FINAL

FIVE-YEAR REVIEW REPORT
Five-Year Review of Interim Remedial Action at Former Area P Lagoons
Louisiana Army Ammunition Plant
Shreveport, Louisiana

Prepared for:

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND 21010

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December 1995

FIVE-YEAR REVIEW REPORT
FIVE-YEAR REVIEW OF INTERIM REMEDIAL ACTION AT FORMER AREA P LAGOONS
LOUISIANA ARMY AMMUNITION PLANT, SHREVEPORT, LOUISIANA

FINAL

Submitted to:

U.S. Army Environmental Center
Installation Restoration Division
SFIM-AEC-IRB
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LIST OF ACRONYMS AND ABBREVIATIONS

AMCCOM	U.S. Army Armament, Munitions, and Chemical Command
ASTM	American Society for Testing and Materials
BDL	Below Detection Limit
BLS	Below Land Surface
CCV	Continuing Calibration Verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	Cubic Feet per Second
COC	Contaminant of Concern
CRL	Certified Reporting Limit
DCL	DataChem Laboratories
1,3-DNB	1,3-Dinitrobenzene
2,4-DNT	2,4,-Dinitrotoluene
2,6-DNT	2,6-Dinitrotoluene
DO	Dissolved Oxygen
DQO	Data Quality Objective
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ETA	Engineering Technologies and Associates, Inc.
FFA	Federal Facilities Agreement
ft/day	Feet per Day
ft/year	Feet per Year
GOCO	Government-Owned, Contractor-Operated
gpd/ft	Gallons per Day per Foot
HAL	Health Advisory Level
HEAST	Health Effects Assessment Summary Table
HMX	Cyclotetramethylenetetranitramine
ICV	Initial Calibration Verification
IMP	Generally Improving
IRA	Interim Remedial Action

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

IRP	Installation Restoration Program
IRDMIS	Installation Restoration Data Management Information System
K_{oc}	Soil Sorption Constant
K_{ow}	Log Water Partition Coefficient
LAAP	Louisiana Army Ammunition Plant
LAP	Load-Assemble-Pack
LCS	Laboratory Control Sample
LDEQ	Louisiana Department of Environmental Quality
LSU	Louisiana State University
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MSL	Mean Sea Level
NB	Nitrobenzene
NGVD	National Geodetic Vertical Datum
NPL	National Priorities List
OSWER	Office of Solid Waste and Emergency Response
PARCC	Precision, Accuracy, Representativeness, Comparability, and Completeness
ppm	Parts per Million
PRI	Potomac Research Institute
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QC	Quality Control
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
RfD	Reference Dose
SAIC	Science Applications International Corporation
SDWA	Safe Drinking Water Act
SOP	Standard Operating Procedure

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

SOW	Statement of Work
STA	Stabilized Condition
TETRYL	N-methyl-N,2,4,6-tetranitroaniline
1,3,5-TNB	1,3,5-Trinitrobenzene
TNT	Trinitrotoluene
2,4,6-TNT	2,4,6-Trinitrotoluene
USACE	U.S. Army Corps of Engineers
USAEC	U.S. Army Environmental Center
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
USFWS	U.S. Fish and Wildlife Service

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EXECUTIVE SUMMARY

Science Applications International Corporation (SAIC), under-contract to the U.S. Army Environmental Center (USAEC), has completed a Five-Year Review to assess the effectiveness of the interim remedial action at the Former Area P Lagoons site at the Louisiana Army Ammunition Plant (LAAP). This review is conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 and U.S. Environmental Protection Agency (EPA) guidance (EPA 1991, USATHAMA 1992).

LAAP is a government-owned, contractor-operated (GOCO) facility and is under contractual agreement with Thiokol Corporation to manufacture metal shell parts and load-assemble-pack (LAP) ammunition items. The facility is located approximately 22 miles east of Shreveport, Louisiana, and covers 14,974 acres.

The scope of this Five-Year Review consisted of preparing project work plans, conducting field investigation activities, evaluating sampling data, and preparing a Five-Year Review Report. The final project work plans were submitted to USAEC and appropriate regulatory agencies on February 18, 1994. The field program was conducted from February 21 through March 8, 1994. Specific subtasks of the field program included inspecting the cap and fence surrounding Area P, surveying the surface elevation of the cap, and determining shallow groundwater quality at Area P by sampling 13 wells located on and adjacent to Area P.

The objectives of the Five-Year Review of the Interim Remedial Action at Former Area P Lagoons are to:

- Determine if the clay cap of the Former Area P Lagoons has been effective in preventing surface erosion of incinerated soil
- Determine if the clay cap has been effective in minimizing infiltration of rainwater through residual explosive-contaminated soil existing below the depth of the incinerated soil
- Determine the integrity of the clay cap and the fence surrounding Area P.

SUMMARY OF CAP AND FENCE INSPECTION

SAIC conducted a cap and fence inspection on February 21 and 22, 1994. The cap inspection identified bare spots greater than 1 foot in area. This study recommended that these bare spots be seeded and mulched to prevent erosion. A low-lying area near the southwestern boundary of Area P also was identified. Water tends to pond in this area after periods of heavy precipitation. The fence inspection identified one area on the northeast boundary that was damaged by a fallen pine tree. The fence has since been repaired by LAAP personnel.

SUMMARY OF TOPOGRAPHIC SURVEY OF AREA P CAP

The Area P cap was topographically surveyed by Farmer, Downs, and Associates between March 3 and 9, 1994. The survey was conducted to determine if any subsidence has occurred at Area P by comparing the 1994 and 1990 surface elevations. The 1994 topographic survey indicates that no subsidence has occurred since the cap was installed in 1990.

SUMMARY OF GROUNDWATER SAMPLING RESULTS

Twelve of the proposed 13 wells were sampled during the Five-Year Review of Area P. Due to bent well casings, well GO010 was substituted with well GO014, and well GO011 could not be sampled. The samples were analyzed for explosives only, since they have been identified as contaminants of concern (COCs) for Area P.

Nine wells screened in the Upper Terrace aquifer were sampled during the Five-Year Review of Area P Lagoons. Concentrations of hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), 1,3,5-trinitrobenzene (1,3,5-TNB), 1,3-dinitrobenzene (1,3-DNB), 2,4,6-trinitrotoluene (2,4,6-TNT), and nitrobenzene (NB) were above the drinking water health advisory levels (HALs). Concentrations of 2,4-dinitrotoluene (2,4-DNT), 2,6-dinitrotoluene (2,6-DNT), cyclotetramethylenetetranitramine (HMX), and N-methyl-N,2,4,6-tetranitroaniline (TETRYL) were below the HALs. The maximum concentration for explosives was detected in well GO104 located southwest of Area P. The 1994 concentration of explosives in the Upper Terrace aquifer was lower than the 1990 concentration, indicating that the groundwater quality at Area P has improved since the remedial measure was completed.

SAIC sampled three wells screened in the Lower Terrace aquifer during the Five-Year Review field investigation activities. The COCs detected in the Lower Terrace aquifer at Area P were the same as those found in the Upper Terrace aquifer. As in the Upper Terrace aquifer, the concentrations of RDX, 1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, and NB were above the HALs. Generally, the concentration of the COCs in the Lower Terrace aquifer was less than the concentration detected in the Upper Terrace aquifer. The concentration in the Lower Terrace aquifer was higher than the 1990 concentration for wells GO105 and GO106 located southwest of Area P. This may be a result of downward migration of the COCs from the Upper Terrace aquifer.

Three ponded areas were identified during the Five-Year Review of Area P. Water tends to pond in these areas after periods of heavy precipitation. A ponded area was identified on the Area P cap near wells GO068, GO109, and GO110. This area, which is along the drainage pathway from the Area P cap, should be filled with soil and graded to blend smoothly with the surrounding area. The area should be seeded and mulched to prevent erosion. The ponding of the water observed in the southwest corner of the Area P cap after periods of heavy precipitation is a result of the surface drainage pattern from the cap. The ponded area south of well GO012 is outside the cap area. No maintenance is recommended for these two areas.

SUMMARY OF GROUNDWATER ANALYSIS

A statistical regression analysis approach was used to identify the groundwater trends at Area P. Groundwater sampling data were evaluated from 1980 through 1994. Quadratic and linear analyses were conducted for 108 sampling data sets (12 wells x 9 COCs). Trend categories were assigned to each of the data sets based on improving, deteriorating, and stable groundwater quality of COCs. Data sets with no specific trend also were identified. Based on the trend categories, trend indices were determined by well for each COC, and Area P overall. The overall trend indices for both the Upper and Lower Terrace aquifers were positive, indicating that the groundwater quality at Area P is generally improving.

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1. INTRODUCTION

Science Applications International Corporation (SAIC) prepared this Five-Year Review Report of Former Area P Lagoons to satisfy the requirements of Task Order No. 0010 (IAW ELIN A009) of the U.S. Army Environmental Center (USAEC) Contract No. DAAA15-91-D-0017. Task Order 0010 requires SAIC to perform a Five-Year Review of the interim remedial action effectiveness at Former Area P Lagoons at Louisiana Army Ammunition Plant (LAAP), a U.S. Army Armament, Munitions, and Chemical Command (AMCCOM) installation, in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 and U.S. Environmental Protection Agency (EPA) guidance (EPA 1991, USATHAMA 1992).

