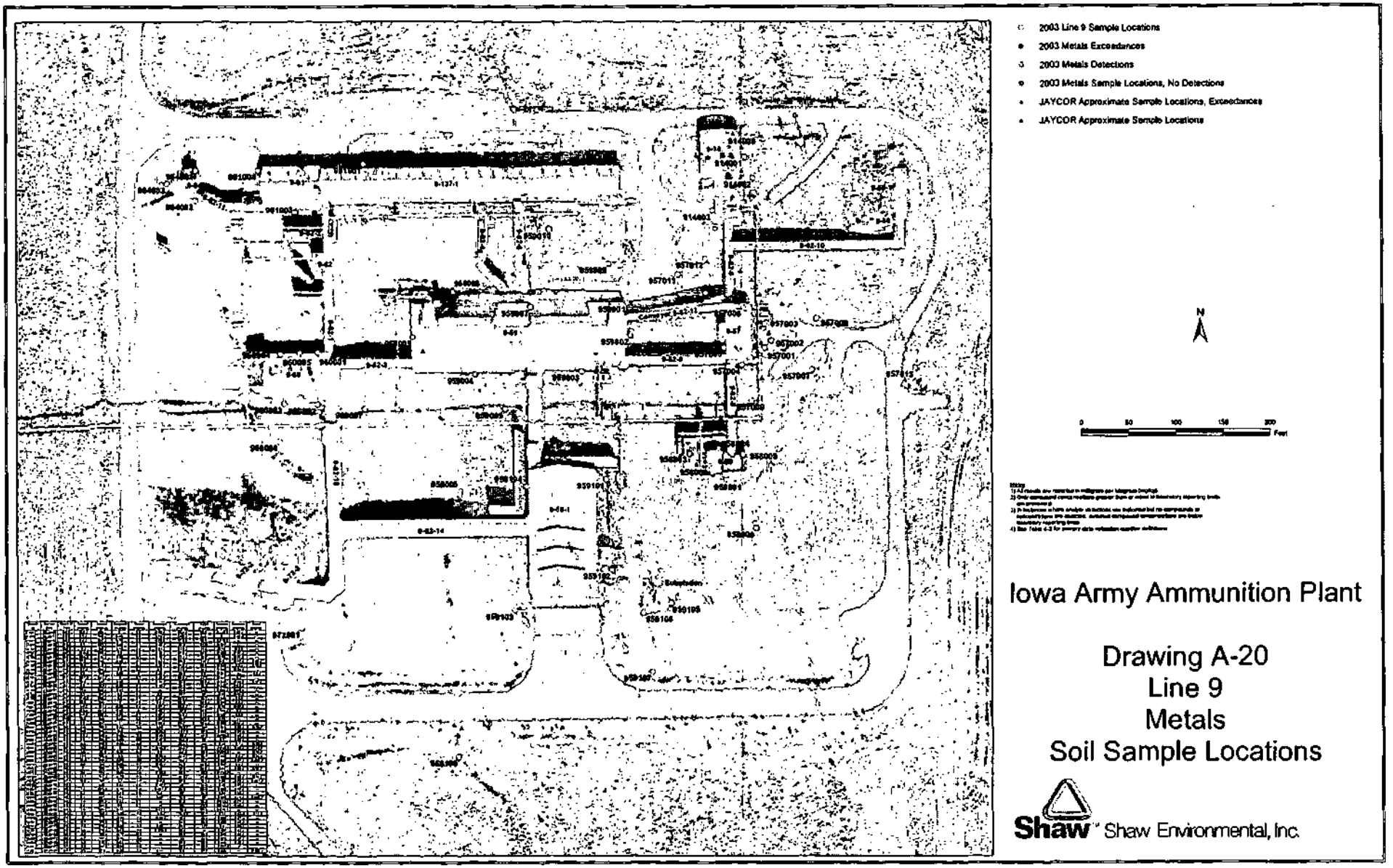
Source: Remedial Action Work Plan Addendum for Soil Excavation - Phase 4 Soil Sites - Draft Final - 20 May 2004



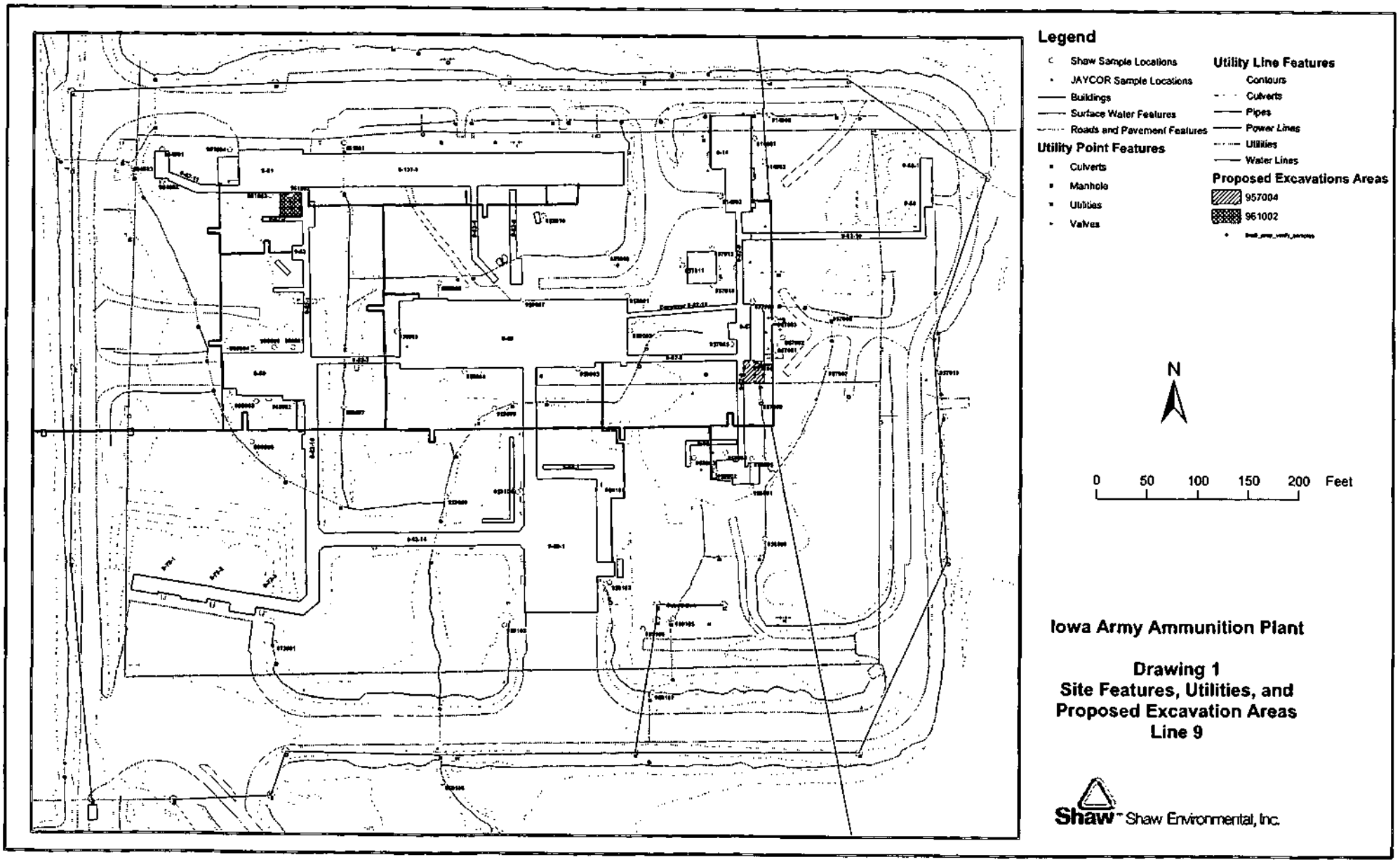
Source: Remedial Action Work Plan Addendum for Soil Excavation - Phase 4 Soil Sites - Draft Final - 20 May 2004



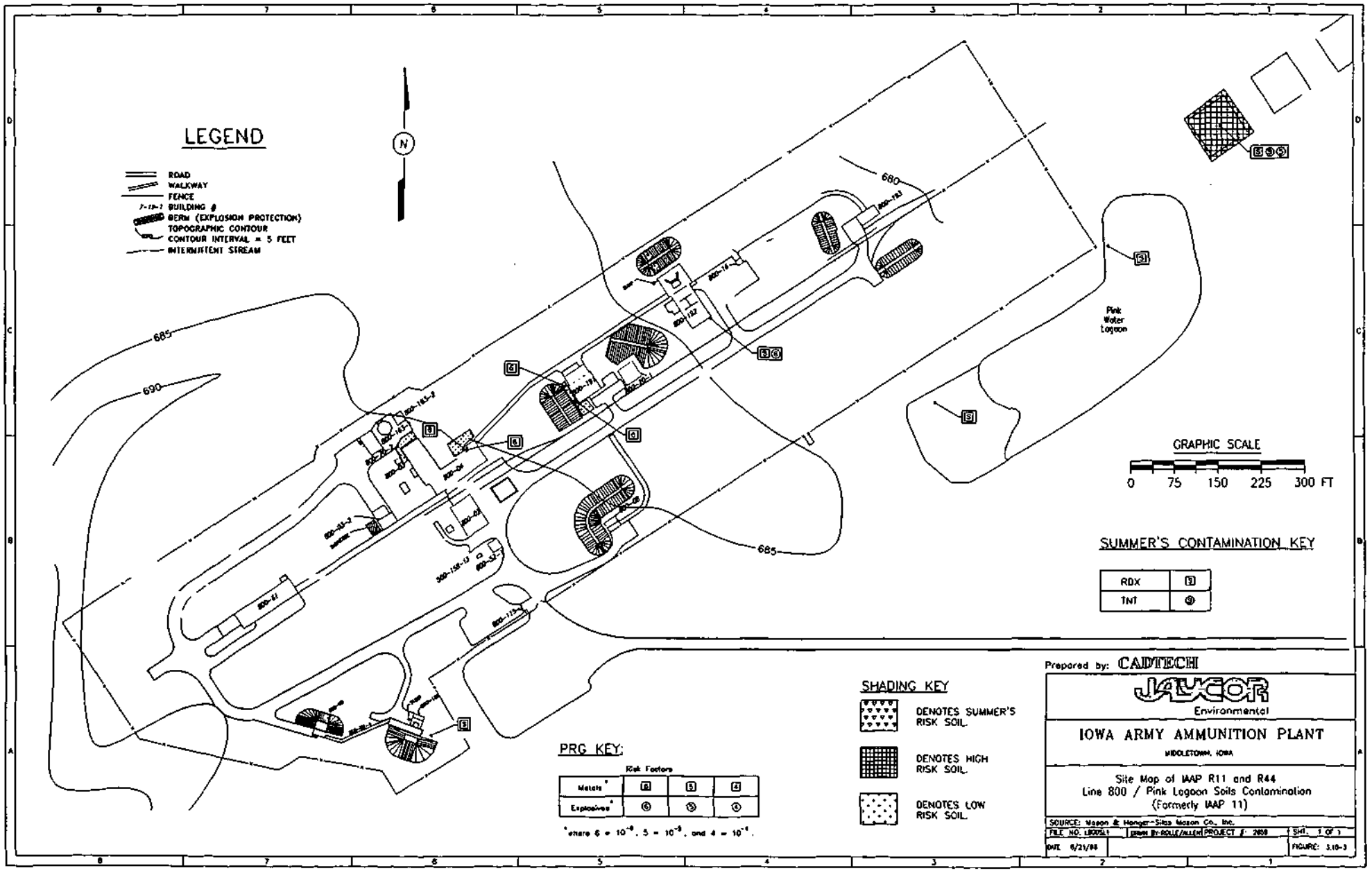
Source: Remedial Action Work Plan Addendum for Soil Excavation - Phase 4 Soil Sites - Draft Final - 20 May 2004



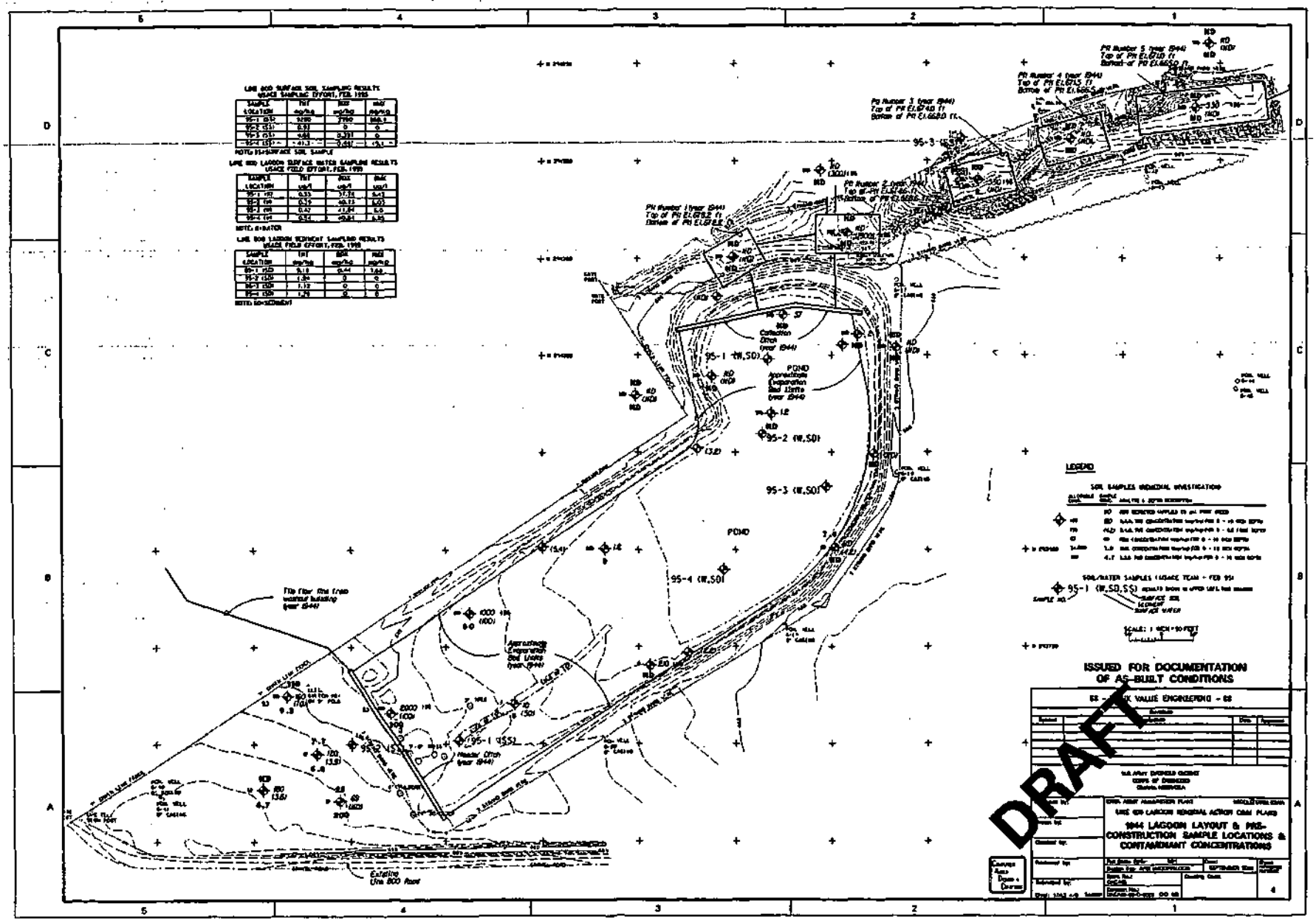
Source: Remedial Action Work Plan Addendum for Soil Excavation - Phase 4 Soil Sites - Draft Final - 20 May 2004



Source: Remedial Action Work Plan Addendum for Soil Excavation - Phase 4 Soil Sites - Draft Final - 20 May 2004

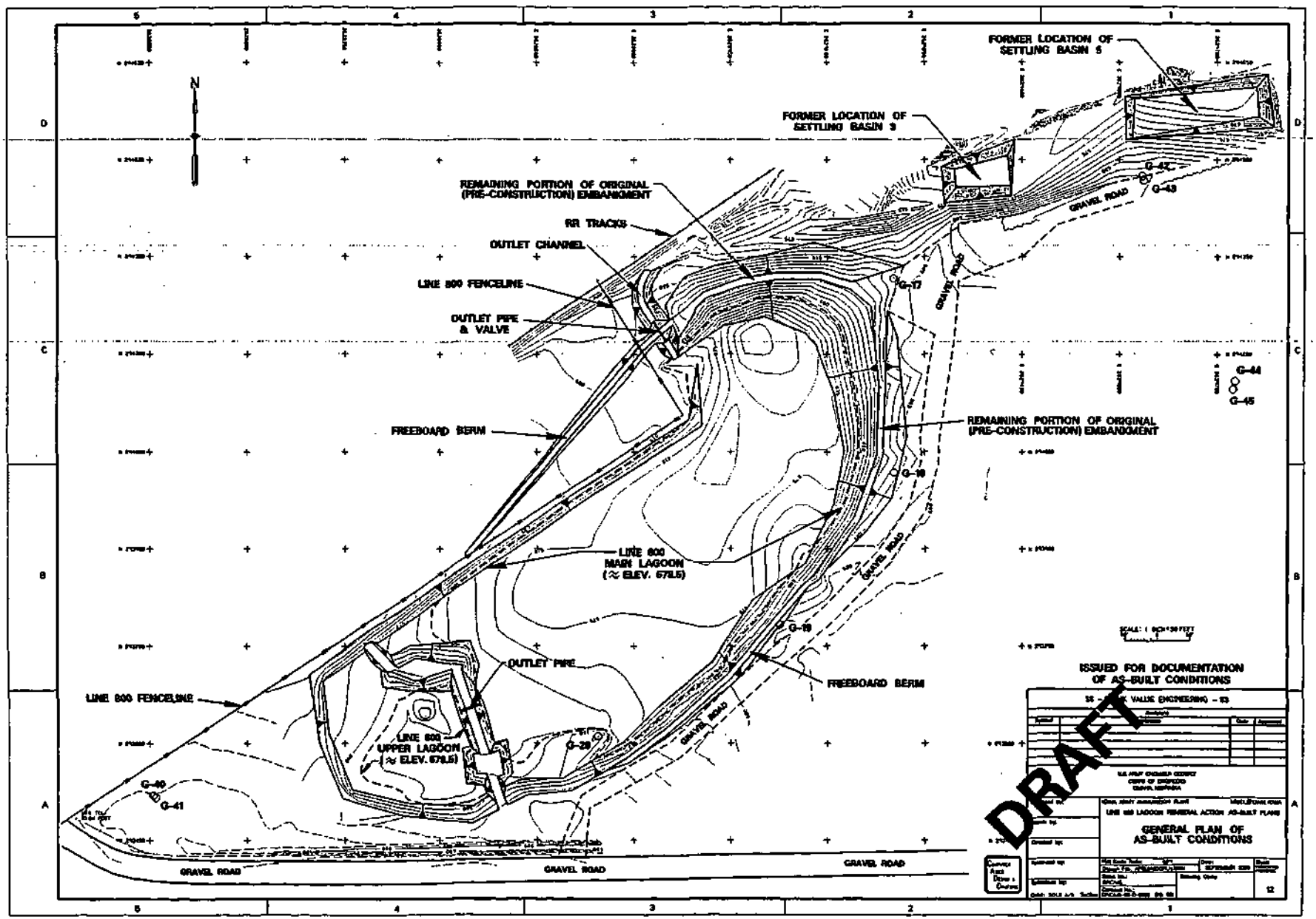


Source: Soils Focused Feasibility Study - Draft Final - 08 May 1997



ia03gprv.m gfoxbjl@GEONT14 on Wednesday June 19 2002 at 01:18:35 PM CDT

Source: Operations and Maintenance Manual - Line 800 Pinkwater Lagoon - September 2002



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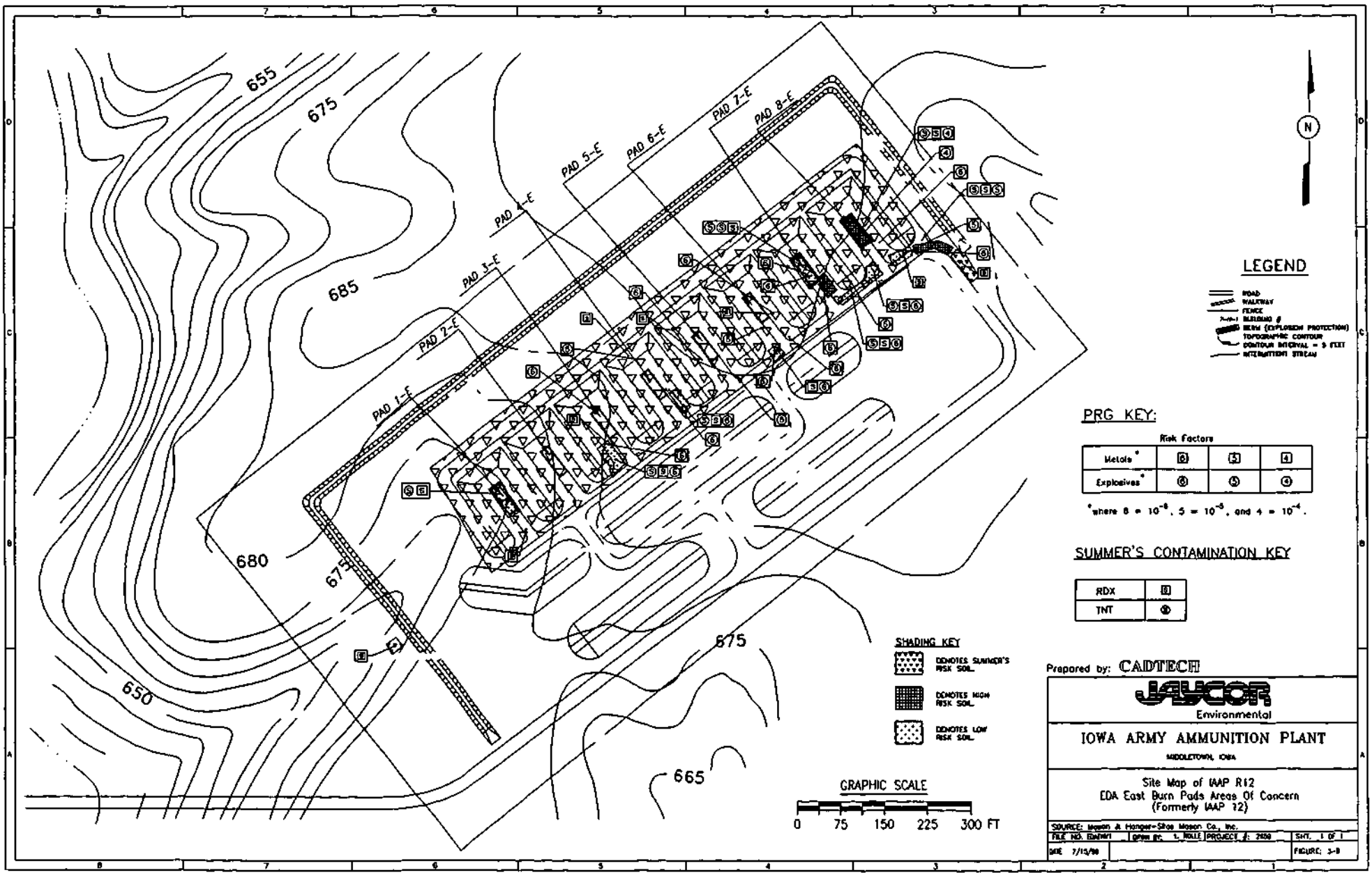
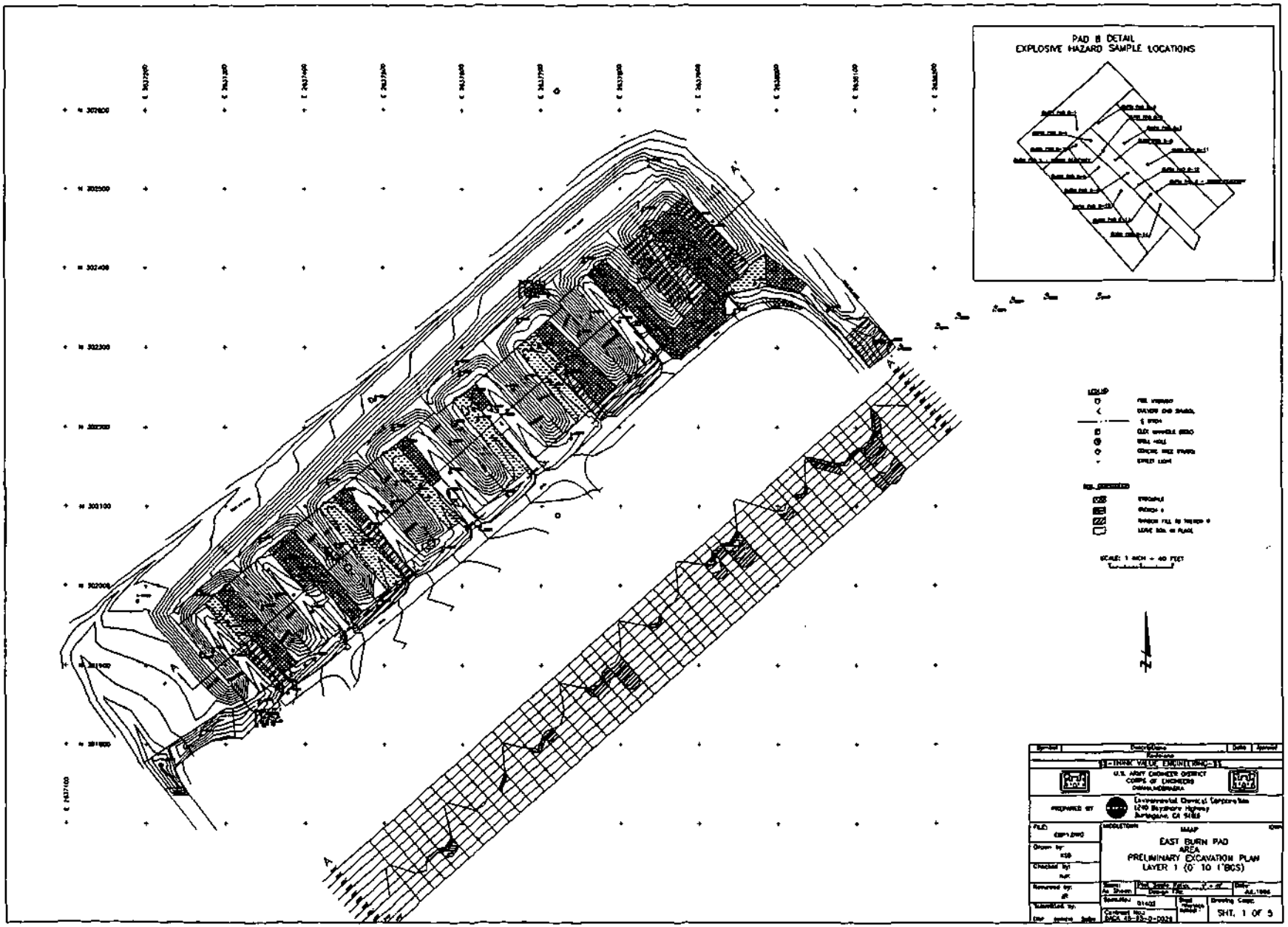
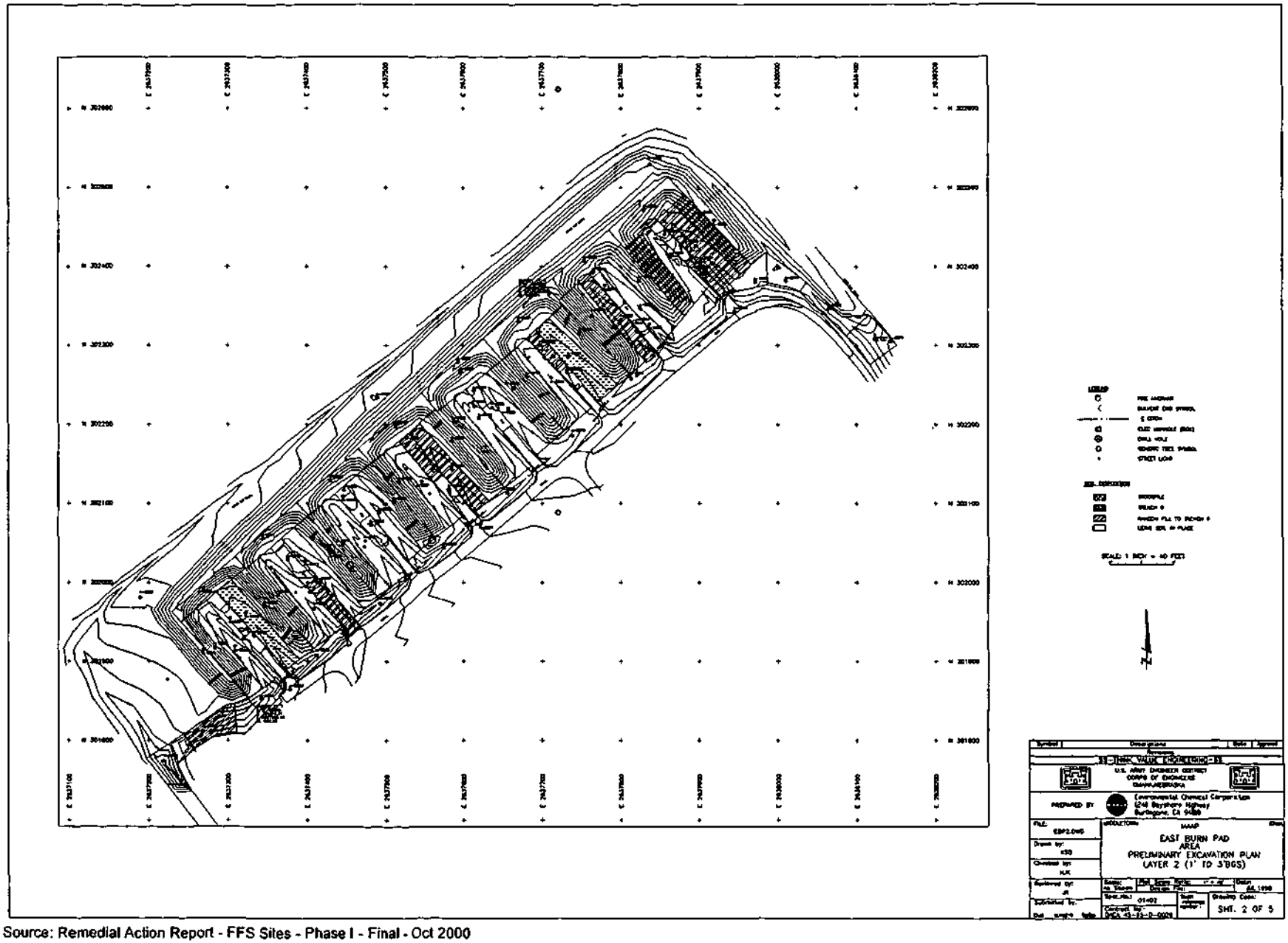
Source: Operations and Maintenance Manual - Line 800 Pinkwater Lagoon - September 2002



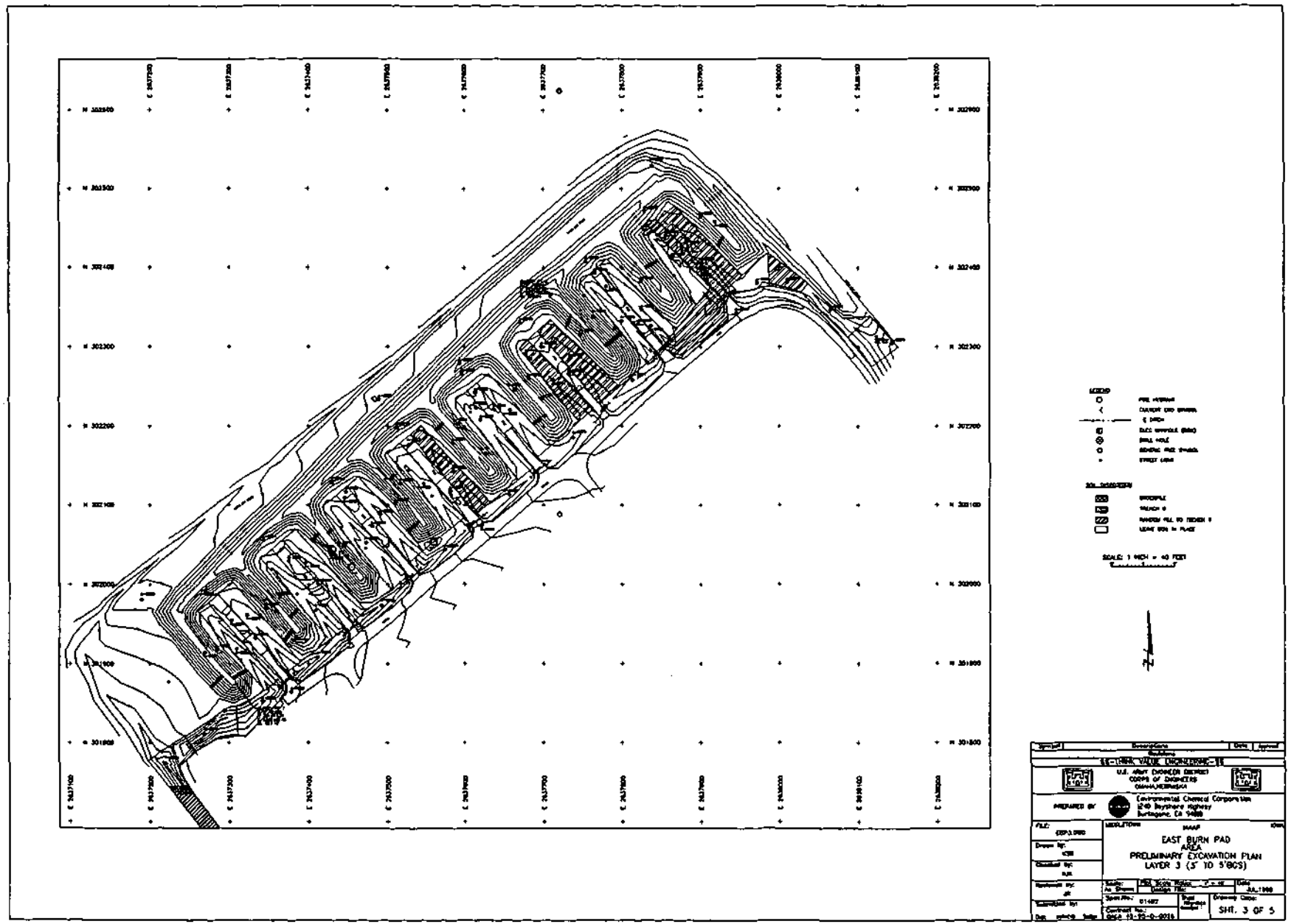
Source: Soils Focused Feasibility Study - Draft Final - 08 May 1997



Source: Remedial Action Report - FFS Sites - Phase I - Final - Oct 2000



Source: Remedial Action Report - FFS Sites - Phase I - Final - Oct 2000



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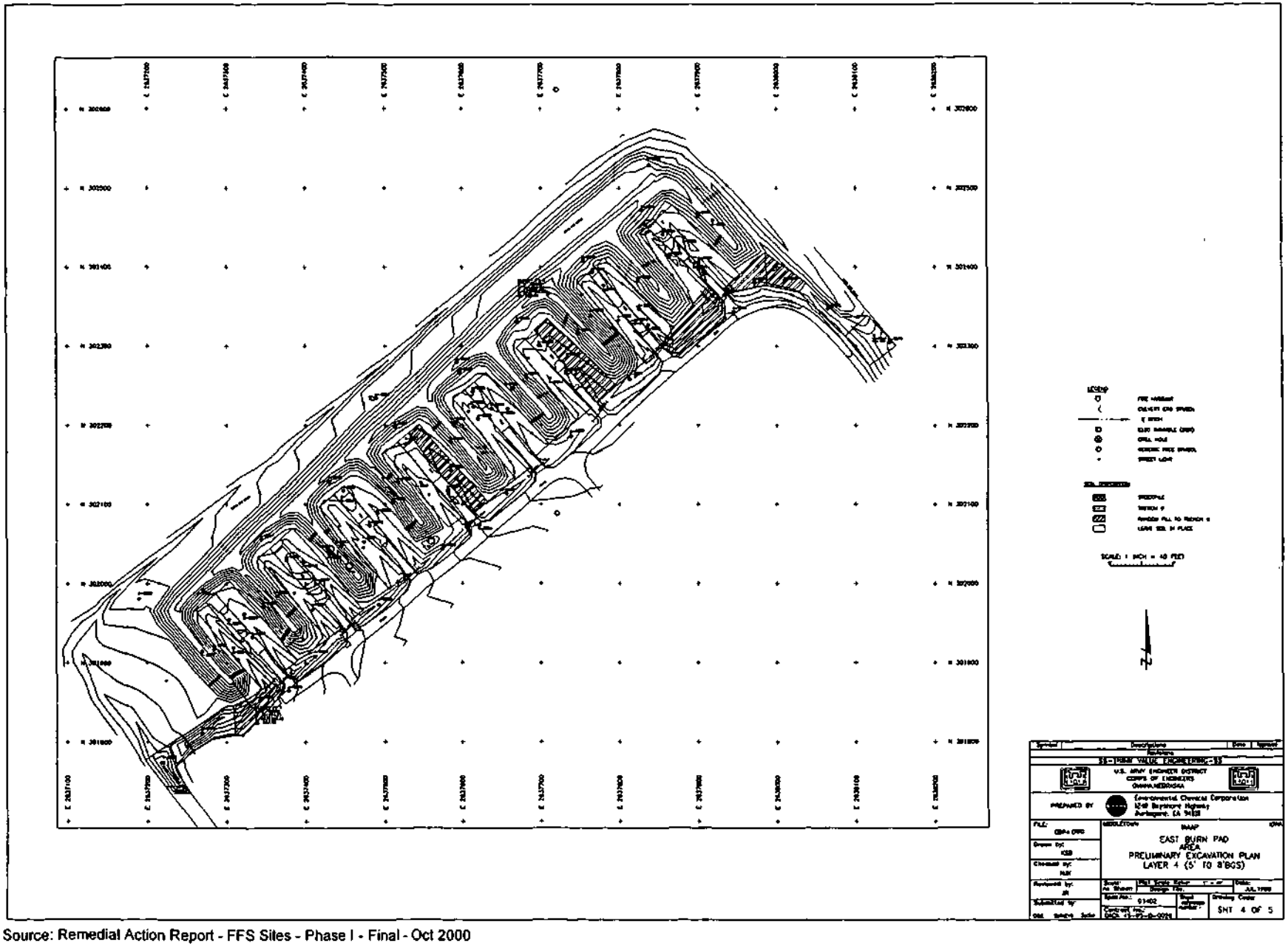

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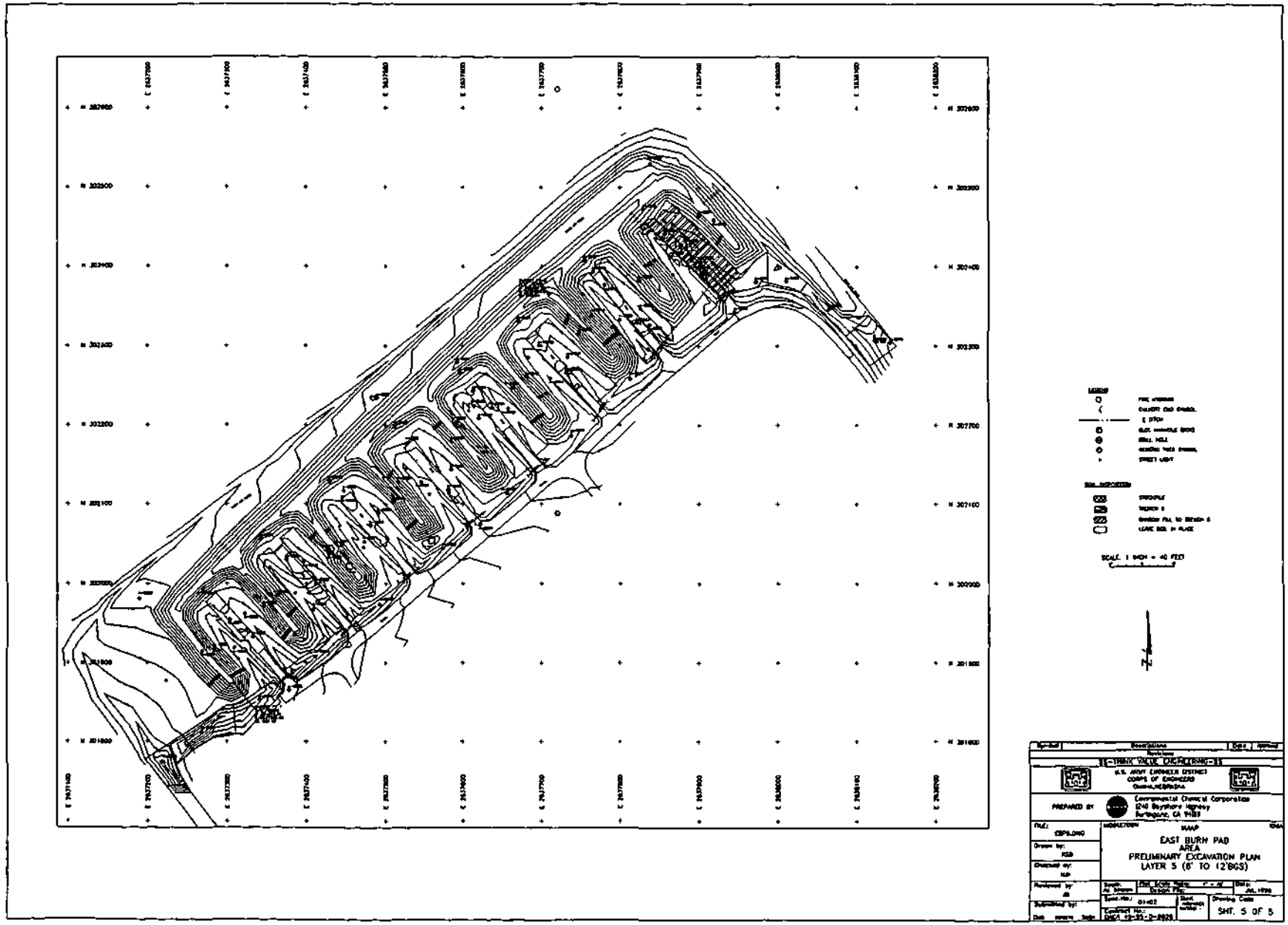
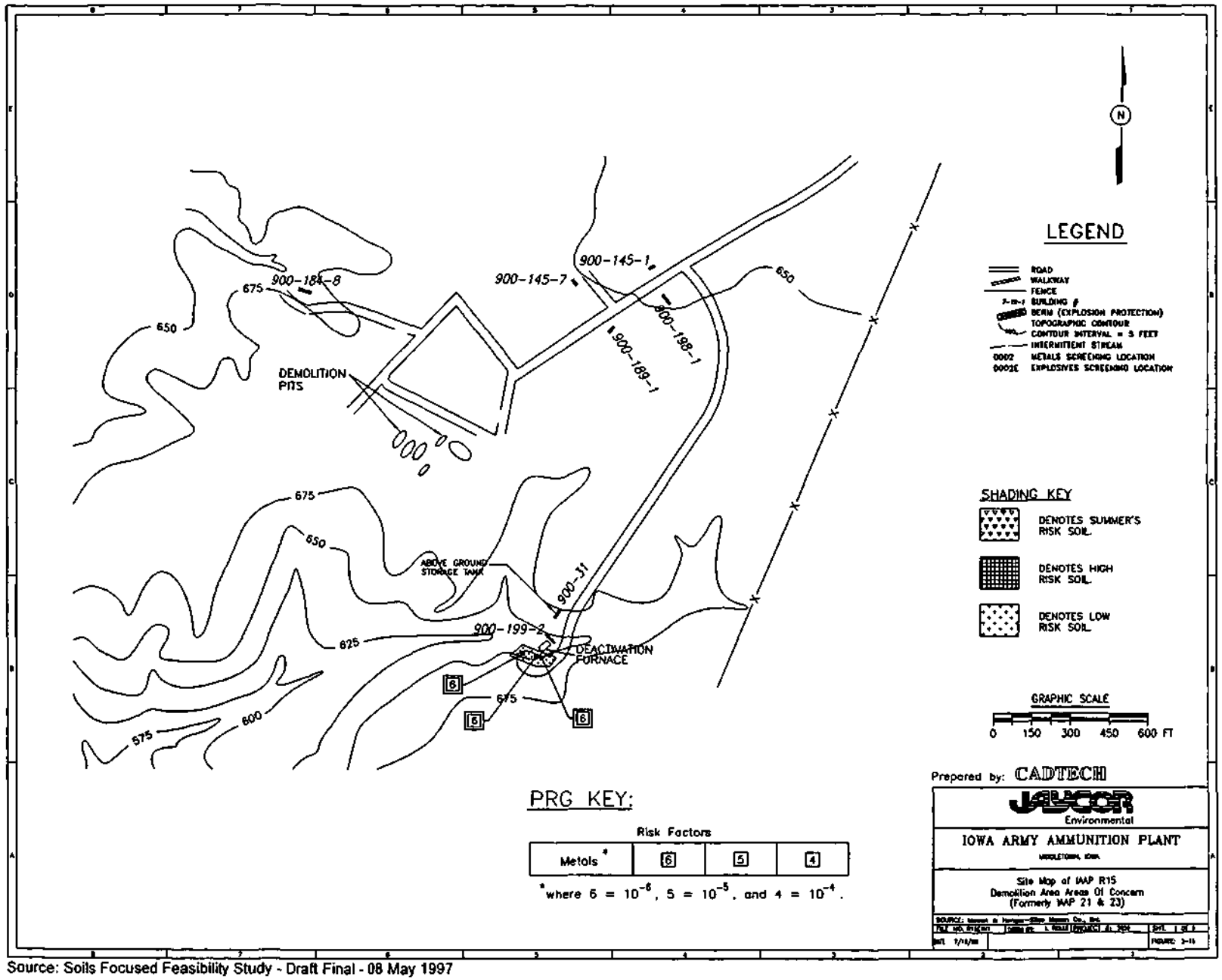
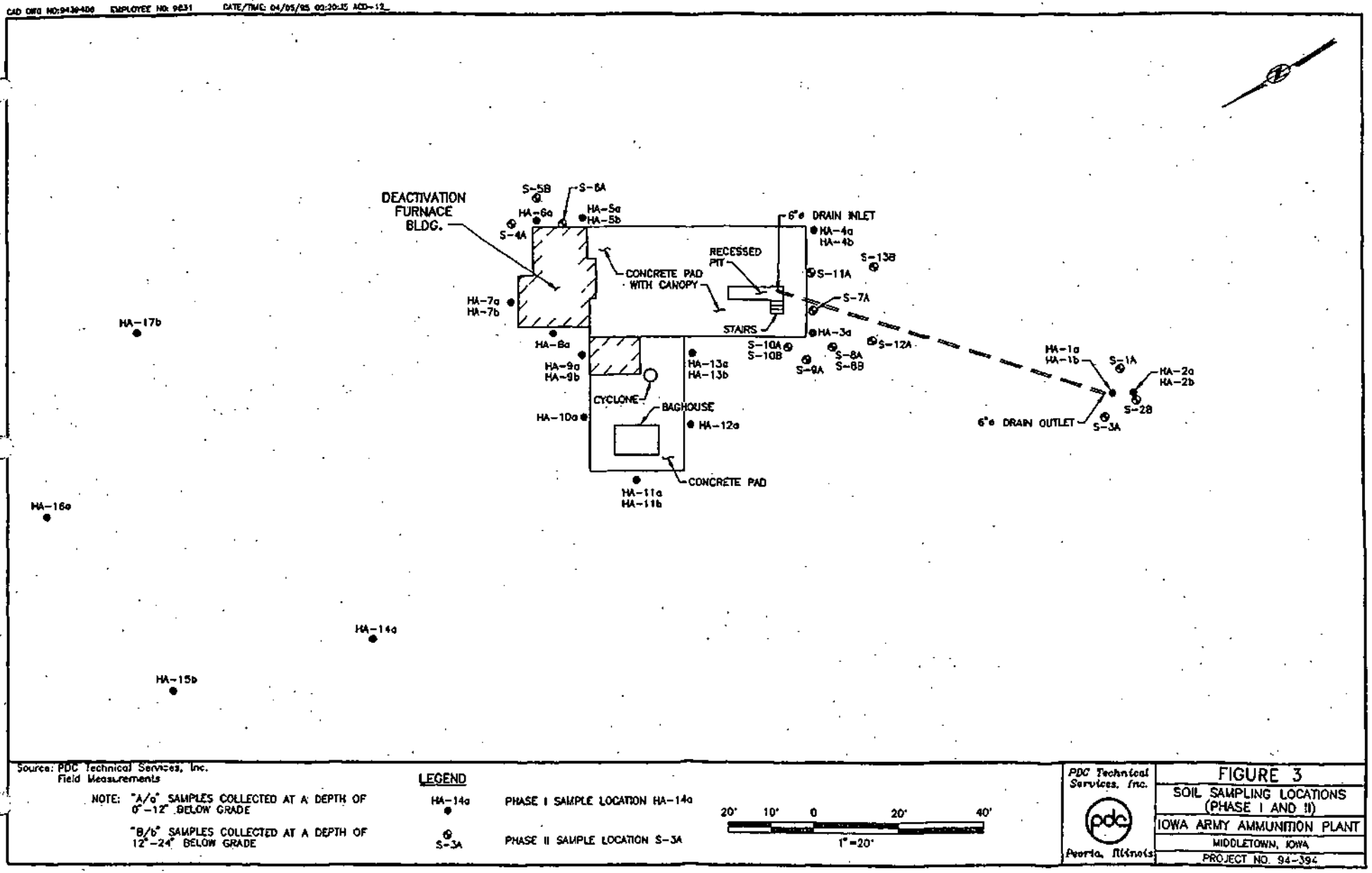