1.1 REGULATORY INITIATIVES

According to CERCLA, a review of the remedy effectiveness at Area P must be conducted every 5 years unless future risk assessments indicate that health risks at the site are acceptable for unrestricted use. Section 121c of CERCLA requires that, for "a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site," the U.S. Army "shall review such remedial action no less often than every five years after the initiation of such remedial action to ensure that human health and the environment are being protected by the remedial action being implemented." The EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9320.2-03B, states "...EPA will ensure that five-year reviews are conducted for all remedial actions which result in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure" (EPA 1989).

The Five-Year Review of interim remedial actions completed at the Former Area P Lagoons in 1990 is being conducted at LAAP in accordance with CERCLA under the Federal Facilities Agreement (FFA) signed by EPA Region VI, the Louisiana Department of Environmental Quality (LDEQ), and the U.S. Army on February 10, 1989.

1.2 OBJECTIVES OF FIVE-YEAR REVIEW

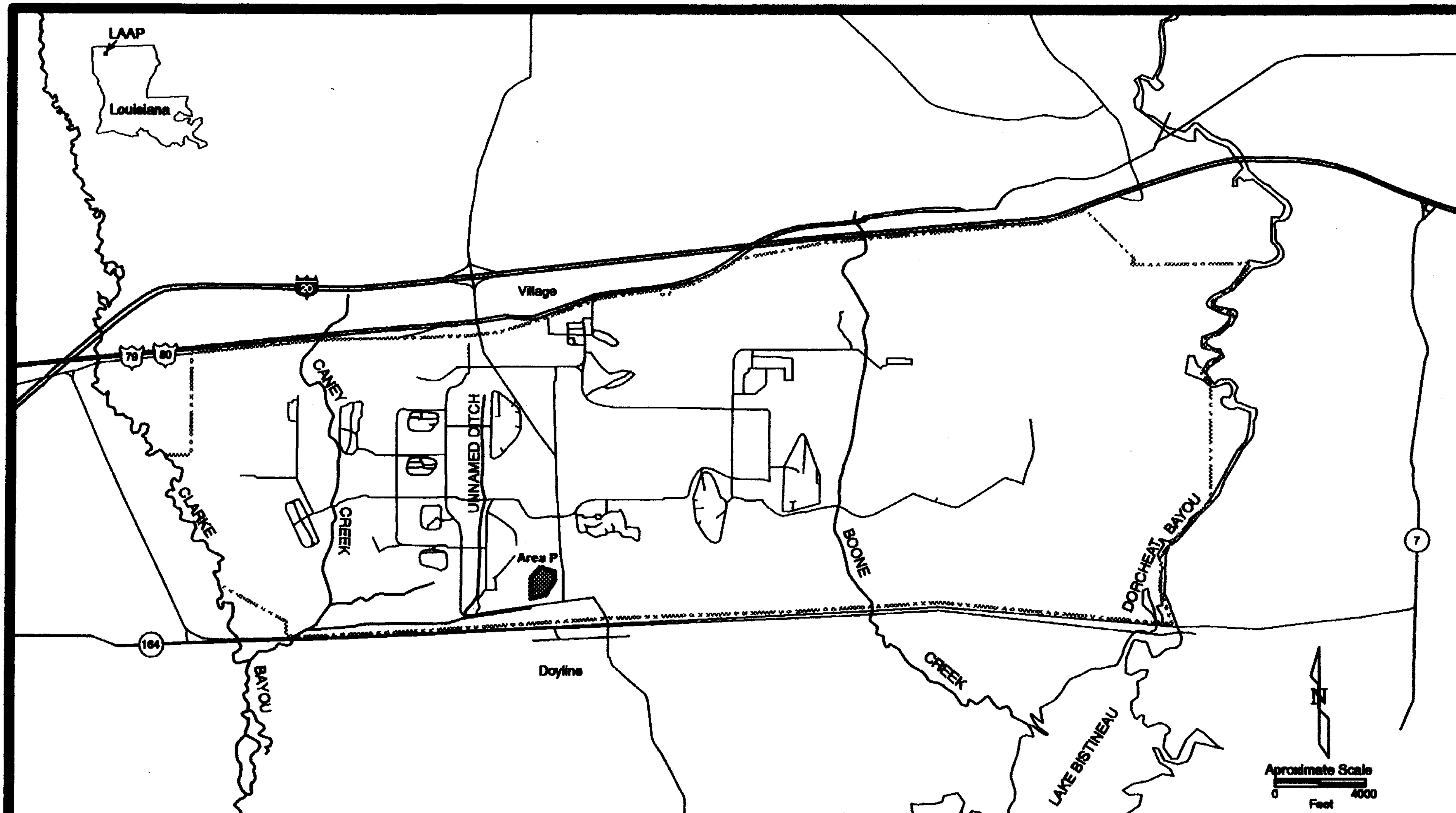
The primary objectives of this Five-Year Review of Area P, as outlined in the statement of work (SOW) and Maintenance Plan for LAAP (USATHAMA 1992), was to inspect the current site conditions, determine the effectiveness of the interim remedial measure (cap), and identify any additional actions that should be taken in accordance with CERCLA. To accomplish these objectives, data were collected during the following inspection, survey, and monitoring activities:

- Cap inspection
- Fence inspection
- Groundwater sampling and analysis
- Topographic survey of Area P cap.

The field investigation activities were conducted between February 21 and March 4, 1994. The objective of the cap inspection was to determine the stability of the cap; hence, its capability to be effective. The objective of the fence inspection was to determine if access to Area P is being controlled. The groundwater sampling was conducted to evaluate the groundwater quality in the shallow aquifer. The sample results were compared with the historical data to determine variations in explosive compound concentrations. The objective of the topographic survey was to determine if any subsidence of the cap had occurred since its installation in 1990.

1.3 SITE DESCRIPTION

LAAP is a government-owned, contractor-operated (GOCO) facility located approximately 22 miles east of Shreveport, Louisiana, and is under contractual agreement with Thiokol Corporation to manufacture metal shell parts and load-assemble-pack (LAP) ammunition items. The facility is bound to the north by Interstate 20 and U.S. Highway 80, to the south by State Route 164, to the east by Dorcheat Bayou, and to the west by Clarke Bayou. A map of the general vicinity is provided in Figure 1-1. Two streams, Boone Creek and Caney Creek, flow north to south across the site. LAAP lies within both the Bossier and Webster Parishes and consists of 14,974 acres of land, of which 74 acres are administrative and residential, 2,970



LEGEND

- Road
- Plant Property Boundary
- Interstate
- U.S. Highway

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

PLANT LOCATION MAP

Louisiana Army Ammunition Plant

Figure: 1-1	Project: 01-0827-03-[illegible]-012

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acres are devoted to production lines and mission support facilities, and 11,930 acres are woodlands. The area surrounding LAAP is used primarily for agriculture, with some residential and commercial development. The closest community to LAAP is the village of Doyline, which is adjacent to the southern boundary. The area topography is relatively level to moderately rolling, with elevations ranging from 170 to 225 feet above mean sea level (MSL). All surface drainage from LAAP is discharged into Lake Bistineau, located approximately 2 miles south of the installation.

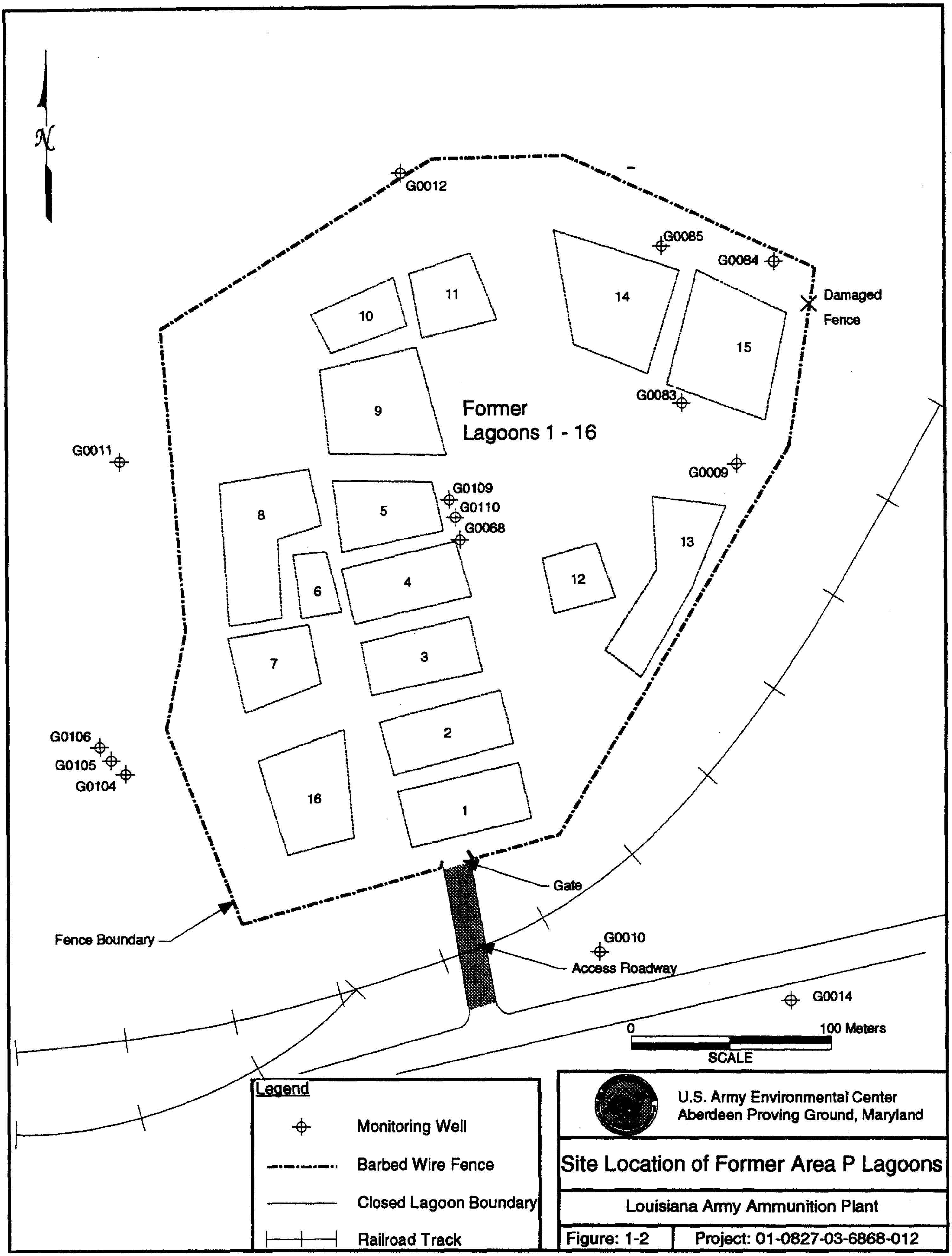
1.4 SITE HISTORY

The primary mission of LAAP is to load, assemble, and pack ammunition items; manufacture ammunition metal parts; and provide associated support functions for ammunition production. Eight ammunition lines and one ammonium nitrate graining plant were constructed by the Silas Mason Company between July 1941 and May 1942. Production ceased in August 1945 at the conclusion of World War II. The plant was placed on standby status in September 1945, and in November 1945, the Federal Government relieved Silas Mason Company of responsibilities for plant operations (USATHAMA 1992).

Remington Rand, Inc., under contractual agreement with the Federal Government, reactivated the plant in February 1951 and maintained operations during the Korean Conflict. Ammunition production was suspended and the facility was again placed on standby status in October 1957.

In September 1962, the Federal Government again reactivated the facility and contracted Sperry Rand Corporation to operate the munitions production in support of the Vietnam Conflict. Thiokol Corporation took over the facility operations in 1974 when Sperry Rand Corporation relinquished the contract.

Area P consisted of 16 unlined lagoons of approximately 25 acres in area and is located in the south-central part of the installation, as shown in Figure 1-2. The Area P Lagoons were in active use between 1940 and 1981. During this time, untreated explosives-laden wastewater from industrial operations within LAAP was collected in concrete sumps at each of various


N
G0012
G0085
G0084
Damaged Fence
G0083
G0011
G0009
G0109
G0110
G0068
Former Lagoons 1 - 16
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
G0106
G0105
G0104
Gate
Fence Boundary
G0010
Access Roadway
G0014
0
100 Meters
SCALE
Legend
Monitoring Well
Barbed Wire Fence
Closed Lagoon Boundary
Railroad Track
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland
Site Location of Former Area P Lagoons
Louisiana Army Ammunition Plant
Figure: 1-2
Project: 01-0827-03-6868-012

industrial areas and hauled by tanker trucks to Area P. The wastewater is now listed as hazardous waste according to 40 CFR 261.32, Waste from Specific Source, and classified "K047-Pink/Red Water from Trinitrotoluene (TNT) Operations."

LAAP was placed on the National Priorities List (NPL) in March 1989 due to contamination caused by past disposal of explosives-laden wastewater into unlined surface impoundments. Numerous investigations have been conducted for the Area P Lagoons to determine the nature and extent of soil and groundwater contamination. An interim remedial action was initiated in 1988 because the explosives-contaminated wastewater at Area P was found to be contributing to groundwater contamination. The source of the contamination was remediated by draining and treating wastewater in the lagoons, excavating the soil from the lagoons and adjacent areas, and treating the soil in an incinerator to destroy the explosives. The lagoons were excavated until a total field-determined explosives concentration of less than 100 parts per million (ppm) was reached. The incineration of 101,929 tons of soil and the treatment of 53,604,490 gallons of wastewater and rainwater collected within the 16 former pink-water lagoons was completed in 1990. The area was backfilled with the incinerated soil, capped, and vegetated.

The lagoons were covered with a minimum 2-foot thick compacted cap of uncontaminated clay soil from Area P and a nearby borrow pit on LAAP. The remediation of the site increased the elevation of the lagoon area above the surrounding topography to promote surface drainage. Drainage was to the west and south, matching the prevailing drainage in that area. After periods of heavy precipitation, most of the runoff from Area P cap drains to the Unnamed Ditch located south of Area P. This ditch runs west along the plant boundary to Caney Creek before leaving the plant.

The clay cap covers not only the lagoons, but all of the original Area P. It is compacted to at least 90 percent of the standard proctor density for the material used. The cap is covered with 4 inches of topsoil and has a slope of at least 1 percent over the lagoons. The cap is vegetated and fenced with posted signs.

1.5 REPORT ORGANIZATION

The remainder of this Five-Year Review Report contains the following sections:

- Section 2, Study Area Characterization, presents an overview of the environmental setting at Area P of LAAP.
- Section 3, Five-Year Review Results and Significance of Findings, presents field sampling data evaluation, cap and fence inspection findings, evaluation of the topographic survey of the Area P cap, and groundwater trend analysis.
- Section 4, Conclusions and Recommendations, presents the findings of the Five-Year Review and presents recommendations for corrective measures and future Five-Year Reviews of Area P.

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2. STUDY AREA CHARACTERIZATION

2.1 INTRODUCTION

This section presents the regional physical setting of the Louisiana Army Ammunition Plant (LAAP). A brief summary of the geographic setting, hydrology, geology, hydrogeology, ecology, and demographics of the LAAP area is included.

2.2 GEOGRAPHIC SETTING

Northwest Louisiana lies within the East Texas Timber Belt subdivision of the West Gulf Coastal Plain physiographic province. LAAP is located in an area with three major landform types, including uplands in the west, slightly rolling low land in the east, and the ancient Red River floodplain underlying the central portion of the installation. The elevation is approximately 130 feet above mean sea level (MSL) at Dorcheat Bayou to the east, and approximately 180 feet above MSL at the Clarke Bayou to the west. The maximum elevation at LAAP is approximately 225 feet above MSL. The topography is primarily the result of erosion caused by surface drainage to the tributaries of the Red River and has generated a relatively level to moderately rolling topography.

2.3 HYDROLOGY

2.3.1 Climate

The climate of northwest Louisiana has been characterized as continental, with cool winters and hot summers. The mean winter temperature is 45°F, and the average monthly minimum temperature is 35°F. January is the coldest month, with temperatures approximately 40°F. The mean summer temperature is 81°F, while the average monthly maximum temperature during the summer is 92°F. July is the hottest month, with temperatures averaging 83°F. The relative humidity is 60 percent for 75 percent of the year and less than 40 percent for only 7 percent of the year.

The town of Minden lies approximately 2 miles northeast of the LAAP boundary and has an average annual rainfall of 53 inches per year. Monthly rainfall averages 5 inches during winter and spring, and 3 inches during summer and autumn. The wettest months are October and November, while the least amount of rain generally falls during August and September. During the winter, 98.6 percent of the precipitation is rain. An average of only 2 inches of snow falls each winter.