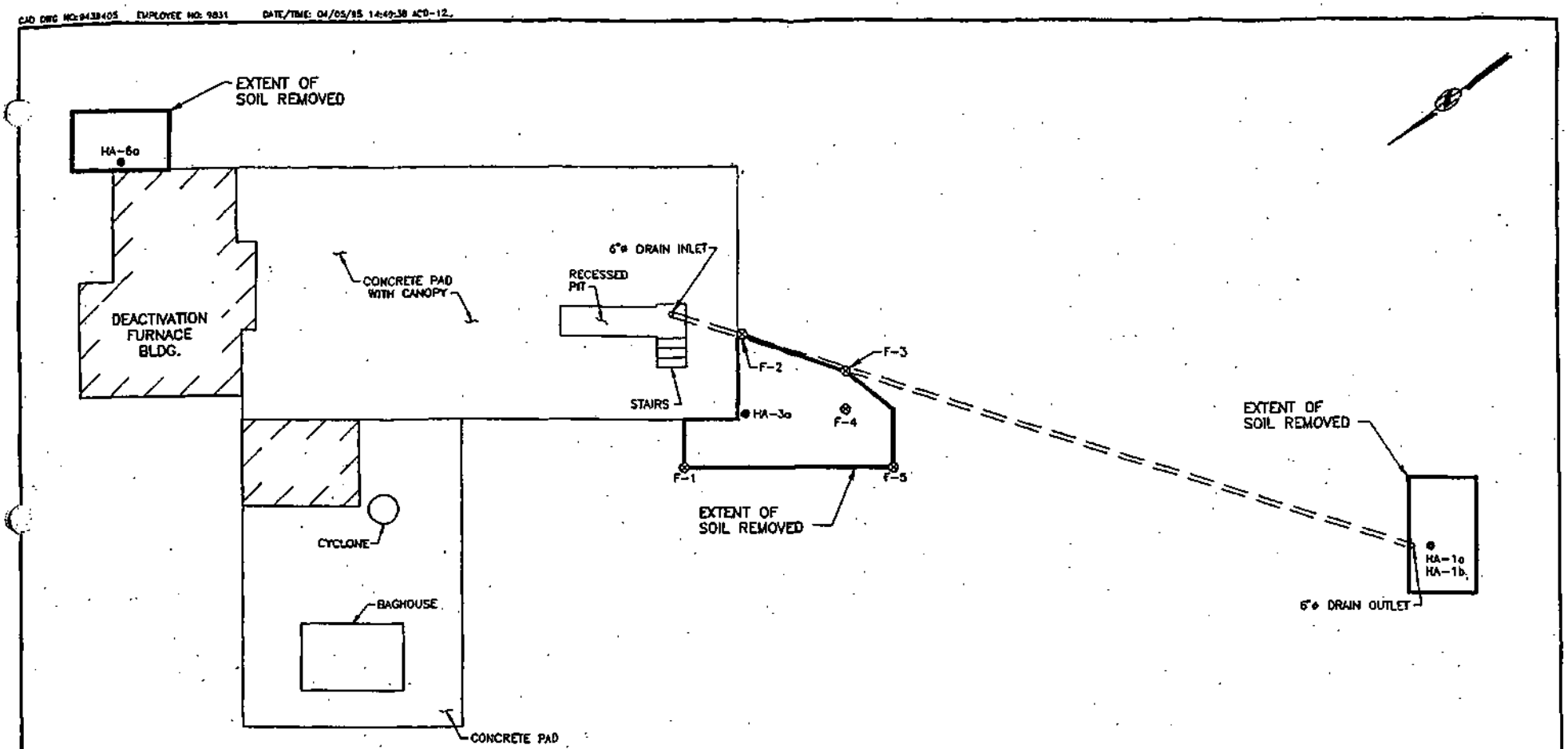
Source: Remedial Action Report - FFS Sites - Phase I - Final - Oct 2000



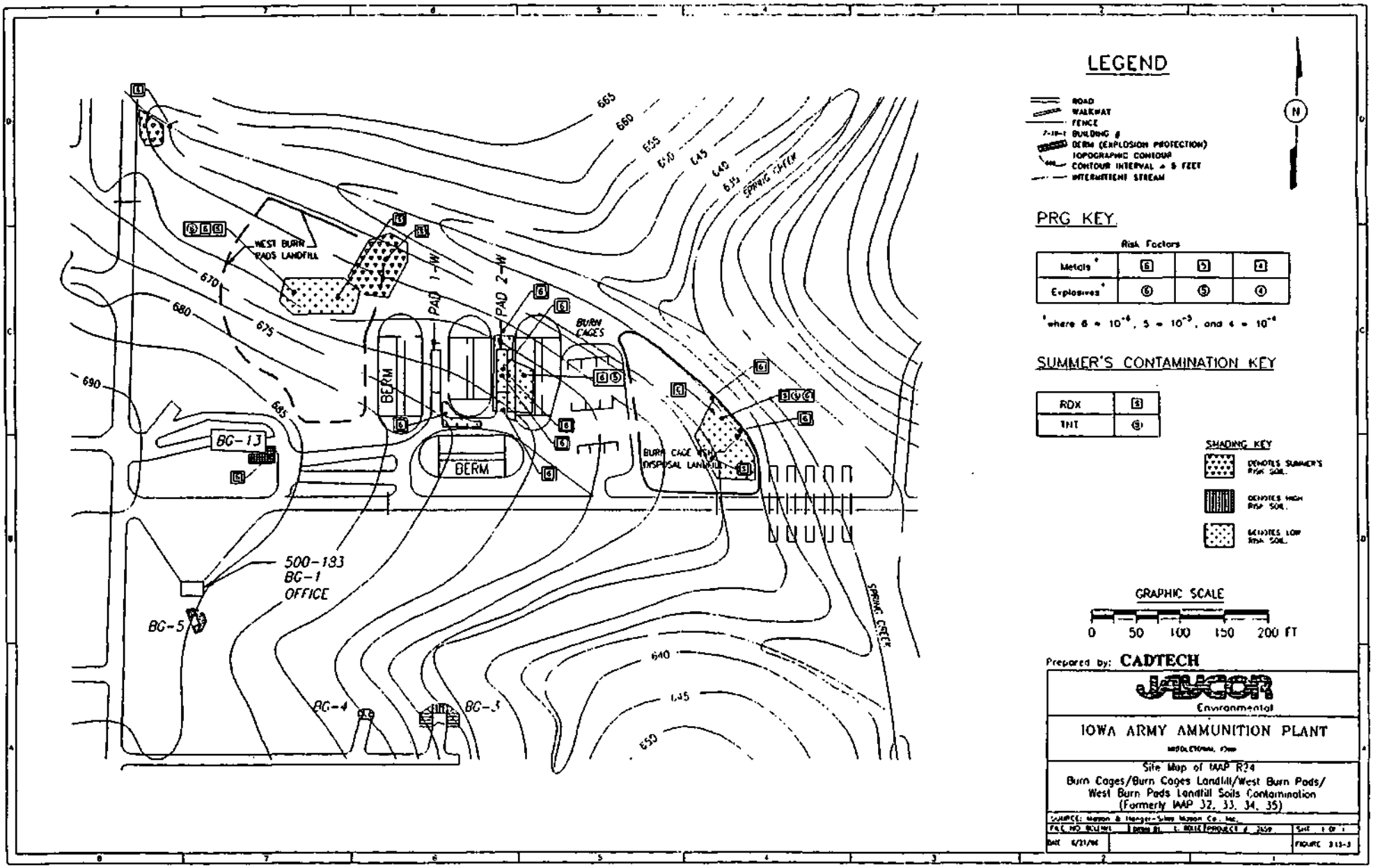
Source: Soils Focused Feasibility Study - Draft Final - 08 May 1997



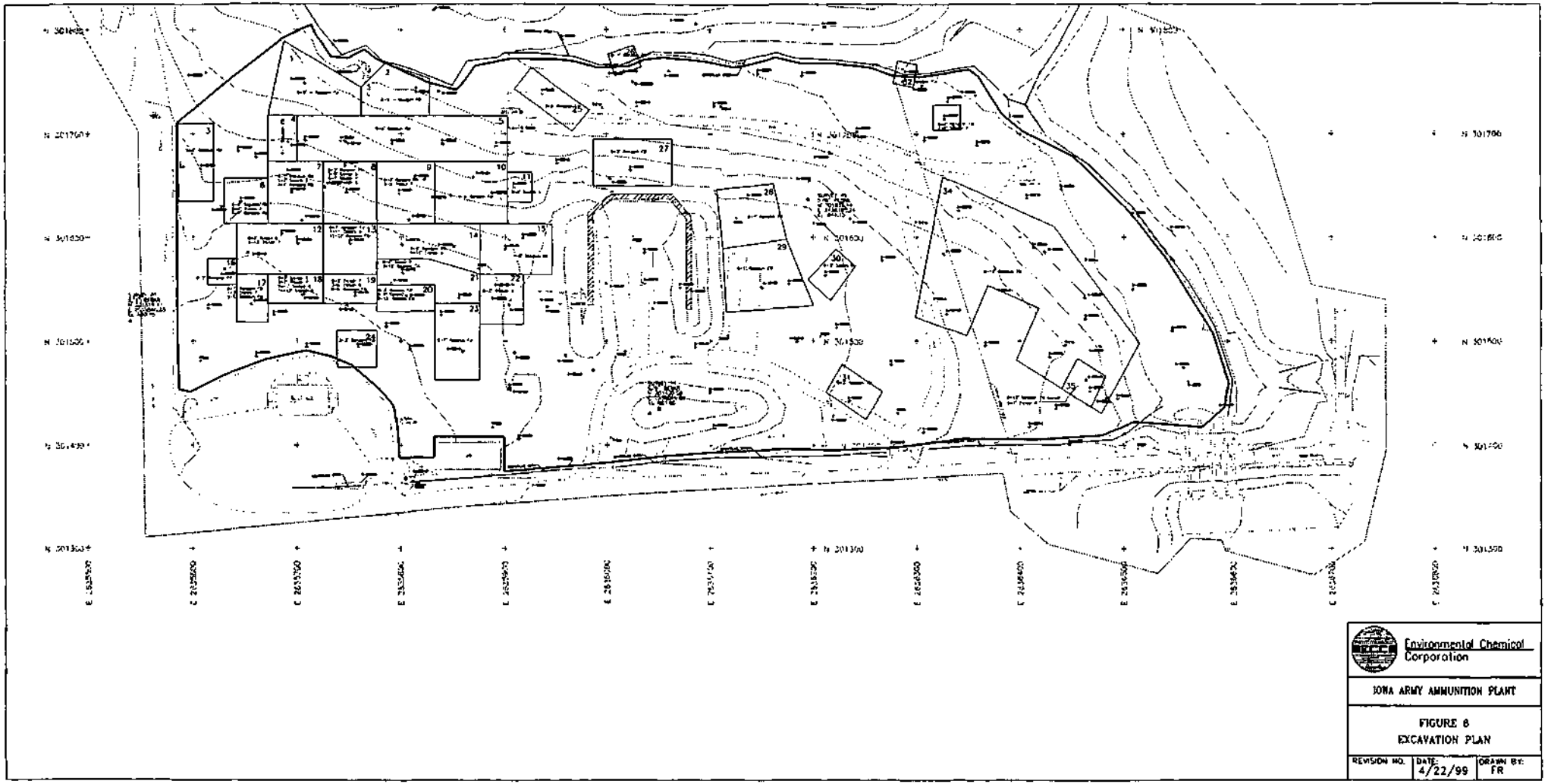
Source: RCRA Closure Report - Deactivation Furnace - 1995



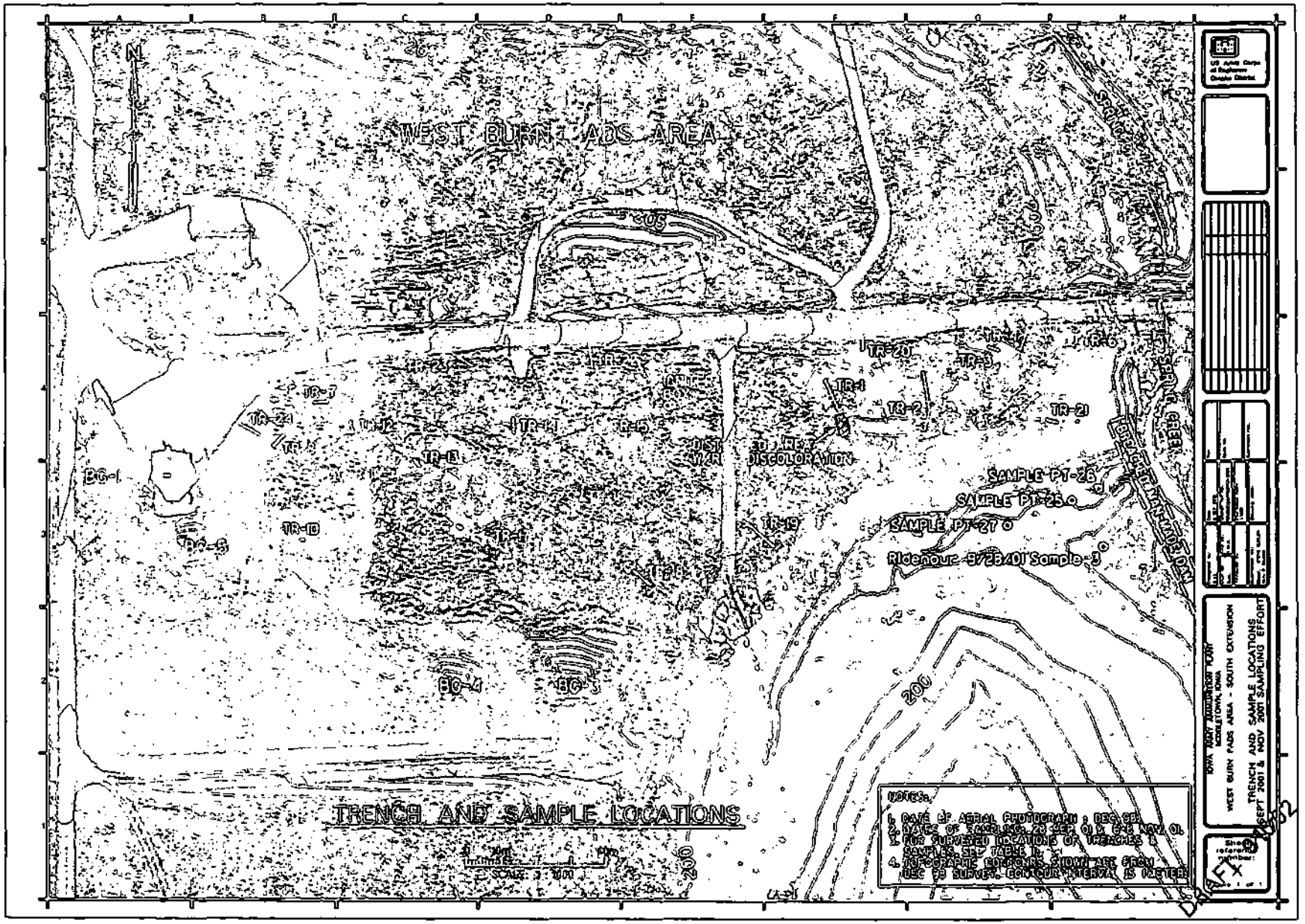
Source: RCRA Closure Report - Deactivation Furnace - 1995



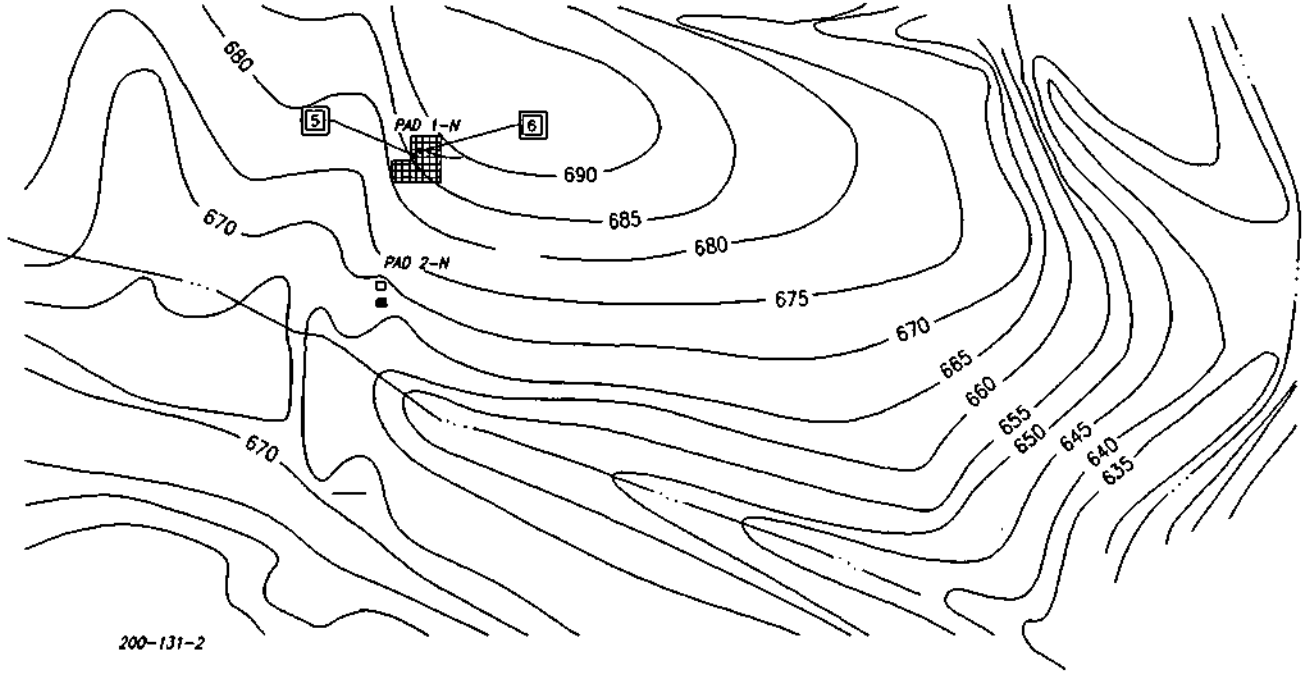
Source: Soils Focused Feasibility Study - Draft Final - 08 May 1997



Source: Excavation Report - FFS Sites - Phase 3 - Remedial Action - West Burn Pads Area - Final - Nov 2001



Source: West Burn Pads Area - South Extension - Investigation Report - Draft- Sep 2002



LEGEND

- ROAD
- WALKWAY
- FENCE
- 7-IN-1 BUILDING #
- BERM (EXPLOSION PROTECTION)
- TOPOGRAPHIC CONTOUR
- CONTOUR INTERVAL = 5 FEET
- INTERMITTENT STREAM

N

SHADING KEY

- DENOTES SUMMER'S RISK SOIL.
- DENOTES HIGH RISK SOIL.
- DENOTES LOW RISK SOIL.

GRAPHIC SCALE

0 38 75 113 150 FT

PRG KEY:

Risk Factors

Metals *	6	5	4

*where 6 = 10^{-6}, 5 = 10^{-5}, and 4 = 10^{-4}.

Prepared by: CADTECH

JACOBS Environmental

IOWA ARMY AMMUNITION PLANT

MIDDLETOWN, IOWA

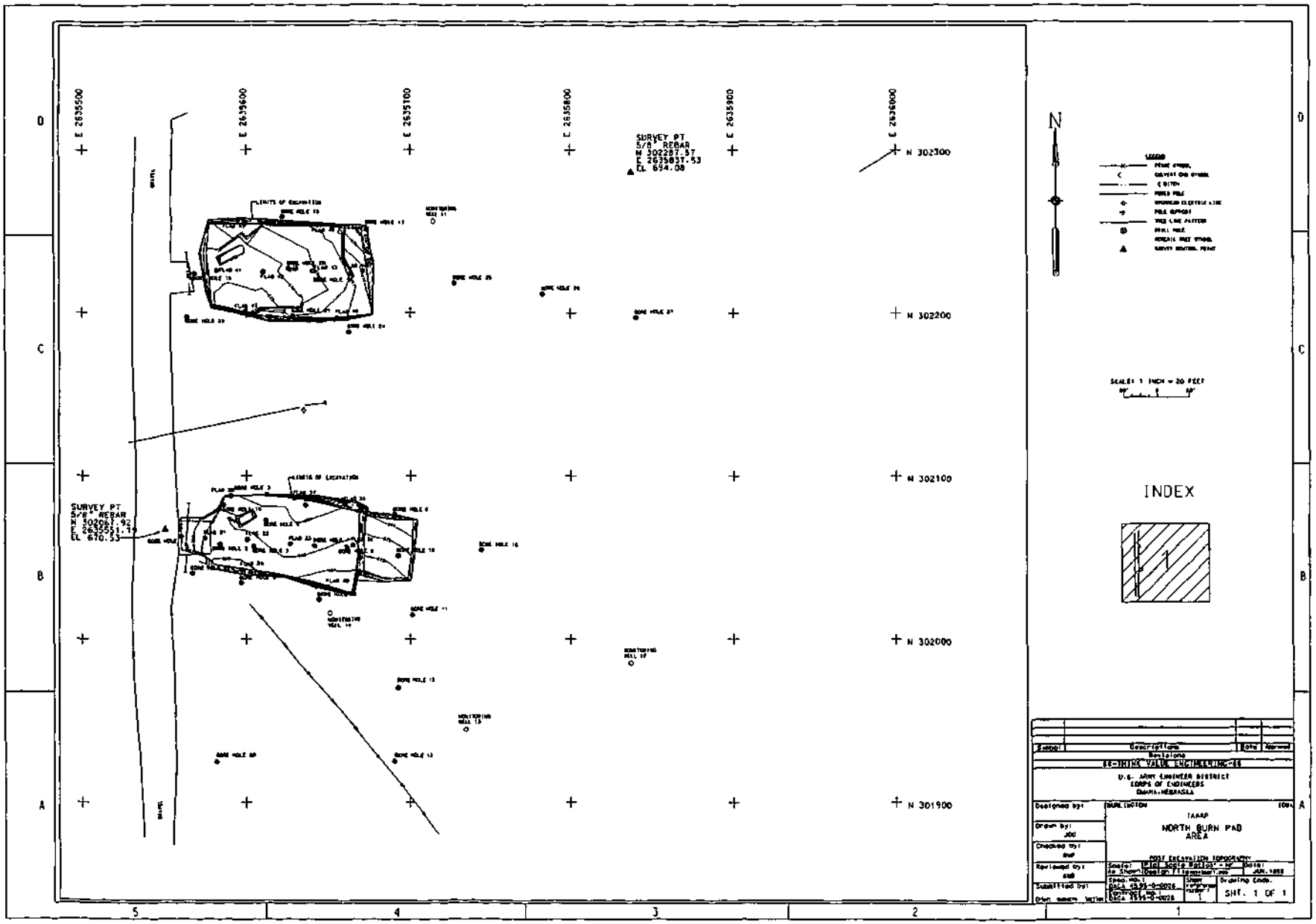
Site Map of IAAP R25
North Burn Pads Areas Of Concern
(Formerly IAAP 36)

SOURCE: Mason & Hanger-Silas Mason Co., Inc.

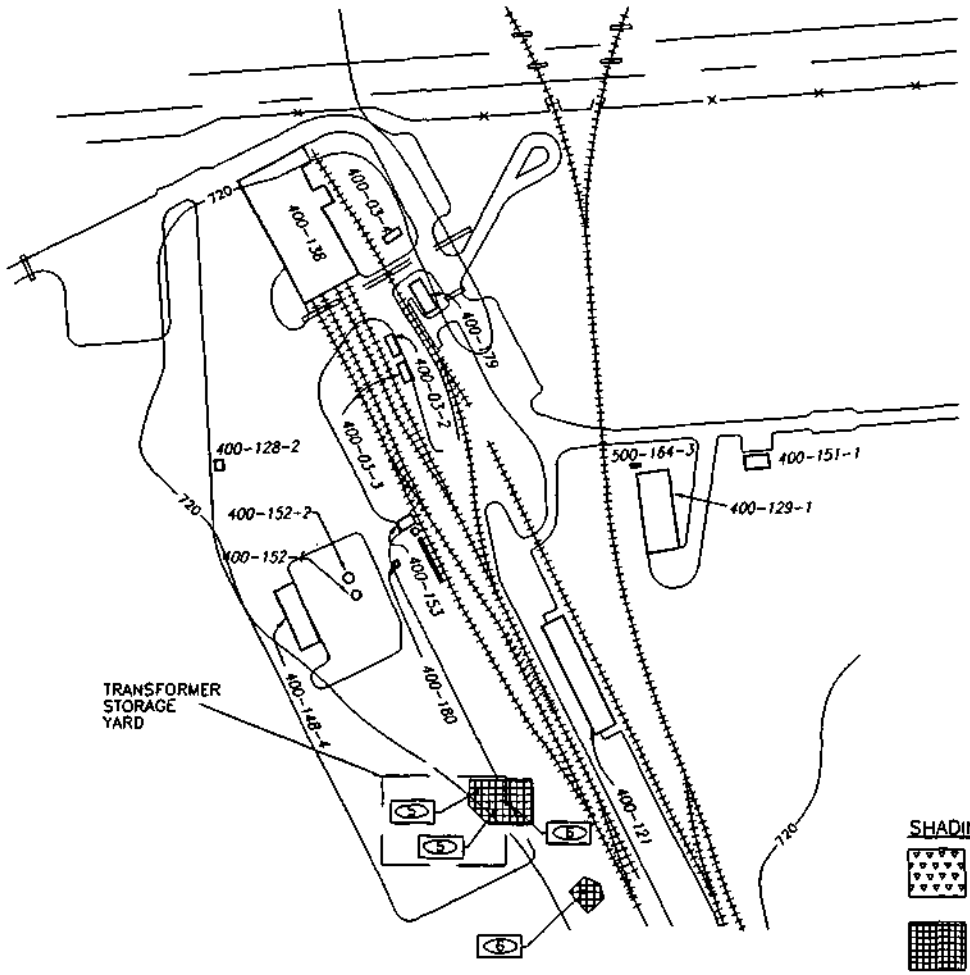
FILE NO. 40PERM1 | DRWN BY: D. ALLEN | PROJECT #: 7659 | SHT. 1 OF 1

DATE 7/17/98 | FIGURE: 3-12a

Source: Soils Focused Feasibility Study - Draft Final - 08 May 1997



Source: Remedial Action Report - FFS Sites - Phase I - Final - Oct 2000



N

LEGEND

ROAD
WALKWAY
FENCE
BUILDING #
BERM (EXPLOSION PROTECTION)
TOPOGRAPHIC CONTOUR
CONTOUR INTERVAL = 5 FEET
INTERMITTENT STREAM

PRG KEY:

Risk Factors

Pest/PCBs*	6	5	4

*where 6 = 10^{-6}, 5 = 10^{-5}, and 4 = 10^{-4}.

GRAPHIC SCALE

0 50 100 150 200 FT

SHADING KEY

DENOTES SUMMER'S RISK SOIL.

DENOTES HIGH RISK SOIL.

DENOTES LOW RISK SOIL.

Prepared by: CADTECH

Jacobs Environmental

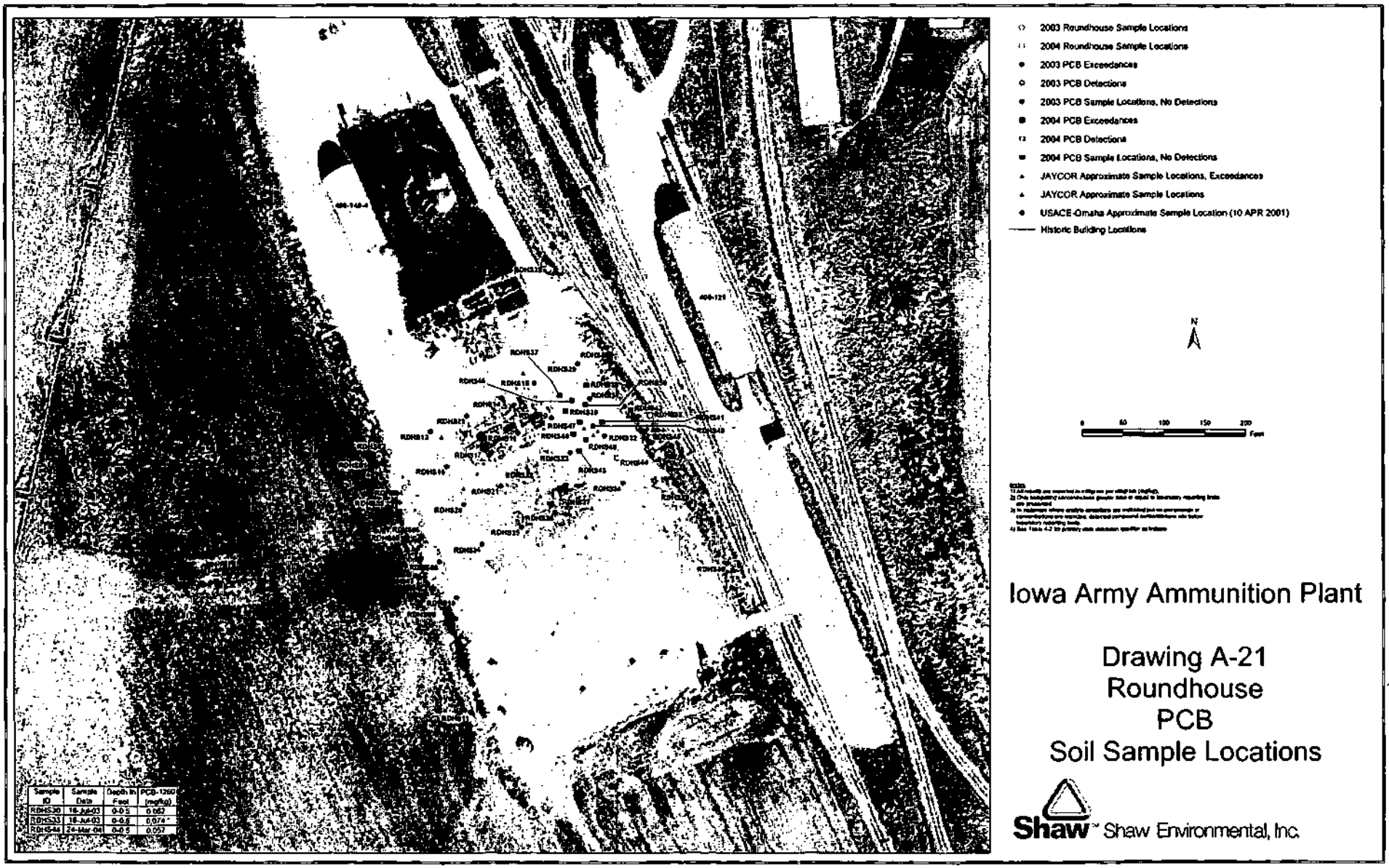
IOWA ARMY AMMUNITION PLANT

MIDDLETOWN, IOWA

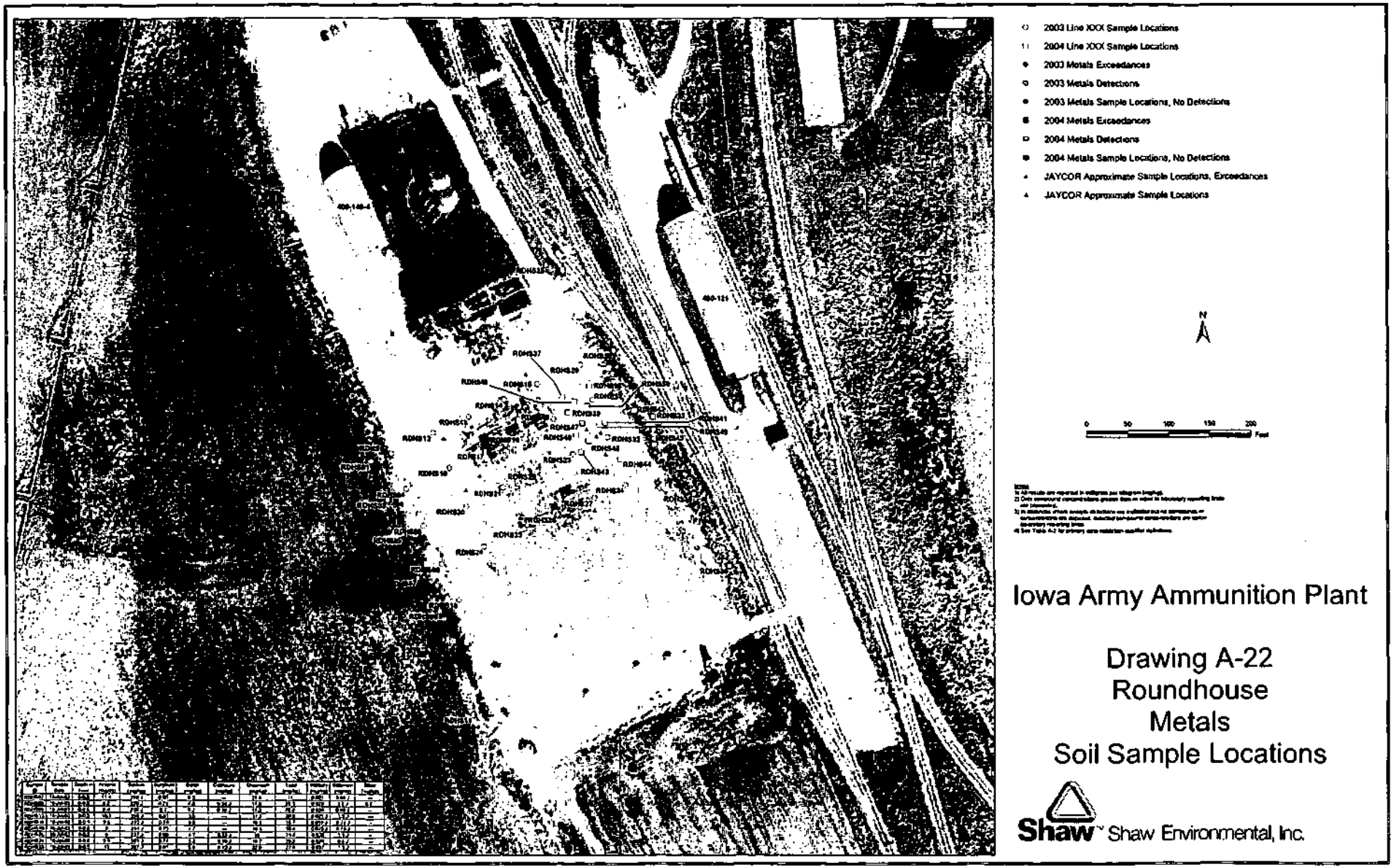
Site Map of IAAP R28
Roundhouse Transformer Storage Area
Soils Contamination (Formerly IAAP 40)

SOURCE: Mason & Hanger-Silas Mason Co., Inc.
FILE NO. R1SUM1 | Drawn By: D. ALLEN | PROJECT #: 7550 | SHT. 1 OF 1
DATE 8/21/98 | FIGURE: 3.15-3

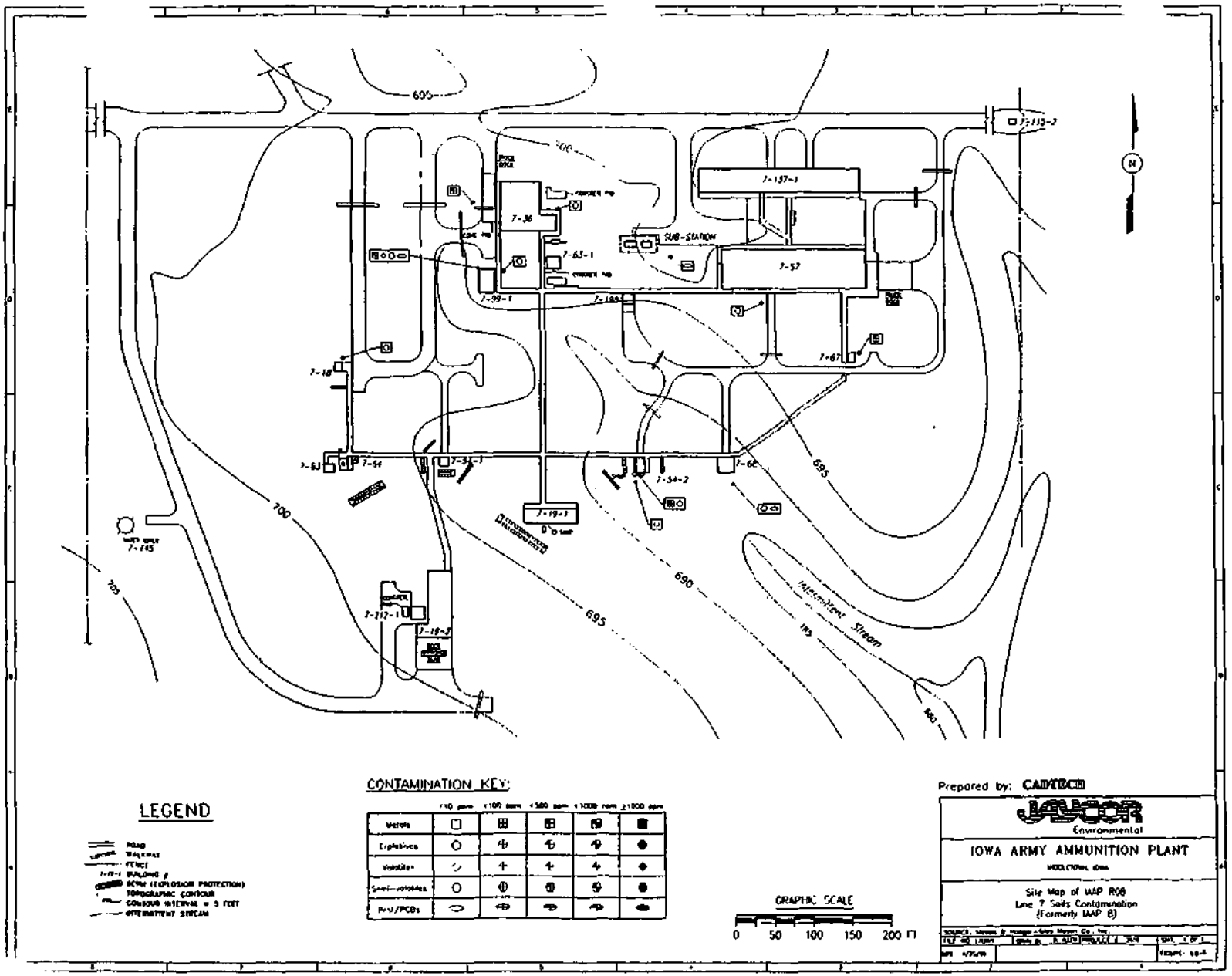
Source: Soils Focused Feasibility Study - Draft Final - 08 May 1997



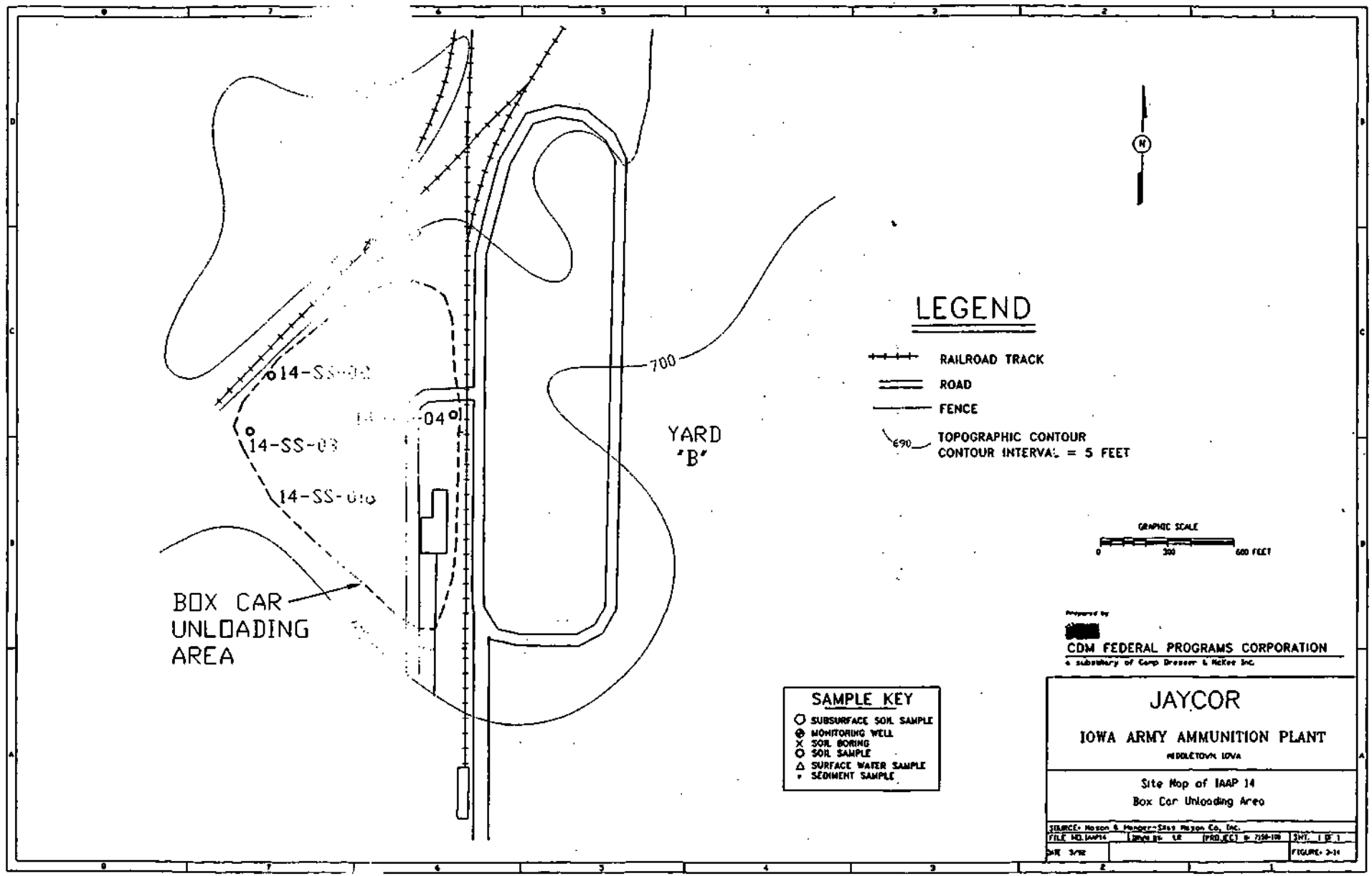
Source: Remedial Action Work Plan Addendum for Soil Excavation - Phase 4 Soil Sites - Draft Final - 20 May 2004