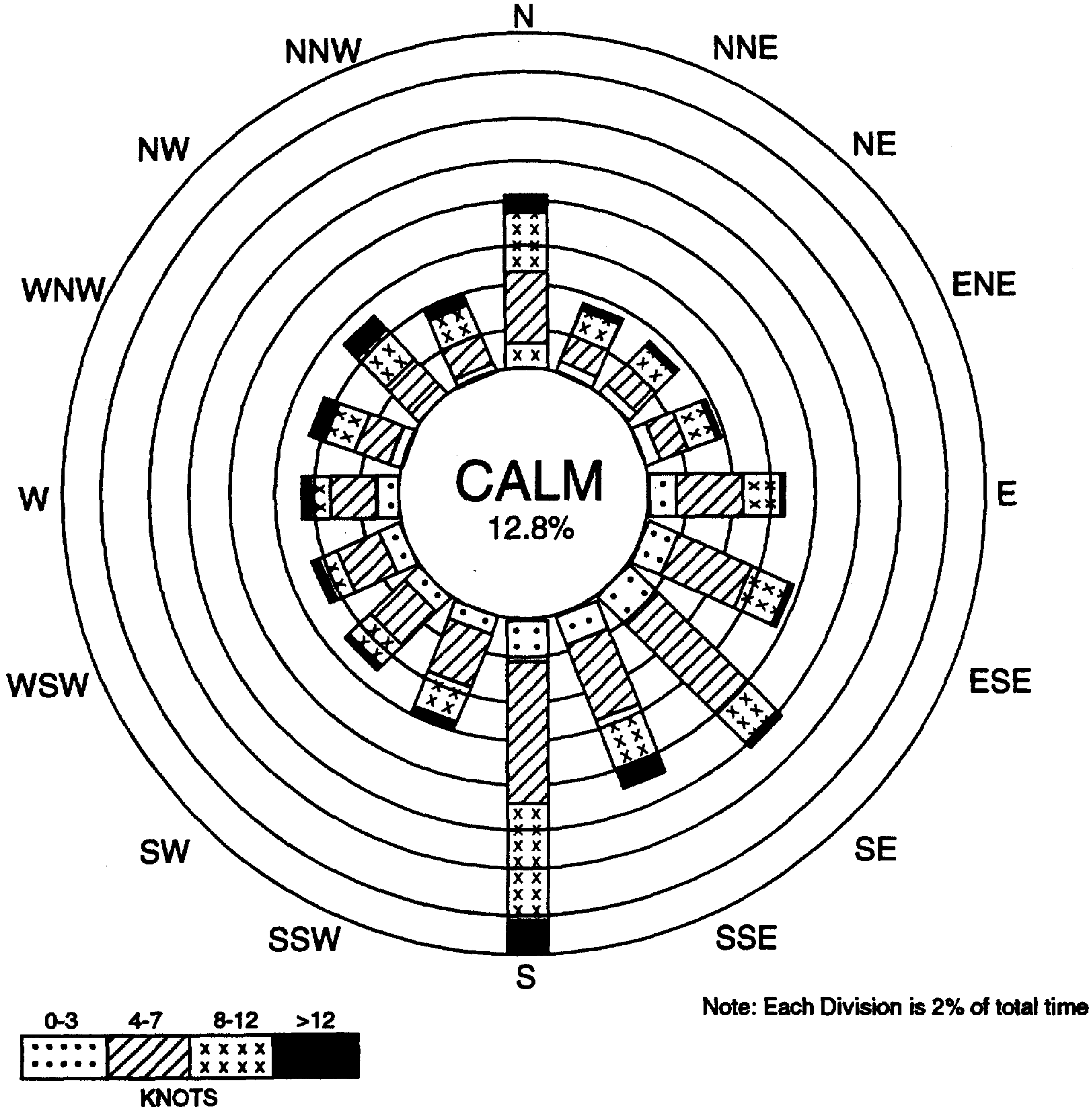
During the summer, the prevailing southerly winds provide a moist, warm, tropical climate; however, erratic pressure distributions occasionally generate westerly winds and hot, dry weather. These same prevailing patterns alternately generate moist tropical air and dry, cold air during the winter. As a result, temperature changes can be extreme. Figure 2-1 provides a "wind rose" showing wind directions and velocities for the LAAP area.

2.3.2 Surface Water Hydrology

Surface drainage for the installation (Figure 1-1) flows into Lake Bistineau (located 2 miles south of the plant) by way of Clarke Bayou, Caney Creek, Boone Creek, an unnamed drainage ditch, and Dorcheat Bayou. These main drainages are generally intermittent, slow-moving (less than 1 cubic foot per second [cfs]), shallow streams (less than 6 feet deep). Characteristically, surface water drainages at LAAP have minimal flow, turbid water, and eroded banks. The bottom substrate is generally composed of silty clay with an abundance of decaying plant material. Water quality measurements are variable, and most locations have relatively low levels of dissolved oxygen (DO) (ESE 1992). All of these waterways, with the exception of the unnamed drainage ditch, originate north of the facility.

The Clarke Bayou flows to the southward along the western edge of the installation, establishing the western boundary. Clarke Bayou and one of its tributaries, Caney Creek, are the primary drainage pathways for the western quarter of LAAP, which includes Area P. Caney Creek, located 1 to 2 miles east of Clarke Bayou, flows due south across the installation, as shown in Figure 1-1 (ESE 1992).

Surface drainage for the majority of the eastern to central portion of the installation is controlled by Boone Creek and its tributaries, which are located on the eastern third of the property. The unnamed, manmade drainage ditch within LAAP lies 6.4 miles west of Boone



SOURCE: International Technology Corporation (1987)

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Annual Wind Rose
Area P Lagoons
Louisiana Army Ammunition Plant
Shreveport, Louisiana

Figure: 2-1	Project: 01-827-03-6868-012

Creek. The ditch originates just north of Area C and flows in a southerly direction toward the plant boundary. The ditch then turns to the west and continues to its junction with Caney Creek.

2.4 GEOLOGY

2.4.1 Regional Geology

The geologic units underlying LAAP consist of unconsolidated sediments ranging in age from Eocene to Pleistocene. The major strata are the Pleistocene terrace deposits (alluvium), and the Tertiary Claiborne Group Formations (Sparta Sand, Cane River, and Carrizo Sand), and the Tertiary Wilcox Group. Table 2-1 summarizes the major stratigraphic units in northeast Louisiana.

The Pleistocene terrace deposits cover the entire surface of LAAP. This uppermost geologic strata is an alluvium consisting of interlayered, discontinuous sand seams, silt, and clay. These sediments represent floodplain and fluvial deposits of the ancestral Red River and have been classified into four separate terraces. LAAP is positioned on the Montgomery terrace, the second youngest terrace in this classification. The thickness of the Pleistocene section at LAAP ranges from 30 to 150 feet and rests unconformably on top of the Claiborne Group. Formations at the installation had been eroded before or during deposition of the terrace strata, resulting in a structural unconformity. At LAAP, the Claiborne Group consists of the Sparta Sand, Cane River, and Carrizo Sand formations.

The Eocene Sparta Sand, a member of the Claiborne Group, lies unconformably below the Pleistocene terrace deposits. The formation consists of nonmarine massive sand, silty sand, and silty shale, with occasional lignite and lignitic shale (Payne 1968). Recent researchers (ETA 1991) have reported regional dips of approximately two degrees (170 feet/mile) to the northeast for the Sparta Sand and the subsequent underlying units.

The basal sand and gravel of the Pleistocene terraces and those of the Sparta Sand physically appear to be similar. However, the Sparta Sand probably does not exist at Area P. The current theory regarding the Sparta Sand was presented by Engineering Technology and Associates, Inc. (ETA) in 1991. As per ETA's report, "Sparta Sand is not present at Area P

Table 2-1. Generalized Geologic Column, Northeast Louisiana

System	Stratigraphic Unit		Description and typical thickness	Hydrologic unit
Quaternary	Terrace deposits (undifferentiated)		Sand, gravel, and some clay. Limited to western part of study area. Thickness probably about 50 ft.	Terrace aquifer
Tertiary	Claiborne Group	Cook Mountain Formation	Clay, partly sandy; glauconitic. Thickness about 100 to 200 ft.	Confining bed
		Sparta Sand	Interbedded clay and fine to medium sand; lignitic. Thickness about 400 to 700 ft. Unit is 20 to 100 percent sand.	Sparta aquifer
		Cane River Formation	Clay; glauconitic, lignitic. Thickness about 100 to 300 ft.	Confining bed
		Carrizo Sand	Fine to coarse sand; discontinuous. Thickness to 150 ft.	Wilcox-Carrizo aquifer
	Wilcox Group	Undifferentiated	Interbedded clay, sand, silt; lignitic. Thickness about 390 to 850 ft. Unit is 20 to 30 percent sand.	
	Midway Group	Undifferentiated	Dense clay. Thickness about 600 ft.	Confining bed

Source: USACE, 1984

because the Cane River Formation has been truncated from its usual thickness of 200 feet down to 80 feet. This erosional truncation could not occur without also truncating the Sparta Sand above." For purposes of hydrogeologic characterization, a precise stratigraphic identification of the formations is not necessary, since the hydrogeologic characteristics of the lower Pleistocene are similar to the Sparta. Therefore, in the hydrogeologic discussion contained in this report, the two units have been combined into one aquifer, the Lower Terrace/Sparta Sand aquifer.

The Eocene Cane River Formation lies directly below the Sparta Sand and follows the same northeasterly dip as the overlying unit. The Cane River Formation consists primarily of marine clay with abundant foraminifera, but also contains some silt and shale, often gray-green in color (Martin et al. 1954). Regionally, the thickness of the Cane River Formation varies from 100 to 300 feet.

The Eocene Carrizo Sand, the oldest member of the Claiborne Group, underlies the Cane River Formation and consists of fine- to coarse-grained sand deposited on the eroded surface of the underlying Wilcox Formation. Because of nondeposition or erosion, the Carrizo Sand is a discontinuous unit. Payne (1975) reports the Carrizo to be absent over most of LAAP. Where it does exist, the Carrizo is composed primarily of well-sorted sand deposited as fill.

The Wilcox Group sediments consist mainly of nonmarine, white to gray, thin bedded micaceous sand and sandy shale. Regionally, the sequence varies in thickness from 350 to 1,000 feet; however, maximum thickness at LAAP is approximately 550 feet.

2.4.2 Geology of Area P

The geologic units underlying Area P consist of unconsolidated Pleistocene-aged upper terrace deposits, Lower Terrace/Sparta Sand, the Cane River Formation, and the Wilcox Formation. Although the geology at Area P is highly variable in the Pleistocene terrace deposits, some general trends have been identified. The alluvium in the immediate vicinity of the former lagoons is predominantly sand and silty sand with lesser quantities of interbedded silt and clay. Similar conditions apparently exist to the east and north of the lagoons. South of the lagoons, the alluvium is extremely variable and ranges from predominantly clay to predominantly sand. At Area P, these deposits extend from the surface to a depth of approximately 40 to 50 feet below land surface (BLS).

Several previous reports describe the Sparta Sand at Area P; however, ETA's 1991 report *Groundwater Model for Selected Sites at the Louisiana Army Ammunition Plant,* indicates that the Sparta Sand does not exist at Area P due to an erosional truncation of the formation. For purposes of this report, the exact lithologic identification is not necessary. The sands of the basal Pleistocene (Sparta) range in thickness from 8 to 30 feet. The upper part of the sand is generally a fine quartz sand; however, the unit generally becomes coarser with depth and grades into medium- to coarse-grained sand.

The Cane River Formation lies below the sand of the basal Pleistocene. The unit consists of bluish-green to dark gray, finely laminated, interbedded clay, silt, and sand. The Wilcox Formation is projected to be 175 feet BLS at Area P. It consists mainly of nonmarine, white to gray, thin bedded micaceous sand and sandy shale.

2.5 HYDROGEOLOGY

The hydrologic units underlying Area P and the characteristics of each of the geologic units are discussed below.

2.5.1 Upper Terrace Aquifer

The shallow aquifer underlying LAAP consists of Pleistocene terrace deposits that form the entire surface of LAAP. Groundwater in the Upper Terrace aquifer generally exists under water-table (unconfined) conditions at depths typically 25 feet BLS. The direction of groundwater flow in the Upper Terrace aquifer is controlled primarily by topography and the surface water system. Although terrace aquifer production wells are not located at LAAP, the aquifer supports production wells off the installation. Domestic wells using the terrace aquifer have been completed in the surrounding towns of Haughton, Princeton, Dixie Inn, Minden, Sibley, and Doyline.

Groundwater quality simulations conducted at Area P by ETA in 1991 show contaminant migration in the Upper Terrace aquifer generally travels downward with a small amount of horizontal spreading (ETA 1991). Water level measurements collected during the Five-Year Review in the Upper Terrace aquifer indicate that the regional groundwater flow is toward the southwest (Figure 2-2).

2.5.2 *Lower Terrace/Sparta Sand Aquifer*

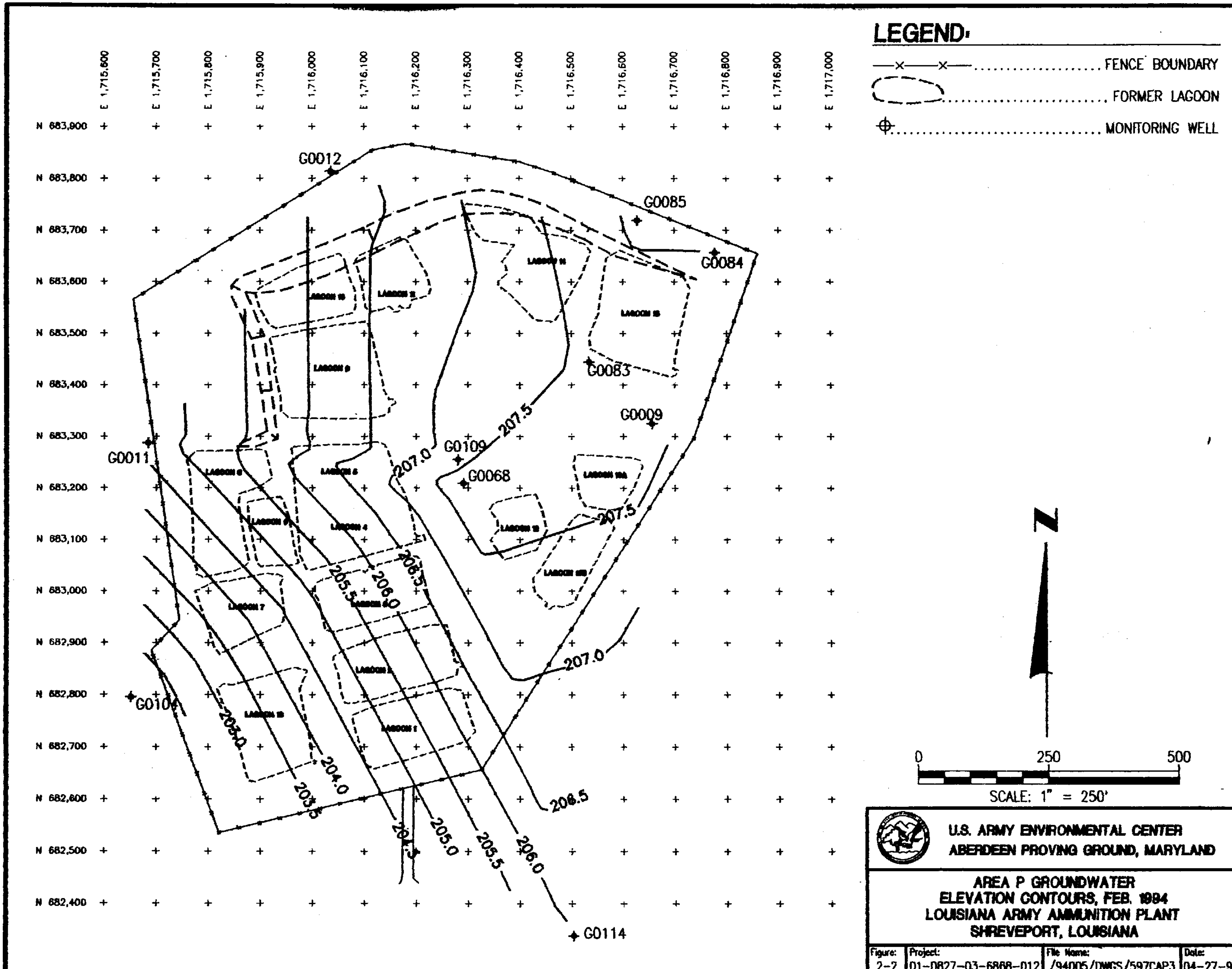
Directly beneath the Upper Terrace aquifer is the Lower Terrace/Sparta Sand aquifer, an important aquifer in the north-central portion of the state and the principal source of drinking water for the town of Minden, located 2 miles northeast of LAAP. However, the Lower Terrace/Sparta Sand thins rapidly from Minden westward into LAAP. At Area P, the Lower Terrace/Sparta Sand does not exist (ETA 1991).

Where the Lower Terrace/Sparta Sand aquifer exists on the LAAP facility, a hydraulic communication exists between this aquifer and the overlying Terrace deposits, resulting in unconfined conditions. The groundwater flow in this shallow aquifer also is dominated by the surface topography and surface water system and groundwater flow direction is generally toward the streams that bisect LAAP.

2.5.3 *Wilcox Group/Carrizo Sand Aquifer*

The Wilcox Group/Carrizo Sand aquifer is the principal aquifer supplying groundwater to LAAP. The average depth of the formation ranges from 100 feet BLS in the southwestern portion of the installation to 500 feet BLS in the northeastern portion. A groundwater gradient of 50 feet per mile toward the northeast exists in the Wilcox/Carrizo aquifer, and aquifer pumping test data show that the sand has an average transmissivity of 5,000 gpd/ft and a storage coefficient of 0.0002 (ESE 1992). LAAP had previously derived all of its water for plant operation from wells screened in sand layers of the Wilcox aquifer. Locations of all previously used water wells on the plant in the Wilcox formation are shown in Figure 2-3.

The Cane River formation, a stratum of low permeability, overlies the Wilcox aquifer and acts as a confining layer. Because of the confining Cane River formation and the dip of the