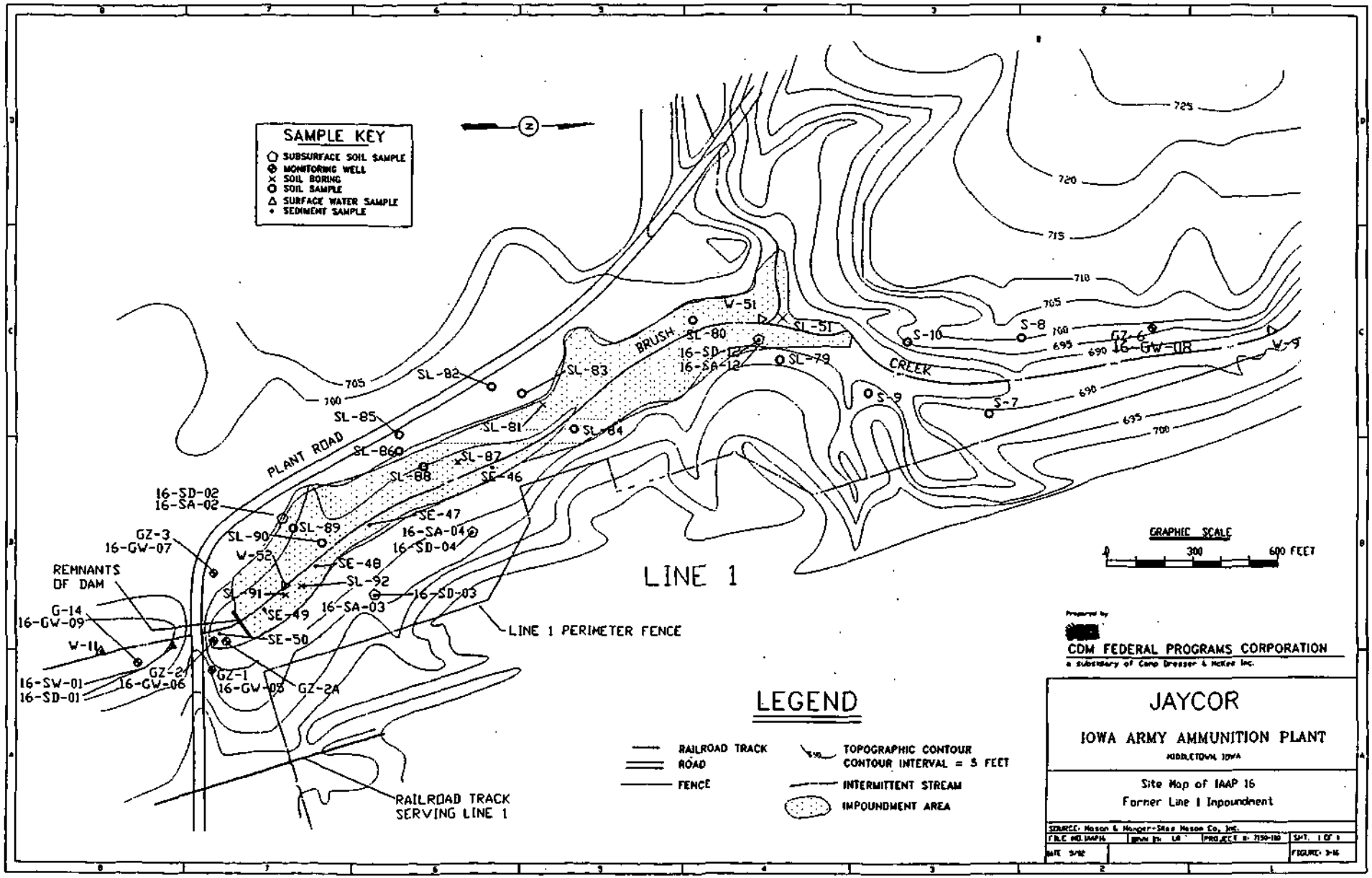
Source: Remedial Action Work Plan Addendum for Soil Excavation - Phase 4 Soil Sites - Draft Final - 20 May 2004



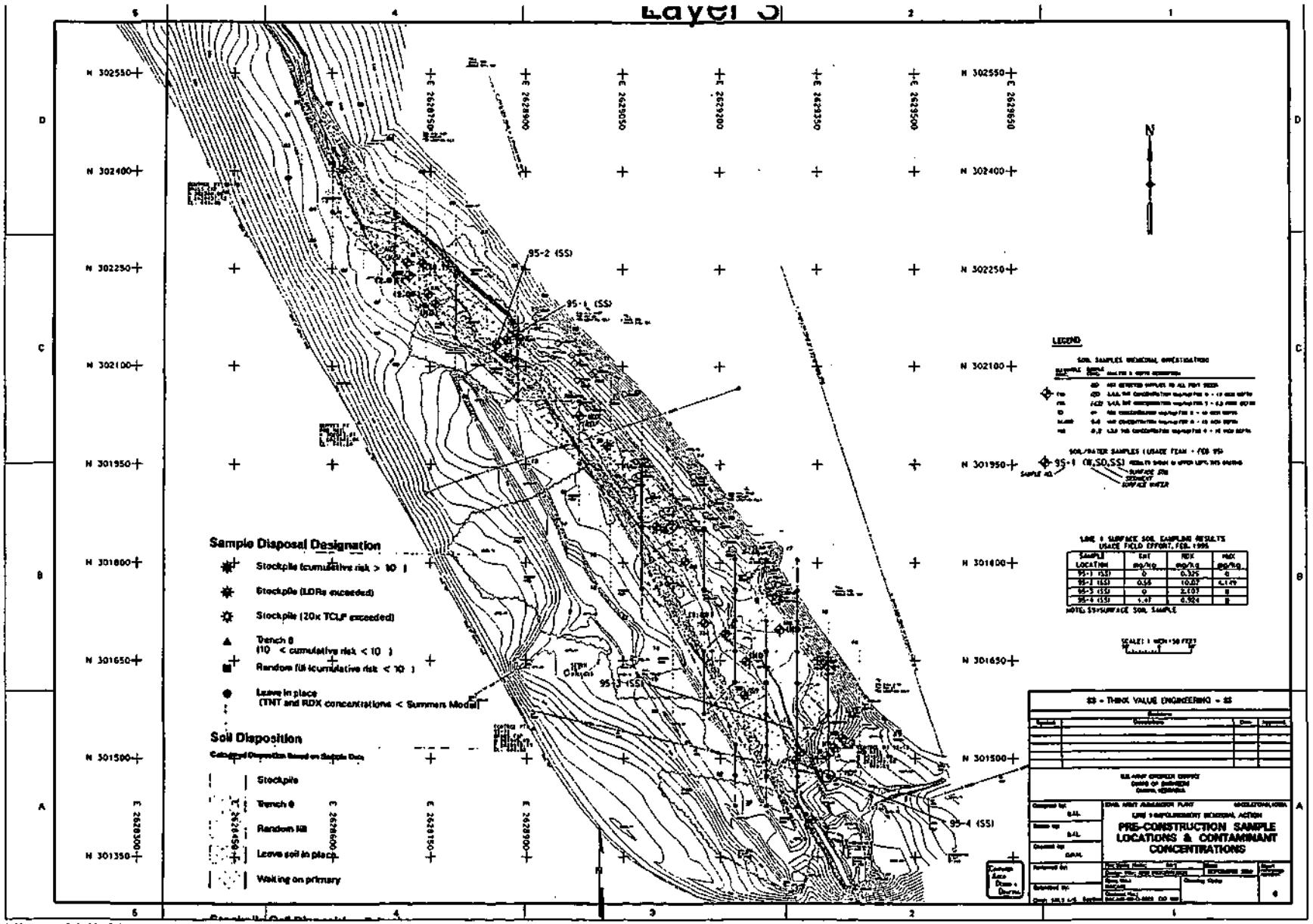
Source: Remedial Investigation/Risk Assessment - Revised Draft Final - 21 May 1996



Source: Final Work Plan - Phase 1 Remedial Investigation/Feasibility Study - June 1992 (Site Investigation)

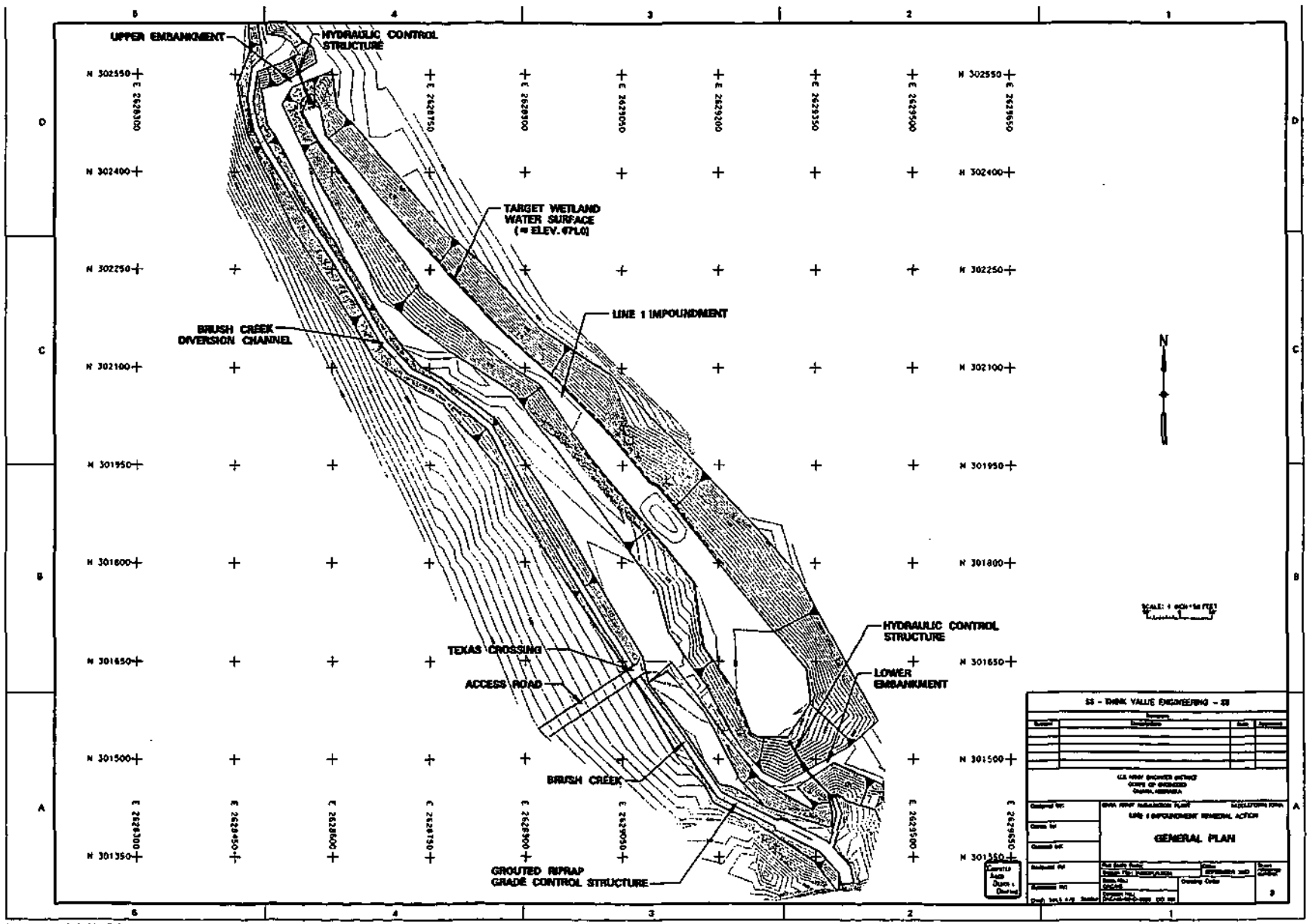


Source: Final Work Plan - Phase 1 Remedial Investigation/Feasibility Study - June 1992 (Site Investigation)



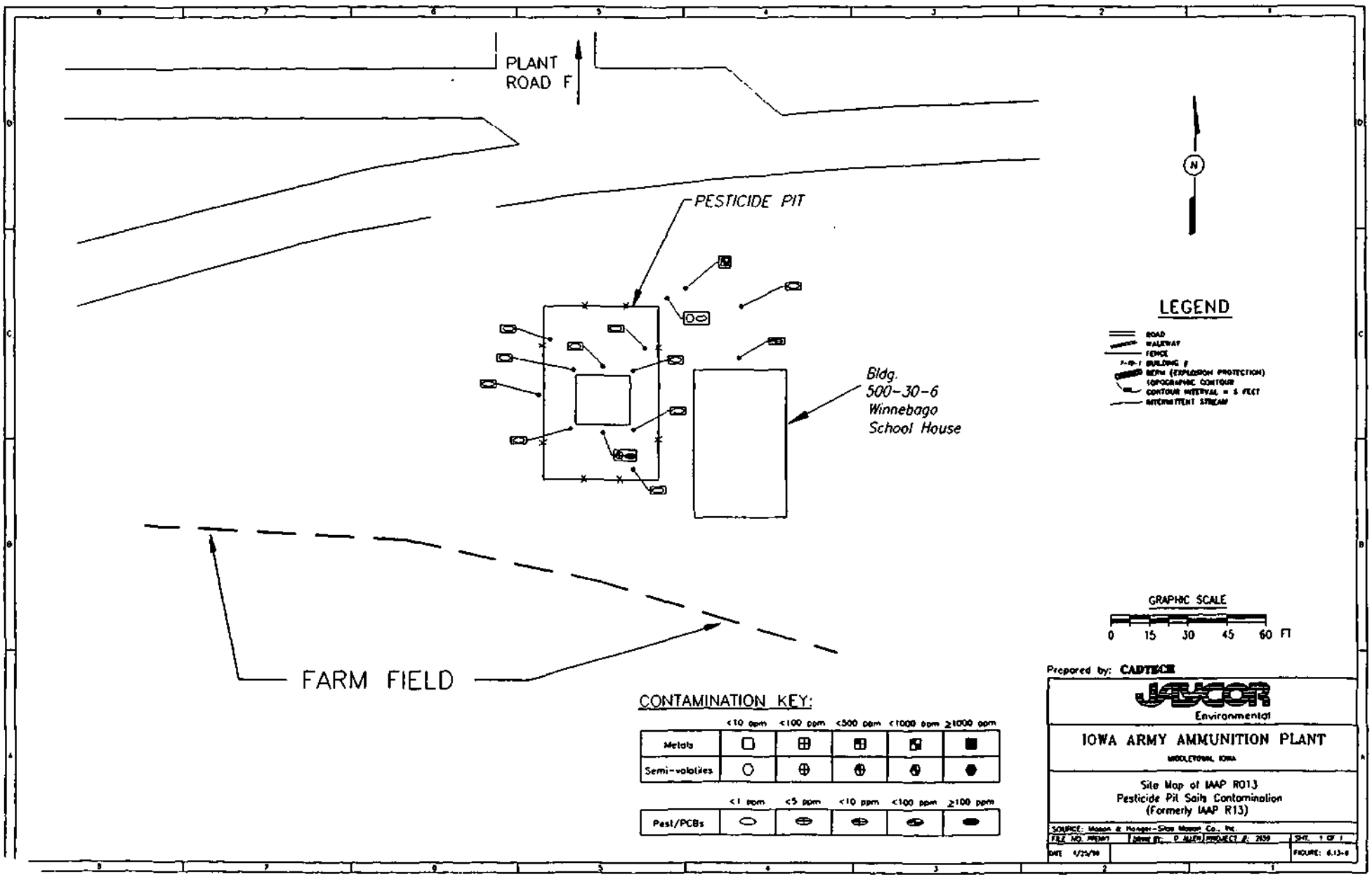
ia02gprv.co g6otbrddm@GEONB1 on Wednesday September 18 2002 at 12:19:35 PM CDT

Source: Operations and Maintenance Manual - Line 1 Impoundment - September 2002

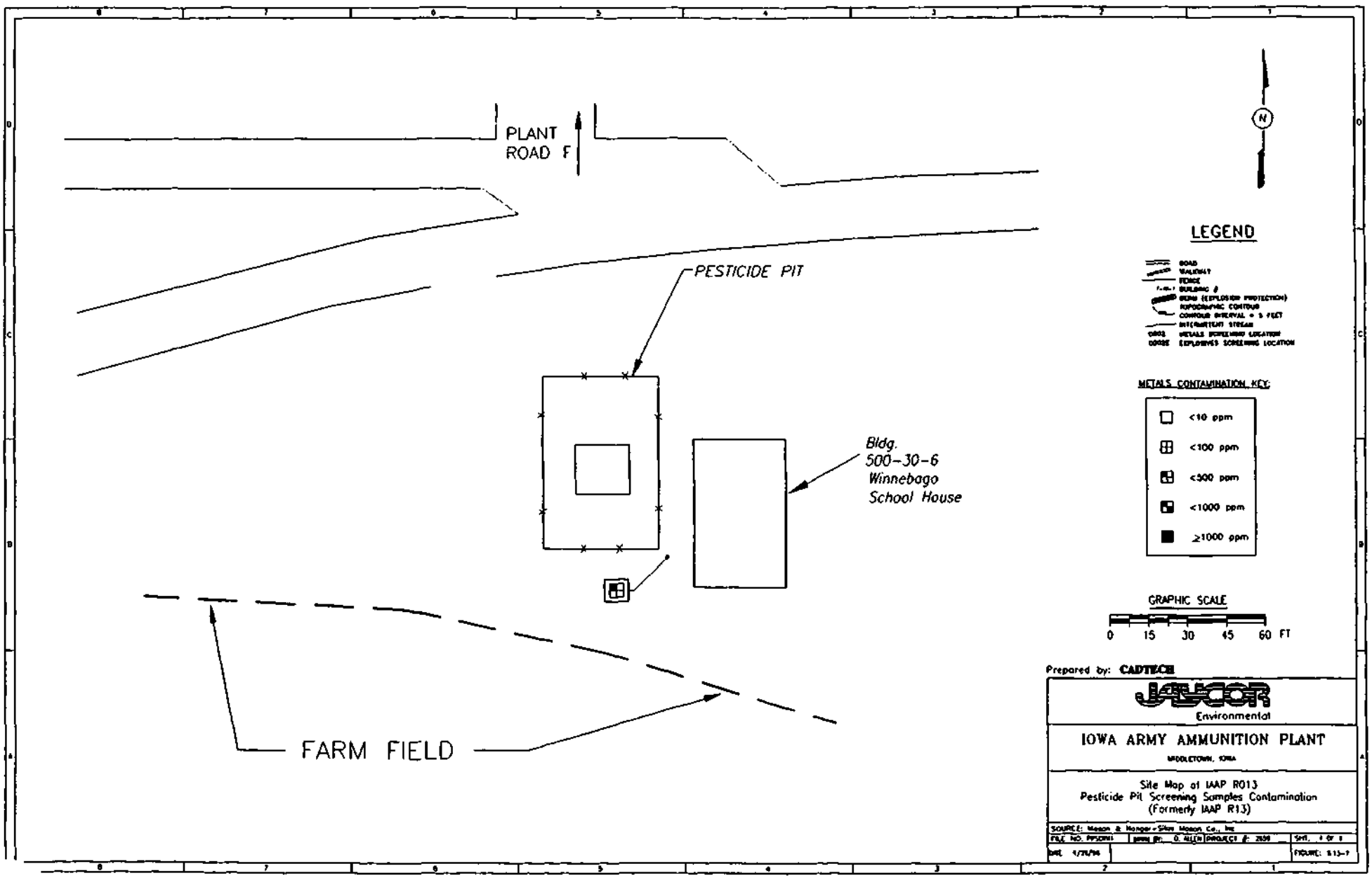


is02gpln.m g6edxddm@GEONB1 on Wednesday September 18 2002 at 12:12:32 PM CDT

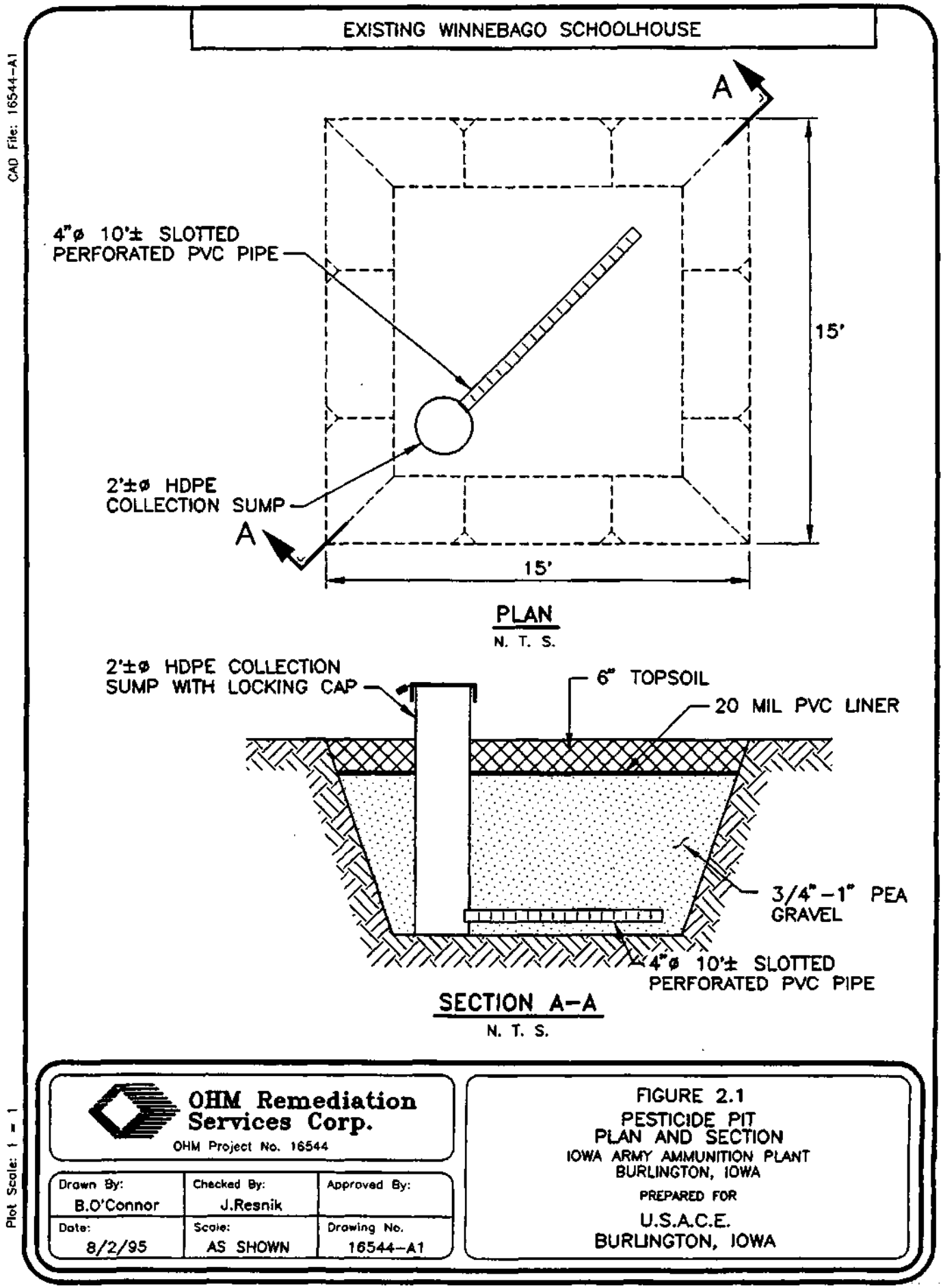
Source: Operations and Maintenance Manual - Line 1 Impoundment - September 2002



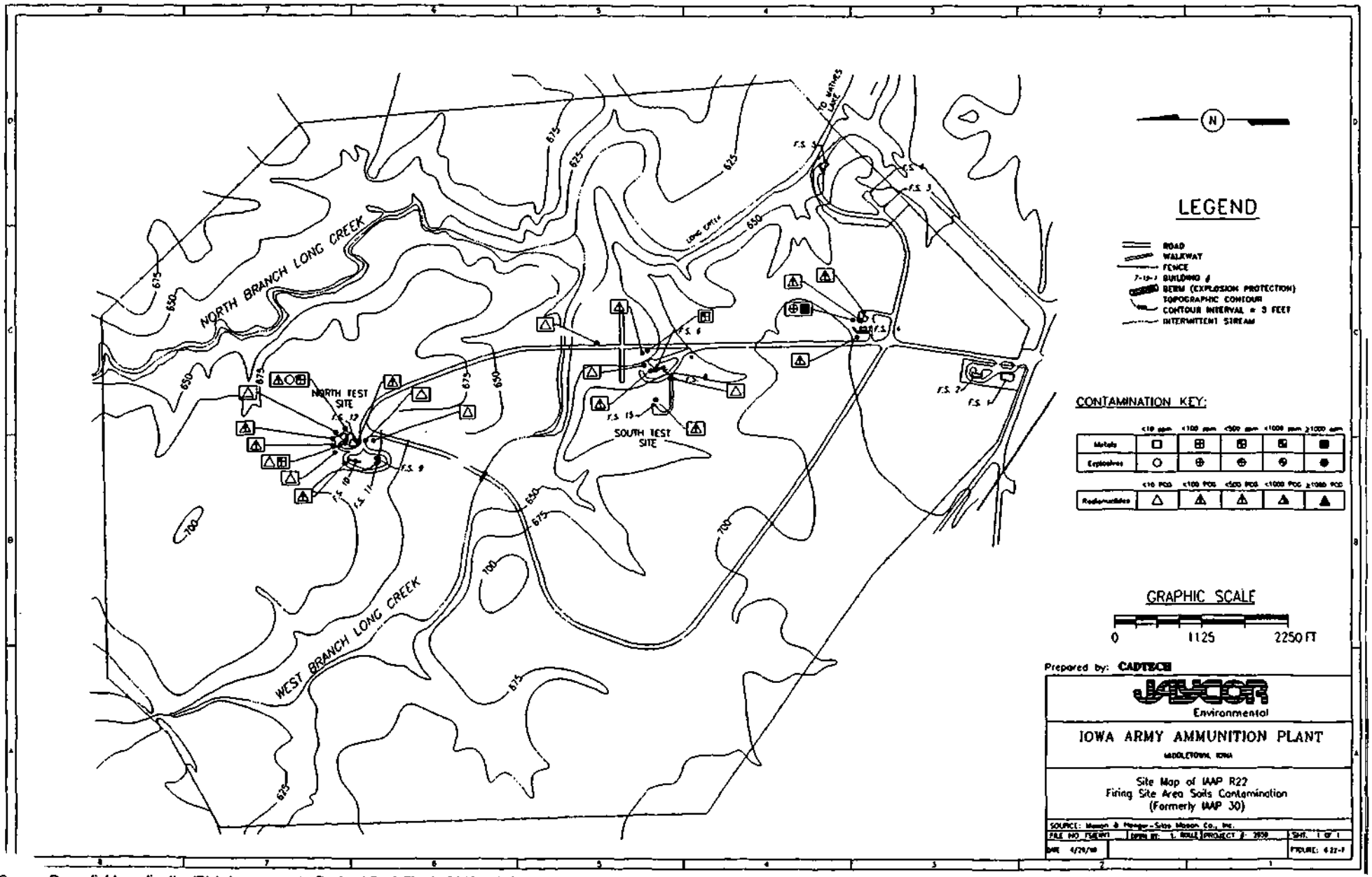
Source: Remedial Investigation/Risk Assessment - Revised Draft Final - 21 May 1996



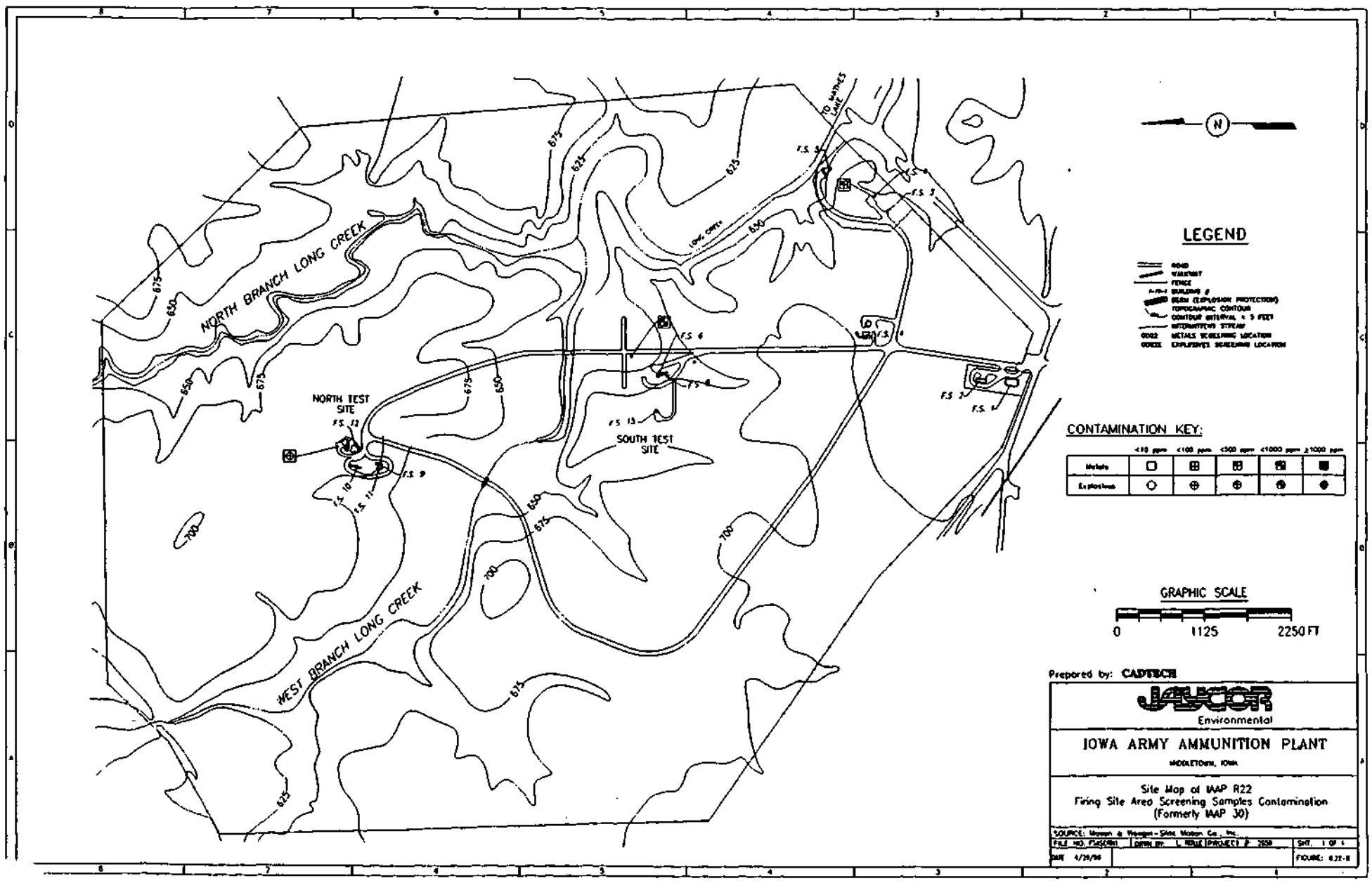
Source: Remedial Investigation/Risk Assessment - Revised Draft Final - 21 May 1996



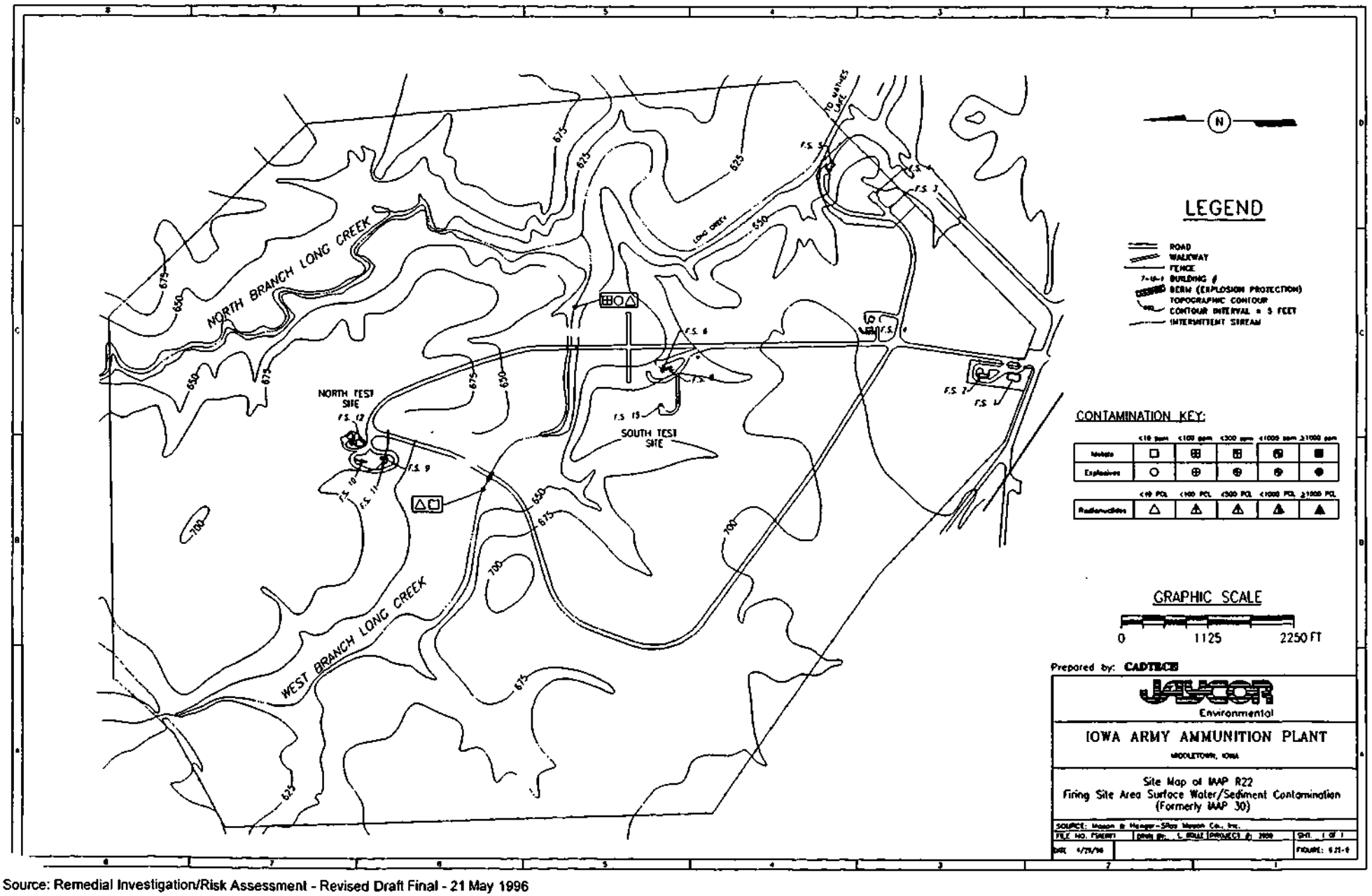
Source: Removal Actions - Contract No. DACW45-94-D-0005 – Draft Final Report - 8 Jan 1996



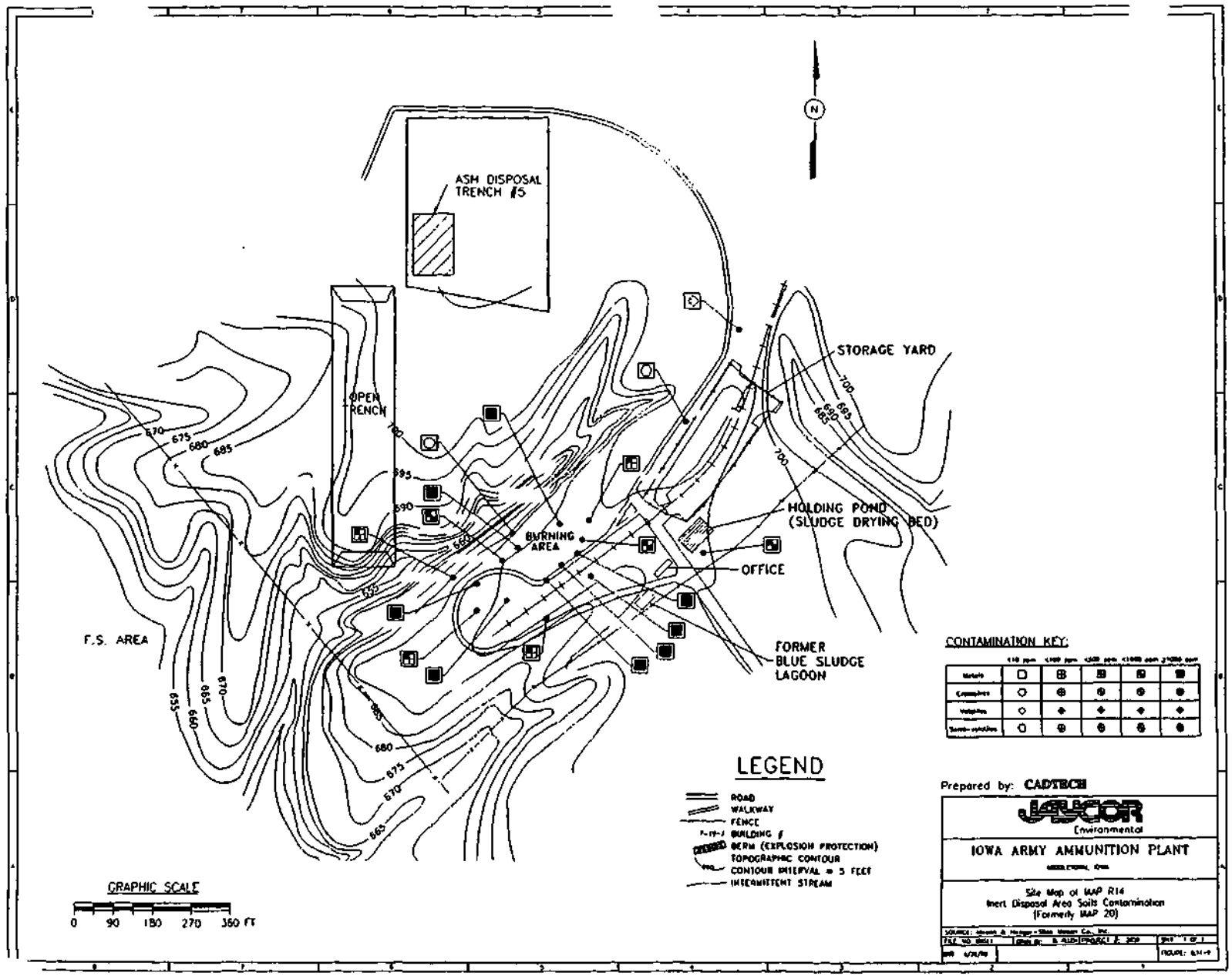
Source: Remedial Investigation/Risk Assessment - Revised Draft Final - 21 May 1996



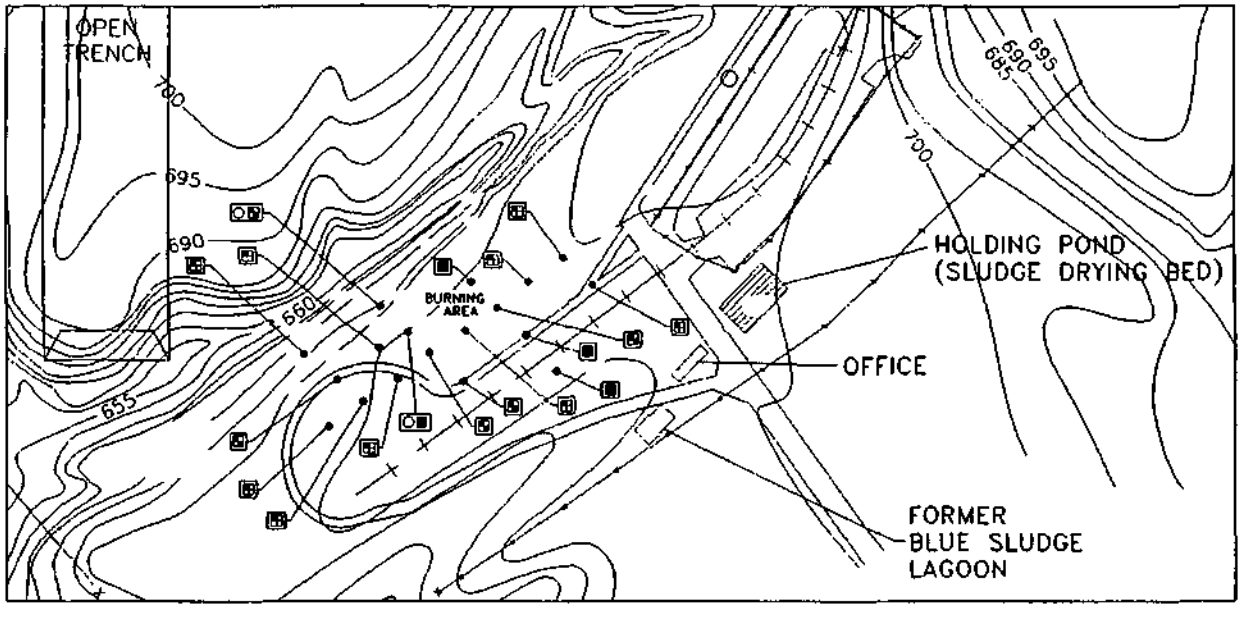
Source: Remedial Investigation/Risk Assessment - Revised Draft Final - 21 May 1996



Source: Remedial Investigation/Risk Assessment - Revised Draft Final - 21 May 1996



Source: Remedial Investigation/Risk Assessment - Revised Draft Final - 21 May 1996



CONTAMINATION KEY:

	<10 ppm	<100 ppm	<500 ppm	<1000 ppm	≥1000 ppm
Metals	□	⊞	⊞	⊡	■
Explosives	○	⊕	⊕	⊕	●

LEGEND

ROAD
WALKWAY
FENCE
BUILDING #
BERM (EXPLOSION PROTECTION)
TOPOGRAPHIC CONTOUR
CONTOUR INTERVAL = 5 FEET
INTERMITTENT STREAM
0002 METALS SCREENING LOCATION
0002X EXPLOSIVES SCREENING LOCATION

GRAPHIC SCALE

0 60 120 180 240 FT

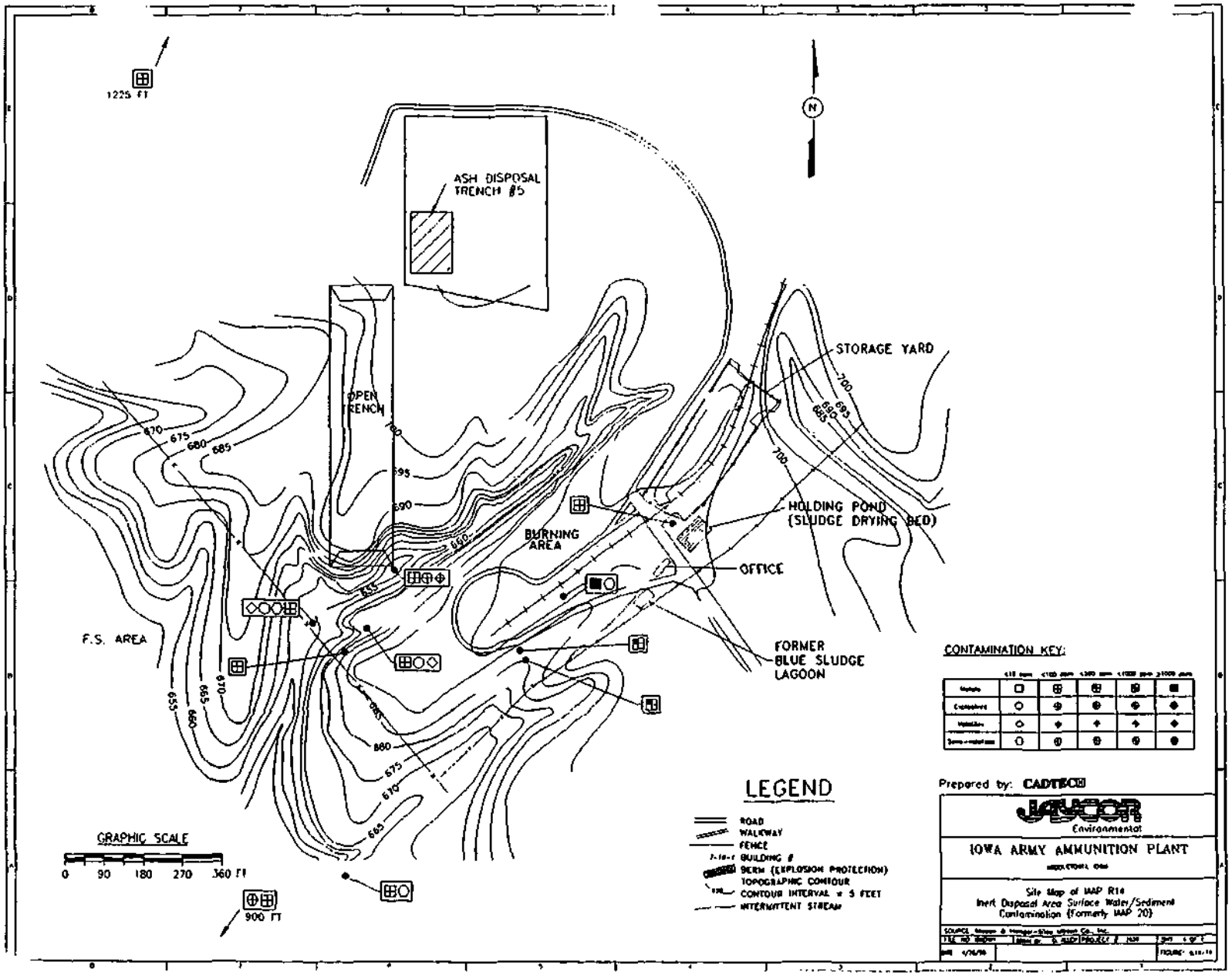
Prepared by: CADTECH

JACOBS Environmental

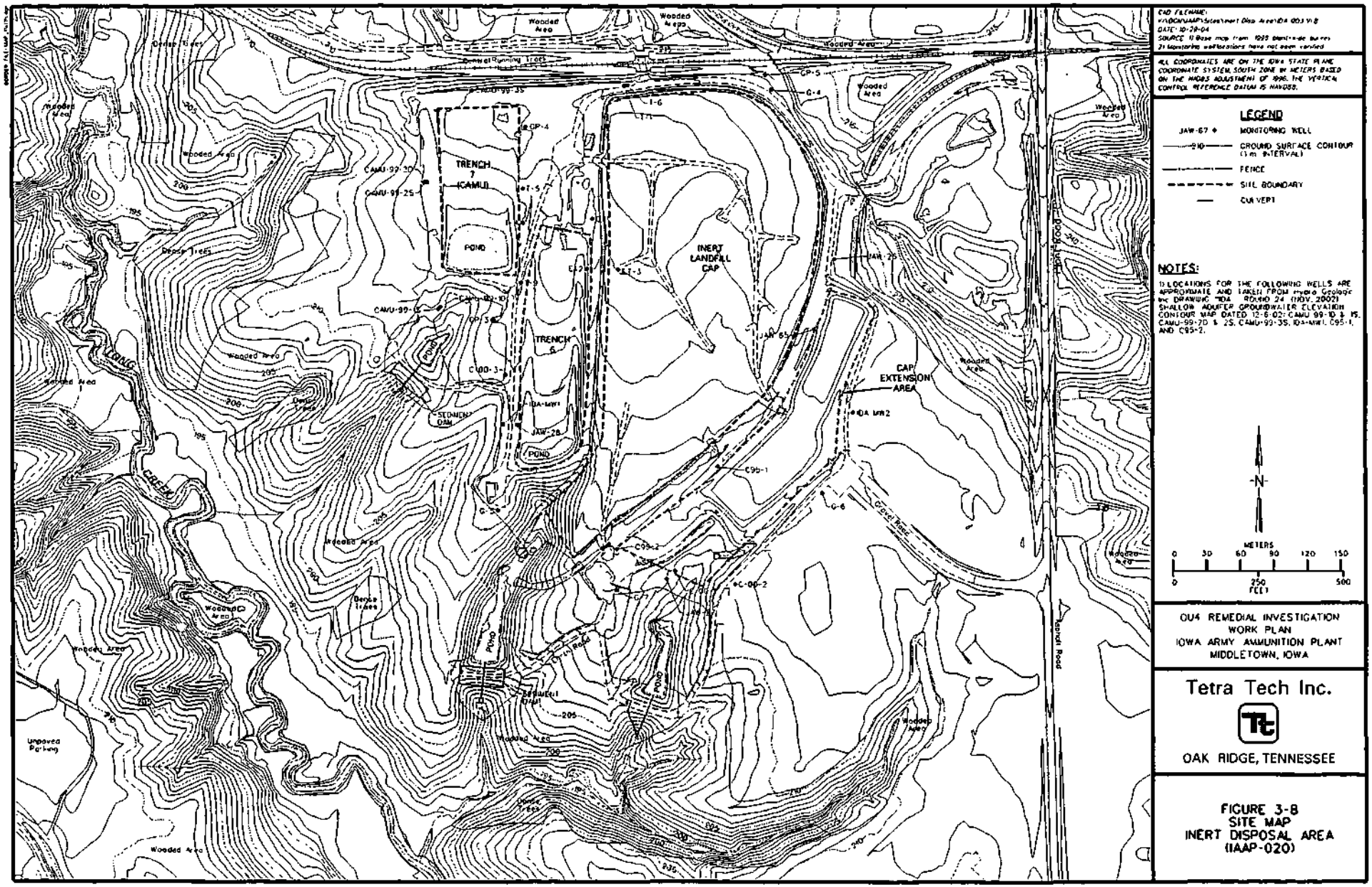
IOWA ARMY AMMUNITION PLANT

Site Map of IAAP R14
Inert Disposal Area Screening Samples
Contamination (Formerly IAAP 20)