LEGEND:
FENCE BOUNDARY
FORMER LAGOON
MONITORING WELL
G0012
G0085
G0084
G0083
G0009
G0109
G0068
G0011
G0106
G0114
207.5
207.0
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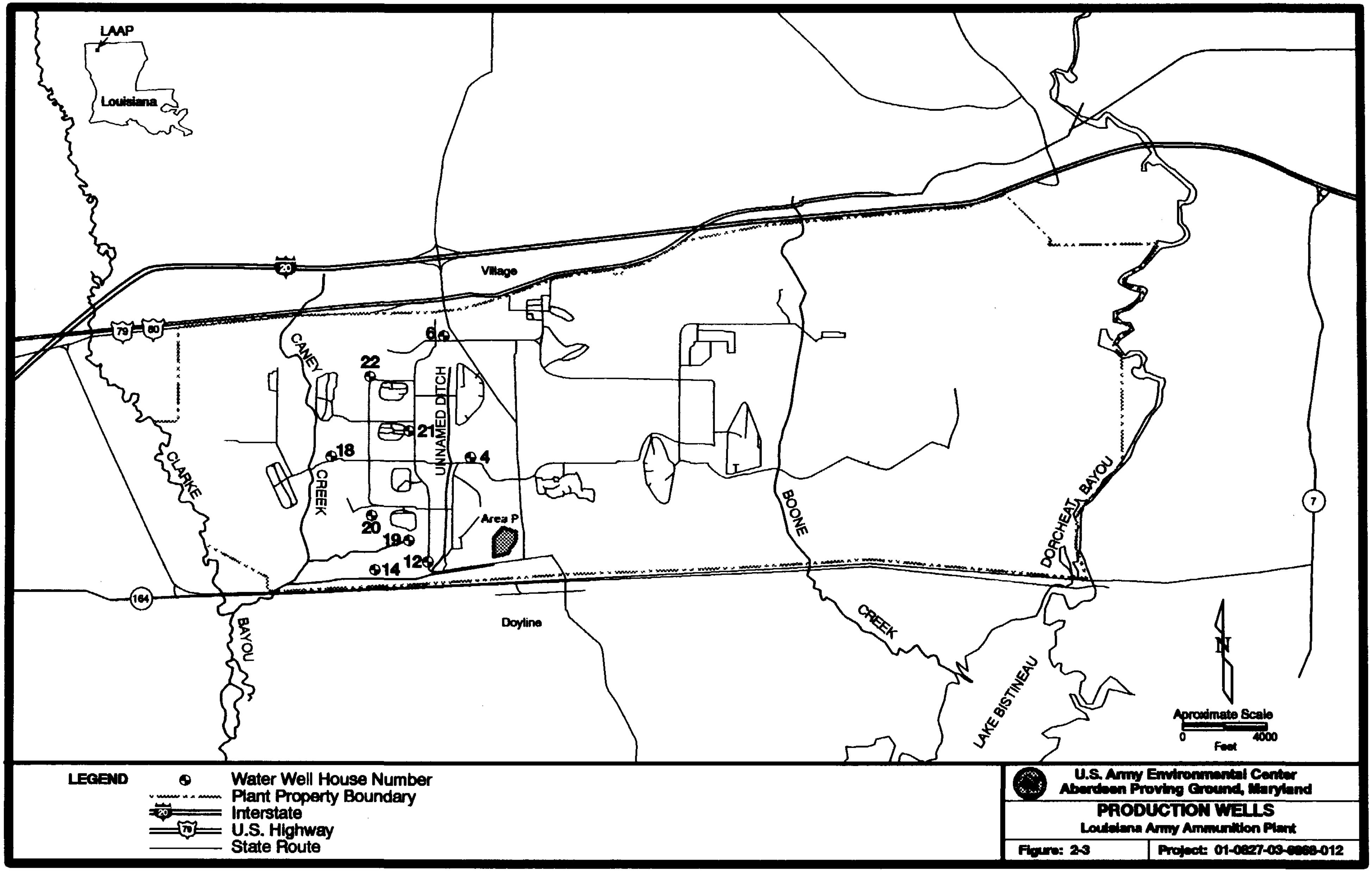
U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND
AREA P GROUNDWATER
ELEVATION CONTOURS, FEB. 1994
LOUISIANA ARMY AMMUNITION PLANT
SHREVEPORT, LOUISIANA
Figure: 2-2
Project: 01-0827-03-6868-012
File Name: /94005/DWGS/597CAP3
Date: 04-27-94


LAAP
Louisiana
Village
20
79
80
CANEY
CREEK
CLARKE
BAYOU
UNNAMED DITCH
6
22
21
18
4
20
19
12
14
Area P
164
Doyline
BOONE
CREEK
LAKE BISTINEAU
DORCHEAT BAYOU
7
N
Aproximate Scale
0
4000
Feet
LEGEND
Water Well House Number
Plant Property Boundary
Interstate
U.S. Highway
State Route
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland
PRODUCTION WELLS
Louisiana Army Ammunition Plant
Figure: 2-3
Project: 01-0827-03-8868-012

347L 101693

Wilcox strata, the hydrostatic head of the Wilcox aquifer rises above the contact between the Cane River Formation and the Wilcox Group. The Wilcox sand is recharged by precipitation that falls upon the Wilcox outcrop areas, and from overlying Quaternary strata where hydrostatic pressure in the Wilcox is less than the overlying material. Perennial streams that cross both the areas and the Quaternary deposits also help recharge the aquifer.

2.6 DEMOGRAPHICS

The area surrounding LAAP is primarily rural, with several small towns located in the near vicinity. The cities of Shreveport (population 198,525) and Bossier City (population 52,721) are approximately 20 miles west of LAAP. The town of Minden (population 15,489) is 2 miles northeast of the installation. The village of Doyline (population 896) is south and adjacent to the facility.

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3. FIVE-YEAR REVIEW RESULTS AND SIGNIFICANCE OF FINDINGS

This section presents the results of the field investigation activities conducted during the Five-Year Review of Area P. These activities were conducted from February 21 through March 8, 1994. The field investigation techniques, methods, and procedures used during the Five-Year Review are presented in the Field Sampling Design Plan (SAIC 1994).

3.1 CAP AND FENCE INSPECTION

In 1990, after the incineration and backfilling of the contaminated soils at the Area P lagoons, the original Area P, including the lagoons, were covered with a minimum of 2 feet of compacted clay and 4 inches of topsoil. The cap was vegetated and fenced with posted signs. The cap was installed to minimize rainwater infiltration through soils laden with residual explosives contamination. The fence is maintained to prevent unauthorized access. The fence and cap will be maintained indefinitely.

3.1.1 Objectives

As a part of interim remedial action, guidelines and procedures for inspection and maintenance of the integrity of the cap and fence were established (USATHAMA 1992). These guidelines and procedures were used to conduct the cap and fence inspection. The guidelines for cap inspection included identifying the following:

- Bare soil spots larger than 1 square foot in area
- Eroded areas deeper than 4 inches
- Ponded areas larger than approximately 20 feet in diameter and deeper than 6 inches
- Any nongrasses that are found growing on the cap
- Any subsided areas
- Surface cracks.

The guidelines for fence inspection included identifying loose or broken wire strands and disturbed or missing fence post and signs.

3.1.2 Significance of Findings

A cap and fence inspection was conducted on February 21 and 22, 1994. The cap inspection identified bare spots greater than 1 square foot in area on the cap (Figure 3-1). A low-lying area near the southwest boundary of Area P and near monitoring wells GO068, GO109, and GO110 also was identified. Water tends to pond in these areas after periods of heavy precipitation (Figure 3-1). The ponding of water in the southwest corner of the Area P cap after periods of heavy precipitation is a result of the surface drainage pattern from the cap. The ponded area south of well GO012 is outside the cap area. The fence inspection identified one area on the northeast boundary damaged by a fallen pine tree. The fence damage was a result of an ice storm that hit the Shreveport area on February 17, 1994. The fence has since been repaired by Louisiana Army Ammunition Plant (LAAP) personnel.

3.2 TOPOGRAPHIC SURVEY OF AREA P CAP

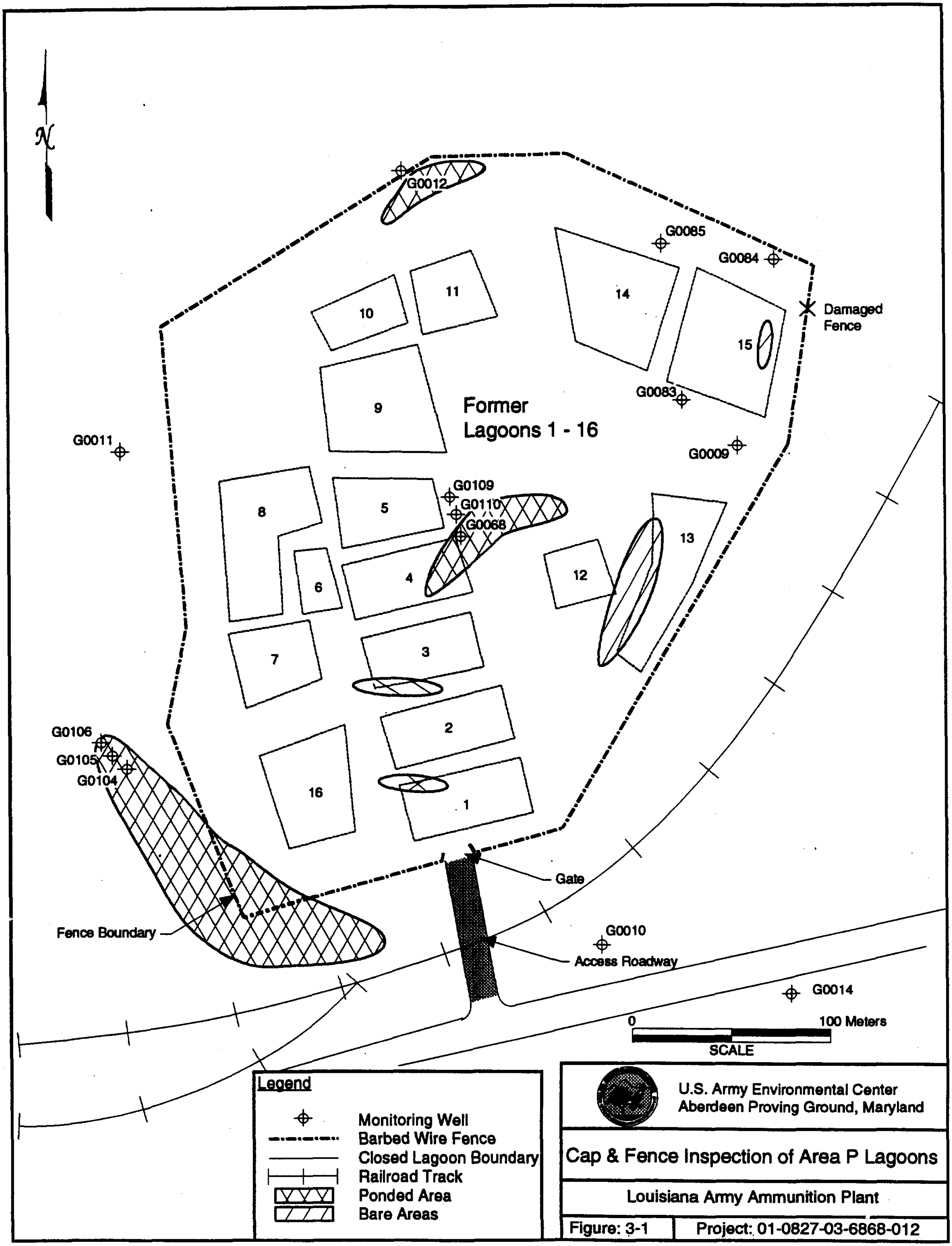
As a part of the Five-Year Review, a topographic survey of the surface elevations of the Area P cap was conducted. The survey was conducted from March 3 through 9, 1994, by Farmer, Downs and Associates of Natchitoches, Louisiana. All survey elevations were tied to the National Geodetic Vertical Datum (NGVD) elevation and the previous local grid system used at Area P in 1990. Elevations were determined along the same 100-foot grid that was constructed during the 1990 survey.