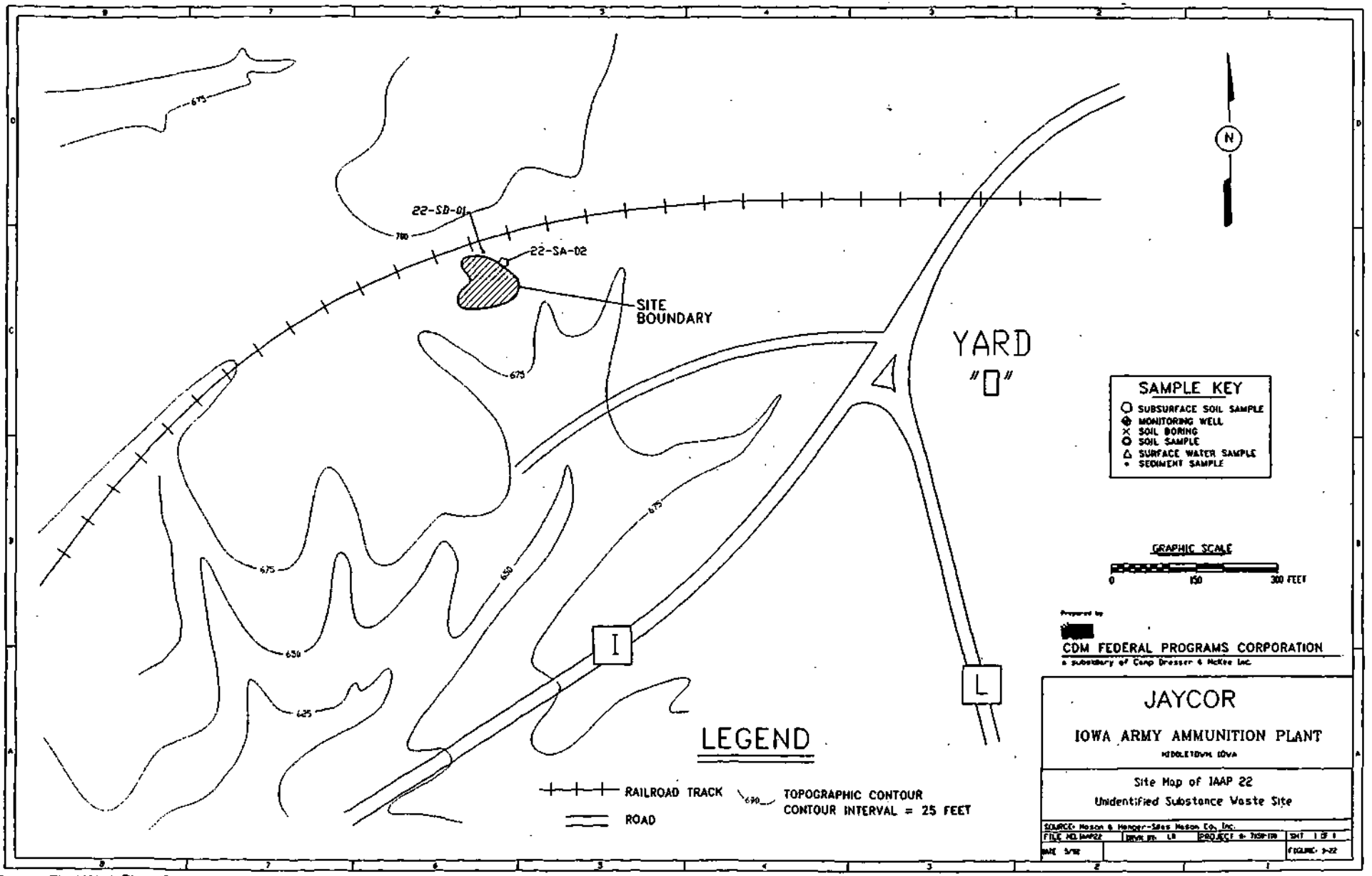
Source: Remedial Investigation/Risk Assessment - Revised Draft Final - 21 May 1996



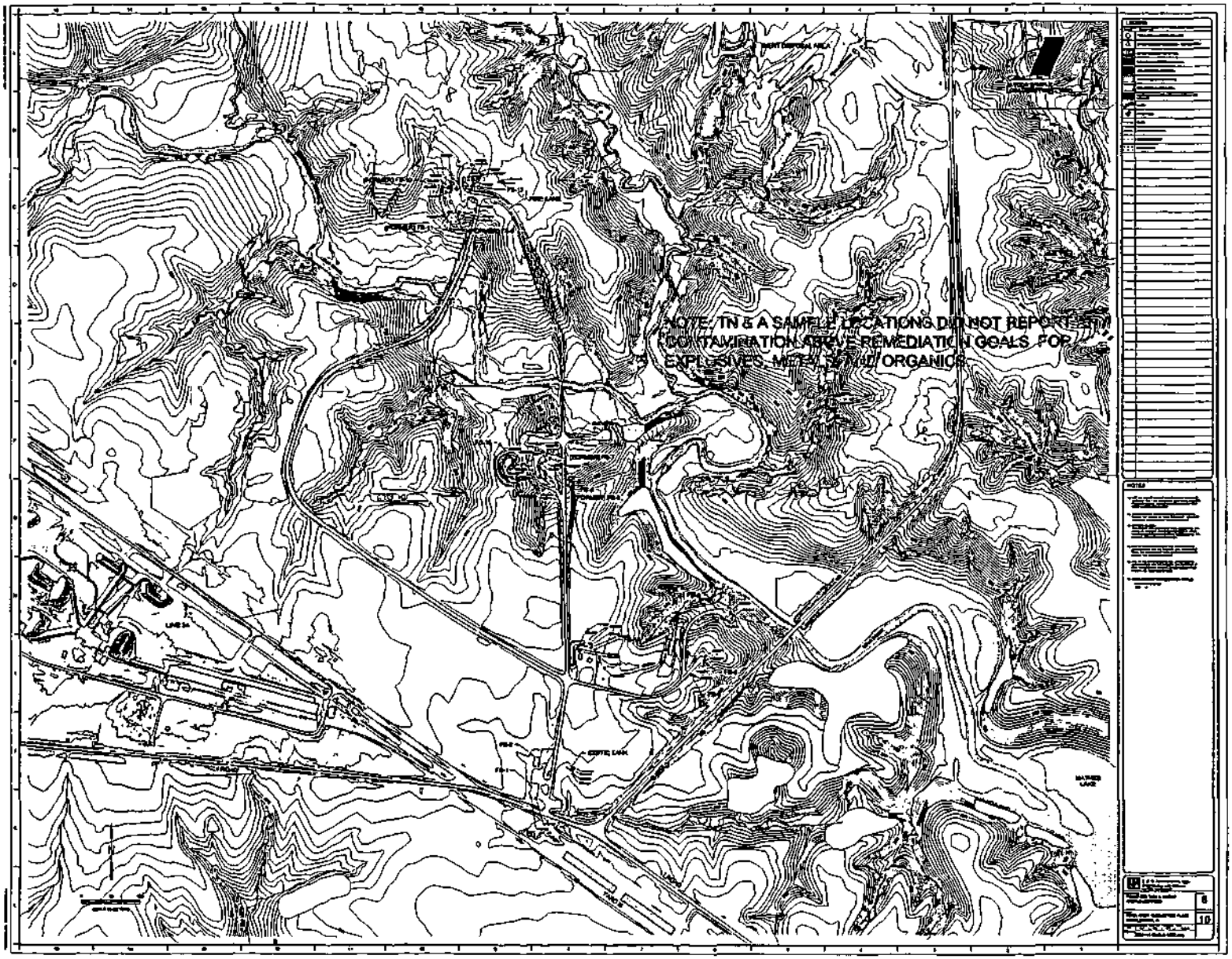
Source: Remedial Investigation/Risk Assessment - Revised Draft Final - 21 May 1996



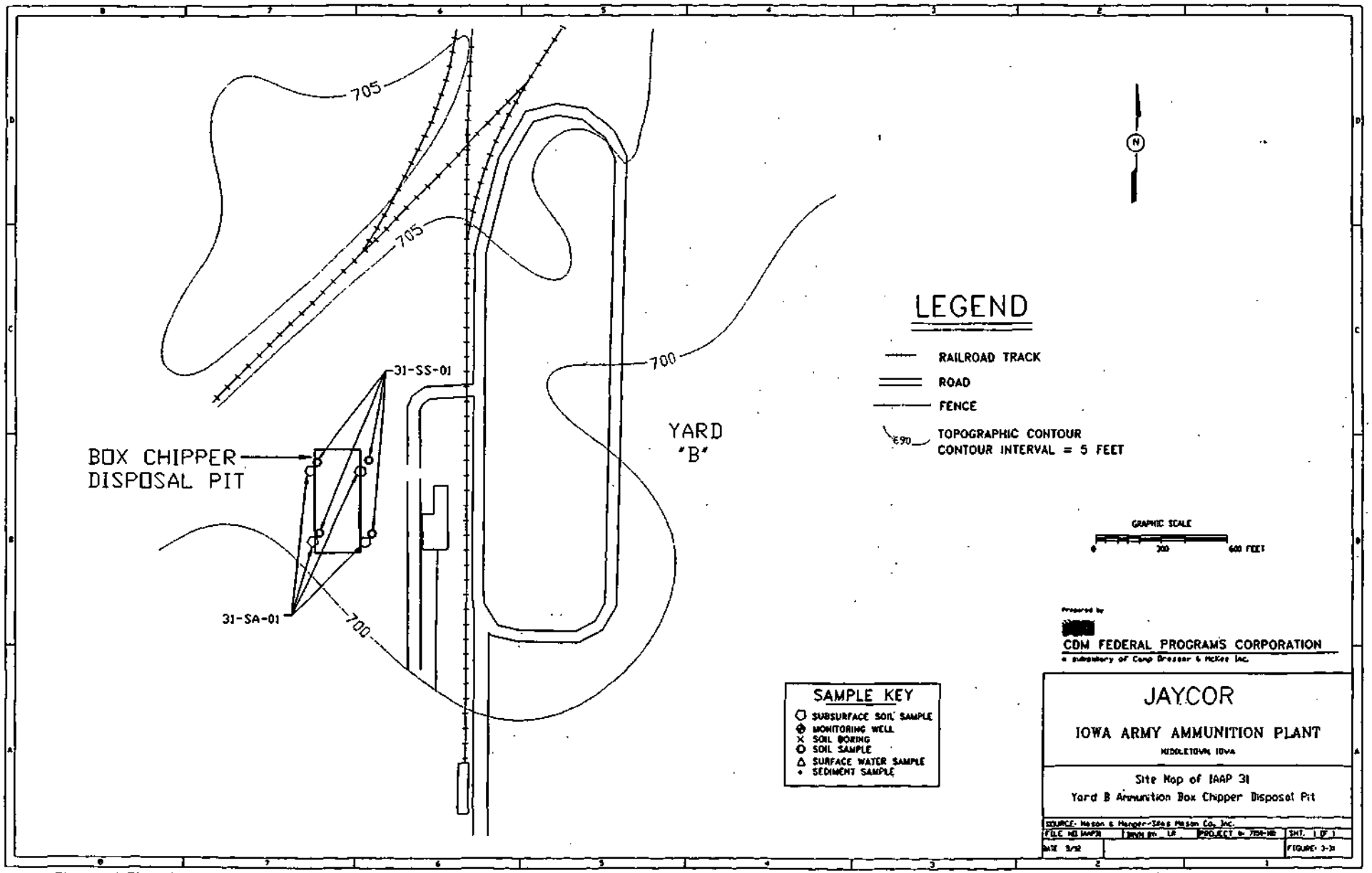
Source: Work Plan for Supplemental Remedial Investigation - Operable Unit 4 - Draft - October 2004



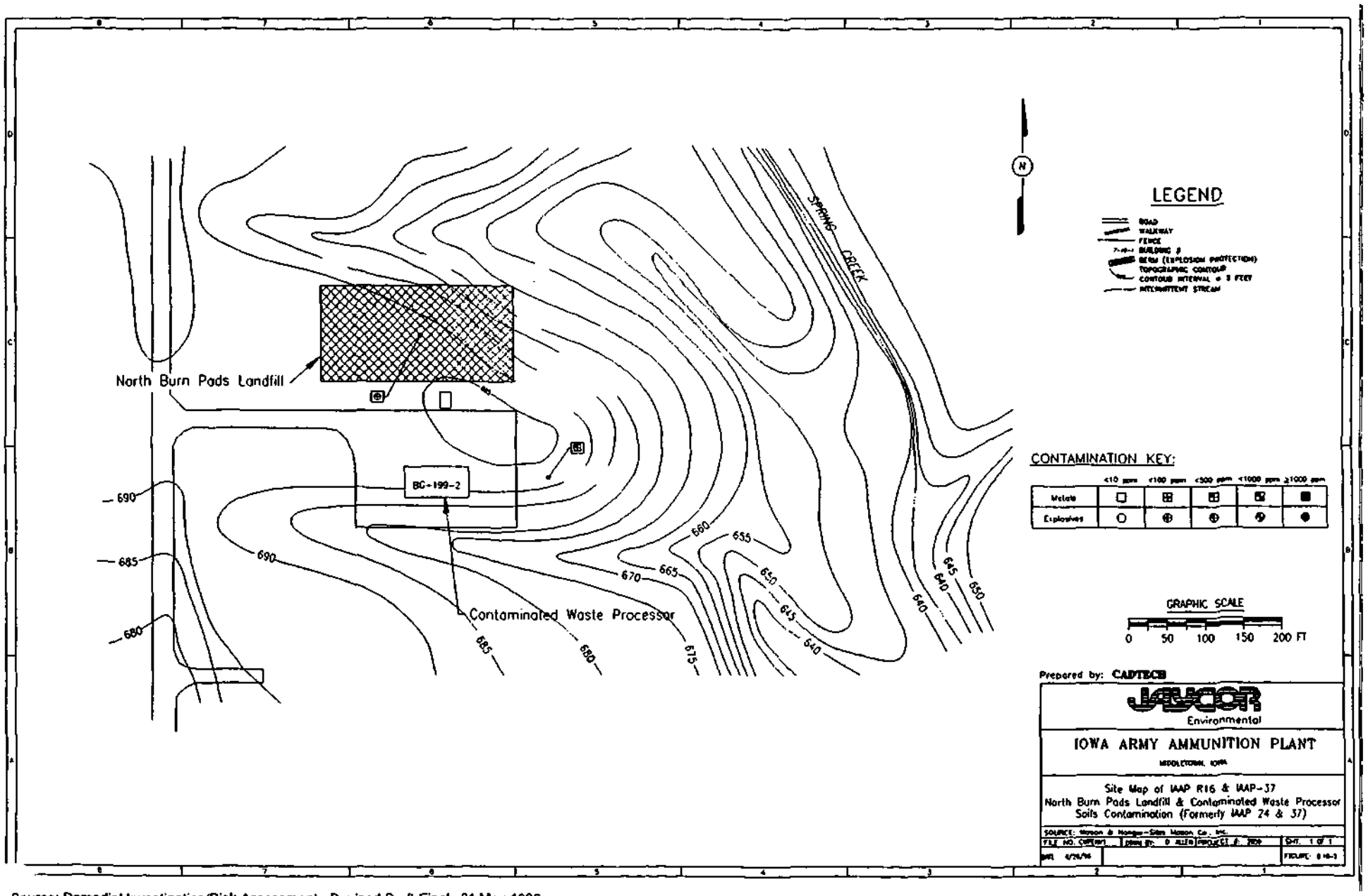
Source: Final Work Plan - Phase 1 Remedial Investigation/Feasibility Study - June 1992 (Site Investigation)



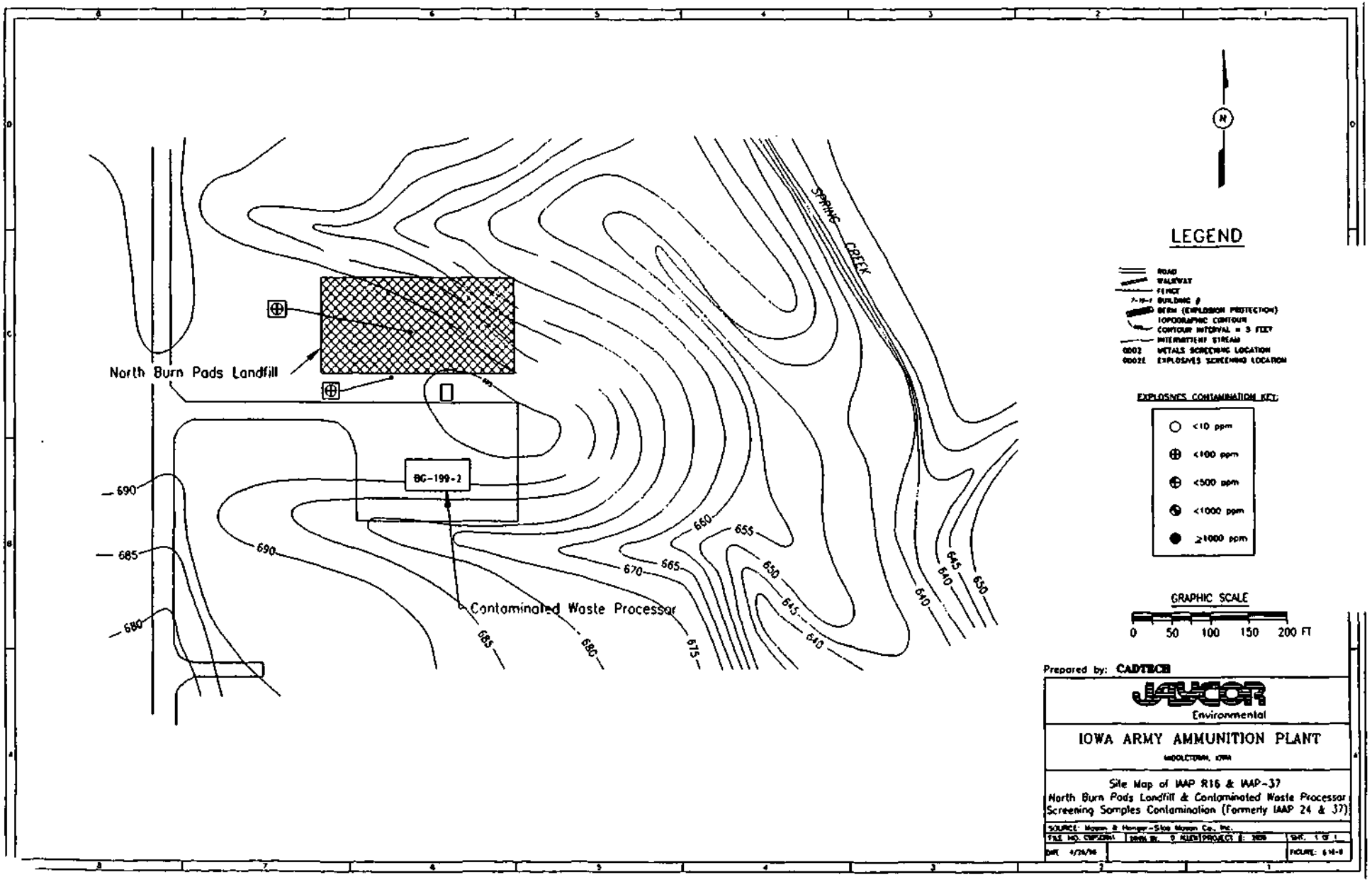
Source: Supplemental Remedial Investigation Report - Line 1 and Firing Site - Draft Final - August 2002



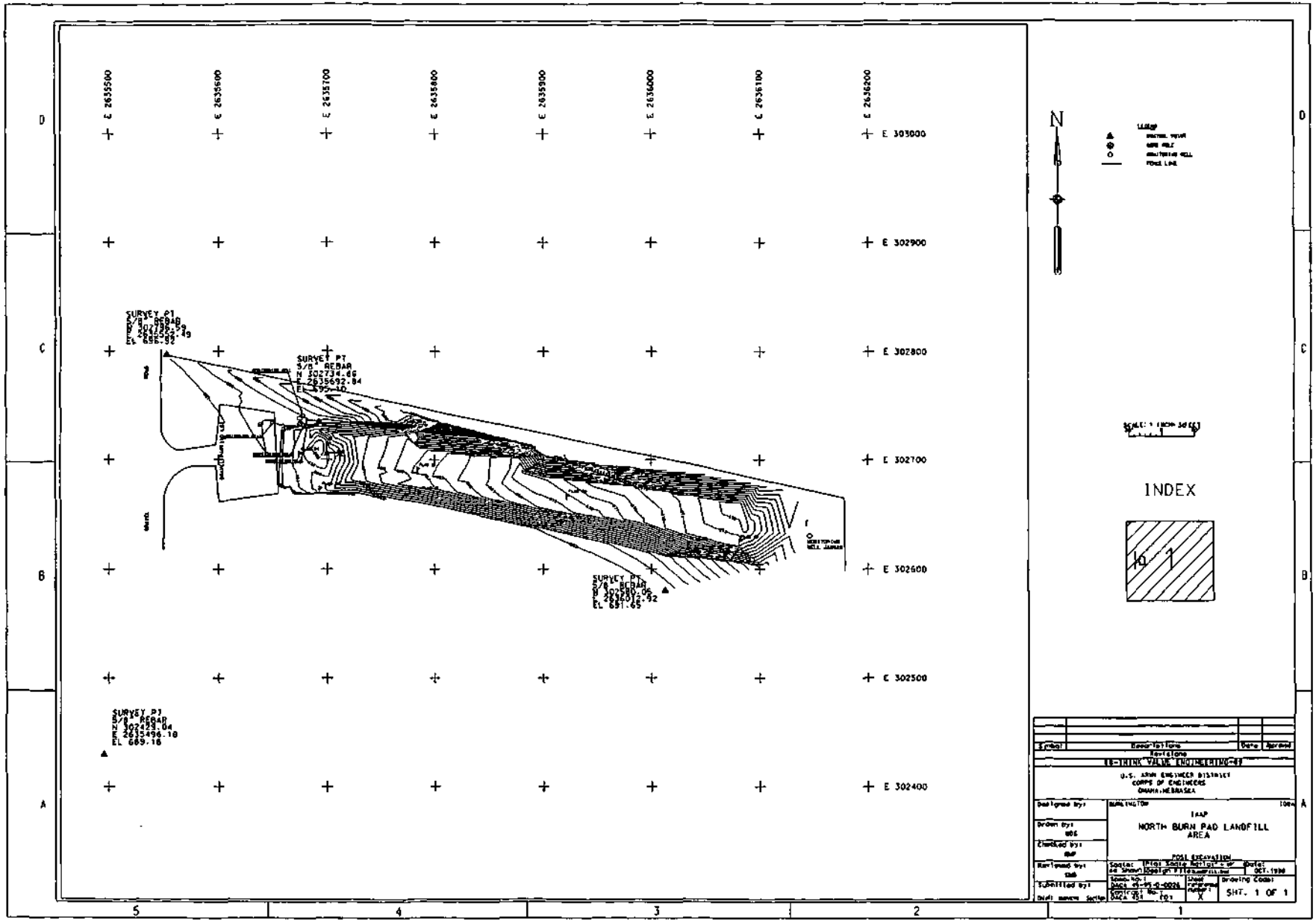
Source: Final Work Plan - Phase 1 Remedial Investigation/Feasibility Study - June 1992 (Site Investigation)



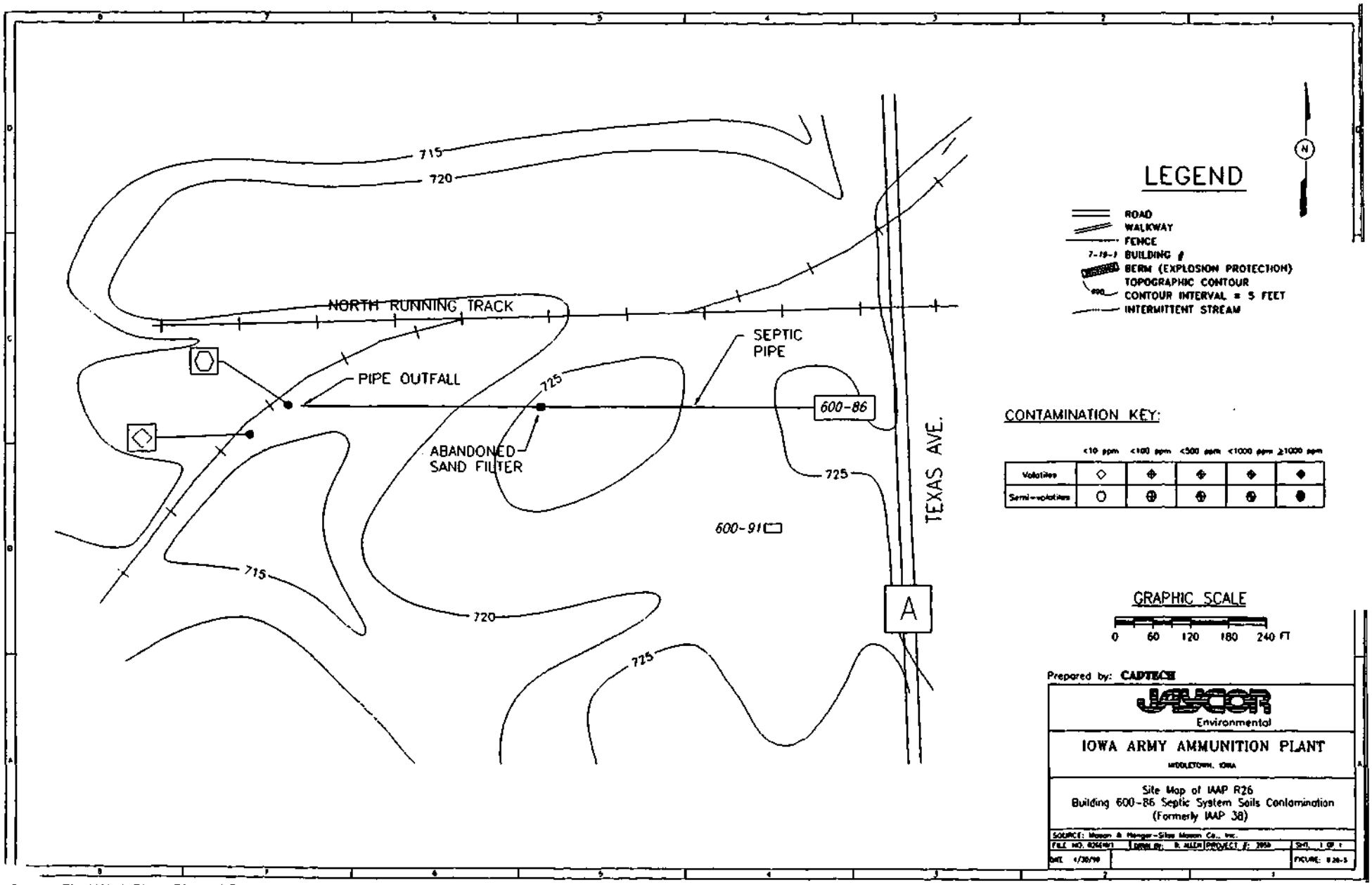
Source: Remedial Investigation/Risk Assessment - Revised Draft Final - 21 May 1996



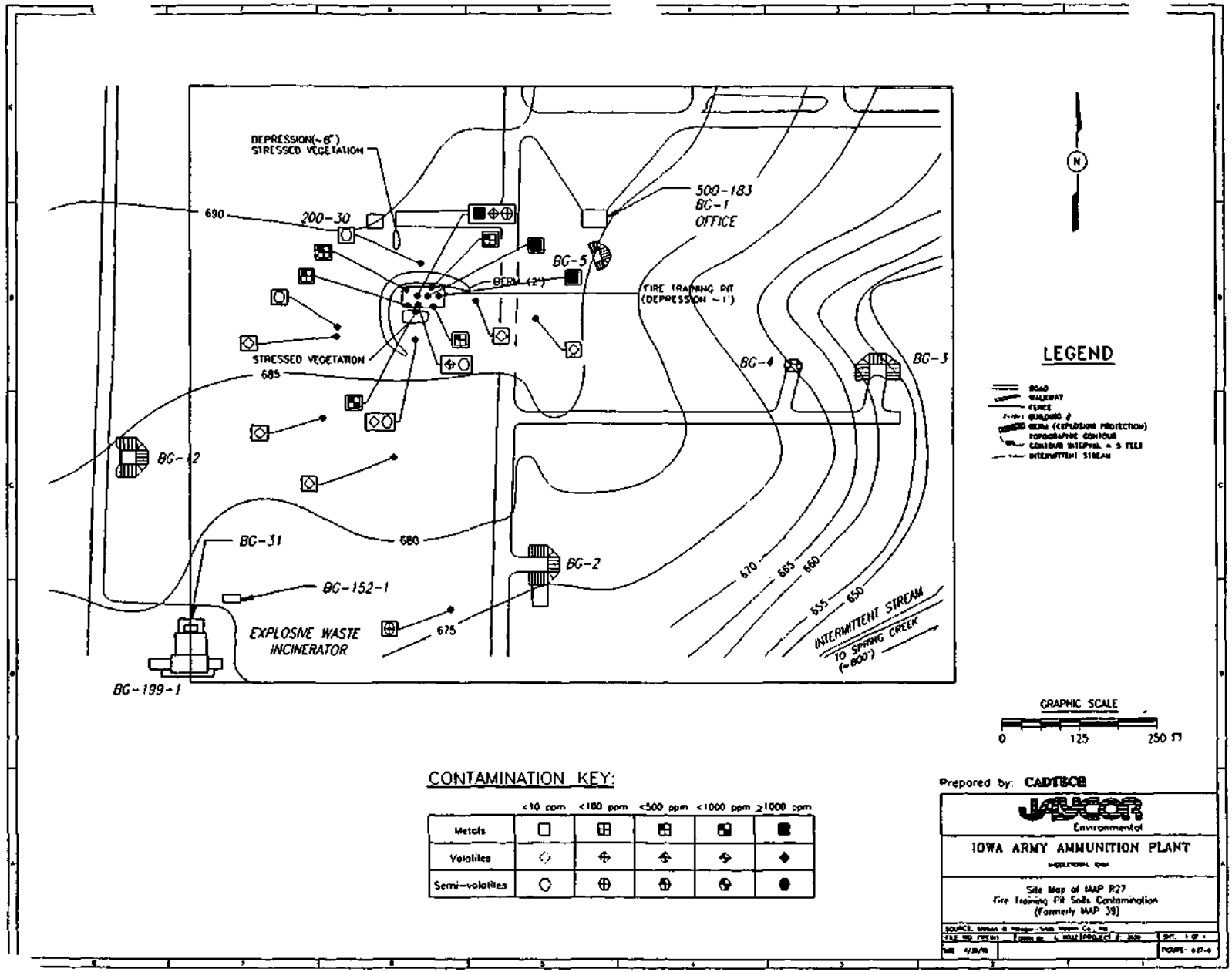
Source: Remedial Investigation/Risk Assessment - Revised Draft Final - 21 May 1996



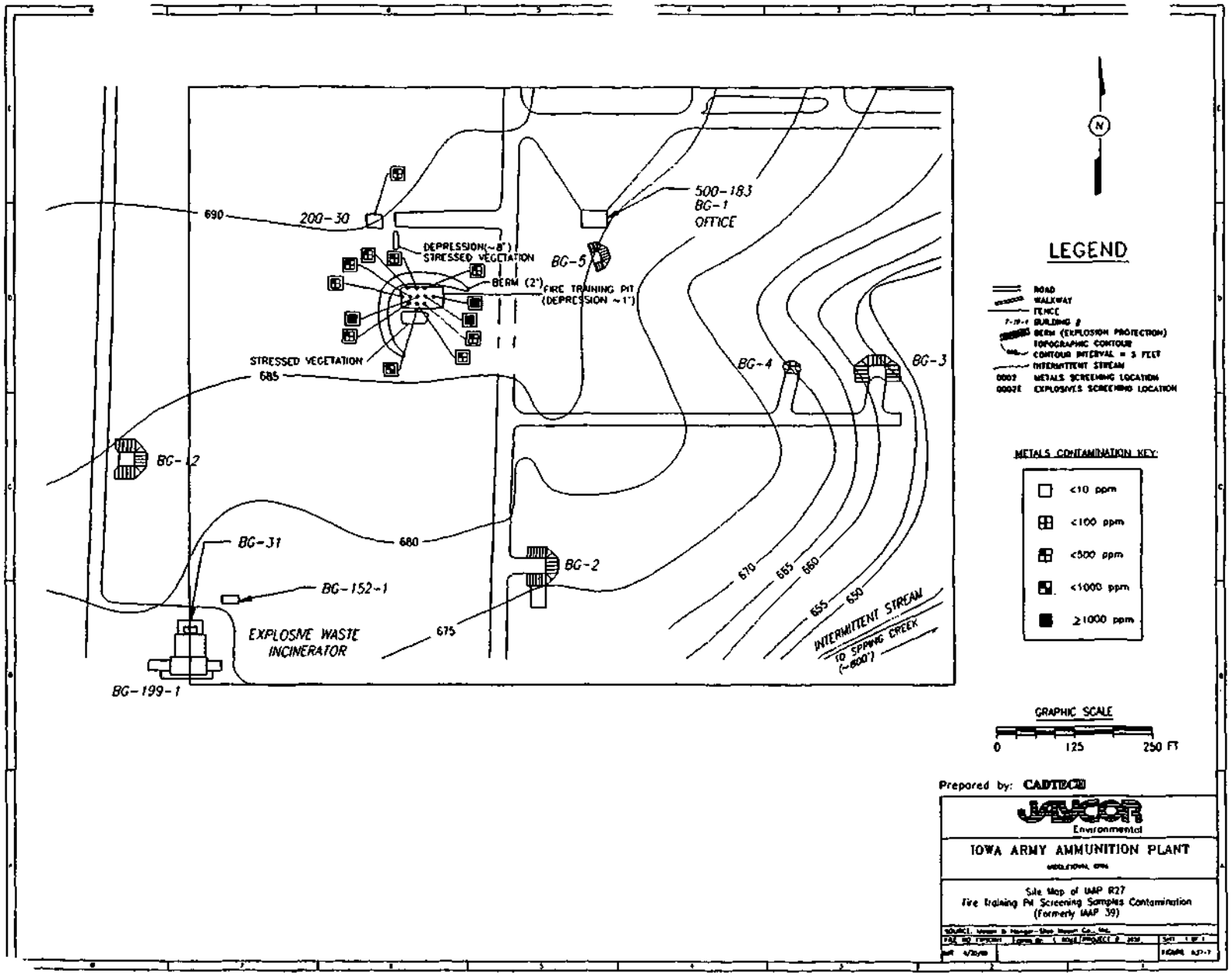
Source: Remedial Action Report - FFS Sites - Phase I - Final - Oct 2000



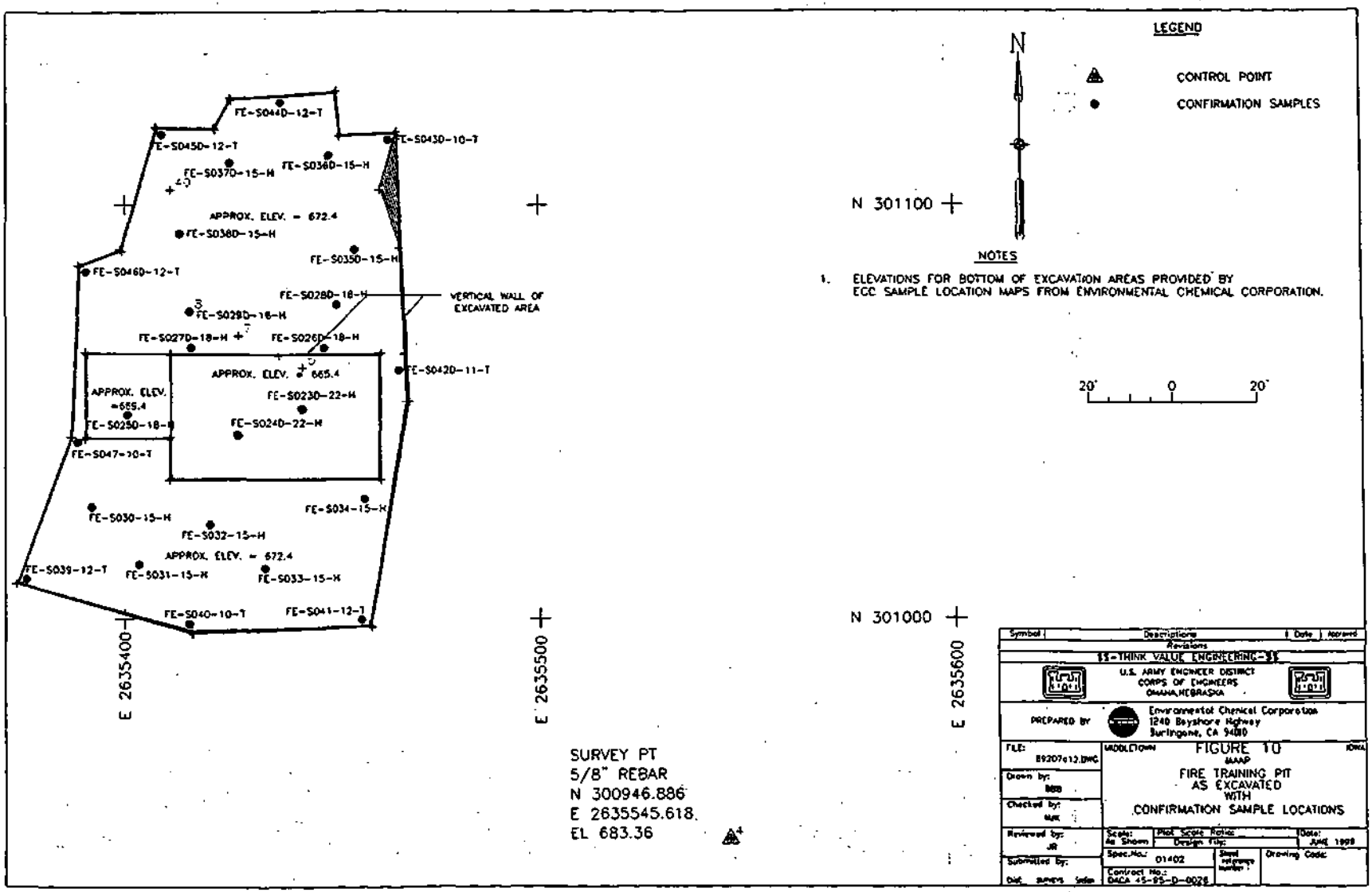
Source: Final Work Plan - Phase 1 Remedial Investigation/Feasibility Study - June 1992 (Site Investigation)



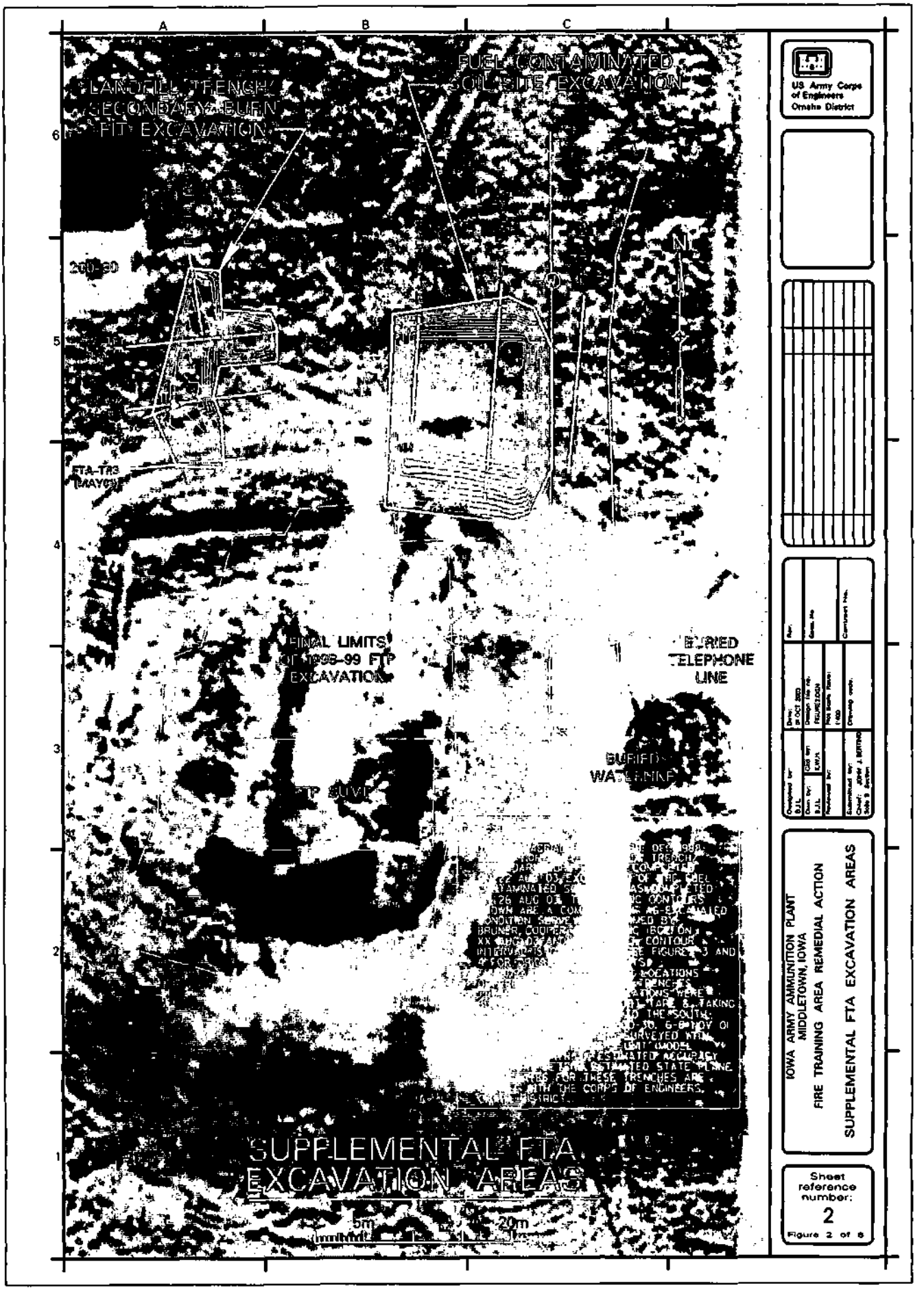
Source: Remedial Investigation/Risk Assessment - Revised Draft Final - 21 May 1996



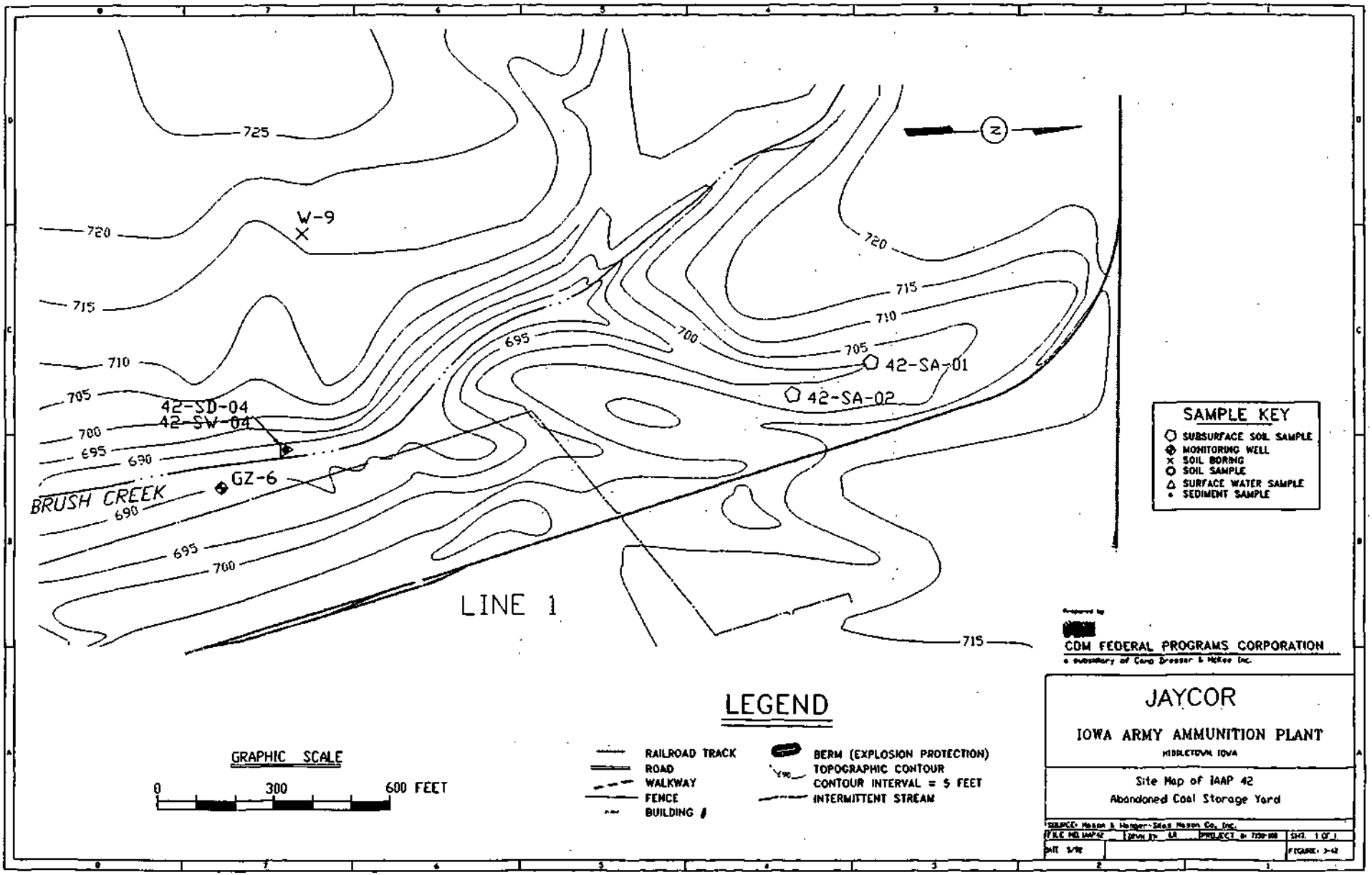
Source: Remedial Investigation/Risk Assessment - Revised Draft Final - 21 May 1996



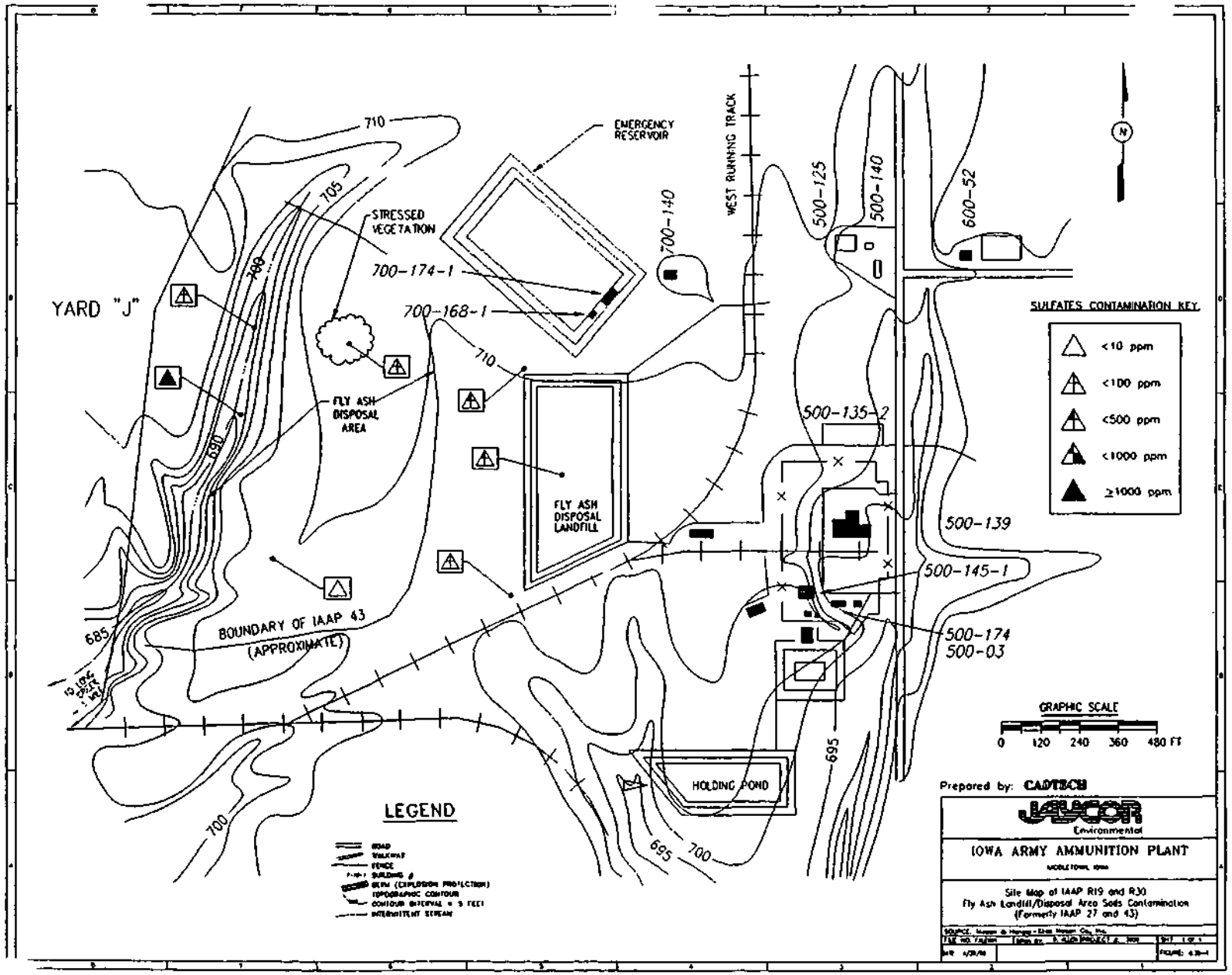
Source: Remedial Action Report - Fire Training Pit - Final - Oct 2000



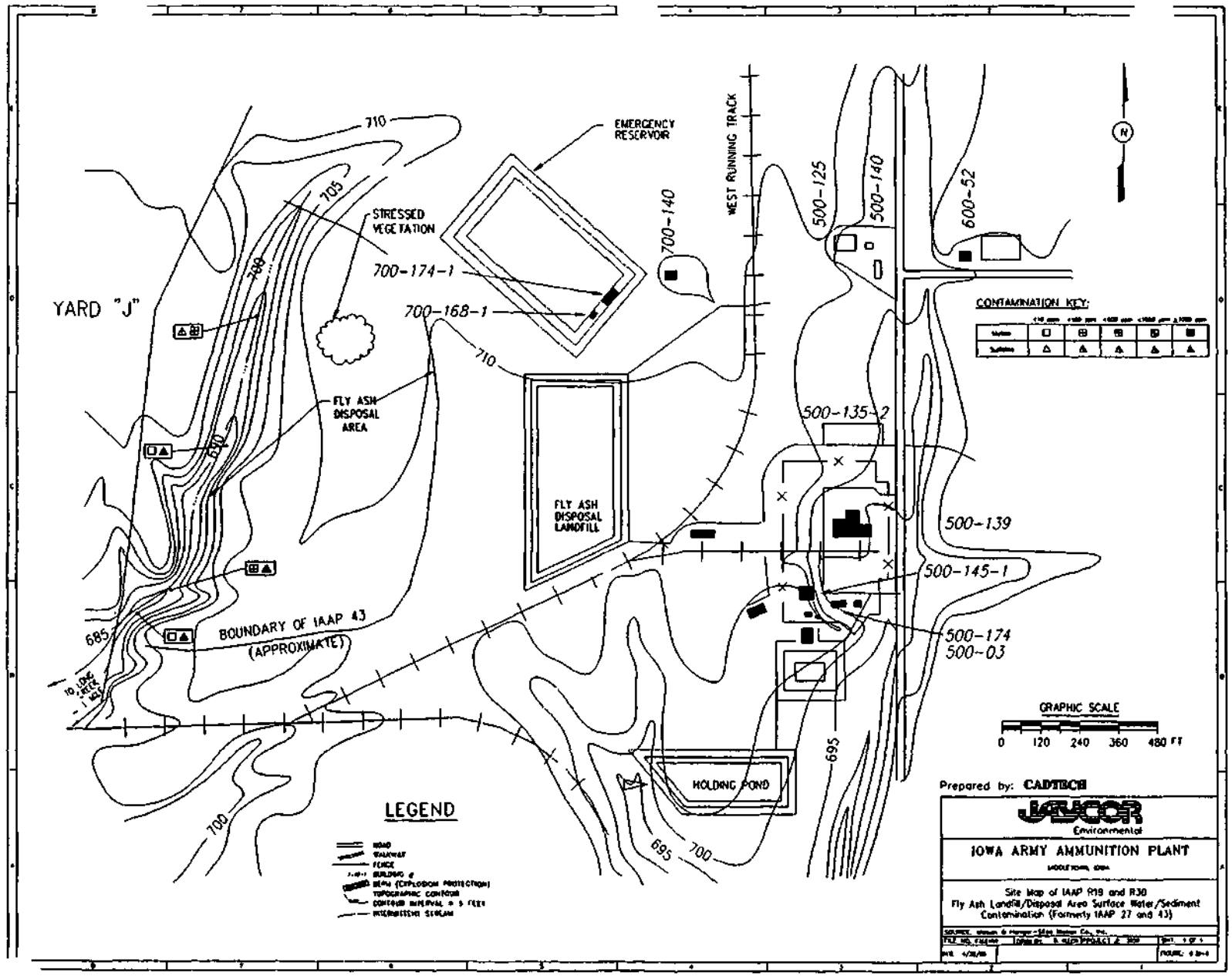
Source: Fire Training Area Remedial Action Report - Draft - October 2003



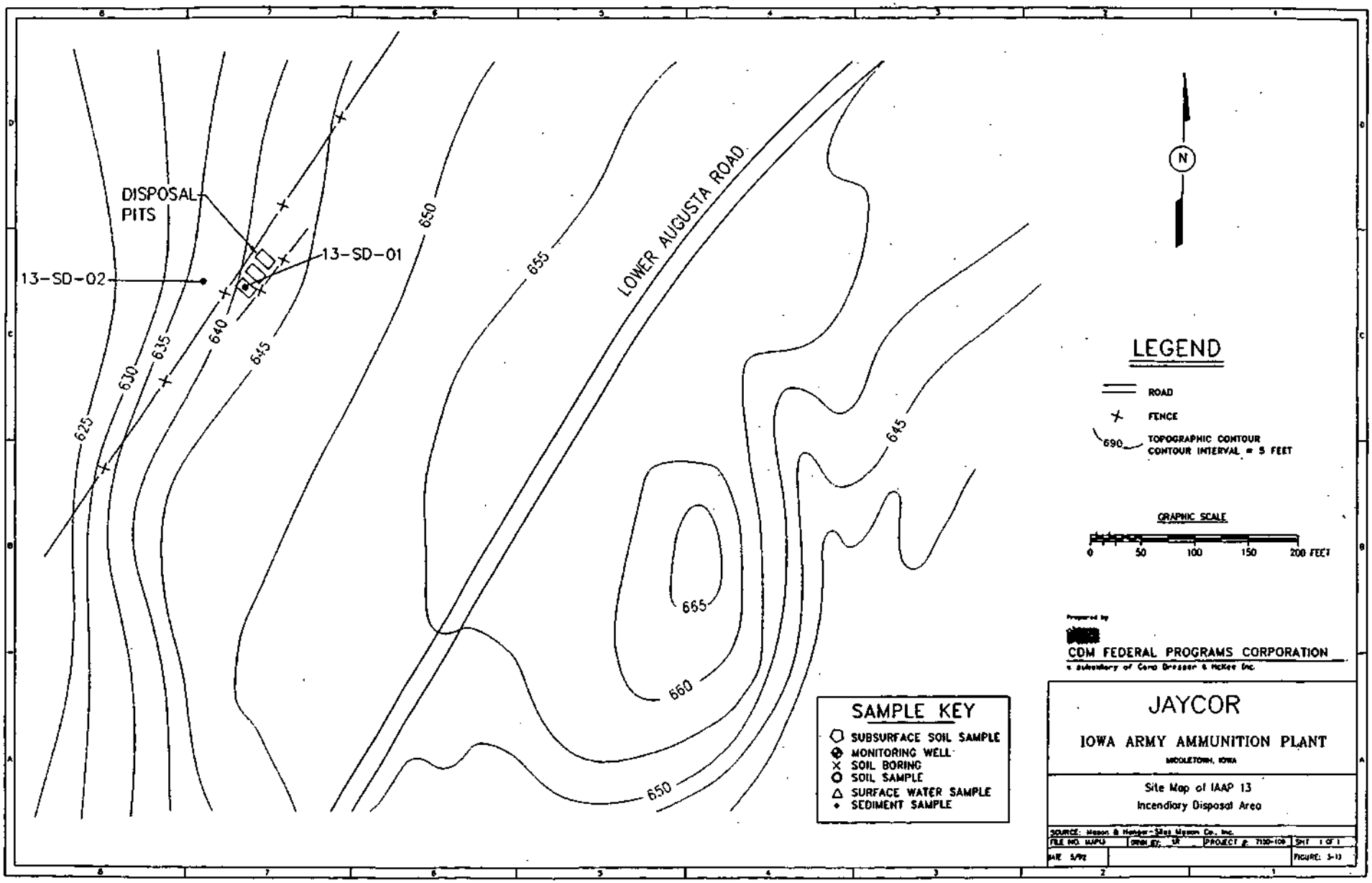
Source: Final Work Plan - Phase 1 Remedial Investigation/Feasibility Study - June 1992 (Site Investigation)



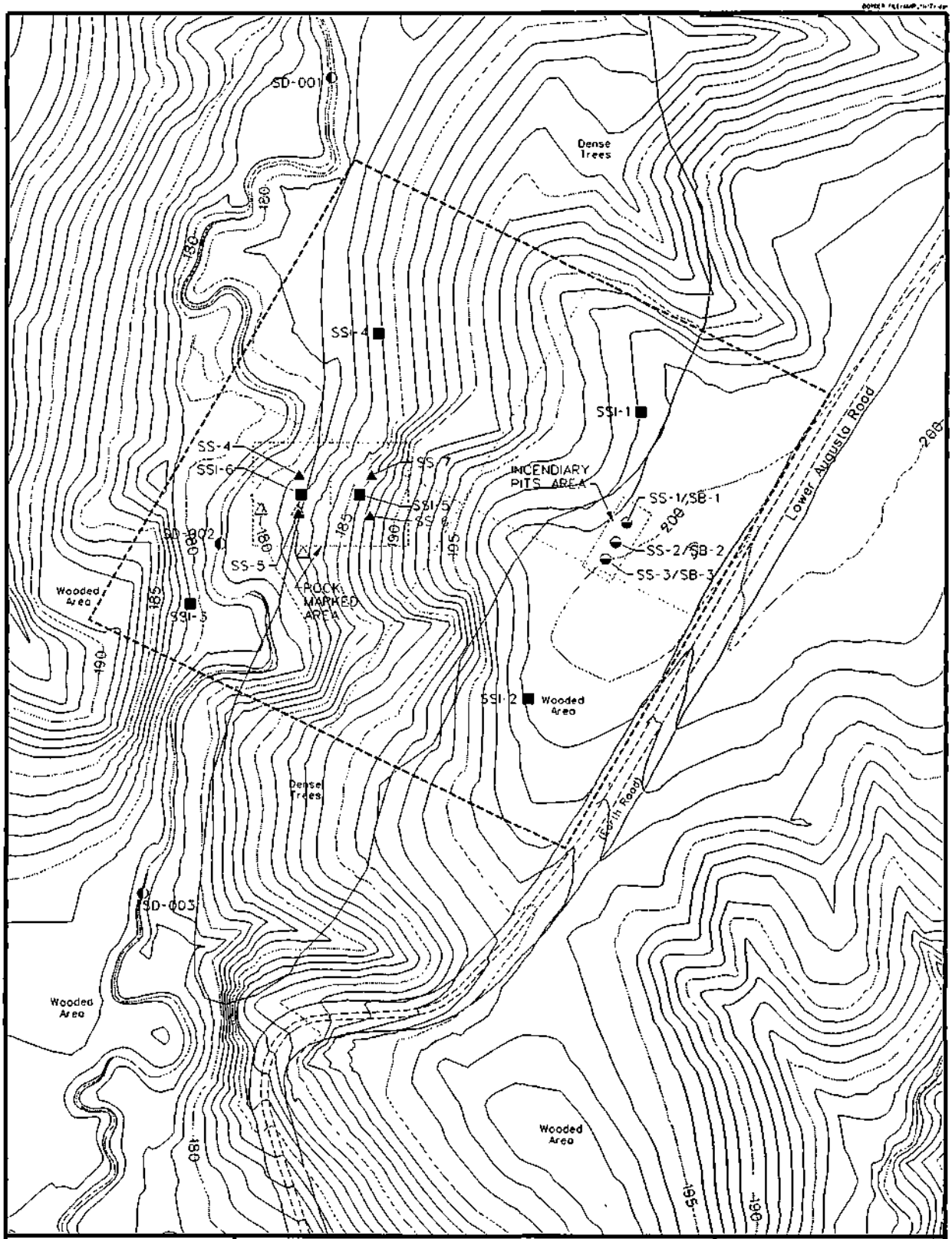
Source: Remedial Investigation/Risk Assessment - Revised Draft Final - 21 May 1996



Source: Remedial Investigation/Risk Assessment - Revised Draft Final - 21 May 1996



Source: Final Work Plan - Phase 1 Remedial Investigation/Feasibility Study - June 1992 (Site Investigation)



CAD FILENAME: K:\DOW\IAAP\Shp\Incendiary Disp Area\INCD-003.mxd
DATE: 10-29-04
SOURCE: 1' Base map from 1998 photo-aide survey
21 Monitoring well locations have not been verified

ALL COORDINATES ARE ON THE IOWA STATE PLANE COORDINATE SYSTEM, SOUTH ZONE IN METERS BASED ON THE NAD83 ADJUSTMENT OF 1998 THE VERTICAL CONTROL REFERENCE DATUM IS NAVD88

OU4 REMEDIAL INVESTIGATION
WORK PLAN
IOWA ARMY AMMUNITION PLANT
MIDDLETOWN, IOWA

LEGEND

- 190 — GROUND SURFACE CONTOUR (1m INTERVAL)
- SITE BOUNDARY
- GRID LINES
- SSI-001 ■ INCREMENTAL SOIL SAMPLE (MKM)
- SS-004 ▲ DISCRETE SHALLOW SOIL SAMPLE (MKM)
- SD-001 ◐ SEDIMENT SAMPLE (MKM)
- SS-001/SB 001 ◒ SHALLOW SOIL/SOIL BORING SAMPLE (MKM)

-N-

NOTES:

1) EXISTING SOIL SAMPLES TAKEN FROM 2004 MKM ENGINEERS, INC. WORK PLAN.

2) ACTUAL SAMPLE LOCATIONS WILL BE DETERMINED DURING FIELD WORK.

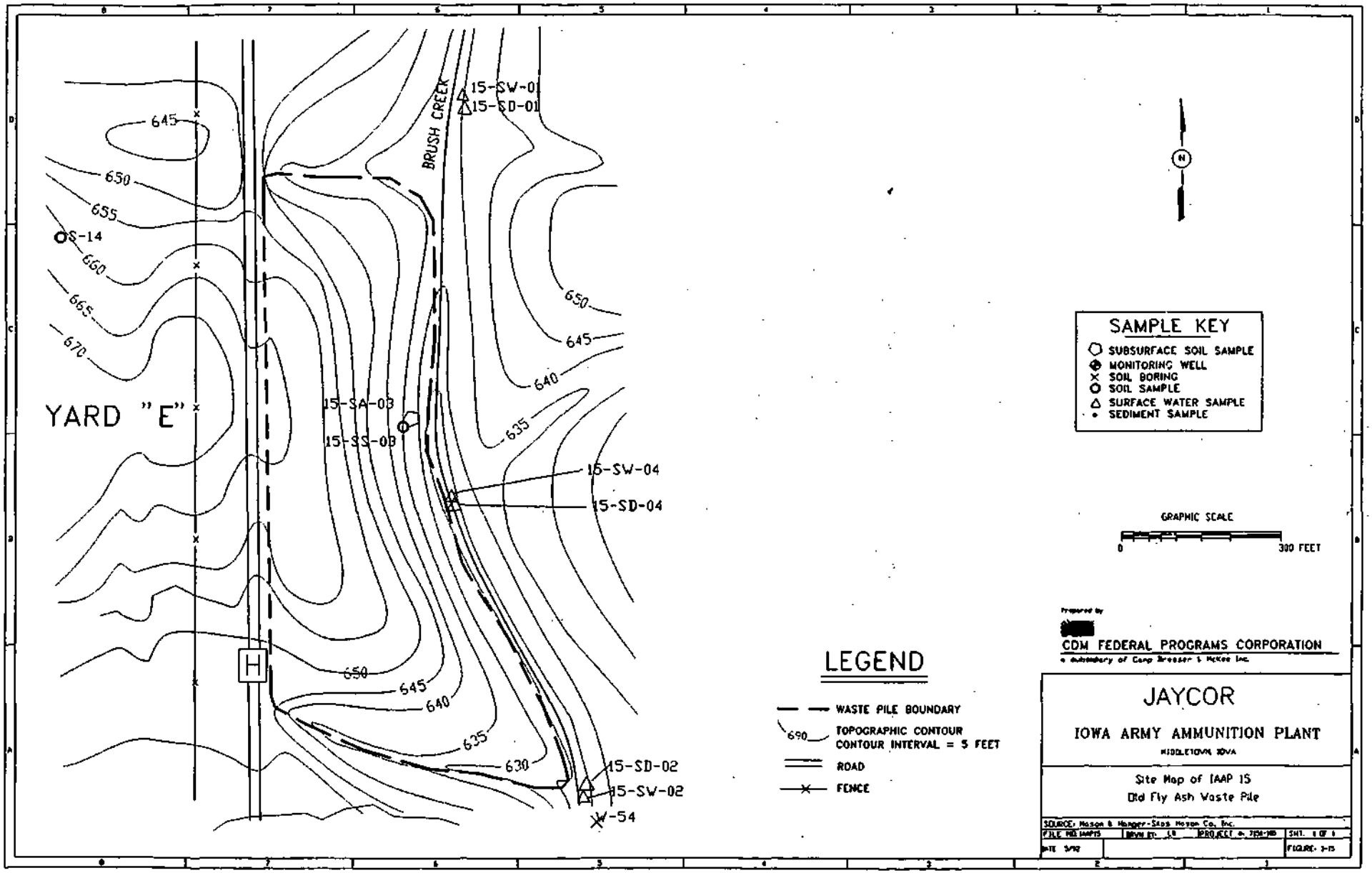
METERS: 0 15 30 45 60 75
FEET: 0 50 100 150 200 250

Tetra Tech Inc.

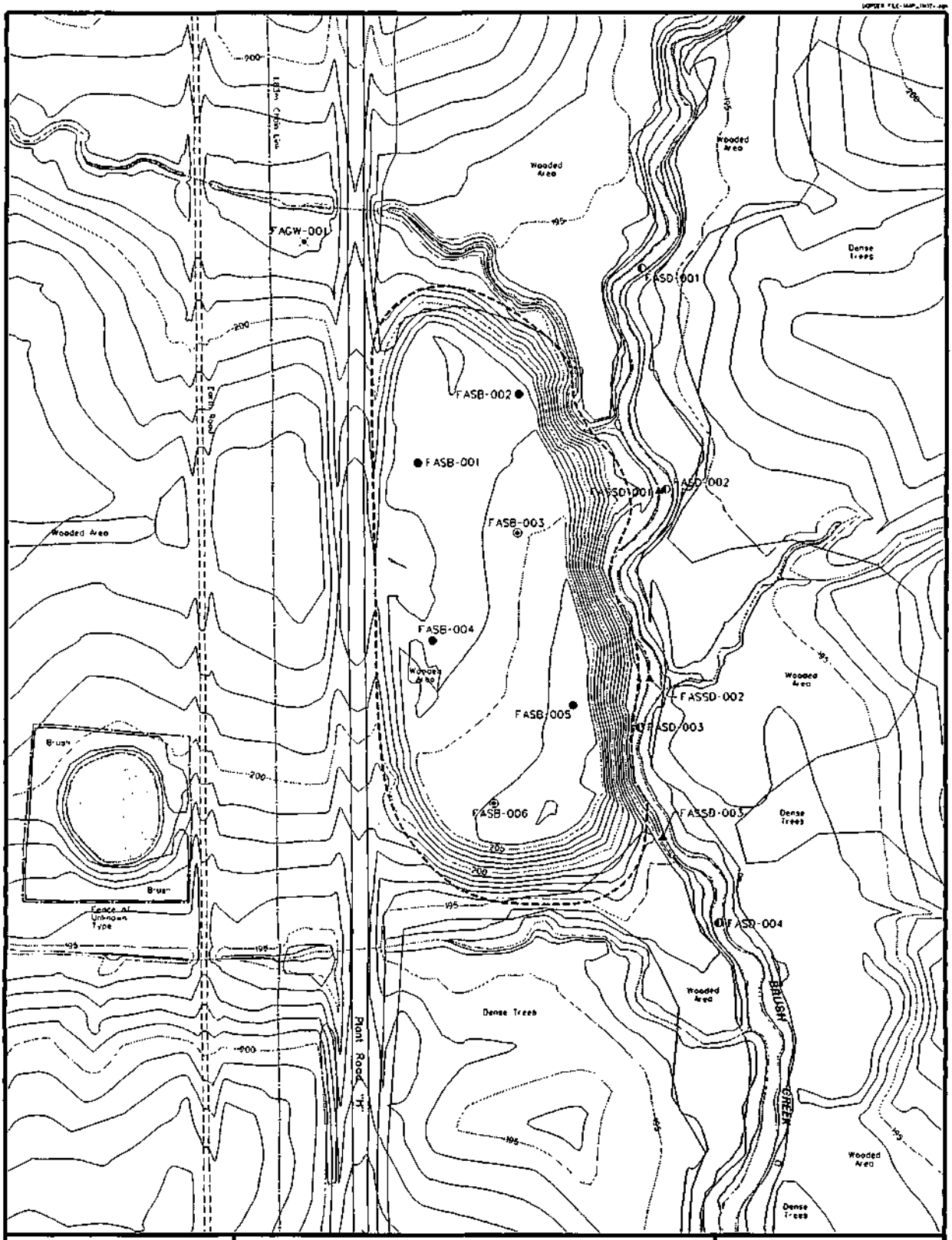
OAK RIDGE, TENNESSEE

FIGURE 3-2
INCENDIARY DISPOSAL AREA
(IAAP-013)
SAMPLE LOCATION MAP

Source: Work Plan for Supplemental Remedial Investigation - Operable Unit 4 - Draft - October 2004



Source: Final Work Plan - Phase 1 Remedial Investigation/Feasibility Study - June 1992 (Site Investigation)



CAD FILENAME:
DATE: 10-27-04
SOURCE: 1) Base map from 1998 planimetric survey;
2) Monitoring well locations have not been verified

ALL COORDINATES ARE ON THE IOWA STATE PLANE COORDINATE SYSTEM, SOUTH ZONE IN METERS BASED ON THE NAD83 ADJUSTMENT OF 1986. THE VERTICAL CONTROL REFERENCE DATUM IS NAVD88.

OU4 REMEDIAL INVESTIGATION
WORK PLAN
IOWA ARMY AMMUNITION PLANT
MIDDLETOWN, IOWA

LEGEND

- 190 — GROUND SURFACE CONTOUR (1m INTERVAL)
- SITE BOUNDARY
- FASSD-001 ▲ DISCRETE SHALLOW SOIL SAMPLE (MKM)
- FASD-002 ◐ SEDIMENT SAMPLE (MKM)
- FASB-001 ● SOIL BORING SAMPLE (MKM)
- FAGW-001 ⊠ GROUNDWATER SAMPLE LOCATION ONLY (MKM)
- FASB-003 ⊛ SOIL BORING AND GROUNDWATER SAMPLE (MKM)

N

NOTES:

1) EXISTING SOIL SAMPLES TAKEN FROM 2004 MKM ENGINEERS, INC. WORK PLAN
2) ACTUAL SAMPLE LOCATIONS WILL BE DETERMINED DURING FIELD WORK

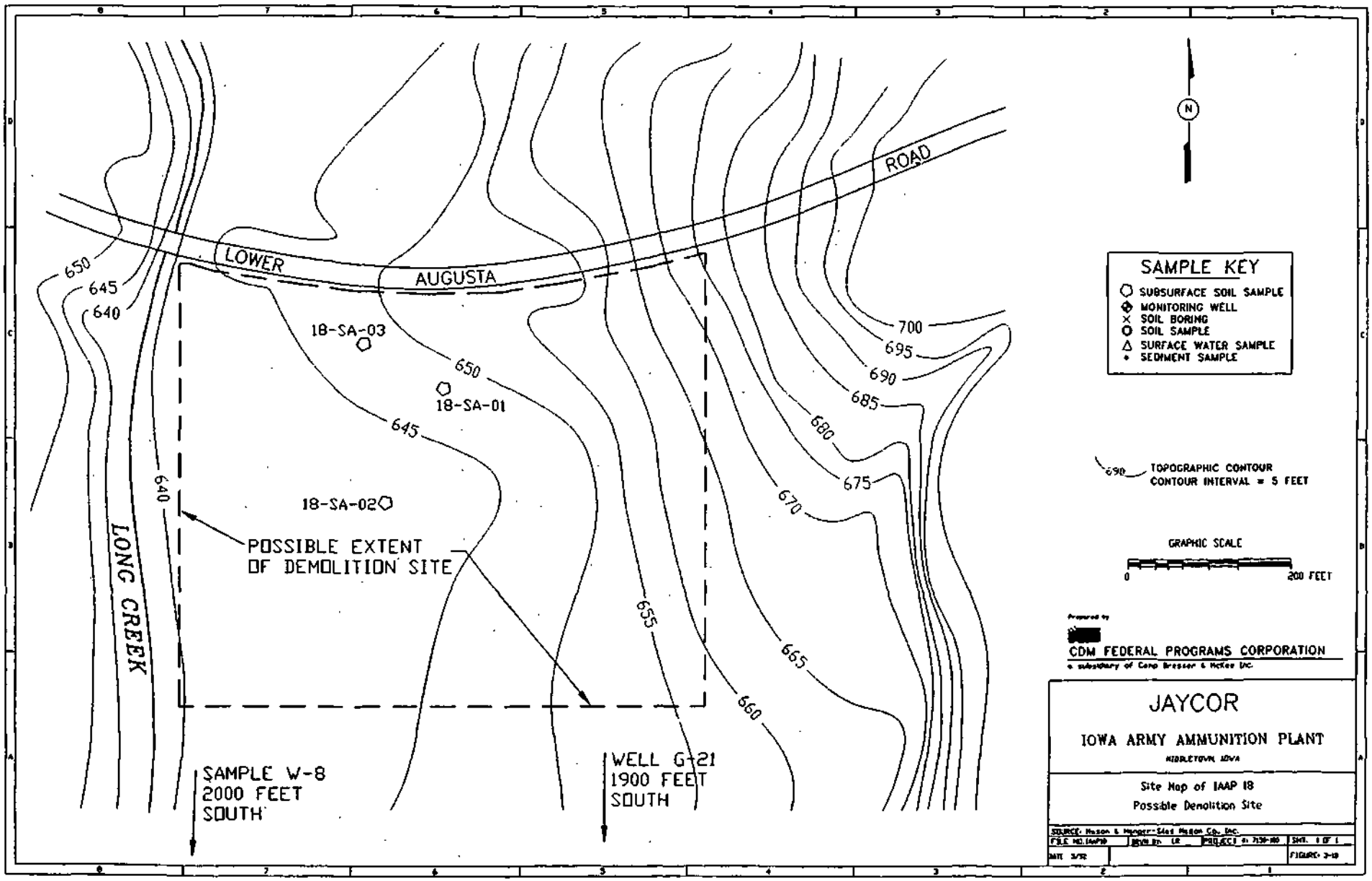
METERS: 0 15 30 45 60 75
FEET: 0 125 250

Tetra Tech Inc.

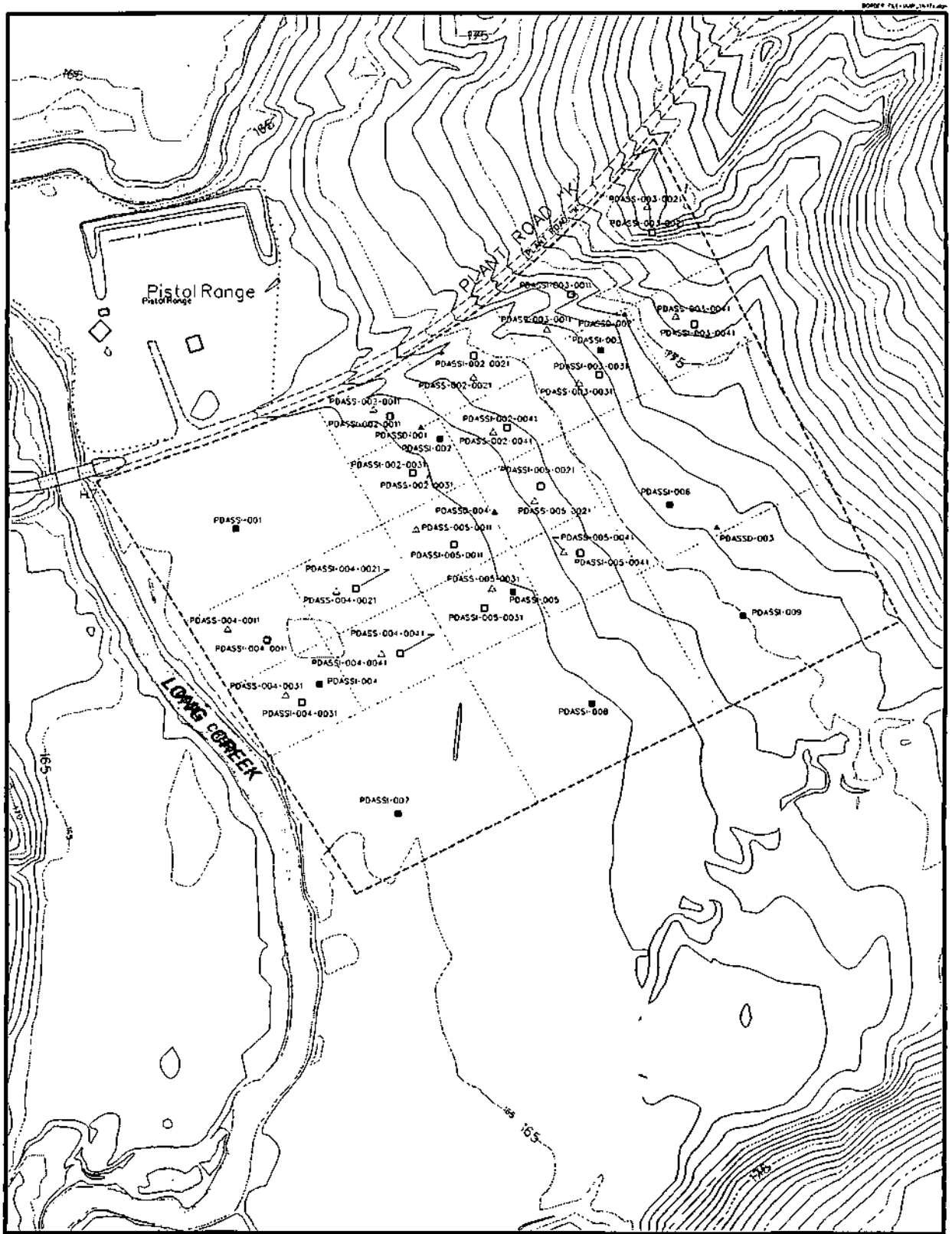
OAK RIDGE, TENNESSEE

FIGURE 3-4
SAMPLE LOCATION MAP
OLD FLYASH WASTE PILE
(IAAP-015)

Source: Work Plan for Supplemental Remedial Investigation - Operable Unit 4 - Draft - October 2004



Source: Final Work Plan - Phase 1 Remedial Investigation/Feasibility Study - June 1992 (Site Investigation)



CAD FILENAME:
DATE: 10-29-04
SOURCE: 1) Base map from 1998 aerial survey
2) monitoring well locations have not been verified

ALL COORDINATES ARE ON THE IOWA STATE PLANE COORDINATE SYSTEM SOUTH ZONE IN METERS BASED ON THE NAD83 ADJUSTMENT OF 1996. THE VERTICAL CONTROL REFERENCE DATUM IS NAVD88

OU4 REMEDIAL INVESTIGATION
WORK PLAN
IOWA ARMY AMMUNITION PLANT
MIDDLETOWN, IOWA

LEGEND

- PDASSI-004-0031 □ SECONDARY INCREMENTAL SOIL SAMPLE
- PDASS-004 △ SECONDARY DISCRETE SHALLOW SOIL SAMPLE
- SS-001 ■ INITIAL INCREMENTAL SOIL SAMPLE (INCW)
- SS-004 ▲ INITIAL DISCRETE SHALLOW SOIL SAMPLE (DISW)
- 190 GROUND SURFACE CONTOUR (1m INTERVAL)
- SITE BOUNDARY
- GRID LINE

-N-

NOTES

1) EXISTING SOIL SAMPLES TAKEN FROM 2004 IAAAA ENGINEERS, INC. WORK PLAN.
2) ACTUAL SAMPLE LOCATIONS WILL BE DETERMINED DURING FIELD WORK.

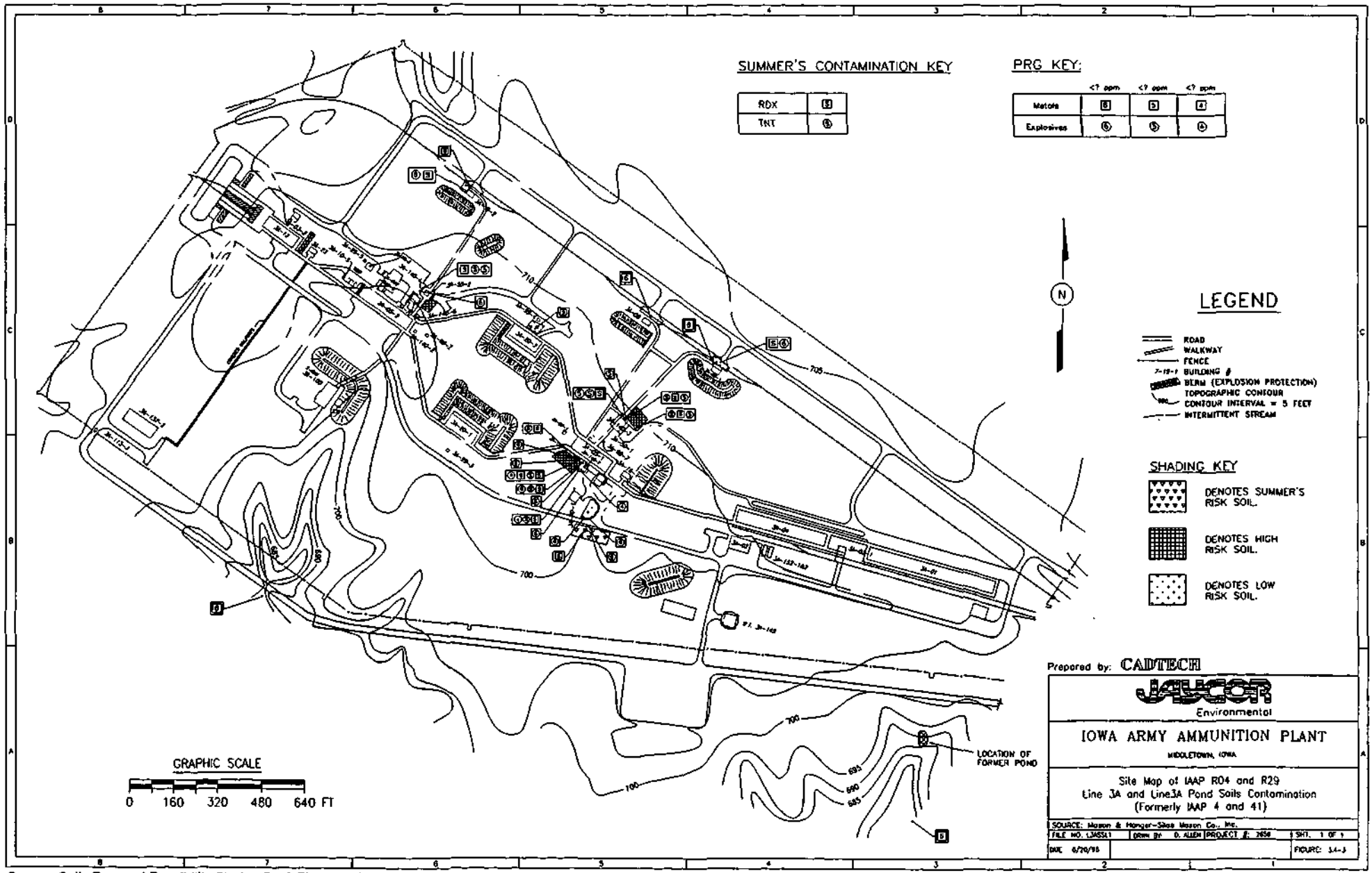
METERS 0 15 30 45 60 75
FEET 0 50 100 150 200 250

Tetra Tech Inc.