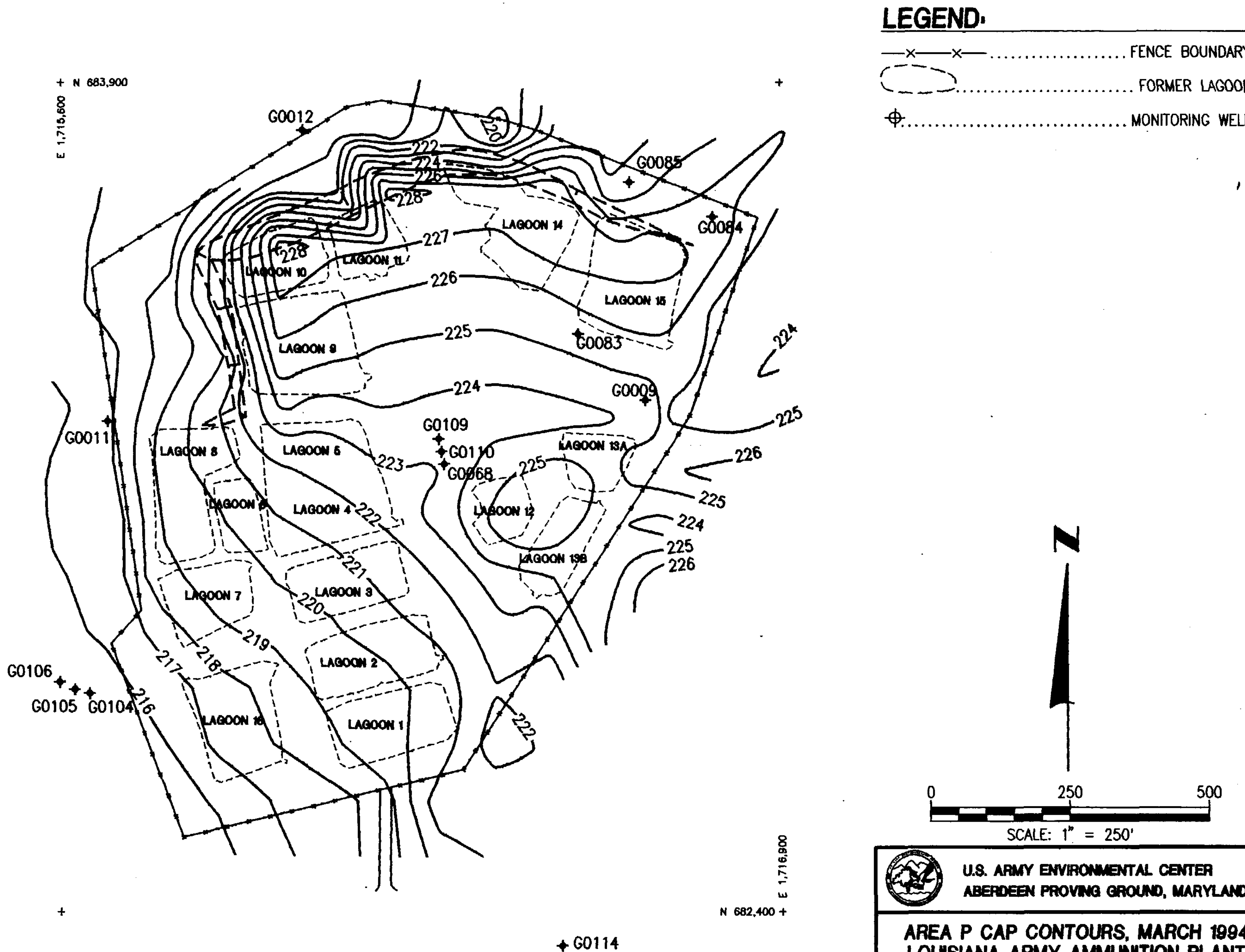
3.2.1 Objective

The objective of the topographic survey of the Area P cap was to determine if cap subsidence has occurred by comparing the survey results from the Five-Year Review to the 1990 survey (USATHAMA 1992). The impermeable cap, installed as a part of the 1990 remedial action, requires the elevation of Area P to be above the surrounding area to promote drainage. Drainage in 1990 was to the west and south, matching prevailing drainage in that area.

3.2.2 Significance of Findings

The topographic survey of the Area P cap indicated that no major subsidence has occurred since the cap was installed in 1990 (Figure 3-2). The 1990 and the 1994 survey maps


N
G0012
G0085
G0084
Damaged Fence
Former Lagoons 1 - 16
G0083
G0009
G0011
G0109
G0110
G0068
G0106
G0105
G0104
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Gate
Fence Boundary
G0010
Access Roadway
G0014
0
100 Meters
SCALE
Legend
Monitoring Well
Barbed Wire Fence
Closed Lagoon Boundary
Railroad Track
Ponded Area
Bare Areas
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland
Cap & Fence Inspection of Area P Lagoons
Louisiana Army Ammunition Plant
Figure: 3-1
Project: 01-0827-03-6868-012



U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

AREA P CAP CONTOURS, MARCH 1994
LOUISIANA ARMY AMMUNITION PLANT
SHREVEPORT, LOUISIANA

Figure:	Project:	File Name:	Date:
3-2	01-0827-03-6868-012	/94005/DWGS/597CAP2	07-05-94

are included in the pocket at the end of this report. The drainage from the cap is to the west and south. The survey was conducted along a 100-foot grid. Therefore, any subsidence between the grid points may not be shown on the topographic map. The area north of the cap and inside the Area P perimeter fence has a natural gradient. The 1990 topographic survey drawing does not show complete contours along the "grading limits" near the northern boundary of the cap (elevation 221 to 226 feet above MSL).

3.3 GROUNDWATER SAMPLING RESULTS

This section summarizes the results of the 1994 groundwater sampling conducted at Area P. A groundwater contamination trend analysis is presented in Section 3.4. The groundwater samples were analyzed for explosives only. The raw data used to compile the sampling result analysis in this section are contained within the Installation Restoration Data Management Information System (IRDMIS) and are summarized in Appendix A. These data have been reorganized and presented in this section to facilitate reporting. Groundwater Sampling Forms, Chain-of-Custody Forms, Water Level Measurement data sheets, and Well Construction Logs are provided in Appendix B.

The descriptions presented below represent the assessment of the detected concentrations of the contaminants of concern (COCs) that were determined by the 1992 Risk Assessment (ESE 1992). The COCs for groundwater at Area P, which includes both the Upper and Lower Terrace aquifers, are as follows:

- Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
- Cyclotetramethylenetetranitramine (HMX)
- 2,4,6-Trinitrotoluene (2,4,6-TNT)
- 1,3-Dinitrobenzene (1,3-DNB)
- 2,4-Dinitrotoluene (2,4-DNT)
- 2,6-Dinitrotoluene (2,6-DNT)
- 1,3,5-Trinitrobenzene (1,3,5-TNB)
- Nitrobenzene (NB)
- N-methyl-N,2,4,6-tetranitroaniline (TETRYL).

The chemical and physical properties of the COCs, including water solubility, log water partition coefficient (K_{ow}), soil sorption constant (K_{oc}), vapor pressure, and Henry's law constant, are provided in Table 3-1. These properties affect the potential contaminant migration.

Maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs) promulgated under the Safe Drinking Water Act (SDWA) do not exist for these COCs. Therefore, the COC concentrations were compared to the drinking water health advisory levels (HALs) presented in Table 3-2. These levels have been derived using the reference dose (RfD) values for noncarcinogenic nitrocompounds.

3.3.1 Objectives

In order to obtain a comprehensive data base for historical and future groundwater contamination comparison, 12 monitoring wells located on and adjacent to Area P were sampled and analyzed for explosive compounds (Figure 3-3). Due to bent well casings, well GO010 was substituted with well GO014, and well GO011 could not be sampled. Table 3-3 summarizes well construction data for the wells investigated during the Five-Year Review, including well depth and organization that constructed the wells. The shallow wells (20 to 36 feet deep) are screened in the Upper Terrace aquifer and used to monitor the top of the water table aquifer. The deeper wells are screened in the unconfined aquifer of the Lower Terrace/Sparta Sand and used to monitor the bottom of the water table aquifer.