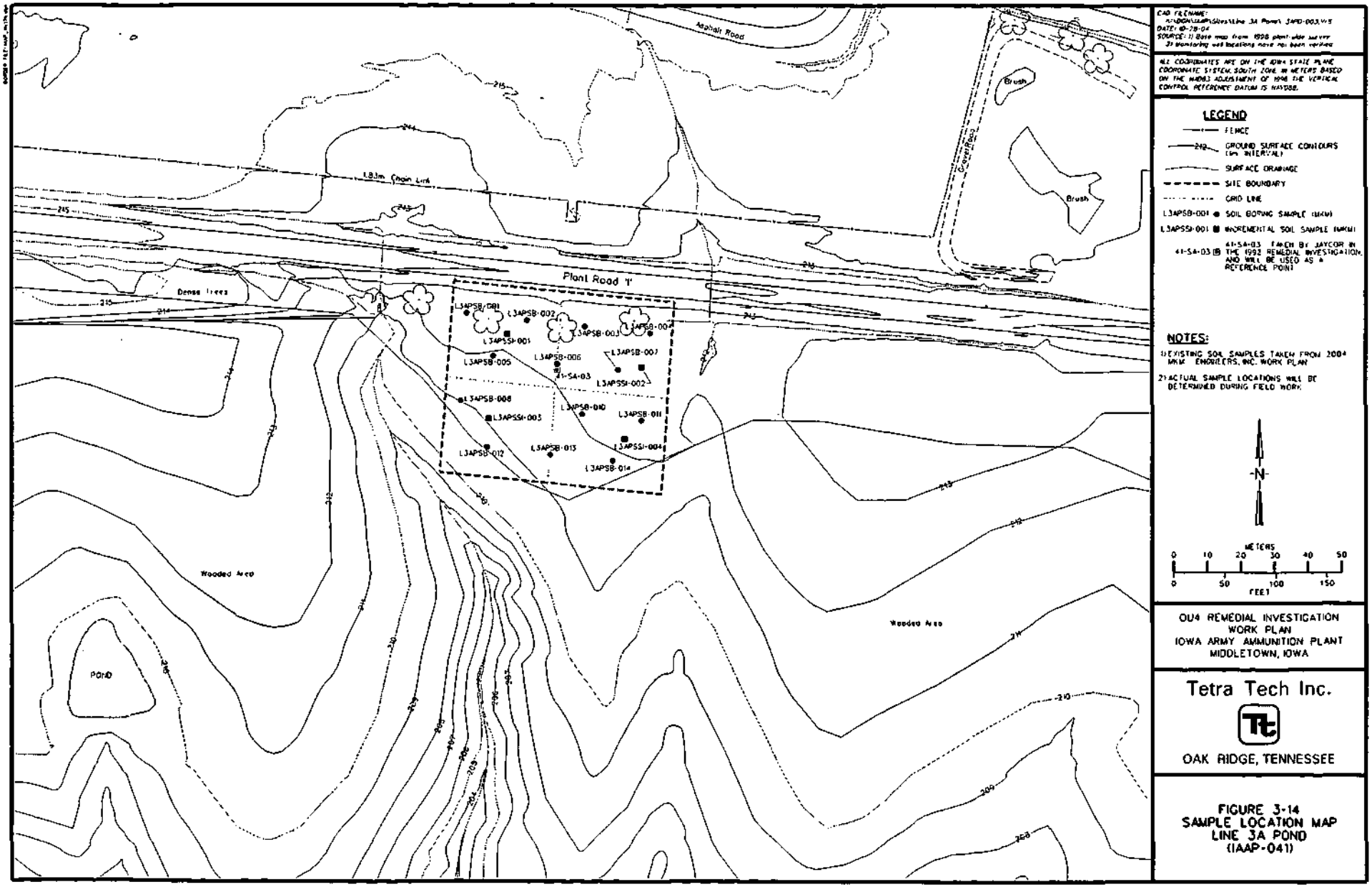
OAK RIDGE, TENNESSEE

FIGURE 3-7
SECONDARY SAMPLE
LOCATION MAP
POSSIBLE DEMOLITION SITE
(IAAP-018)

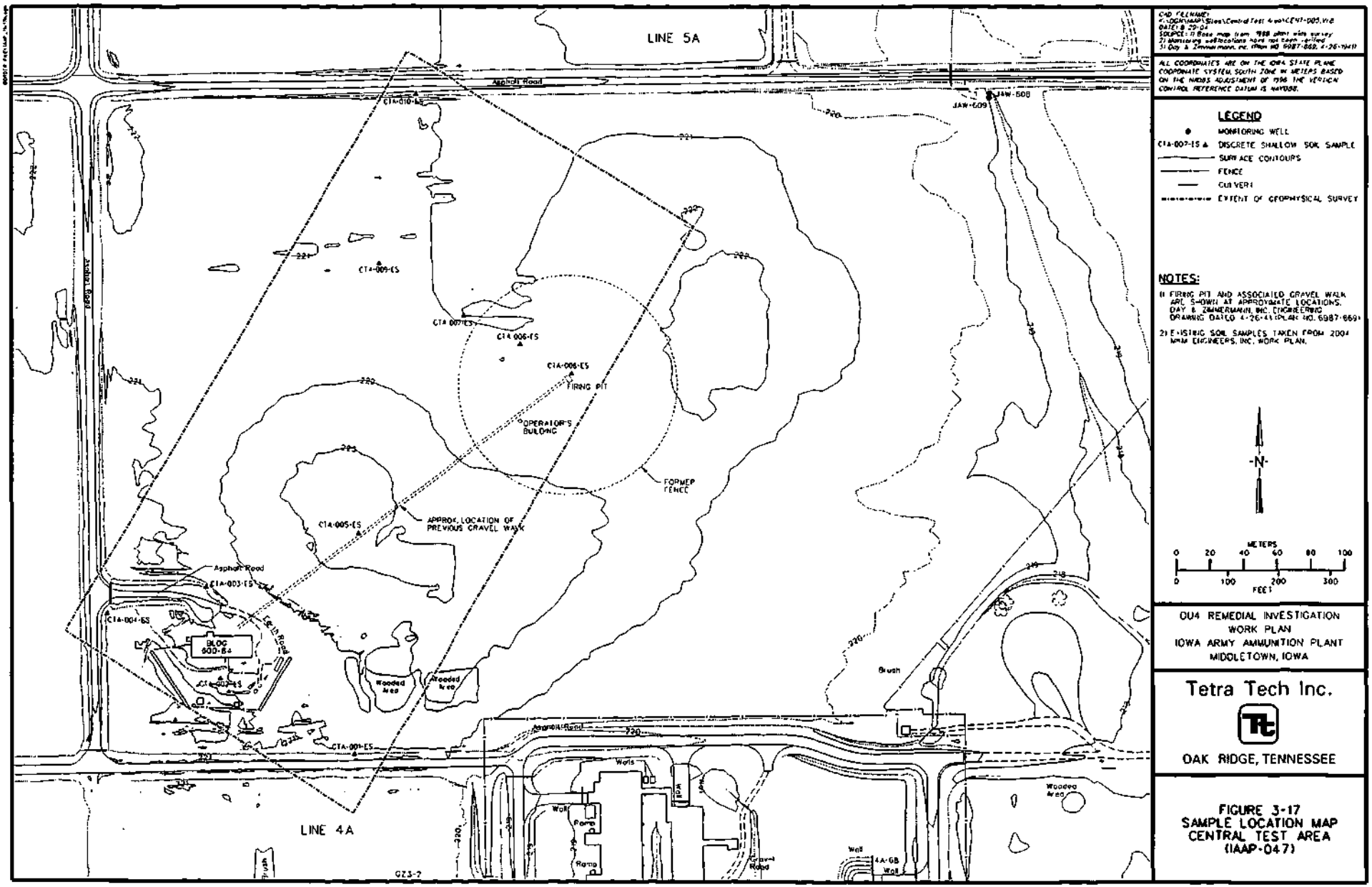
Source: Work Plan for Supplemental Remedial Investigation - Operable Unit 4 - Draft - October 2004



Source: Soils Focused Feasibility Study - Draft Final - 08 May 1997



Source: Work Plan for Supplemental Remedial Investigation - Operable Unit 4 - Draft - October 2004



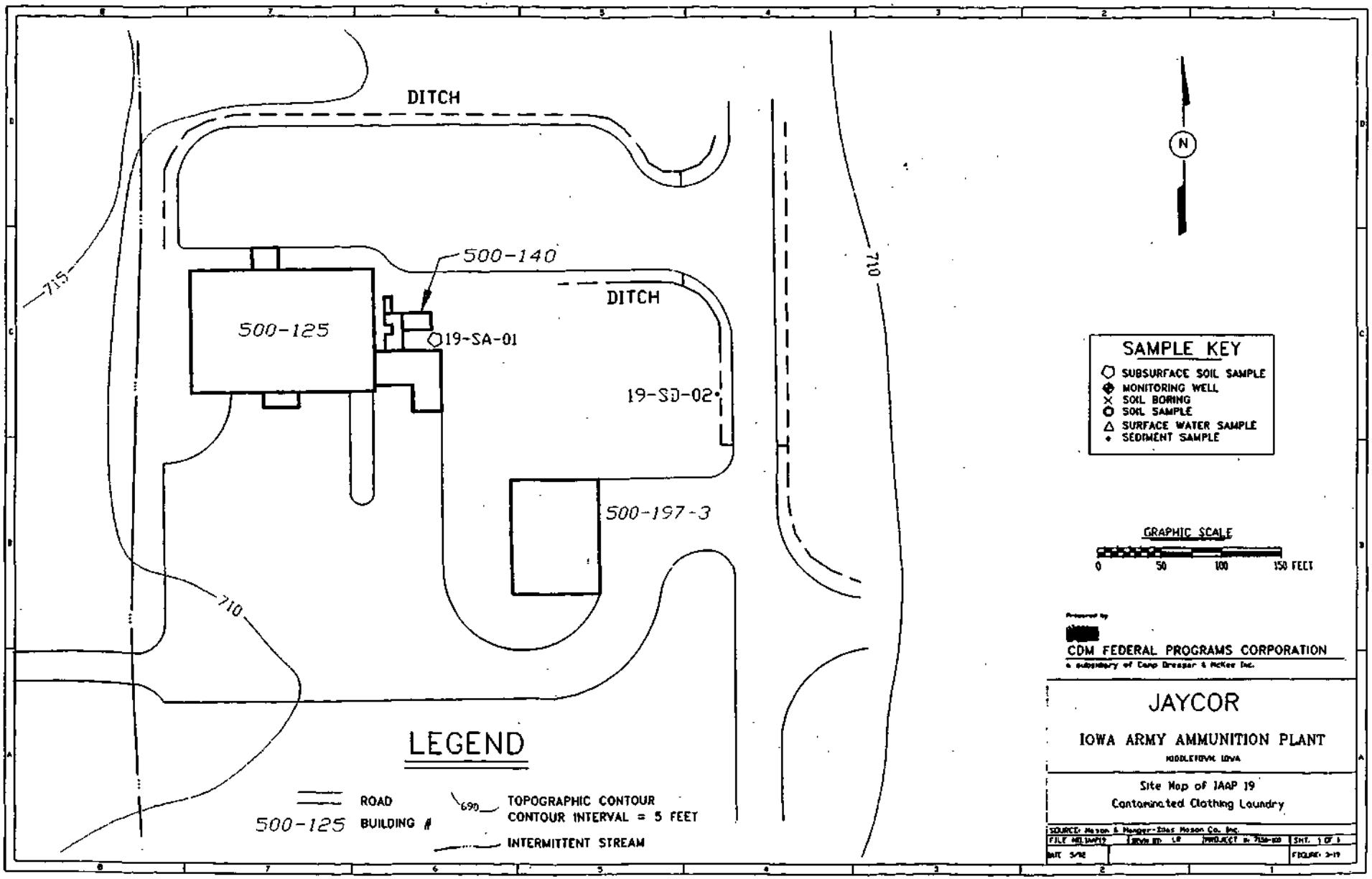
OU4 REMEDIAL INVESTIGATION
WORK PLAN
IOWA ARMY AMMUNITION PLANT
MIDDLETOWN, IOWA

Tetra Tech Inc.

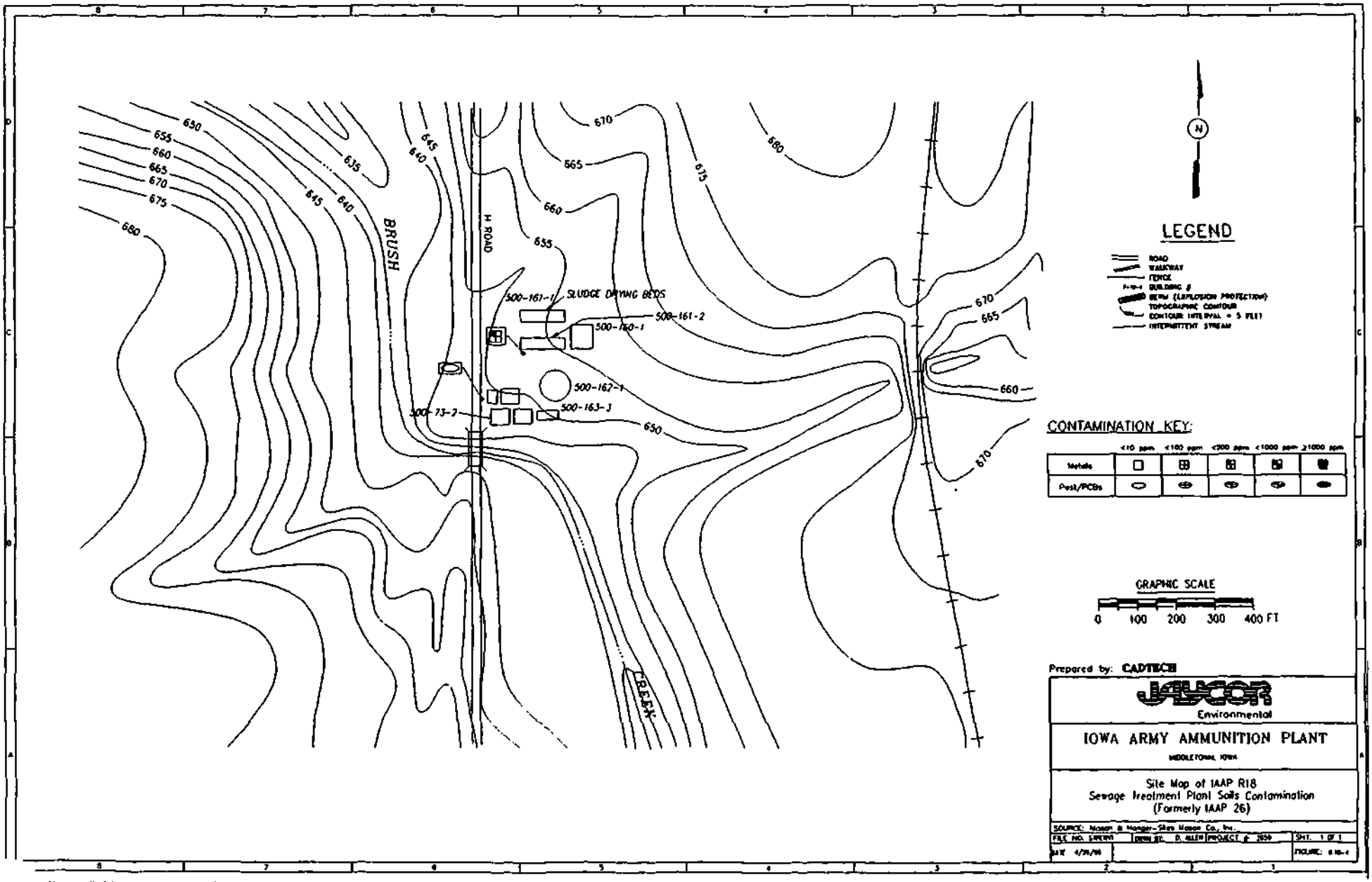
OAK RIDGE, TENNESSEE

FIGURE 3-17
SAMPLE LOCATION MAP
CENTRAL TEST AREA
(IAAP-047)

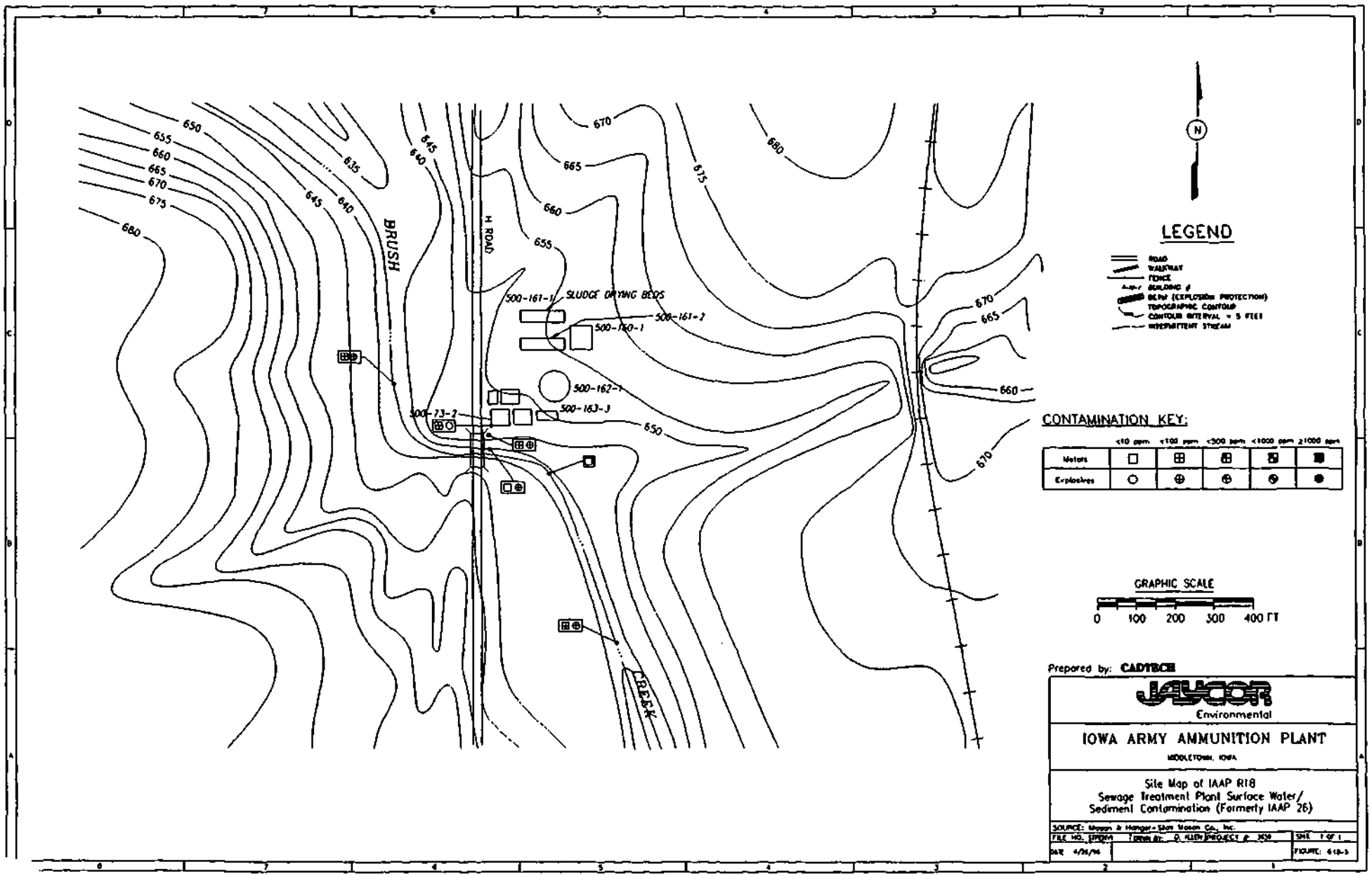
Source: Work Plan for Supplemental Remedial Investigation - Operable Unit 4 - Draft - October 2004



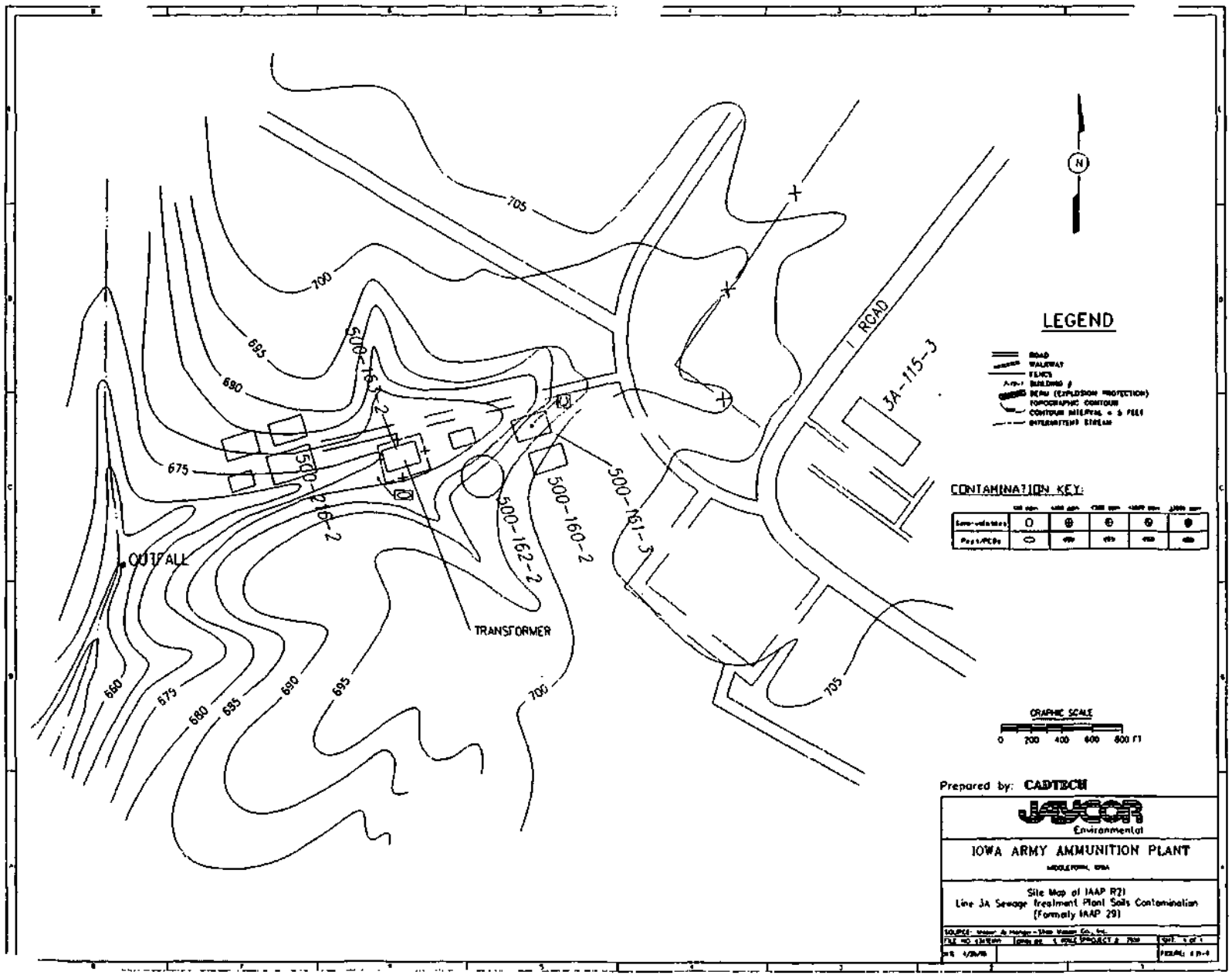
Source: Final Work Plan - Phase 1 Remedial Investigation/Feasibility Study - June 1992 (Site Investigation)



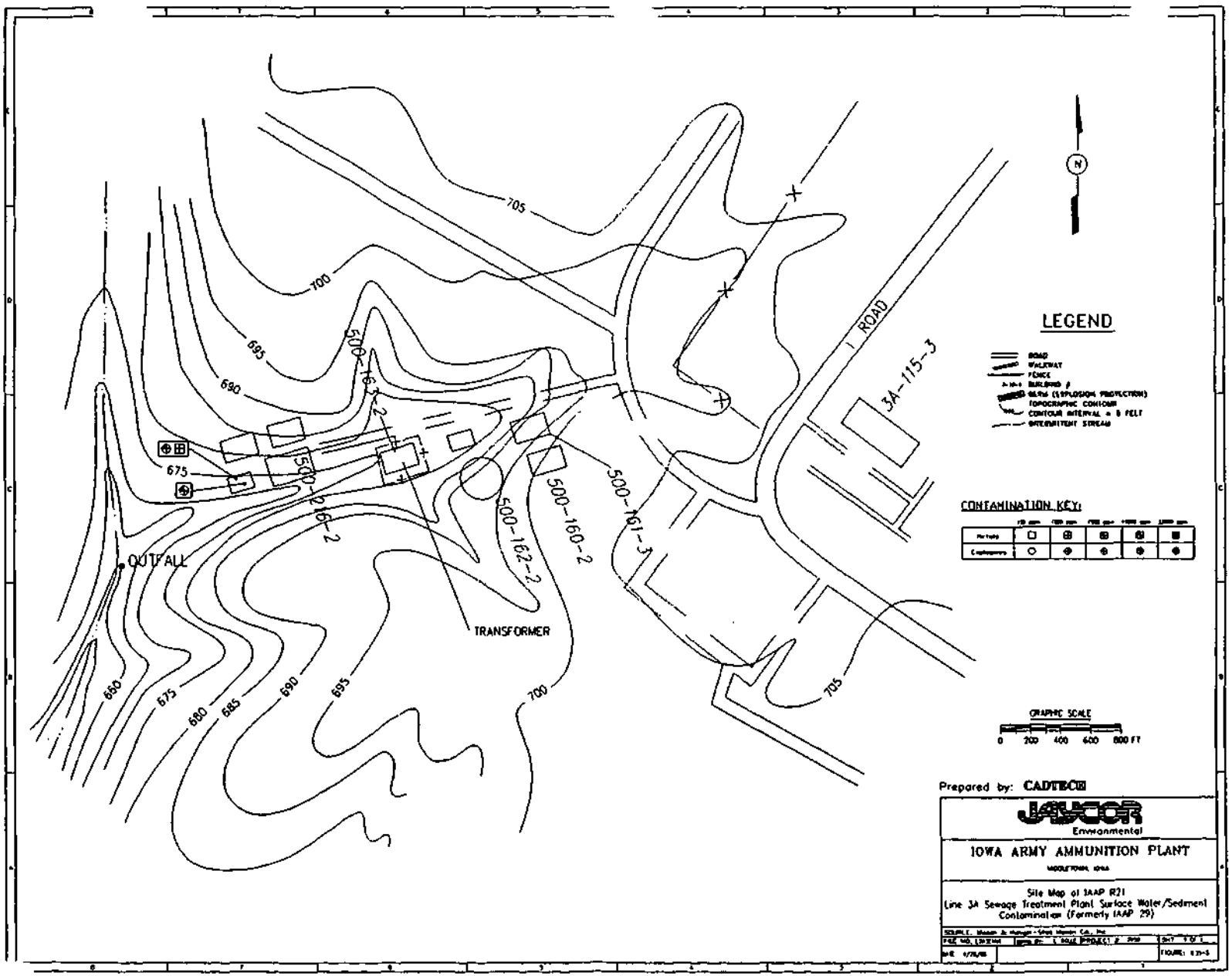
Source: Remedial Investigation/Risk Assessment - Revised Draft Final - 21 May 1996



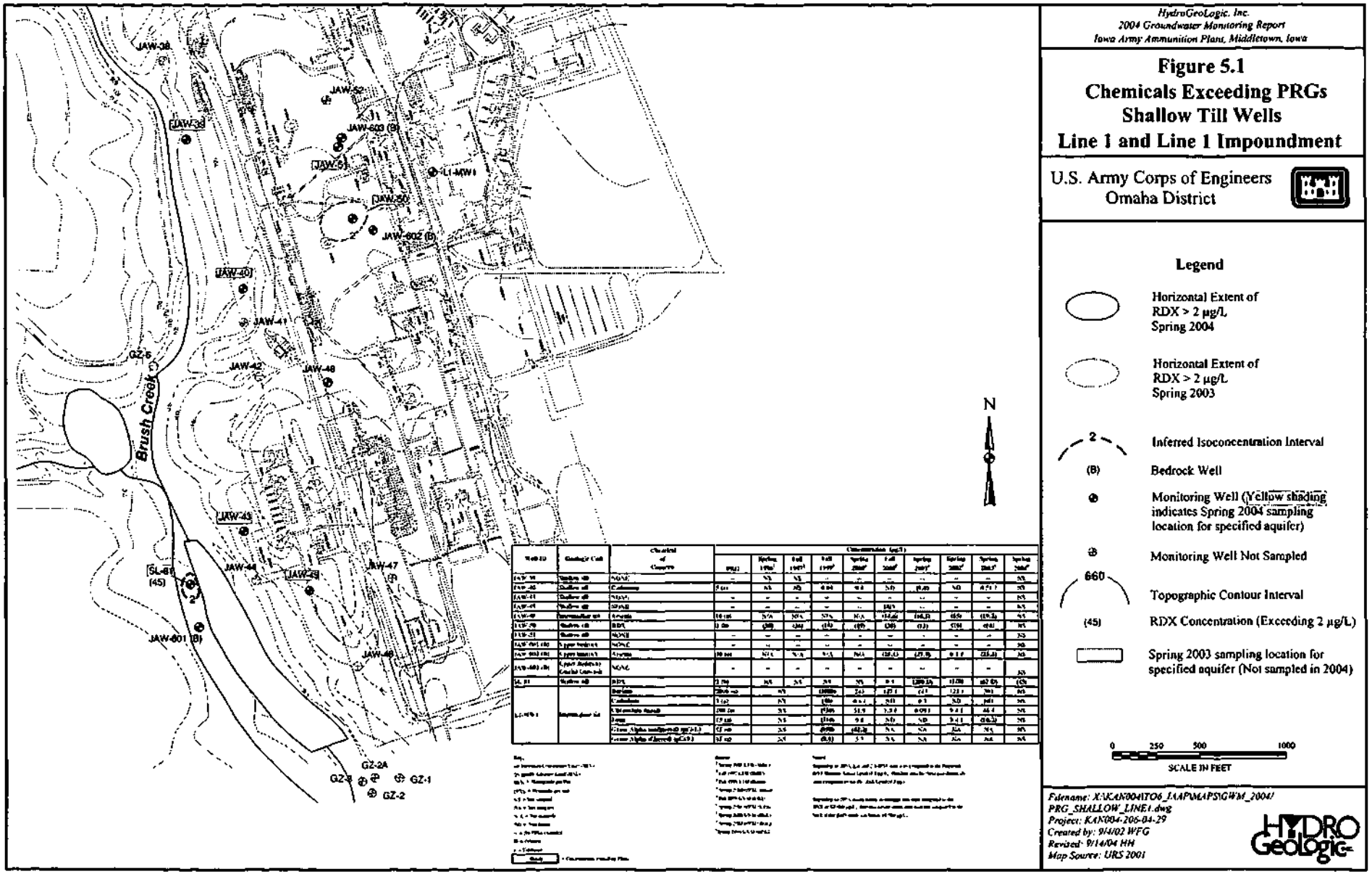
Source: Remedial Investigation/Risk Assessment - Revised Draft Final - 21 May 1996



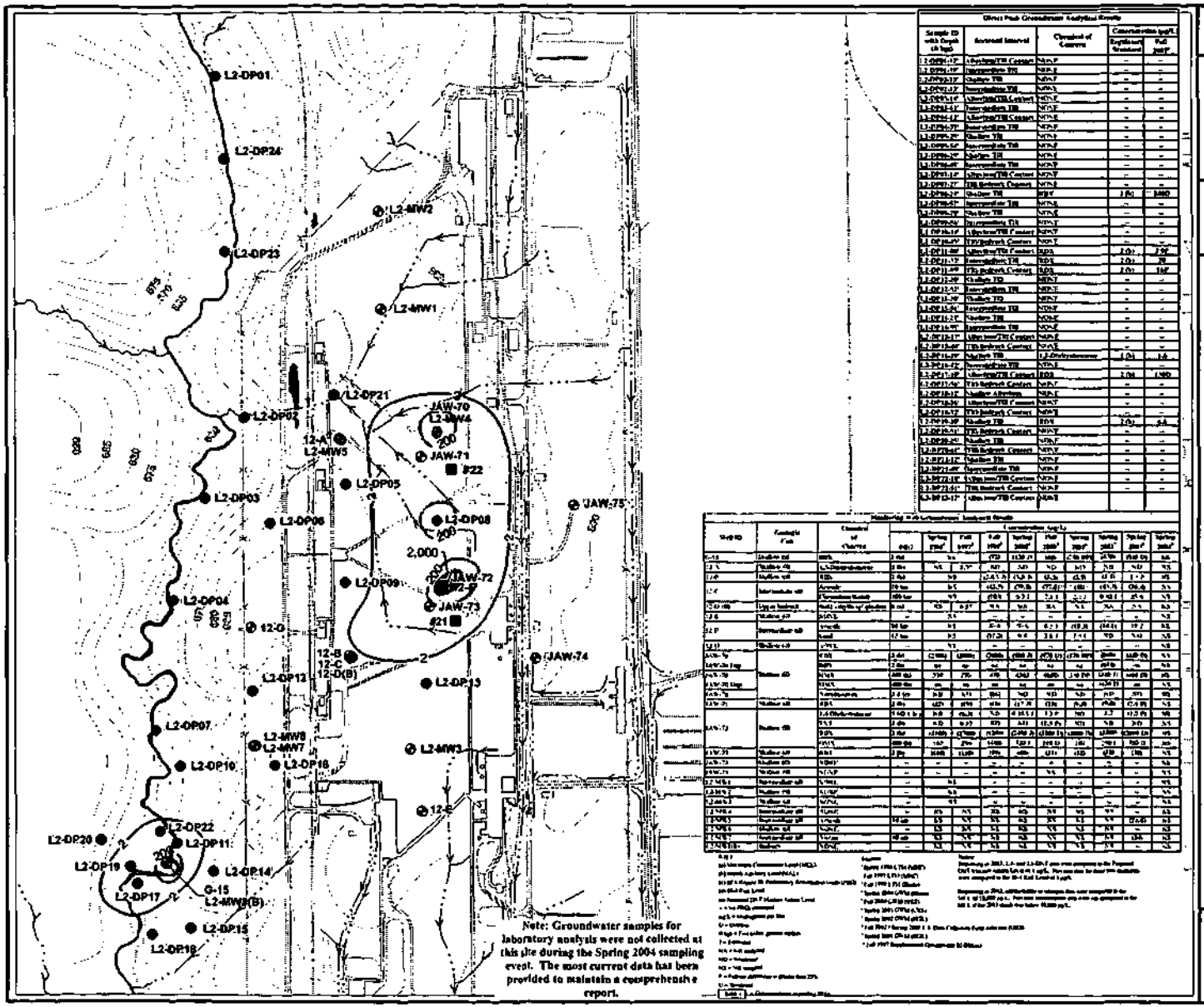
Source: Remedial Investigation/Risk Assessment - Revised Draft Final - 21 May 1996



Source: Remedial Investigation/Risk Assessment - Revised Draft Final - 21 May 1996



Source: 2004 Groundwater Monitoring Report - Draft - October 2004



HydroGeoLogic, Inc.
2004 Groundwater Monitoring Report
Iowa Army Ammunition Plant, Middletown, Iowa

Figure 5.2 a
Chemicals Exceeding PRGs
Shallow Till Wells
Line 2

U.S. Army Corps of Engineers
Omaha District

Legend

- Monitoring Well
- (B) Bedrock Well
- #21 NPDES Outfall
- JAW-74 Shallow Till Monitoring Well Sample Location, Spring 2003
- L2-DP13 Direct Push Groundwater Sample Location, Fall 2002
- 2 Horizontal Extent of RDX>2 µg/L in Shallow Till, Fall 2002/Spring 2003
- 200 Horizontal Extent of RDX>200 µg/L in Shallow Till, Fall 2002/Spring 2003
- 2,000 Horizontal Extent of RDX>2000 µg/L in Shallow Till, Fall 2002/Spring 2003

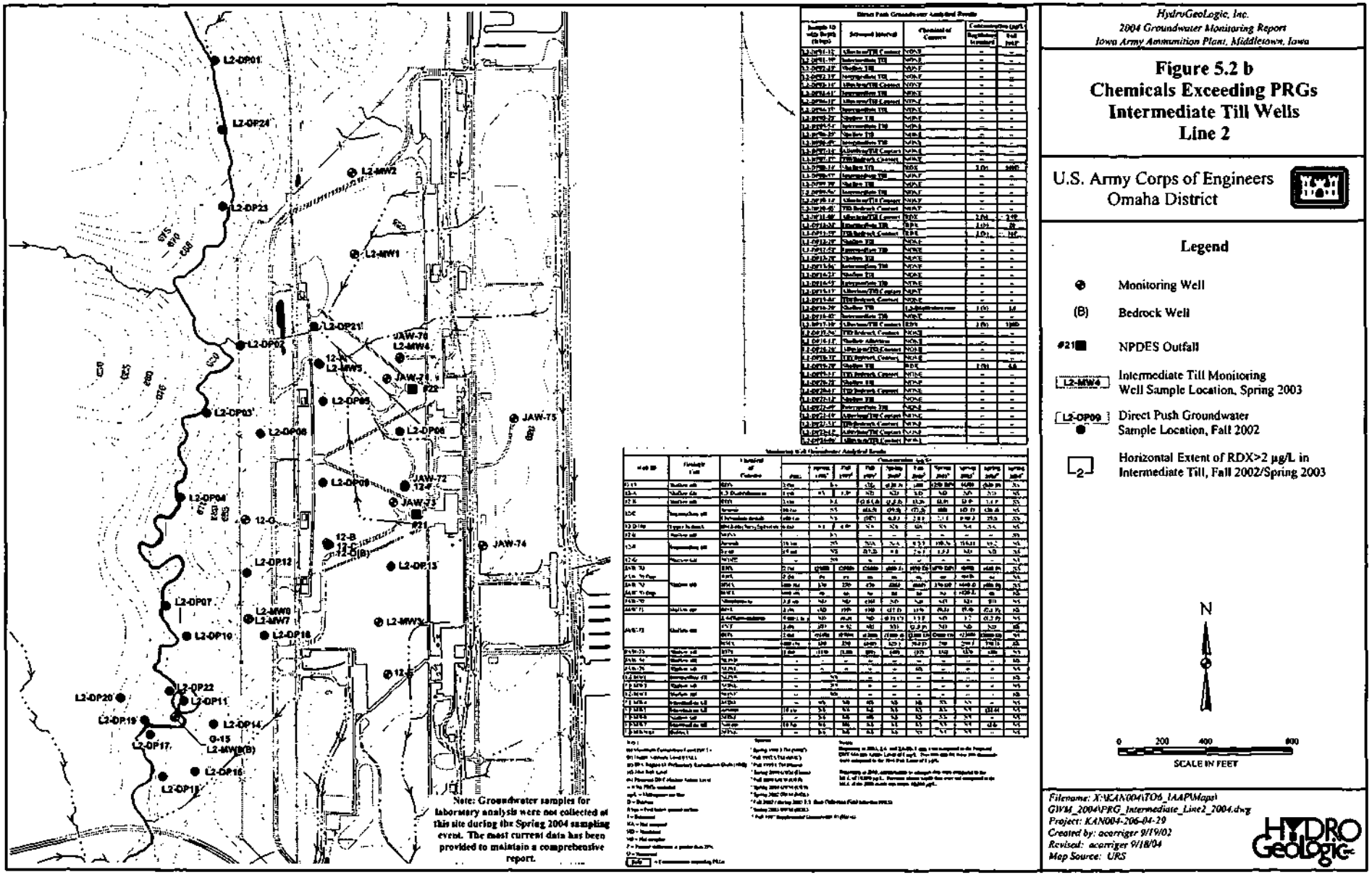
N

0 200 400 800
SCALE IN FEET

Filename: X:\KAN004\TO6_IAAP\Apps\GWM_2004\PRG_Shallow_Line2_2004.shwg
Project: KAN004-206-04-29
Created by: acorriger 09/18/04
Revised: acorriger 9/21/04
Map Source: URS

HydroGeoLogic

Source: 2004 Groundwater Monitoring Report - Draft - October 2004



HydroGeoLogic, Inc.
2004 Groundwater Monitoring Report
Iowa Army Ammunition Plant, Middletown, Iowa

Figure 5.2 b
Chemicals Exceeding PRGs
Intermediate Till Wells
Line 2

U.S. Army Corps of Engineers
Omaha District

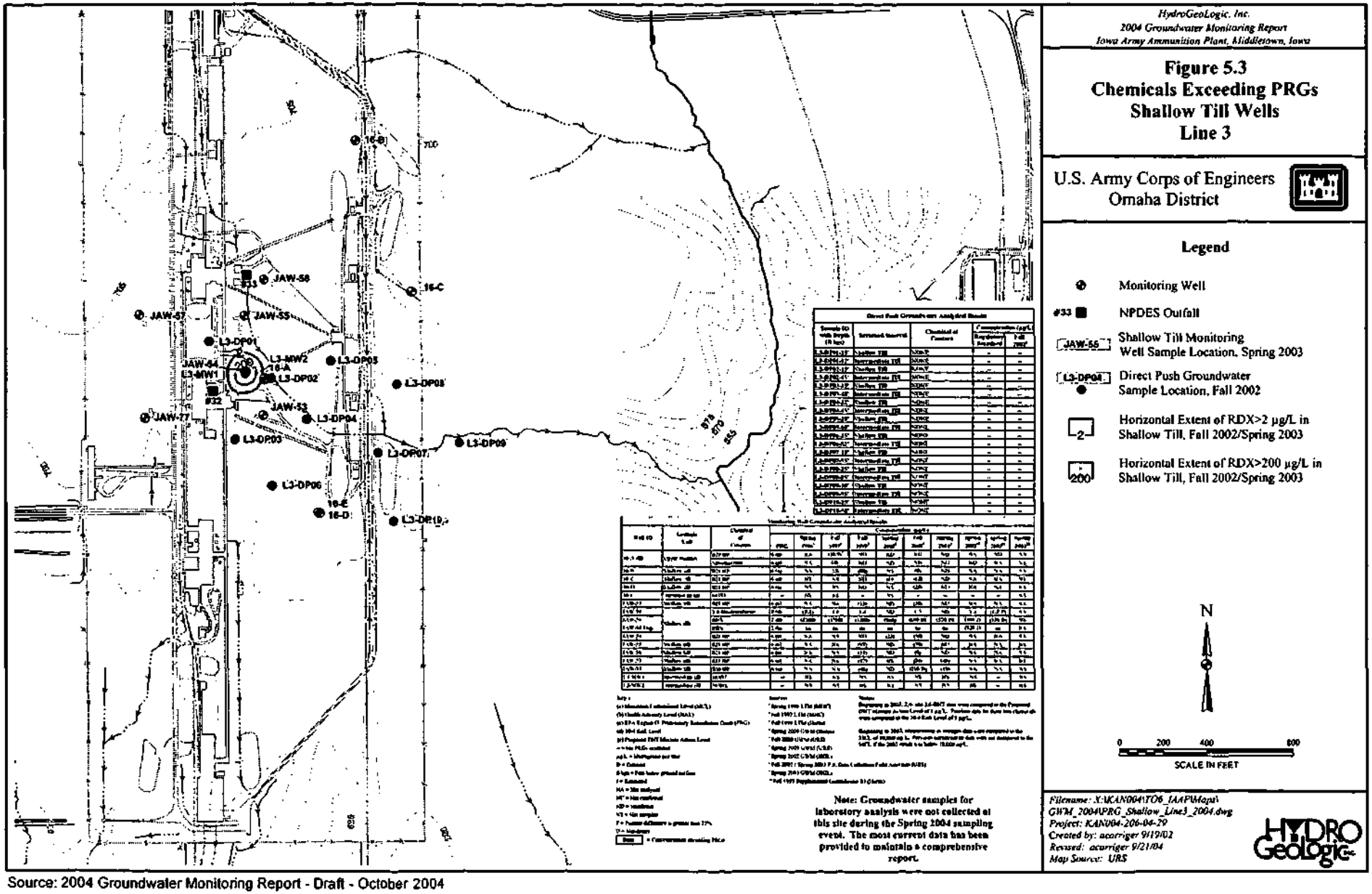
Legend

- Monitoring Well
- (B) Bedrock Well
- #21 NPDES Outfall
- L2-MW4 Intermediate Till Monitoring Well Sample Location, Spring 2003
- L2-DP09 Direct Push Groundwater Sample Location, Fall 2002
- Horizontal Extent of RDX>2 µg/L in Intermediate Till, Fall 2002/Spring 2003

Filename: X:\KAN004\TO6_IAAP\Maps\GWM_2004\PRG_Intermediate_Line2_2004.dwg
Project: KAN004-206-04-29
Created by: acarriger 9/19/02
Revised: acarriger 9/18/04
Map Source: URS

HYDRO GeoLogic

Source: 2004 Groundwater Monitoring Report - Draft - October 2004



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2004 Groundwater Monitoring Report
Iowa Army Ammunition Plant, Middletown, Iowa

Figure 5.3
Chemicals Exceeding PRGs
Shallow Till Wells
Line 3

U.S. Army Corps of Engineers
Omaha District

Legend

- Monitoring Well
- #33 NPDES Outfall
- JAW-55 Shallow Till Monitoring Well Sample Location, Spring 2003
- L3-DP04 Direct Push Groundwater Sample Location, Fall 2002
- 2 Horizontal Extent of RDX>2 µg/L in Shallow Till, Fall 2002/Spring 2003
- 200 Horizontal Extent of RDX>200 µg/L in Shallow Till, Fall 2002/Spring 2003

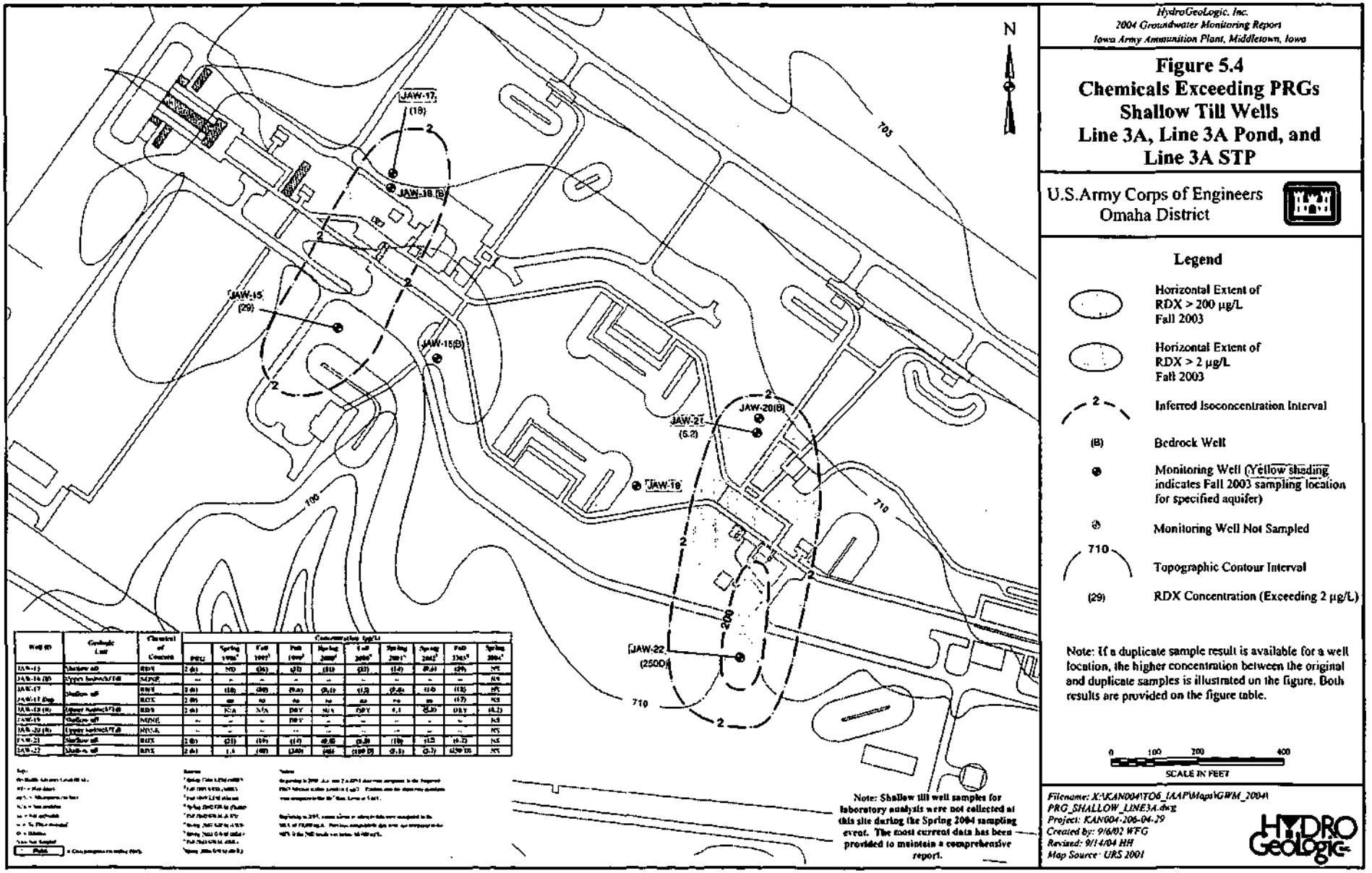
N

0 200 400 800
SCALE IN FEET

Filename: X:\KAN004\TO6_IAAP\Maps\GWM_2004\PRG_Shallow_Line3_2004.dwg
Project: KAN004-206-04-29
Created by: acarriger 9/19/02
Revised: acarriger 9/21/04
Map Source: URS

HydroGeoLogic

Source: 2004 Groundwater Monitoring Report - Draft - October 2004



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2004 Groundwater Monitoring Report
Iowa Army Ammunition Plant, Middletown, Iowa

Figure 5.4
Chemicals Exceeding PRGs
Shallow Till Wells
Line 3A, Line 3A Pond, and Line 3A STP

U.S.Army Corps of Engineers
Omaha District

Legend

- Horizontal Extent of RDX > 200 µg/L Fall 2003
- Horizontal Extent of RDX > 2 µg/L Fall 2003
- 2 — Inferred Isoconcentration Interval
- (B) — Bedrock Well
- Monitoring Well (Yellow shading indicates Fall 2003 sampling location for specified aquifer)
- Monitoring Well Not Sampled
- 710 — Topographic Contour Interval
- (29) — RDX Concentration (Exceeding 2 µg/L)

Note: If a duplicate sample result is available for a well location, the higher concentration between the original and duplicate samples is illustrated on the figure. Both results are provided on the figure table.

0 100 200 400
SCALE IN FEET

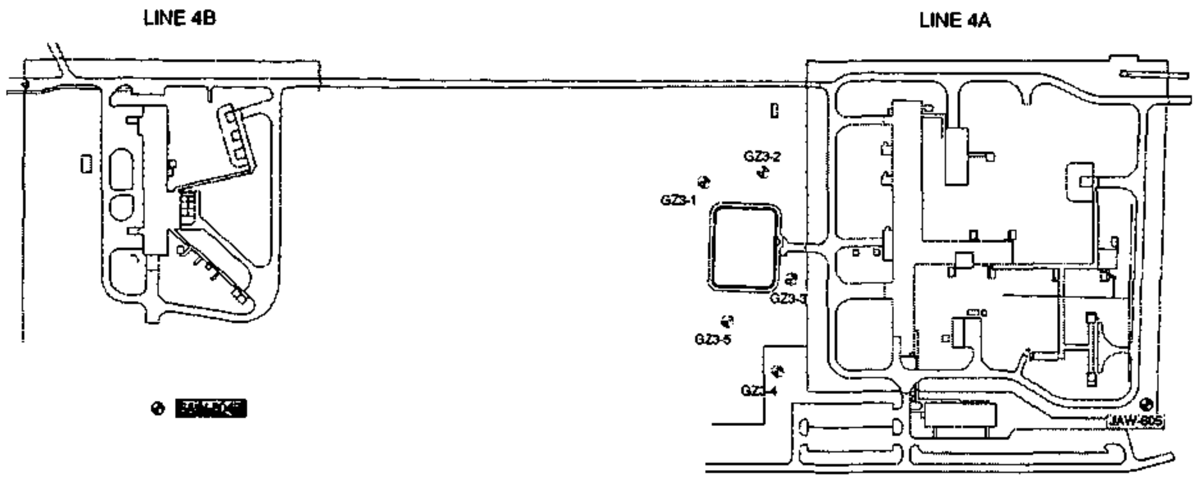
Filename: X:\KAN004\TO6_IAAP\Maps\GWM_2004\PRG_SHALLOW_LINE3A.dwg
Project: KAN004-206-04-J9
Created by: 9/8/02 WFG
Revised: 9/14/04 HH
Map Source: URS 2001

HydroGeoLogic

Source: 2004 Groundwater Monitoring Report - Draft - October 2004

Figure 5.5
Chemicals Exceeding PRGs Shallow Till Wells Line 4A and 4B

U.S. Army Corps of Engineers
Omaha District



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[illegible]	[illegible]	[illegible]	[illegible]	NA	NA	[illegible]	ND	ND	ND	ND	[illegible]			
		[illegible]	[illegible]	N/A	[illegible]	[illegible]	[illegible]	[illegible]	ND	NA				
[illegible]	[illegible]	[illegible]	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	–	–	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	N/A	NA	[illegible]	ND	[illegible]	ND	NA	NA	[illegible]	[illegible]

Legend

(B) Bedrock Well

Monitoring Well

(Yellow shading indicates Spring 2003 sampling location for specified aquifer)

(Green shading indicates Spring and Fall 2003 sampling location for specified aquifer)

Monitoring Well Not Sampled

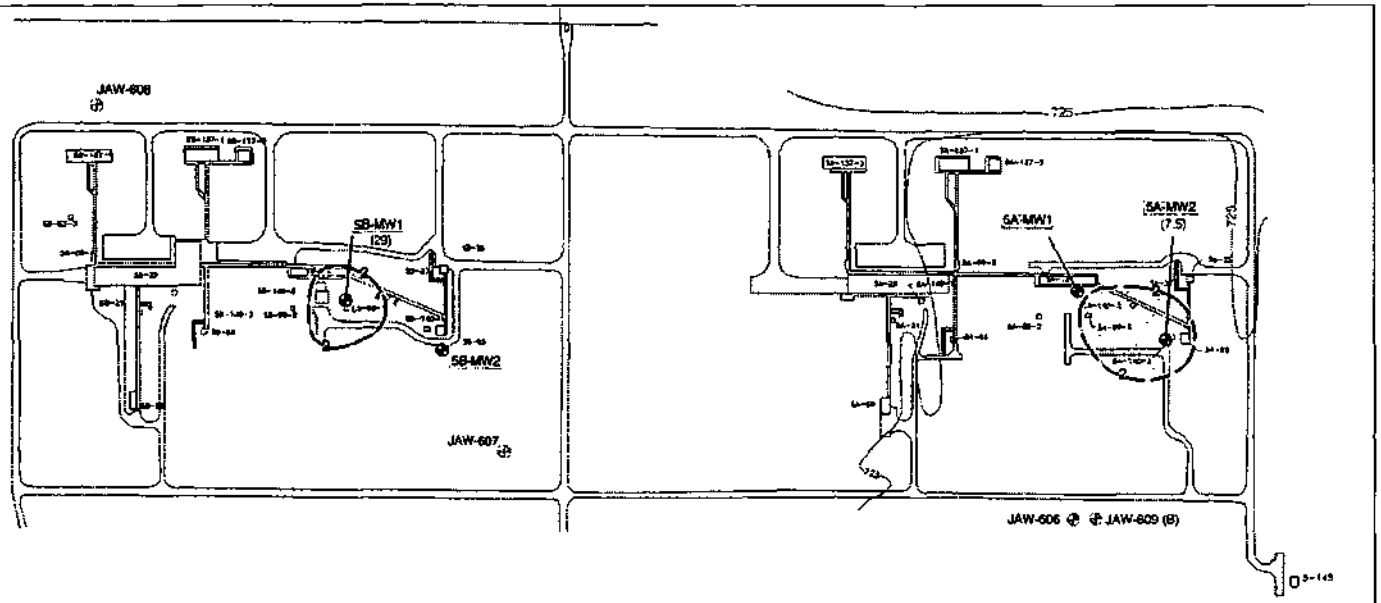
N

0 150 300 600
SCALE IN FEET

Note: Groundwater samples for laboratory analysis were not collected at this site during the Spring 2004 sampling event. The most current data has been provided to maintain a comprehensive report.

Filename: X:\KAN004\TO6_IAAP\Maps\GWM_2004\PRG_SHALLOW_LINE4.dwg
Project: KAN004-206-04-29
Created by: 9/9/02 WFG
Revised: 9/14/04 HH
Map Source: URS 2001

Source: 2004 Groundwater Monitoring Report - Draft - October 2004



Well ID	Geologic Unit	Chemical of Concern	Concentration (µg/L)										
			PRG	1999	2001	Fall 1999	Spring 2003	Fall 2003	Spring 2004	Spring 2004	Spring 2004	Spring 2004	Spring 2004
5A-MW1	Shallow till	RDX	2.00		3.1		(1.7 J)	1.2	(0.3)	(0.39)	ND	ND
		HMX	2.00		3.1		(1.6 J)	(0)	(0.3)	(0.3 J)	1.0	ND
		4,6-DNT	0.05		0.5		0.1	(1.04 B)	ND	ND	ND	ND
5A-MW2	Shallow till	TNT	2.00		2.6		0.9	ND	(1.2)	(0.3)	ND	ND
		RDX	2.00		37.3		1.3 J	1.9	(0.3)	(ND)	(1.0)	ND
		HMX	14.6		9.9		(22.3)	ND	ND	ND	ND	ND
5B-MW1	Shallow till	RDX	2.00		3.1		(6.4 J)	(12)	(46)	(42)	(29)	ND
5B-MW2	Shallow till	*no data	--		3.1		--	--	--	--	--	ND

Note: Groundwater samples for laboratory analysis were not collected at this site during the Spring 2004 sampling event. The most current data has been provided to maintain a comprehensive report.

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Iowa Army Ammunition Plant, Middletown, Iowa

Figure 5.6
Chemicals Exceeding PRGs
Shallow Till Wells
Line 5A and 5B

U.S. Army Corps of Engineers
Omaha District

Legend

- Horizontal Extent of RDX > 2 µg/L Spring 2003
- 2 — Inferred Isoconcentration Interval
- (B) — Bedrock Well
- Monitoring Well (Yellow shading indicates Spring 2003 sampling location for specified aquifer)
- Monitoring Well Not Sampled
- 725 — Topographic Contour Interval
- (29) — RDX Concentration (Exceeding 2 µg/L)

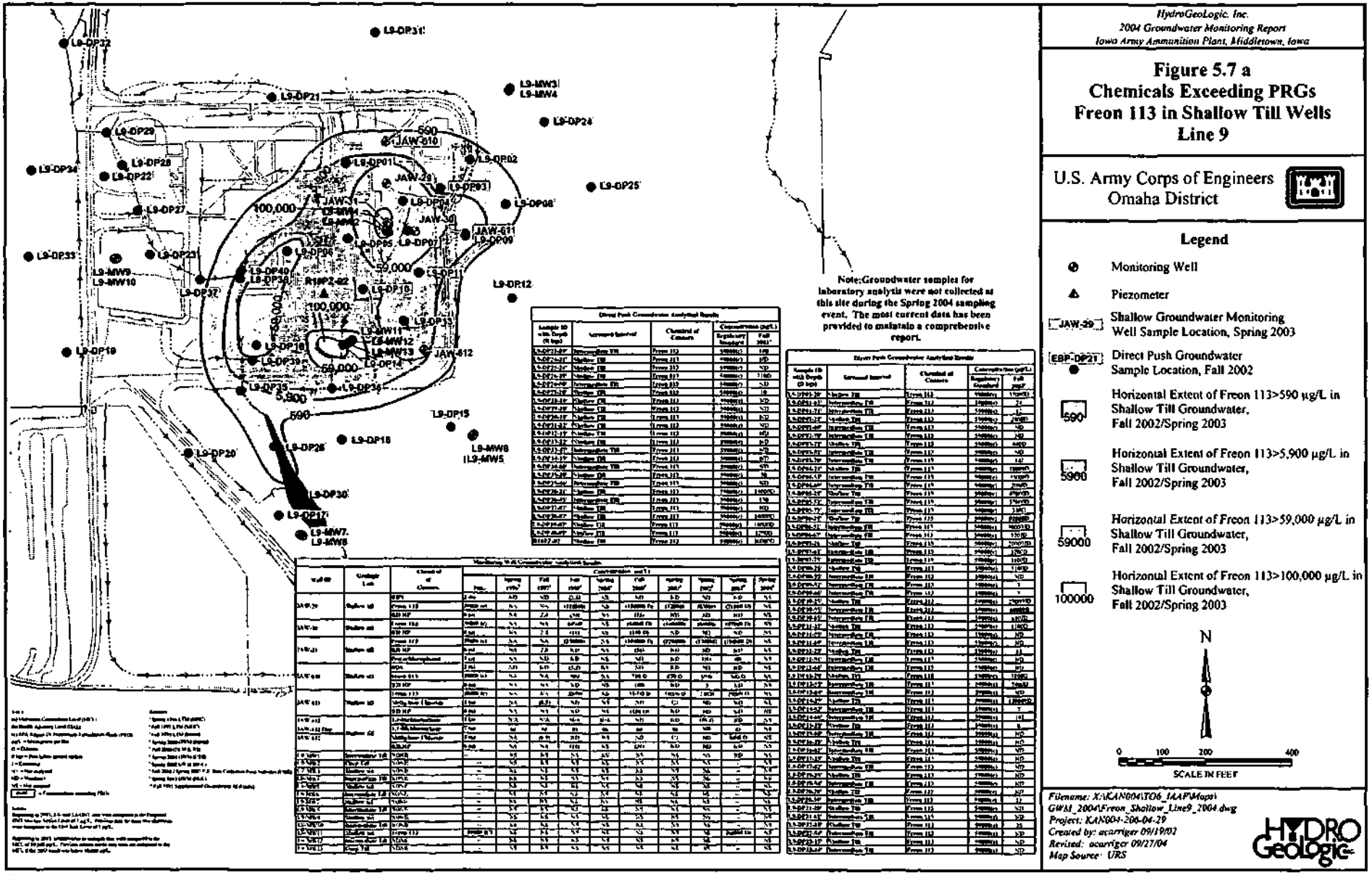
N

0 150 300 600
SCALE IN FEET

Filename: K:\KAN004\T06_IAAP\Maps\GWM_2004\PRG_SHALLOW_LINE5_2004.dwg
Project: KAN004.206-04-29
Created by: 9/16/04 WFG
Revised: 9/14/04 HH
Map Source: URS 2001

HydroGeoLogic

Source: 2004 Groundwater Monitoring Report - Draft - October 2004



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Iowa Army Ammunition Plant, Middletown, Iowa

Figure 5.7 a
Chemicals Exceeding PRGs
Freon 113 in Shallow Till Wells
Line 9

U.S. Army Corps of Engineers
Omaha District

Legend

- Monitoring Well
- Piezometer
- JAW-29 — Shallow Groundwater Monitoring Well Sample Location, Spring 2003
- EBP-DP21 — Direct Push Groundwater Sample Location, Fall 2002
- 590 — Horizontal Extent of Freon 113>590 µg/L in Shallow Till Groundwater, Fall 2002/Spring 2003
- 5900 — Horizontal Extent of Freon 113>5,900 µg/L in Shallow Till Groundwater, Fall 2002/Spring 2003
- 59000 — Horizontal Extent of Freon 113>59,000 µg/L in Shallow Till Groundwater, Fall 2002/Spring 2003
- 100000 — Horizontal Extent of Freon 113>100,000 µg/L in Shallow Till Groundwater, Fall 2002/Spring 2003

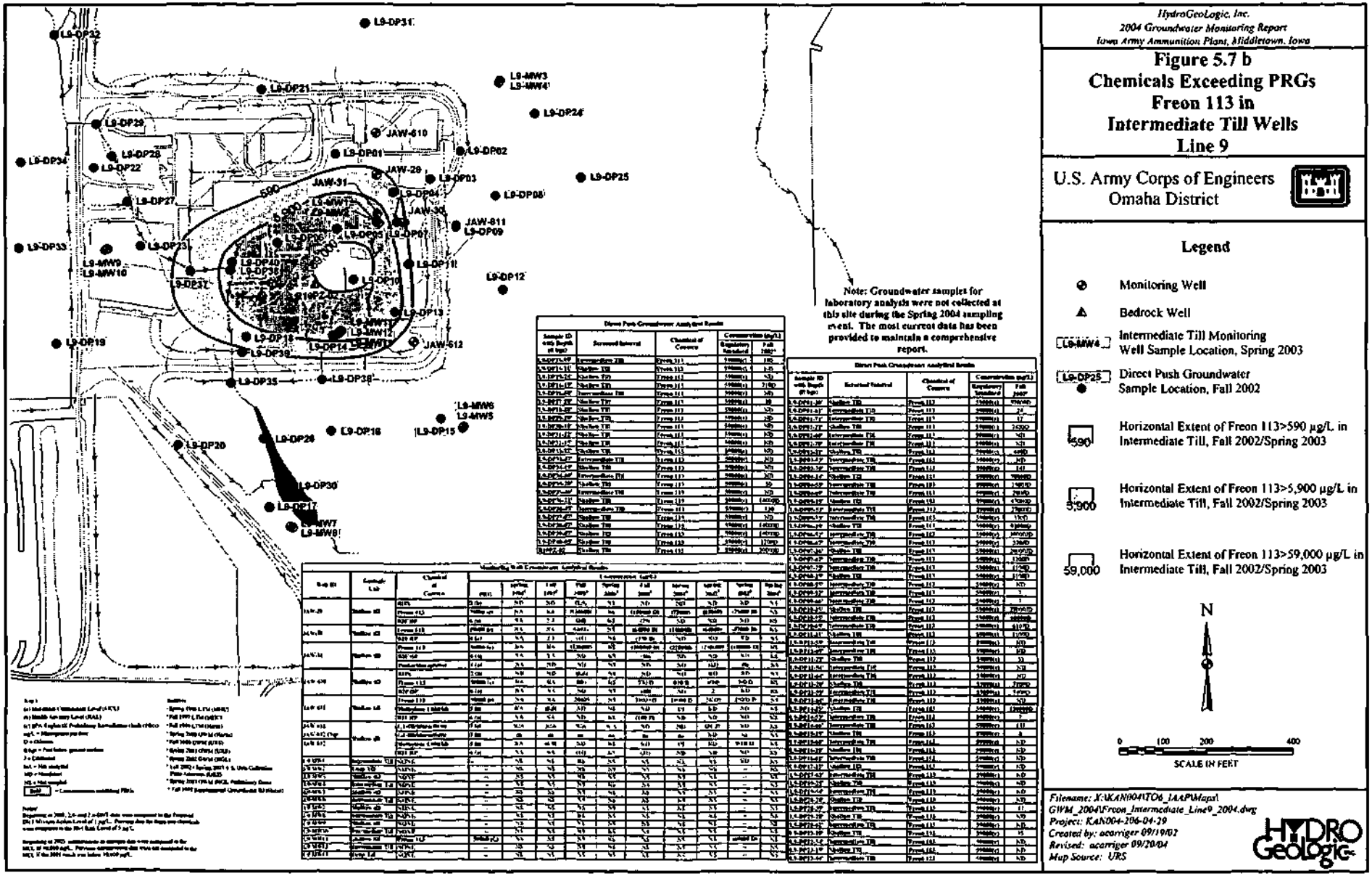
N

0 100 200 400
SCALE IN FEET

Filename: X:\KAN004\TO6_IAAP\Maps\GWM_2004\Freon_Shallow_Line9_2004.dwg
Project: KAN004-206-04-29
Created by: acarriger 09/19/02
Revised: acarriger 09/27/04
Map Source: URS

HYDRO GeoLogic

Source: 2004 Groundwater Monitoring Report - Draft - October 2004



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Iowa Army Ammunition Plant, Middletown, Iowa

Figure 5.7 b
Chemicals Exceeding PRGs
Freon 113 in
Intermediate Till Wells
Line 9

U.S. Army Corps of Engineers
Omaha District

Legend

- Monitoring Well
- Bedrock Well
- L9-MW4 — Intermediate Till Monitoring Well Sample Location, Spring 2003
- L9-DP25 — Direct Push Groundwater Sample Location, Fall 2002
- 590 — Horizontal Extent of Freon 113>590 µg/L in Intermediate Till, Fall 2002/Spring 2003
- 5,900 — Horizontal Extent of Freon 113>5,900 µg/L in Intermediate Till, Fall 2002/Spring 2003
- 59,000 — Horizontal Extent of Freon 113>59,000 µg/L in Intermediate Till, Fall 2002/Spring 2003

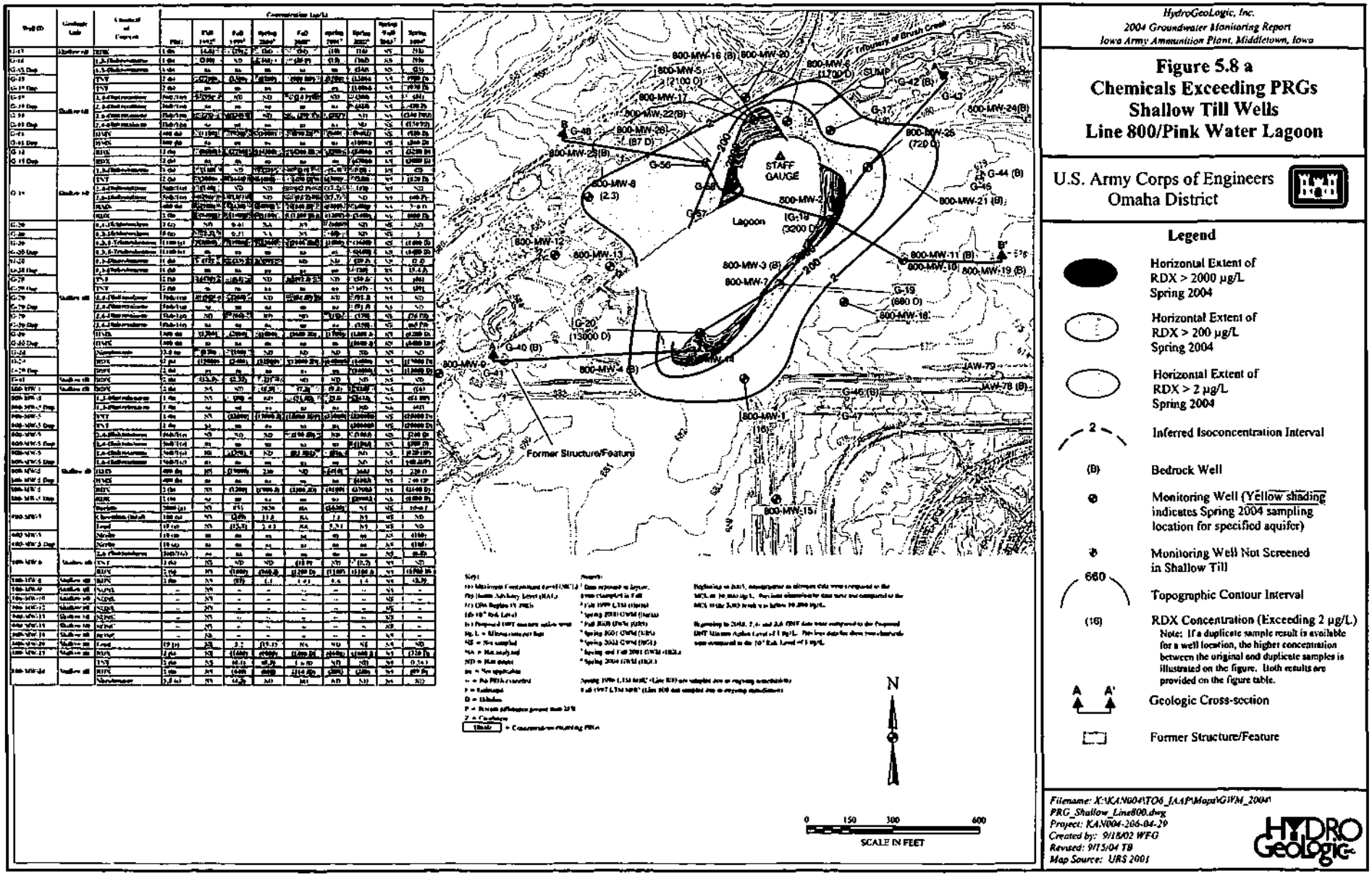
N

0 100 200 400
SCALE IN FEET

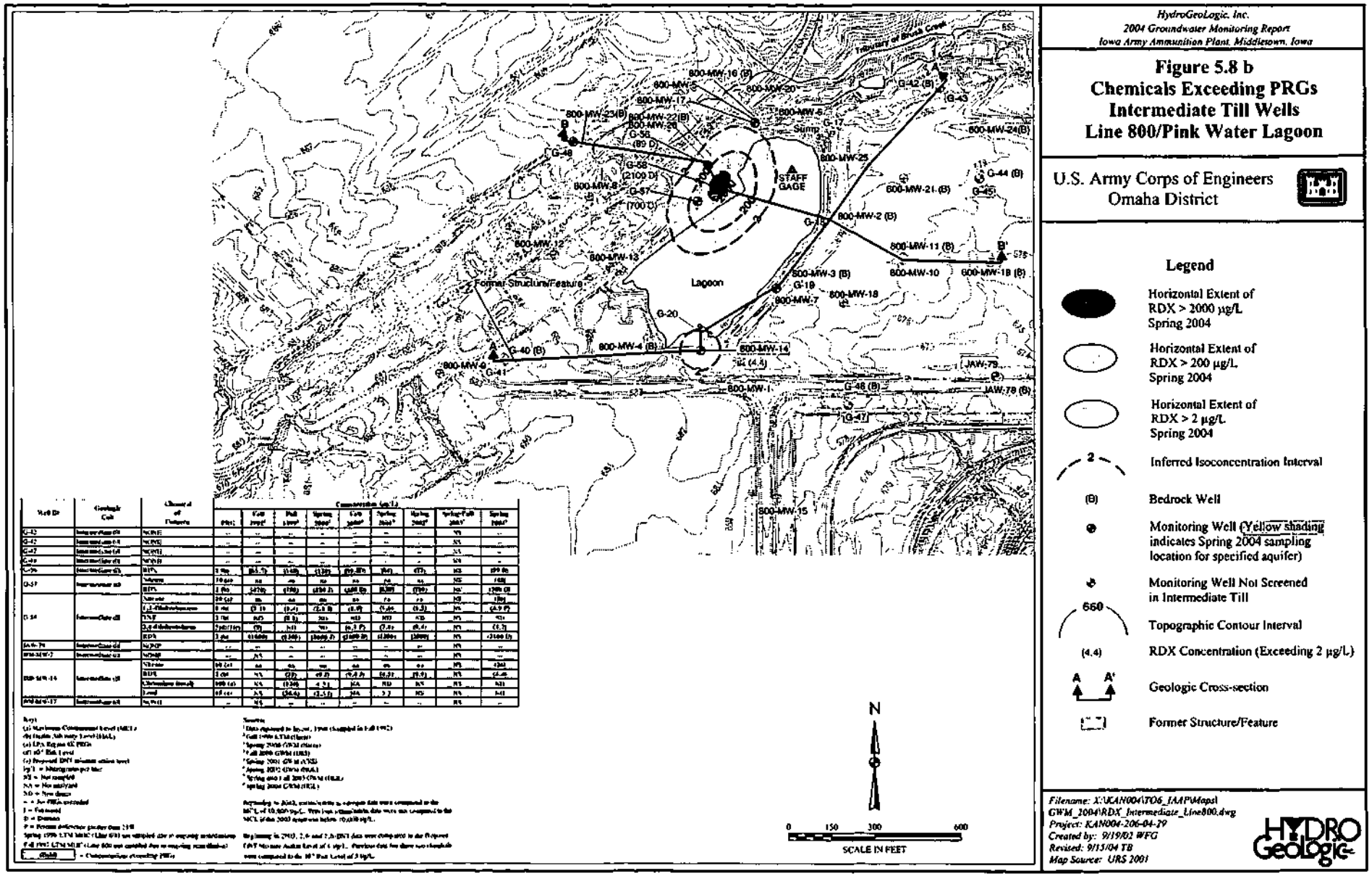
Filename: X:\KAN\004\TO6_IAAP\Maps\GWM_2004\Freon_Intermediate_Line9_2004.dwg
Project: KAN004-206-04-29
Created by: acarriger 09/19/04
Revised: acarriger 09/20/04
Map Source: URS

HYDRO GeoLogic

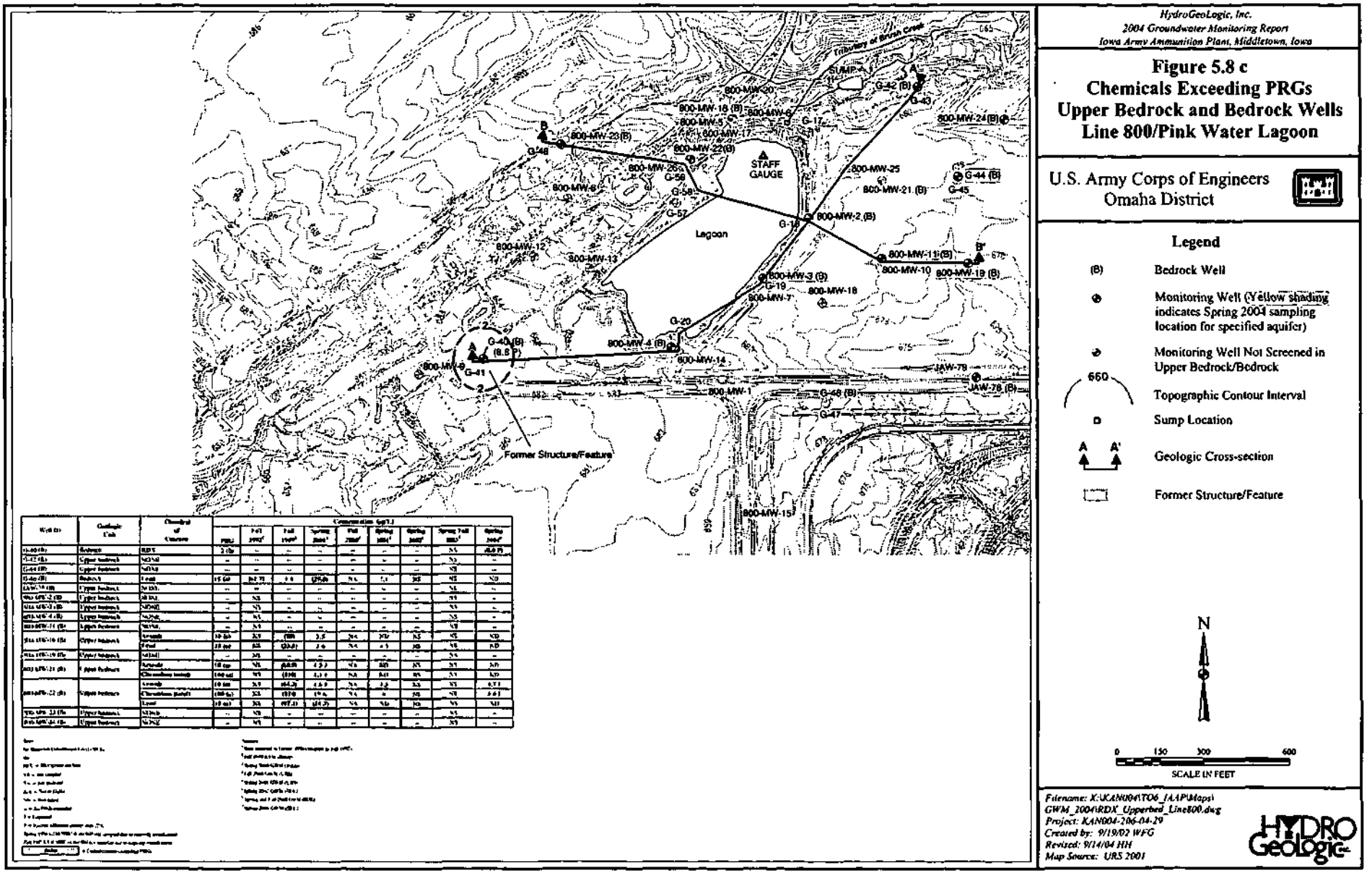
Source: 2004 Groundwater Monitoring Report - Draft - October 2004



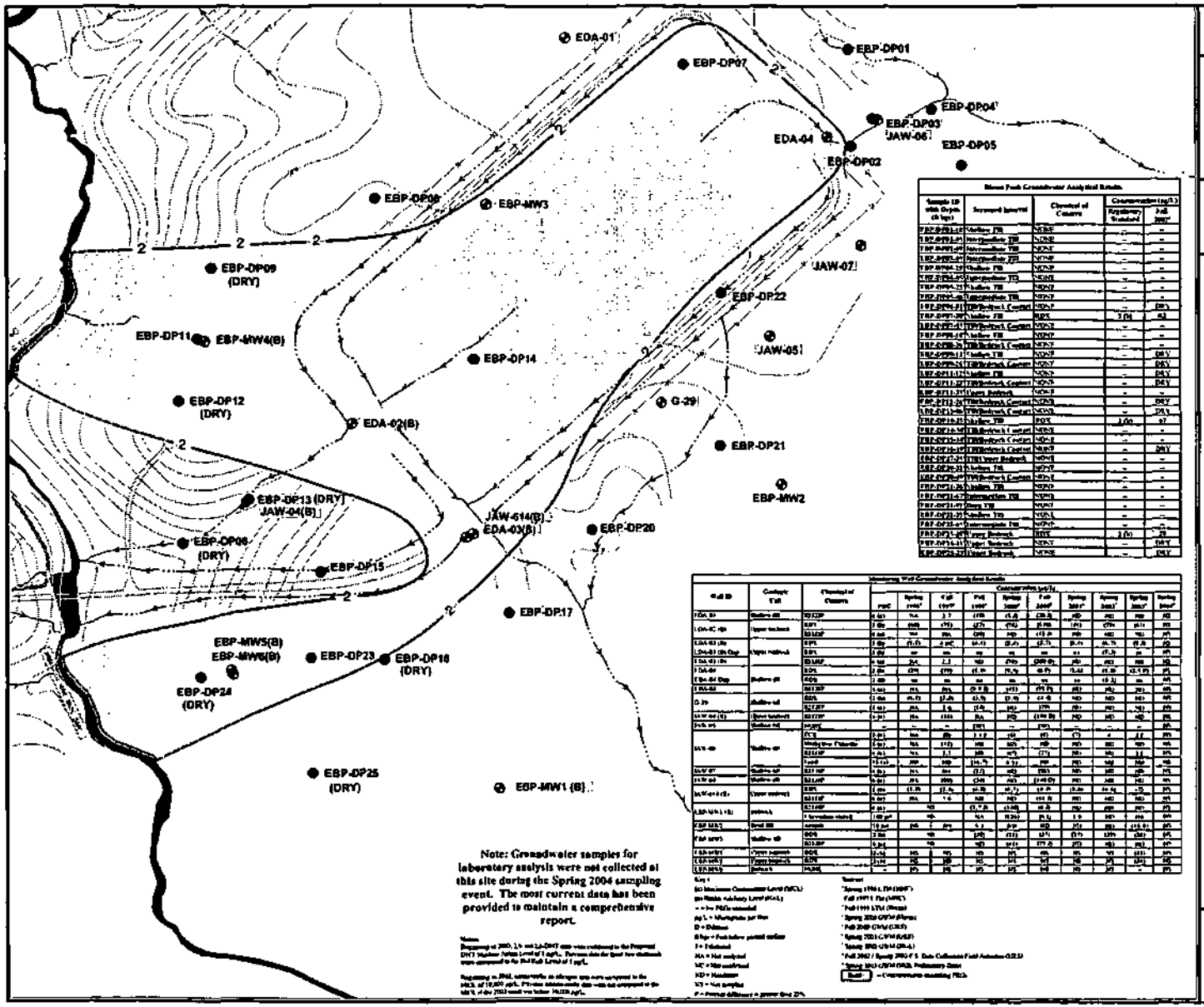
Source: 2004 Groundwater Monitoring Report - Draft - October 2004



Source: 2004 Groundwater Monitoring Report - Draft - October 2004



Source: 2004 Groundwater Monitoring Report - Draft - October 2004



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Iowa Army Ammunition Plant, Middletown, Iowa

Figure 5.9
Chemicals Exceeding PRGs
Shallow Groundwater Wells
East Burn Pads

U.S. Army Corps of Engineers
Omaha District

Legend

- Monitoring Well
- (B) Bedrock Well
- JAW-05 Shallow Groundwater Monitoring Well Sample Location, Spring 2003
- EBP-DP21 Direct Push Groundwater Sample Location, Fall 2002
- Approximate Boundary of Soil Removal Action, 1998
- Location of Previous Site Feature
- 2 Horizontal Extent of RDX>2 µg/L in Shallow Groundwater, Fall 2002/Spring 2003 (Contour interval dashed where inferred)

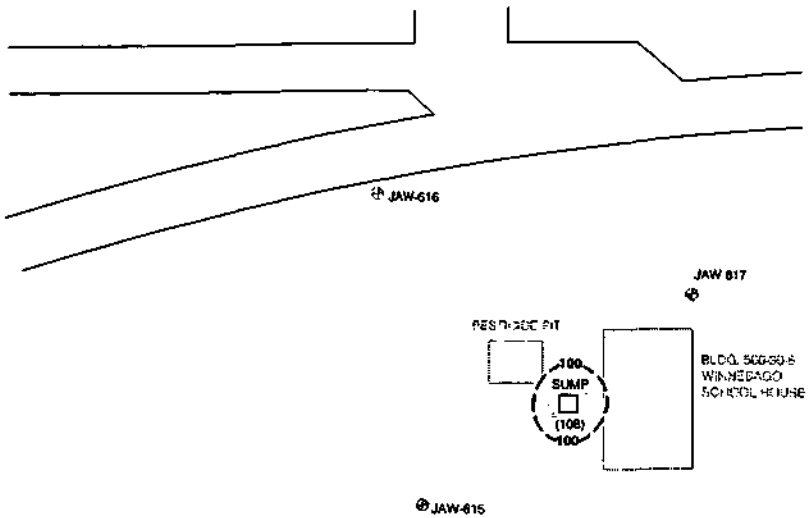
N

0 100 200 400
SCALE IN FEET

Filename: X:\KAN004\TO6_IAAP\Maps\GWM_2004\PRG_Shallow_Eastburn.dwg
Project: KAN004-206-04-29
Created by: acarriger 9/19/02
Revised: acarriger 9/20/04
Map Source: URS

HydroGeoLogic

Source: 2004 Groundwater Monitoring Report - Draft - October 2004



Location	Geologic Unit	Chemical of Concern	Concentration (µg/L)							
			PRG	Fall 1999[1]	Fall 2000	Spring 2001[4]	Spring 2002[6]	Spring 2003[8]	Fall 2003[7]	Spring 2004[8]
SUMP	Shallow till	Chromium	100 (a)	--	--[3]	(186)	DRY	DRY	DRY	(108)

Notes:
(a) Maximum Contaminant Level (MCL)
µg/L = Micrograms per liter
-- = No PRGs exceeded
Spring 1996 LTM MHC (Not sampled)
Fall 1997 LTM MHC (Not sampled)
(Bold) = Concentrations exceeding PRGs

Source:
[1] Fall 1999 GWM (Harza)
[2] Fall 2000 ERA (Harza)
[3] Fall 2000 GWM (URS)
[4] Spring 2001 GWM (URS)
[5] Spring 2002 GWM (HGL)
[6] Spring 2003 GWM (HGL)
[7] Fall 2003 GWM (HGL)
[8] Spring 2004 GWM (HGL)

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Iowa Army Ammunition Plant, Middletown, Iowa

Figure 5.10
Chemicals Exceeding PRGs
Shallow Till Wells
Pesticide Pit

U.S. Army Corps of Engineers
Omaha District

Legend

(B) Bedrock Well

Monitoring Well (Yellow shading indicates 2004 sampling location for specified aquifer)

Monitoring Well Not Sampled

Sump Location

(108) Chromium Concentration (mg/L)

Horizontal Extent of Chromium > 100 µg/L Spring 2004

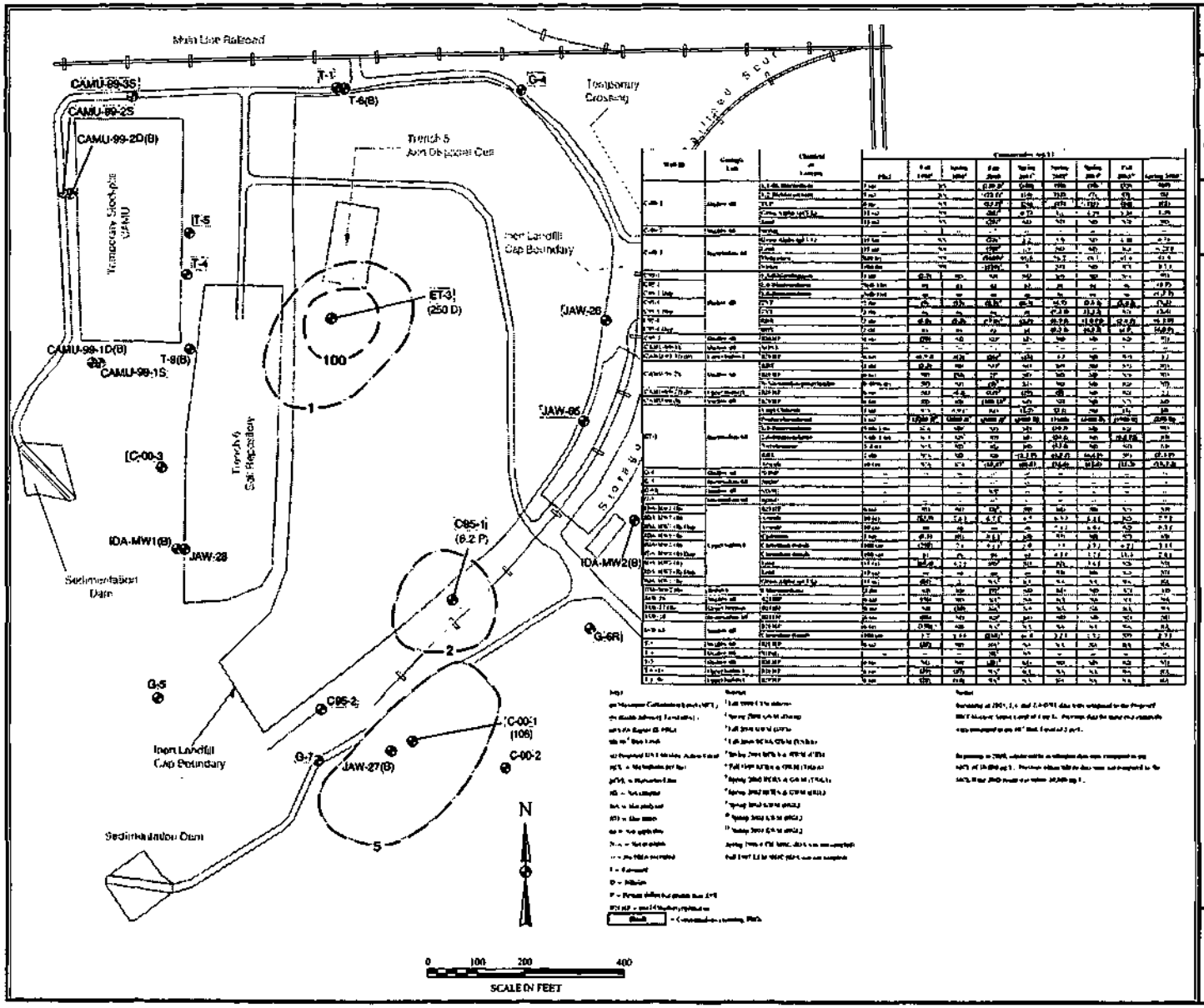
N

0 25 50 100
SCALE IN FEET

Filename: X:\KAN004\TO6_IAAP\Maps\GWM_2004\PRG_SHALLOW_PESTPIT.dwg
Project: KAN004-206-04-29
Created by: 9/12/02 WFG
Revised: 9/15/04 TB
Map Source: URS 2004

HYDRO GeoLogic

Source: 2004 Groundwater Monitoring Report - Draft - October 2004



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Iowa Army Ammunition Plant, Middletown, Iowa

Figure 5.11
Chemicals Exceeding PRGs
Spring 2004
Shallow and Intermediate Till Wells
Inert Disposal Area

U.S. Army Corps of Engineers
Omaha District

Legend

- Horizontal Extent of PCP > 100 µg/L - Spring 2004
- Horizontal Extent of PCP > 1 µg/L - Spring 2004
- Horizontal Extent of Total VOCs > 5 µg/L - Spring 2004
- Horizontal Extent of RDX > 2 µg/L - Spring 2004

  Note: If a duplicate sample result is available for a well location, the higher concentration between the original and duplicate samples is illustrated on the figure. Both results are provided on the figure table.
- 2 — Inferred Isoconcentration Interval
- (B) — Bedrock Well
- Monitoring Well (Yellow shading indicates Spring 2004 Trench 5 RCRA sampling location for specified aquifer)
- Monitoring Well (Yellow shading indicates Spring 2004 Trench 7 CAMU sampling location for specified aquifer)
- Monitoring Well (Yellow shading indicates Spring 2004 Installation-wide sampling location for specified aquifer)
- 650 — Topographic Contour Interval
- (6.2 P) — Contaminant Concentration (Exceeding PCP PRG of 1 and RDX PRG of 2 µg/L)
- (108) — Total VOCs (µg/L)

Note: Not all current structures/features are shown. As information becomes available, the illustration will be updated.

Filename: X:\KAN004\To6_iaap\Maps\GWM_2004\PCP-VOC_INERT_Spring04.dwg
Project: KAN004-206-04-29
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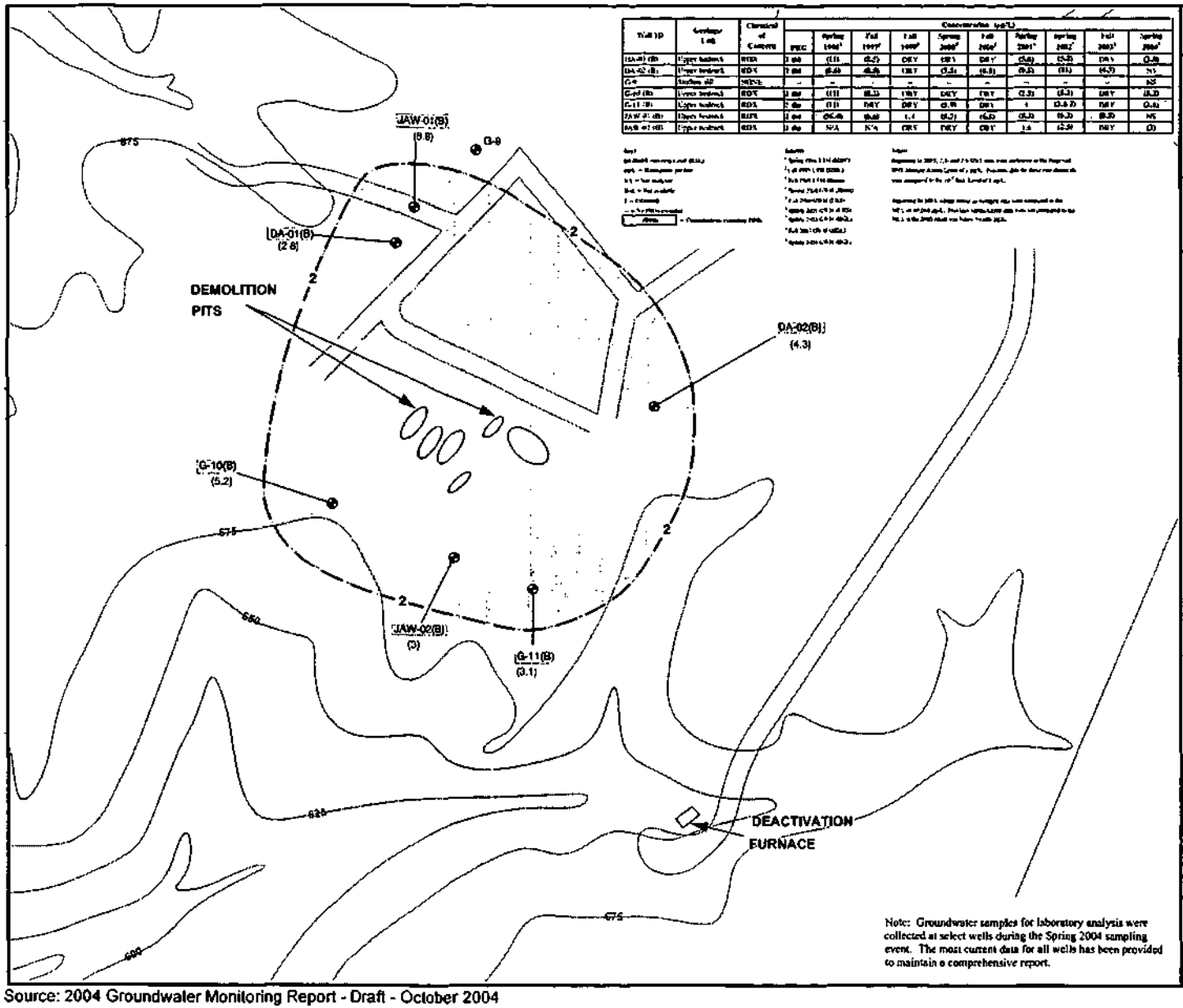
Revised: 9/15/04 TB
Map Source: URS 2001

HydroGeoLogic

Source: 2004 Groundwater Monitoring Report - Draft - October 2004



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Iowa Army Ammunition Plant, Middletown, Iowa

Figure 5.12
Chemicals Exceeding PRGs Demolition Area and Deactivation Furnace

U.S. Army Corps of Engineers
Omaha District

Legend

- Horizontal Extent of RDX > 2 µg/L Spring 2004
- 2 — Inferred Isoconcentration Interval
- (B) — Bedrock Well
- Monitoring Well (Yellow shading indicates Spring 2004 sampling location for specified aquifer)
- 660 — Topographic Contour Interval
- (2.8) — 2004 RDX Concentration (Exceeding 2 µg/L)
- (4.3) — 2003 RDX Concentration (Exceeding 2 µg/L)

N

0 100 200 400
SCALE IN FEET

Filename: X:\KAN004\To6_iaap\Maps\GWM_2004\RDX_UPPERBED_DEMO.dwg
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Revised: 9/14/04 HH
Map Source: URS 2001

HYDRO GeoLogic

Source: 2004 Groundwater Monitoring Report - Draft - October 2004

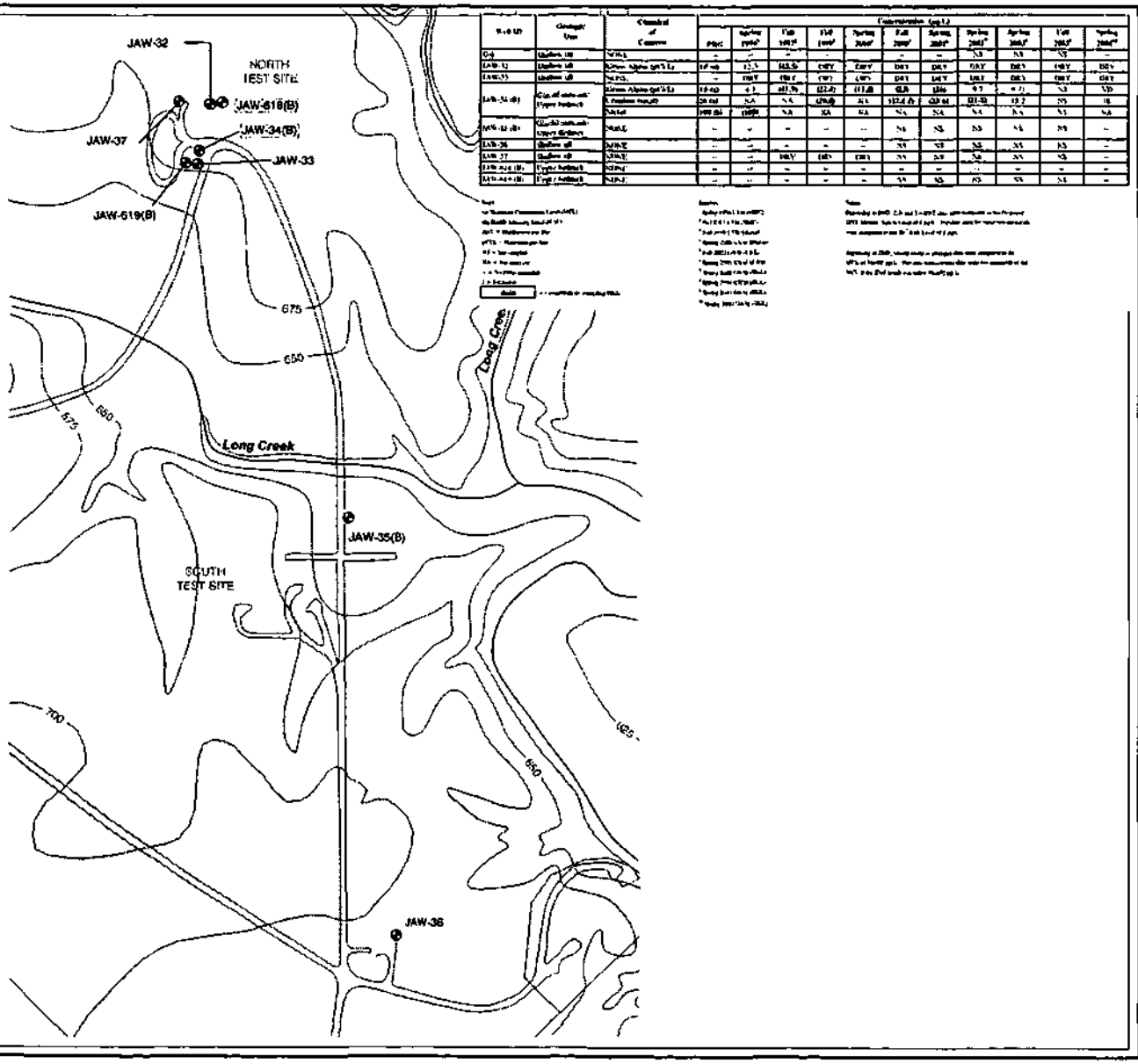

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Figure 5.13

Chemicals Exceeding PRGs Firing Site

U.S. Army Corps of Engineers
Omaha District

Legend

(B) Bedrock Well

Monitoring Well (Yellow shading indicates 2004 sampling location for specified aquifer)

725 Topographic Contour Interval

N

0 200 400 800
SCALE IN FEET

Filename: X:\KAN004\Too_laap\Maps\GWM_2004\PRG_FIRINGSITE.dwg
Project: KAN004-206-04-29
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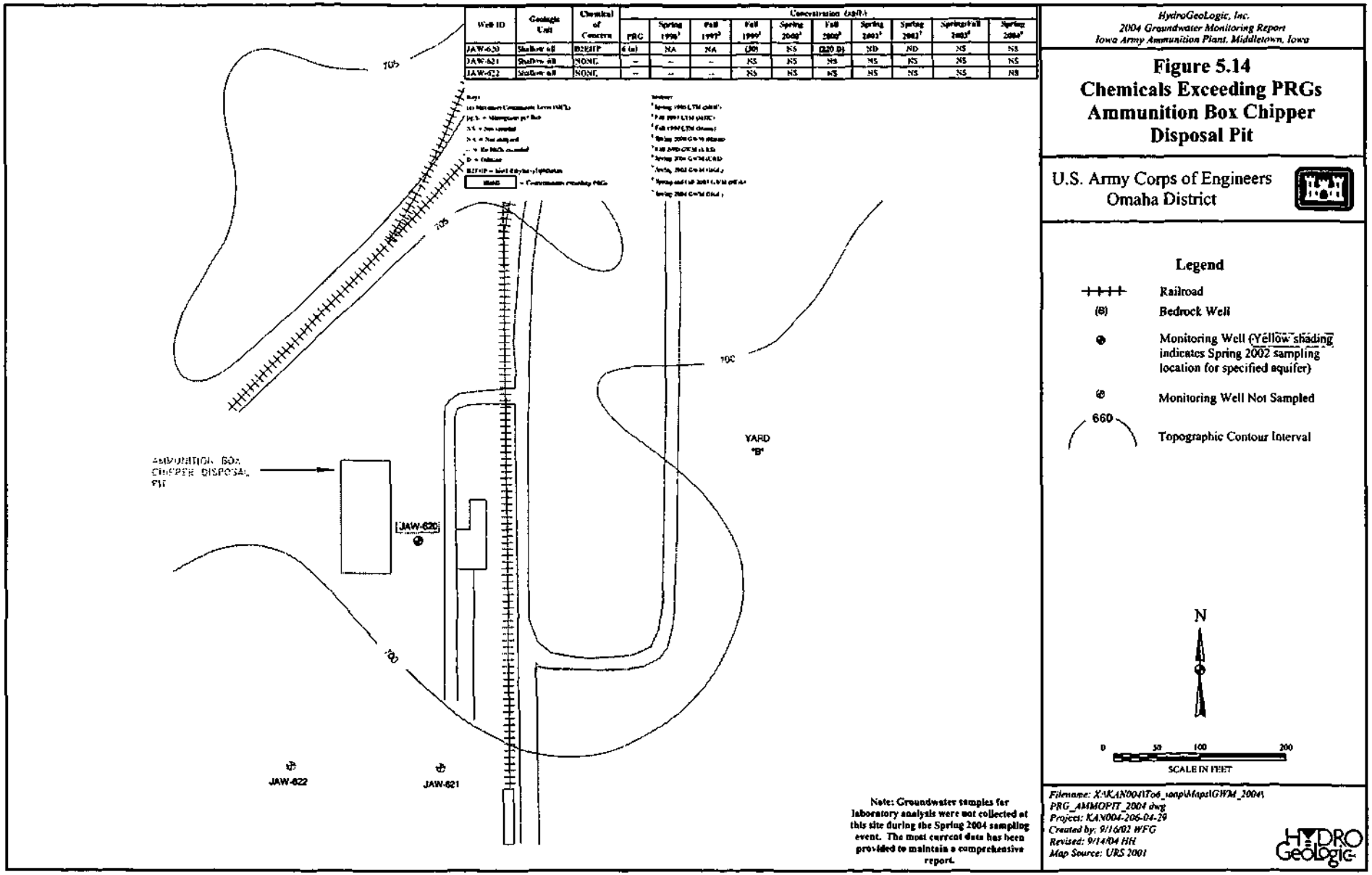
Revised: 9/14/04 IIII
Map Source: URS 2001

HYDRO GeoLogic

Source: 2004 Groundwater Monitoring Report - Draft - October 2004



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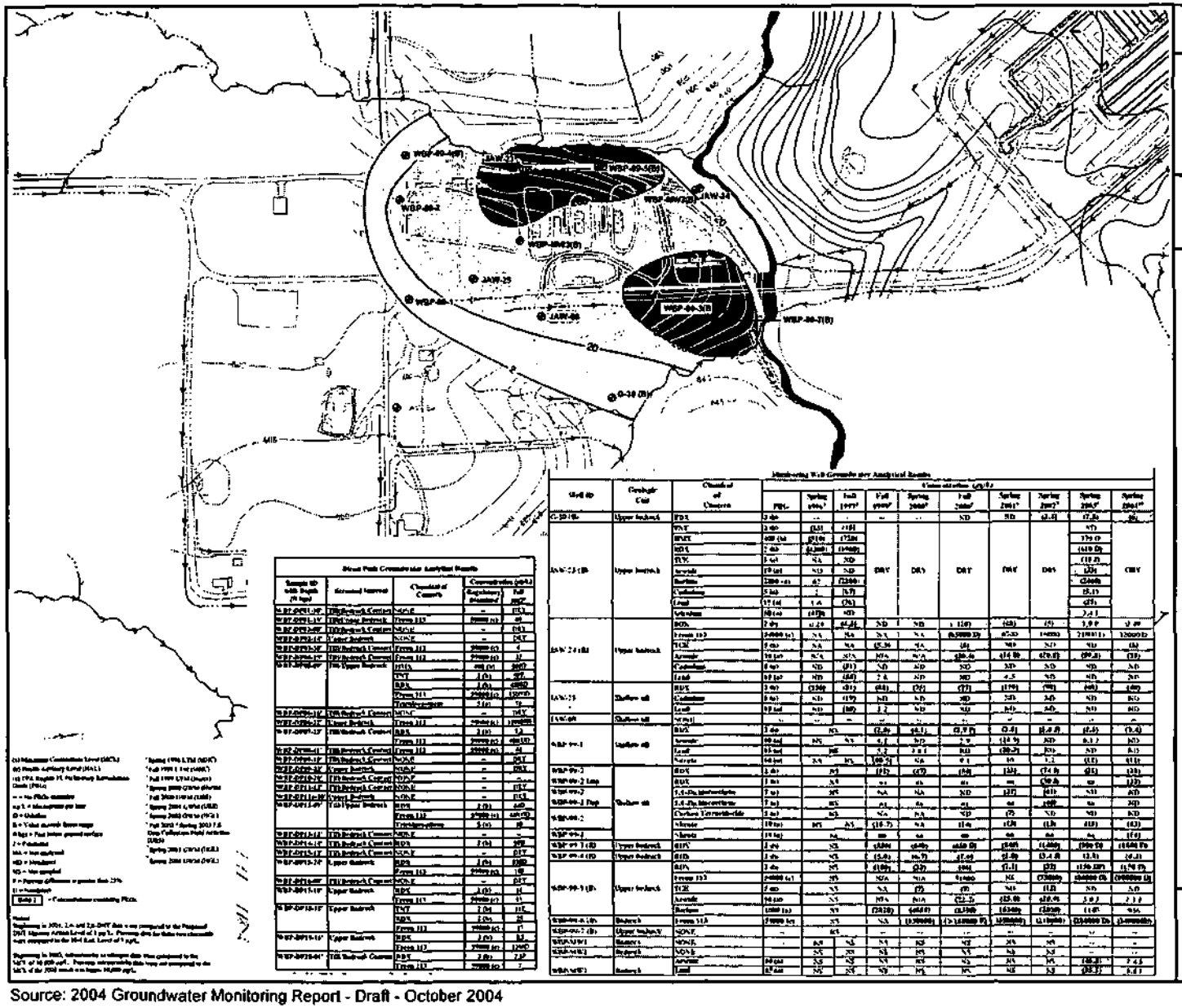

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Iowa Army Ammunition Plant, Middletown, Iowa

Figure 5.15 a
Chemicals Exceeding PRGs
Total Explosives in
Shallow Groundwater Wells
West Burn Pads Area

U.S. Army Corps of Engineers
Omaha District

Legend

- Monitoring Well
- (B) Bedrock Well
- Disturbed Area with Red Discoloration
- 645 Topographic Contour
- Approximate Boundary of Soil Removal Action, 1998
- Location of Previous Site Feature
- WBP-99-1 Shallow Groundwater Monitoring Well Sample Location, Spring 2004
- Horizontal Extent of Total Explosives>2 µg/L in Shallow Groundwater, Spring 2004 (Contour interval dashed where inferred)
- Horizontal Extent of Total Explosives>20 µg/L in Shallow Groundwater, Spring 2004 (Contour interval dashed where inferred)
- Horizontal Extent of Total Explosives>200 µg/L in Shallow Groundwater, Spring 2004 (Contour interval dashed where inferred)

N

0 150 300 600
SCALE IN FEET

Filename: X:\KAN004\TO6_LAAP\Maps\GWM_2004\TOT_EXPL_Shallow_Westburn.dwg
Project: KAN004-206-04-29
Created by: acarriger 9/19/04
Revised: acarriger 9/27/04
Map Source: URS

HYDRO GeoLogic

Source: 2004 Groundwater Monitoring Report - Draft - October 2004

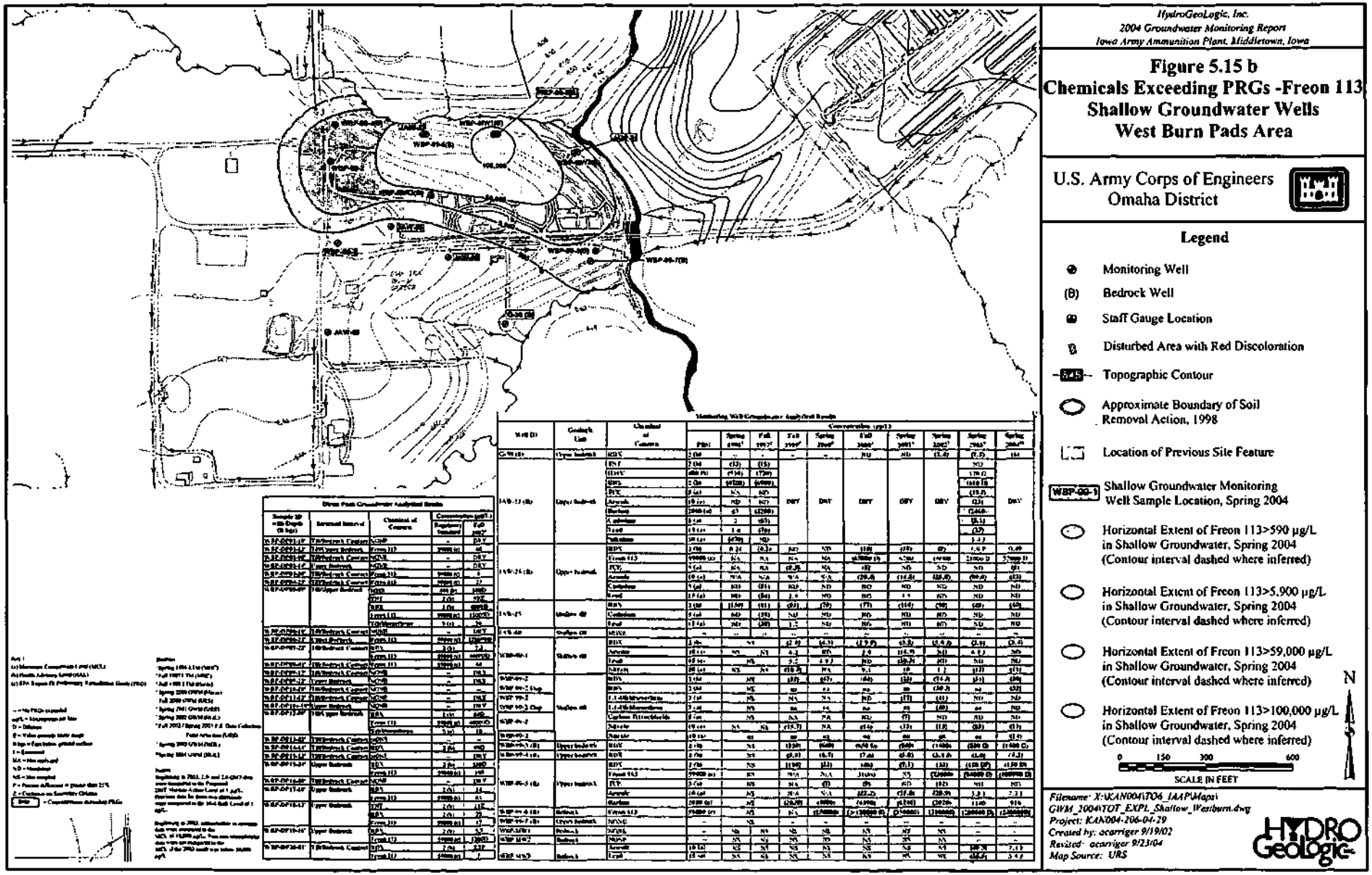

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Figure 5.15 b
Chemicals Exceeding PRGs -Freon 113
Shallow Groundwater Wells
West Burn Pads Area

U.S. Army Corps of Engineers
Omaha District

Legend

- Monitoring Well
- (B) Bedrock Well
- Staff Gauge Location
- Disturbed Area with Red Discoloration
- 845 Topographic Contour
- Approximate Boundary of Soil Removal Action, 1998
- Location of Previous Site Feature
- WBP-00-1 Shallow Groundwater Monitoring Well Sample Location, Spring 2004
- Horizontal Extent of Freon 113>590 µg/L in Shallow Groundwater, Spring 2004 (Contour interval dashed where inferred)
- Horizontal Extent of Freon 113>5,900 µg/L in Shallow Groundwater, Spring 2004 (Contour interval dashed where inferred)
- Horizontal Extent of Freon 113>59,000 µg/L in Shallow Groundwater, Spring 2004 (Contour interval dashed where inferred)
- Horizontal Extent of Freon 113>100,000 µg/L in Shallow Groundwater, Spring 2004 (Contour interval dashed where inferred)

N

0 150 300 600
SCALE IN FEET

Filename: X:\KAN004\TO6_IAAP\Maps\GWM_2004\TOT_EXPL_Shallow_Westburn.dwg
Project: KAN004-206-04-29
Created by: acarriger 9/19/02
Revised: acarriger 9/23/04
Map Source: URS

HydroGeoLogic

Source: 2004 Groundwater Monitoring Report - Draft - October 2004

Well ID	Geologic Unit	Chemical of Concern	Concentration (µg/L)									
			PRG	Spring 1998	Fall 1999	Fall 1999	Spring 2000	Fall 2000	Spring 2001	Spring 2002	Fall 2002	Spring 2004
CW-P	Unknown	NB/NP	--	NS	NS	NS	NS	NS	NS	--	--	NS
JAW-11	Shallow till	NB/NP	--	--	--	--	--	--	--	--	--	NS
JAW-12	Shallow till	NB/NP	--	DRY	DRY	DRY	DRY	DRY	--	--	DRY	NS
JAW-13 (B)	Upper bedrock	NB/NP	--	--	--	DRY	DRY	DRY	DRY	--	DRY	NS
JAW-14 (B)	Upper bedrock	NB/NP	--	--	--	--	--	--	--	--	--	NS
JAW-626	Shallow till	RDX	2 (b)	NA	NA	NA	NA	1.3	(.1	(0.4)	(4.3)	NS
JAW-626 Dup		RDX	2 (b)	na	na	na	na	na	na	na	(4.9)	NS
JAW-627 (B)	Upper bedrock	RDX	2 (b)	NA	(0.4)	(3.1)	(5.7)	(7.1)	(2.7)	(3.5)	(5)	NS
JAW-627 (B) Dup		RDX	2 (b)	NA	na	na	na	na	na	(4.3)	na	NS
NBPLF-MW1 (B)	Upper bedrock	NB/NP	--	NA	NA	--	--	--	--	--	--	NS

Note: Groundwater samples for laboratory analysis were not collected at this site during the Spring 2004 sampling event. The most current data has been provided to maintain a comprehensive report.

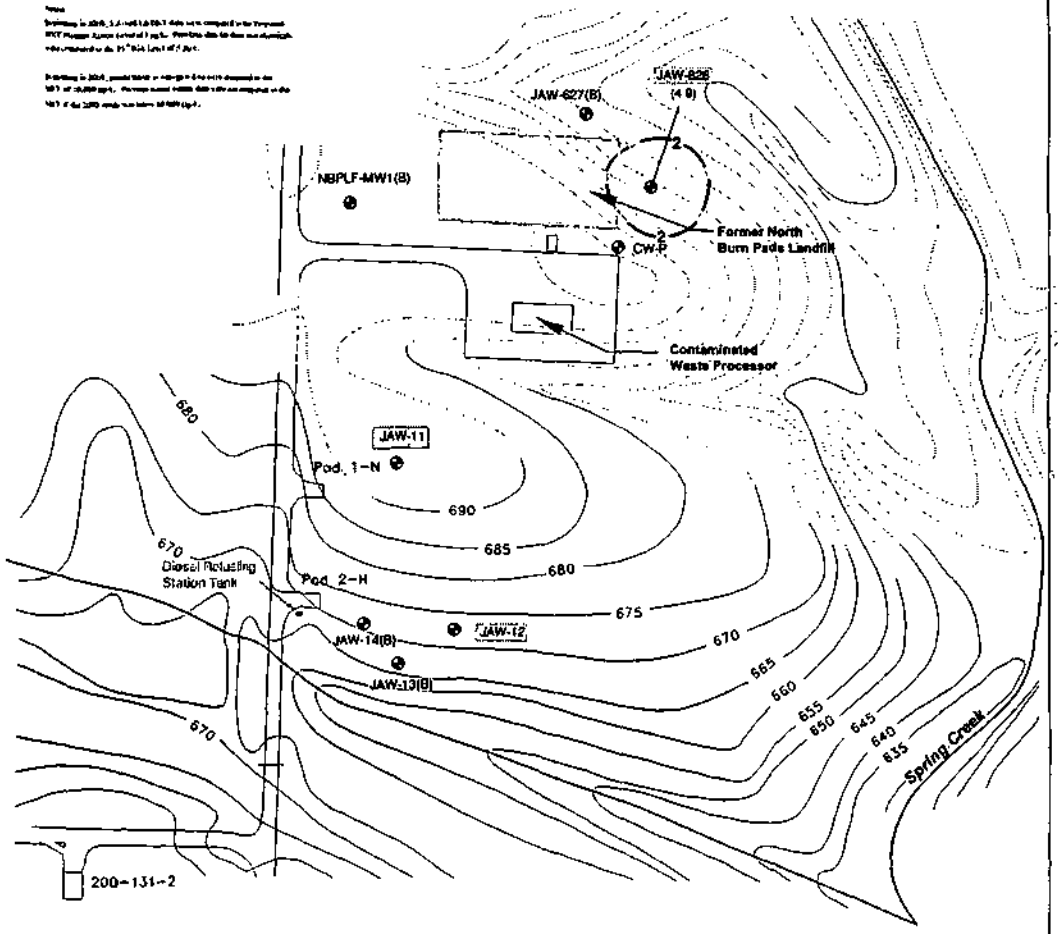

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Figure 5.16 a
Chemicals Exceeding PRGs, RDX in Shallow Till Wells North Burn Pads, North Burn Pads Landfill, and Contaminated Waste Processor

U.S. Army Corps of Engineers
Omaha District

Legend

- Horizontal Extent of RDX > 2 µg/L - Spring 2002
- 2 — Inferred Isoconcentration Interval
- (B) — Bedrock Well
- Monitoring Well (Yellow shading indicates Fall 2003 sampling location for specified aquifer)
- 670 — Topographic Contour Interval
- (4.9) — RDX Concentration (Exceeding 2 µg/L)
- Former Structure/Feature

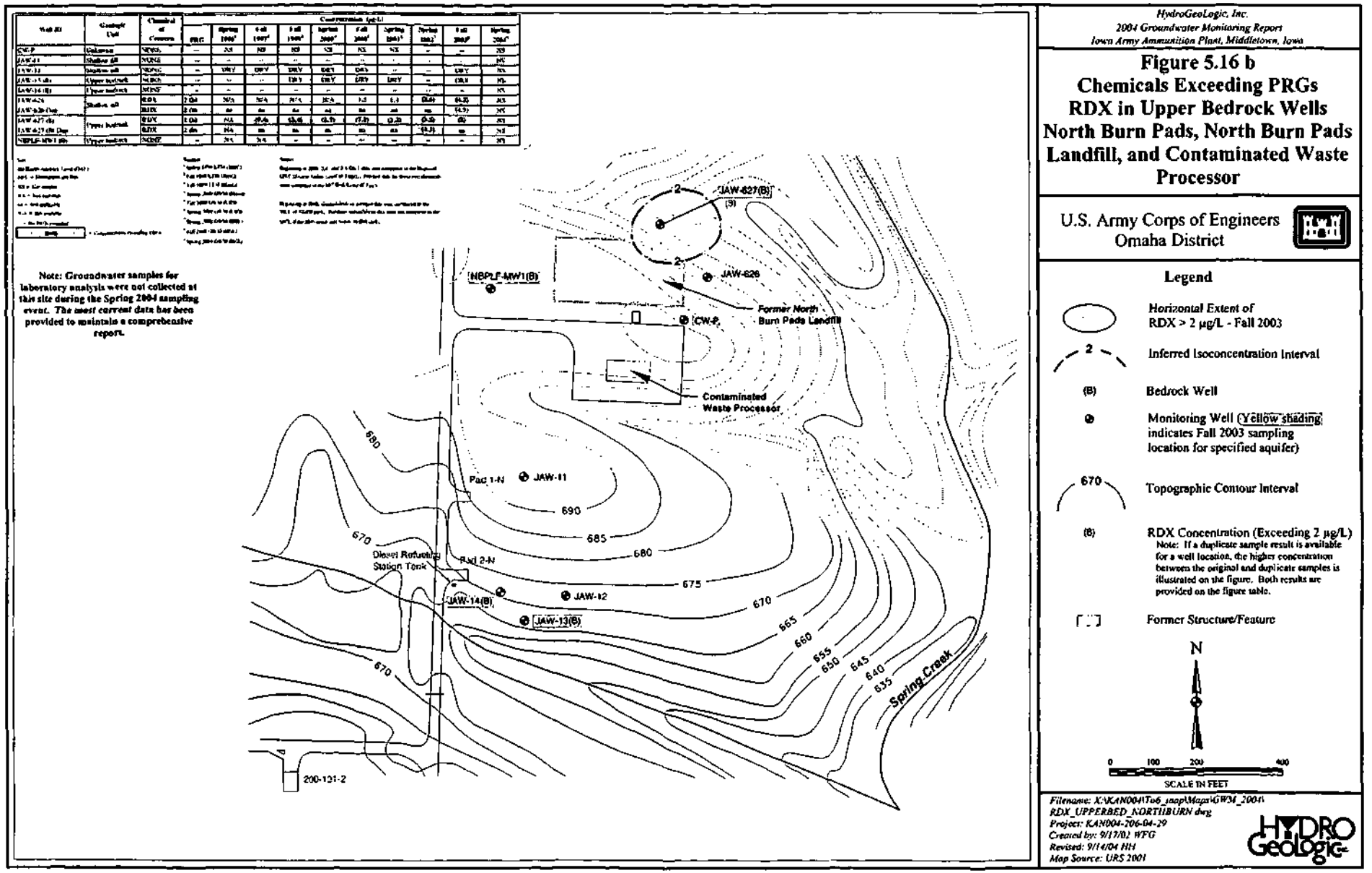
Note: If a duplicate sample result is available for a well location, the higher concentration between the original and duplicate samples is illustrated on the figure. Both the results are provided on the figure table.

0 100 200 400
SCALE IN FEET

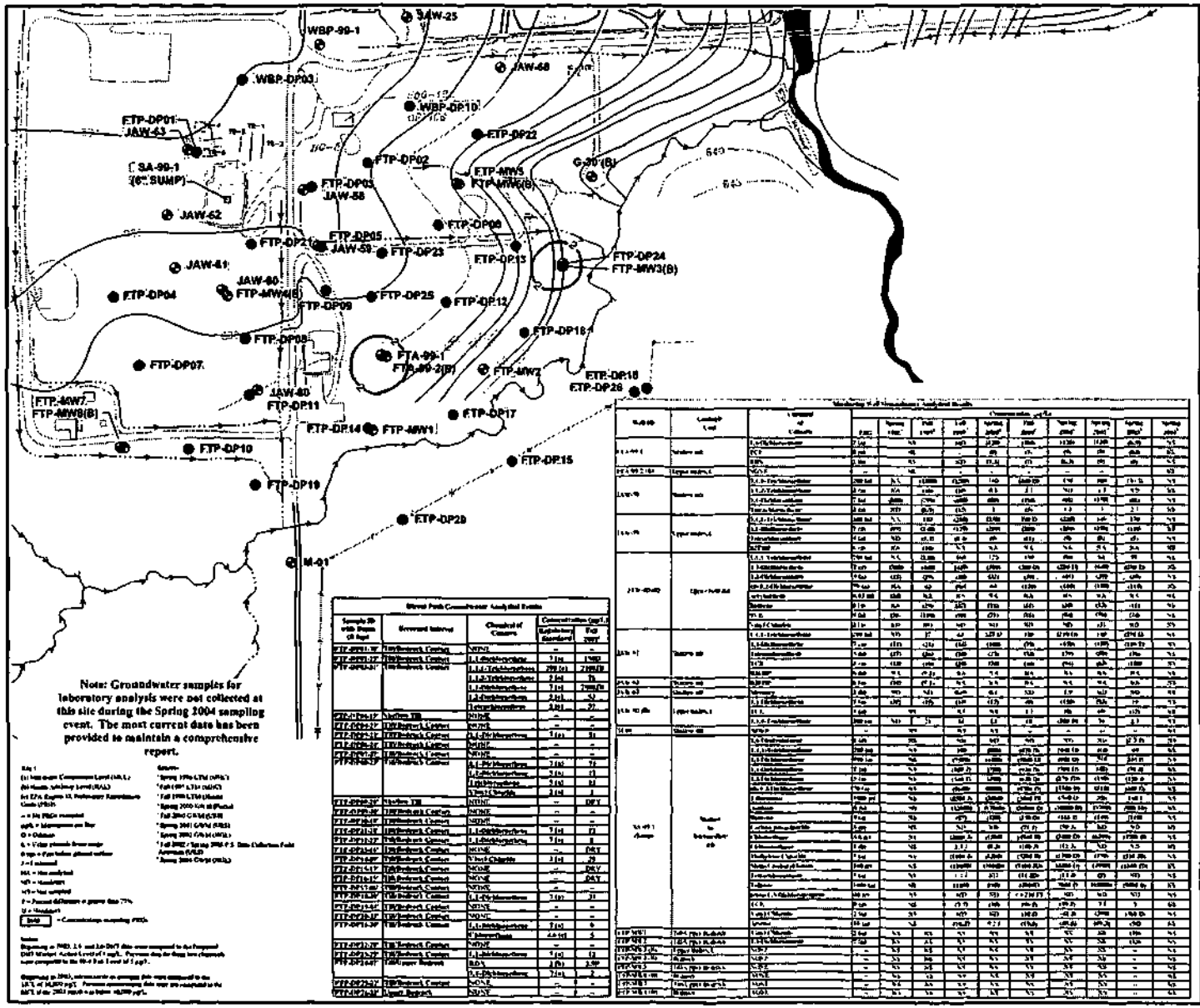
Filename: X:\KAN004\Tod_mxp\Maps\GWM_2003\RDX_SHALLOW_NORTHBURN_2004.dwg
Project: KAN004-206-04-29
Created by: 9/17/02 WFG
Revised: 9/14/04 HH
Map Source: URS 2001

HydroGeoLogic

Source: 2004 Groundwater Monitoring Report - Draft - October 2004



Source: 2004 Groundwater Monitoring Report - Draft - October 2004



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Iowa Army Ammunition Plant, Middletown, Iowa

Figure 5.17 a
Chemicals Exceeding PRGs
RDX in Shallow Groundwater Wells
Fire Training Pit

U.S. Army Corps of Engineers
Omaha District

Legend

- Monitoring Well
- (B) Bedrock Well
- Sump
- FTP-MW2 — Shallow Groundwater Monitoring Well Sample Location, Spring 2003
- FTP-DP20 — Direct Push Groundwater Sample Location, Fall 2002
- ECC Trench Location, November 2001
- ECC Trench Location, May 2001
- Approximate Boundary of Soil Removal Action, 1998
- Location of Previous Site Feature
- Horizontal Extent of RDX>2 µg/L in Shallow Groundwater, Fall 2002/Spring 2003

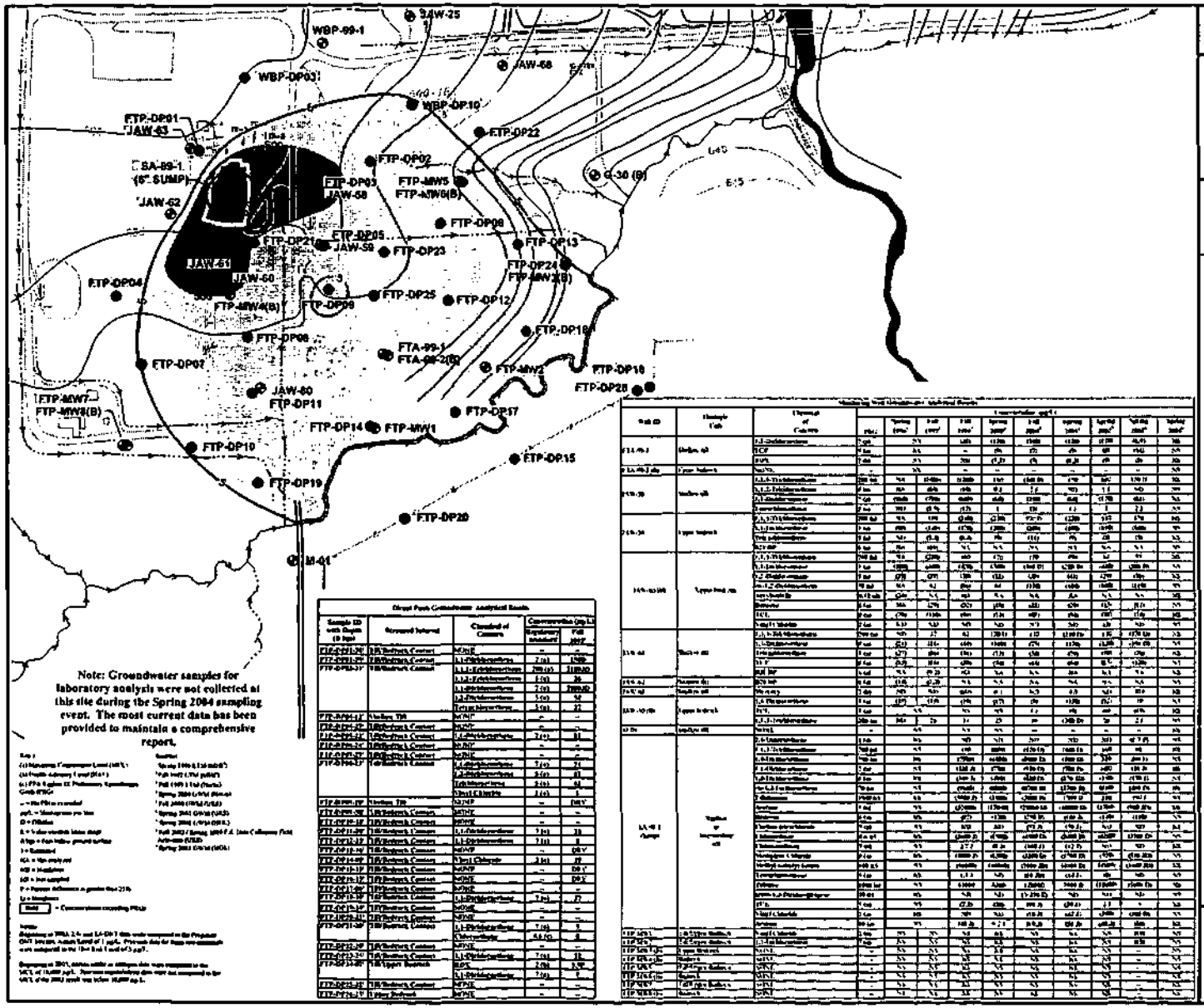
N

0 100 200 400
SCALE IN FEET

Filename: X:\KAN004\TO6_IAAP\Maps\GW\1_2004\RDX_Shallow_Firetrain.dwg
Project: KAN004-006-03-20
Created by: acarriger 09/19/02
Revised: acarriger 09/20/04
Map Source: URS

HydroGeoLogic

Source: 2004 Groundwater Monitoring Report - Draft - October 2004



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Iowa Army Ammunition Plant, Middletown, Iowa

Figure 5.17 b
Chemicals Exceeding PRGs Total VOCs in Shallow Groundwater Wells Fire Training Pit

U.S. Army Corps of Engineers
Omaha District

Legend

- Monitoring Well
- (B) Bedrock Well
- Sump
- FTP-MW2 — Shallow Groundwater Monitoring Well Sample Location, Spring 2003
- FTP-DP20 — Direct Push Groundwater Sample Location, Fall 2002
- TR-3 — ECC Trench Location, November 2001
- TR-9 — ECC Trench Location, May 2001
- Approximate Boundary of Soil Removal Action, 1998
- Location of Previous Site Feature
- 5 — Horizontal Extent of Total VOCs>5 µg/L in Shallow Groundwater, Fall 2002/Spring 2003 (Contour interval dashed where inferred)
- 500 — Horizontal Extent of Total VOCs>500 µg/L in Shallow Groundwater, Fall 2002/Spring 2003 (Contour interval dashed where inferred)
- 10,000 — Horizontal Extent of Total VOCs>10,000 µg/L in Shallow Groundwater, Fall 2002/Spring 2003 (Contour interval dashed where inferred)

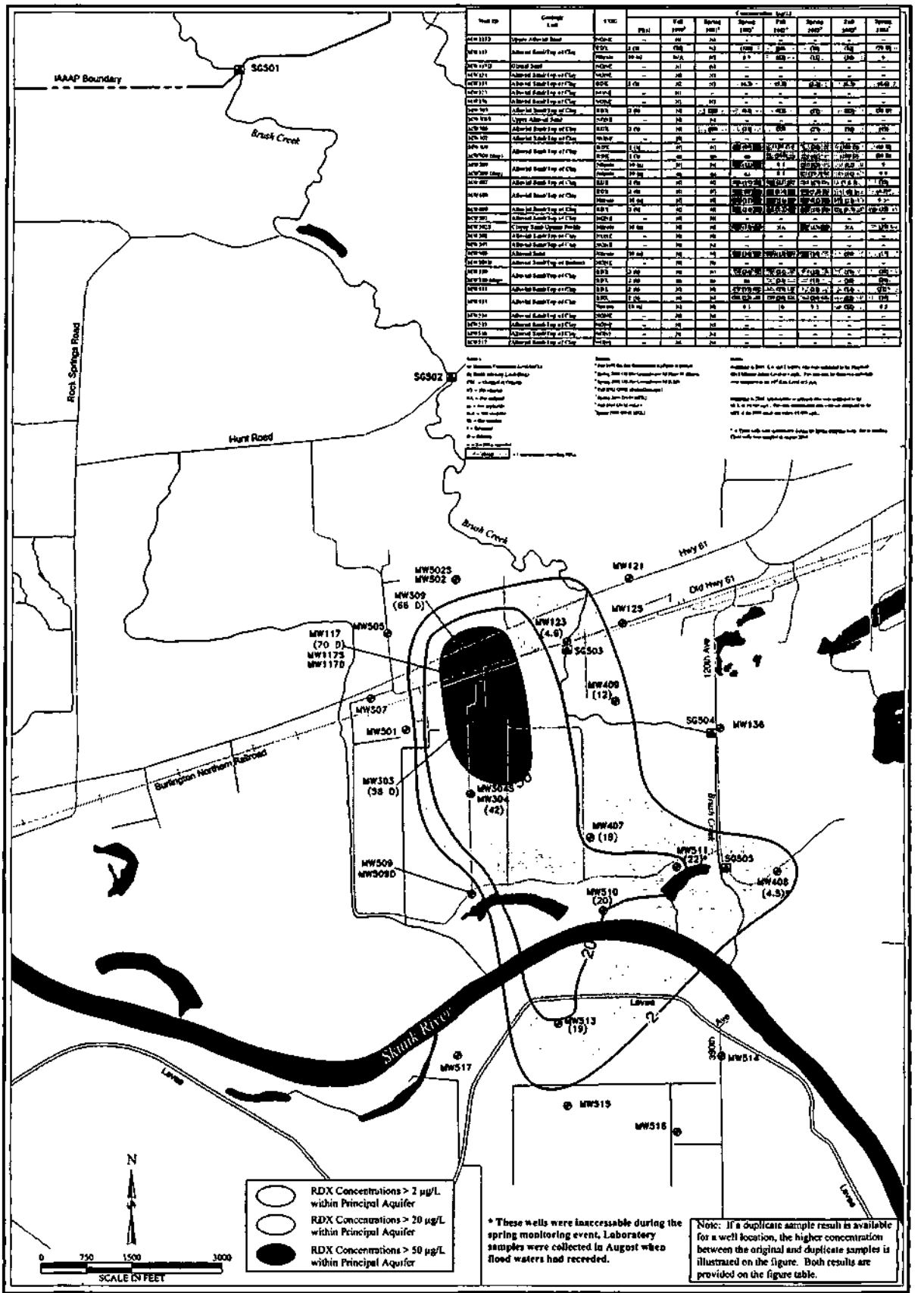
N

0 100 200 400
SCALE IN FEET

Filename: X:\KAN004\TO6_IAAP\Maps\GWM_2004\VOC_Shallow_Firetrain_2004.dwg
Project: KAN004-206-04-29
Created by: acorriger 9/19/02
Revised: acorriger 9/21/04
Map Source: URS

HYDRO GeoLogic

Source: 2004 Groundwater Monitoring Report - Draft - October 2004



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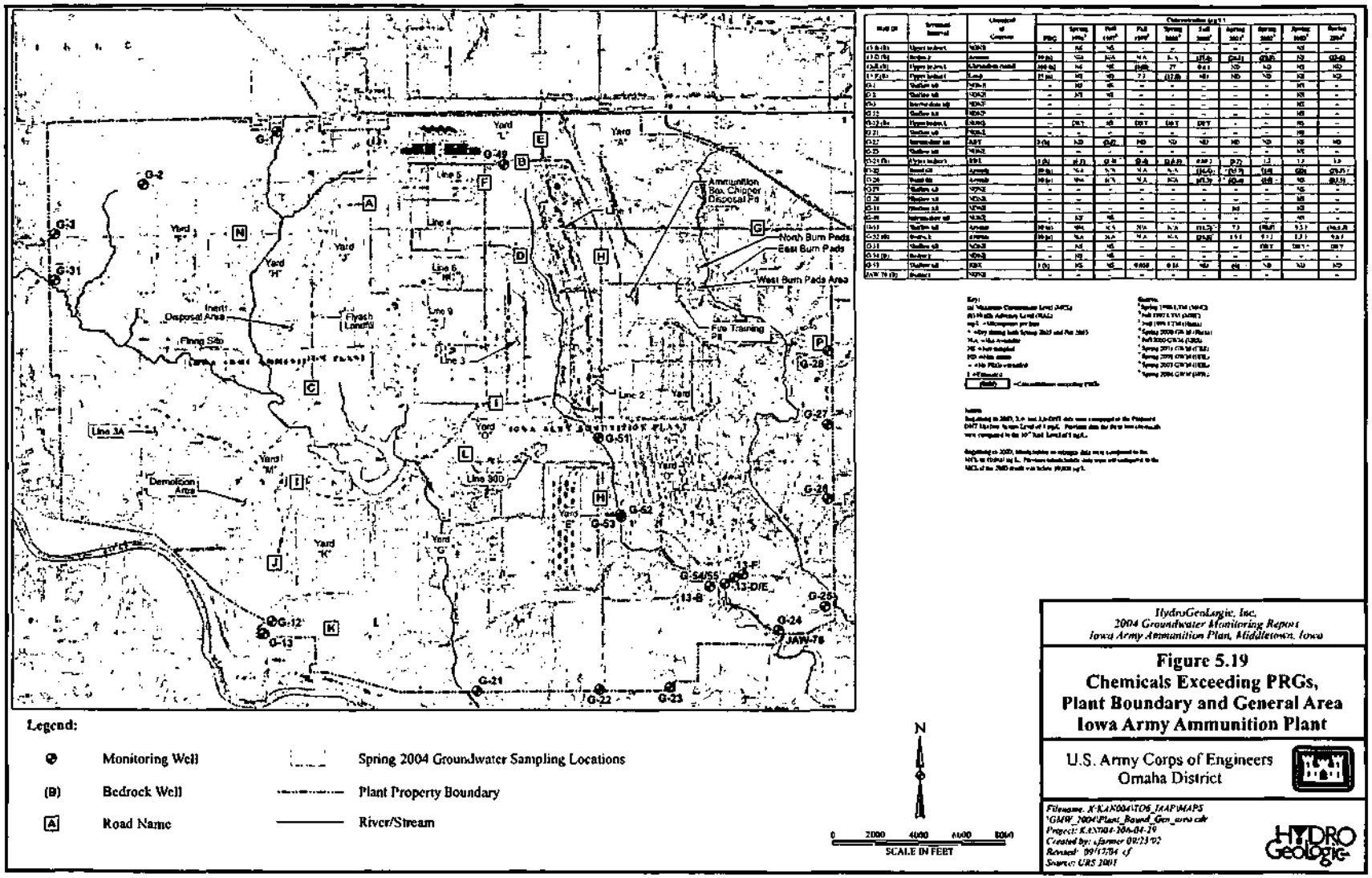
Project: KAN004-206-04-29
Created by: 10/04/02 ACARRIGER
Revised: 9/13/04 thrasewell
Map Source: URS

HYDRO GeoLogic

Legend

- IAAAP Boundary
- Paved or Gravel Road
- MW309 — Monitoring Well Sample Location
- (42) — RDX Concentration (µg/L)
- Staff Gauge Location
- Isoconcentration Interval (µg/L)

Figure 5.18
Chemicals Exceeding PRGs
Off-Site Monitoring Wells
Spring 2004
Iowa Army Ammunition Plant



Source: 2004 Groundwater Monitoring Report - Draft - October 2004