The groundwater sampling results from the Five-Year Review of Area P are presented in Table 3-4. The 1990 sampling results obtained immediately after the Area P cap was installed are presented in Table 3-5. The Five-Year Review sampling data have been compared to the 1990 data in Sections 3.3.2 and 3.3.3 to evaluate the impact of the cap on shallow groundwater quality since the installation of the cap. Section 3.4 compares the groundwater monitoring data collected during the 1994 sampling effort with the historical data and discusses the trend in the groundwater quality. The historical sampling results are provided in Appendix C.

**Table 3-1. Physical and Chemical Properties of the Contaminants of Concern at Area P
Louisiana Army Ammunition Plant**

Contaminant of Concern	Molecular Weight (g/mole)	Water Solubility (mg/L)	Log K_{ow}	K_{oc} (mL/g)	Vapor Pressure (mm Hg)	Henry's Law Constant (atm•m³/mole)
1,3-Dinitrobenzene	168	530	1.49	36	1.3E-04	8.0E-07
2,4-Dinitrotoluene	182	280	1.98	250	2.2E-04	1.9E-07
2,6-Dinitrotoluene	182	210	1.89	78	5.7E-04	4.9E-07
HMX	296	5	0.12	3.5	3.3E-14	2.6E-15
Nitrobenzene	123	1,900	1.85	3.6	1.5E-01	1.3E-05
RDX	222	60	0.85	100	4.0E-09	2.0E-11
Tetryl	287	80	1.65	49	5.7E-09	2.7E-11
1,3,5-Trinitrobenzene	213	380	1.18	20	3.0E-06	2.2E-09
2,4,6-Trinitrotoluene	227	150	2.00	520	5.5E-06	1.1E-08

Note: atm•m³/mole = atmosphere•cubic meters per mole
g/mole = grams per mole
K_{ow} = octanol: water partition coefficient
K_{oc} = soil sorption constant per unit weight organic carbon
mg/L = milligrams per liter
mL/g = milliliters per gram
mm Hg = millimeters of mercury
HMX = cyclotetramethylenetetranitramine
RDX = cyclotrimethylenetrinitramine/cyclonite
Tetryl = nitramine/N-methyl-N,2,4,6-tetranitroaniline.

Sources: Morrison and Boyd 1983
ESE 1992
Perry's Chemical Engineering Handbook 1984

Table 3-2. Health Advisory Levels for Groundwater at Area P Lagoons, LAAP

Analyte	Oral RfD[(a)]	HALs (μg/L)
RDX	3×10^{-3}	2.0
HMX	5×10^{-2}	400.0
1,3,5-TNB	5×10^{-5}	3.5
2,4-DNT	2×10^{-3}	1,000.0
1,3-DNB	1×10^{-4}	1.0
2,6-DNT	1×10^{-3}[(b)]	1,000.0
2,4,6-TNT	5×10^{-4}	2.0
Tetryl	1×10^{-2}[(b)]	430.0
NB	5×10^{-4}	3.5

(a) RfD obtained from IRDMIS, April 1994.
(b) Oral RfD obtained from Health Effects Assessment Summary Tables (HEAST), March 1993.

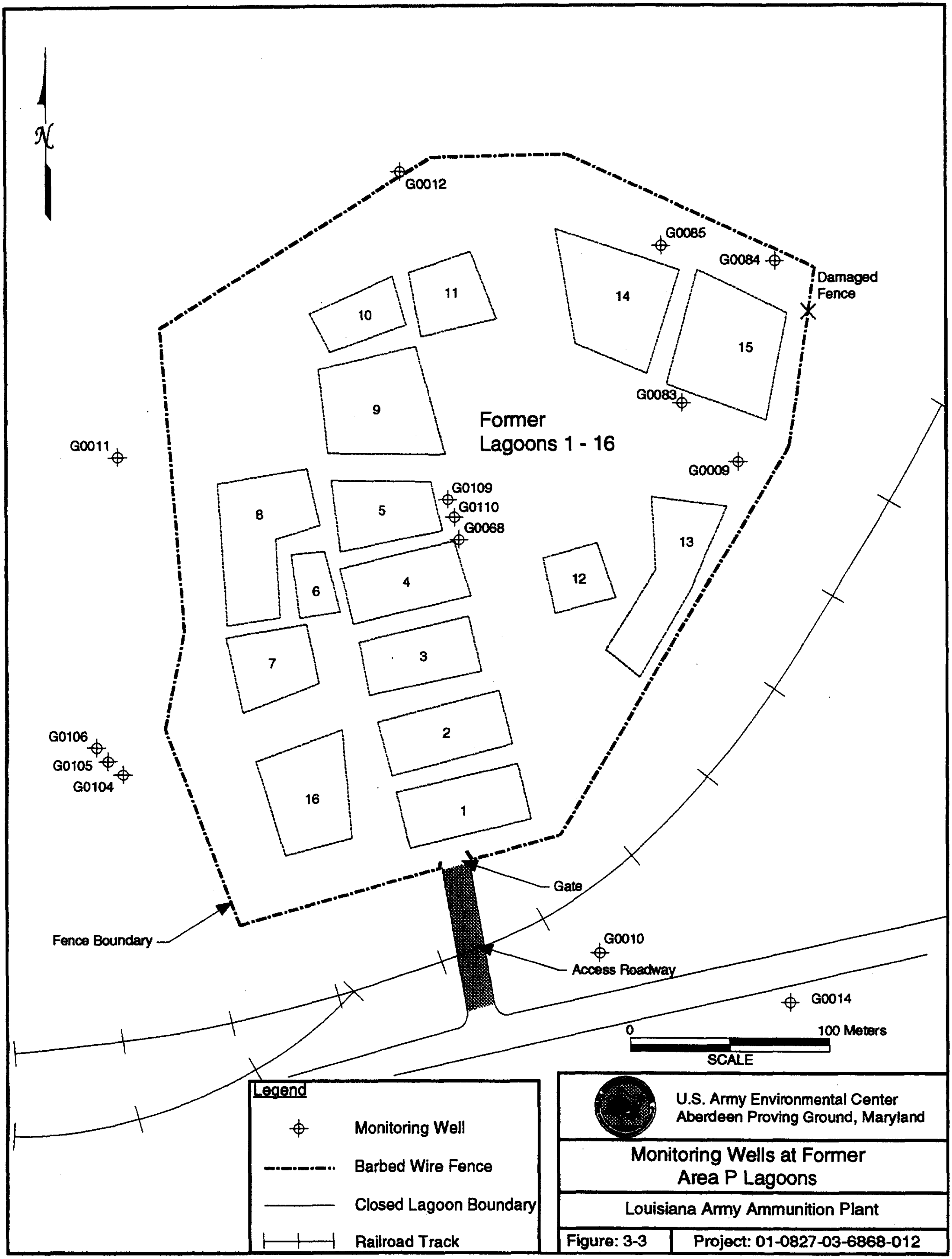

N
G0012
G0085
G0084
Damaged Fence
14
15
11
10
9
G0083
Former Lagoons 1 - 16
G0011
G0009
8
5
G0109
G0110
G0068
13
12
6
4
7
3
G0106
G0105
G0104
2
16
1
Gate
Fence Boundary
G0010
Access Roadway
G0014
0
100 Meters
SCALE
Legend
Monitoring Well
Barbed Wire Fence
Closed Lagoon Boundary
Railroad Track
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland
Monitoring Wells at Former Area P Lagoons
Louisiana Army Ammunition Plant
Figure: 3-3
Project: 01-0827-03-6868-012

Table 3-3. Area P Monitoring Well Data

Year Installed	Well No.	Total Depth (feet)	Aquifer Screened	Organization Conducting Investigation
1979	G0009	25.00	Upper Terrace	USAEHA
1979	G0012	27.52	Upper Terrace	USAEHA
1981	G0068	34.24	Upper Terrace	USATHAMA (EEI)
1982	G0083	32.47	Upper Terrace	USATHAMA (EEI)
1982	G0084	35.65	Upper Terrace	USATHAMA (EEI)
1982	G0085	35.32	Upper Terrace	USATHAMA (EEI)
1986	G0014	29.87	Upper Terrace	USATHAMA (ESE)
1986	G0104	35.62	Upper Terrace	USATHAMA (ESE)
1986	G0105	56.10	Sparta Sand	USATHAMA (ESE)
1986*	G0106	64.20	Sparta Sand	USATHAMA (ESE)
1986	G0109	27.15	Upper Terrace	USATHAMA (ESE)
1986	G0110	86.10	Sparta Sand	USATHAMA (ESE)

* Pump lost within well and currently remains in the well.

Table 3–4. Groundwater Sampling Data for Area P – 1994
Louisiana Army Ammunition Plant

Parameter	HAL	Upper Terrace Aquifer Wells									Lower Terrace Aquifer Wells		
		GO009	GO012	GO014	GO068	GO083	GO084	G0085	GO104	GO109	GO105	G0106	GO110
		1994	1994	1994	1994	1994	1994	1994	1994	1994	1994	1994	1994
Units: ug/L													
RDX	2	430	3100 LT*	14.4	2500	1200	120	3800	8400	3100	330	4100	2800
HMX	400	26	110	2.92	350 LT	99	14	310 LT	370 LT	300	360	53 LT	130
2,4,6 TNT	2	28.3	8700	0.426 LT	3600	3100	250	4200	11000	3600	16.5	6800	570
1,3 DNB	1	0.458 LT	35	0.458 LT	82	5.6	0.46 LT	32	580	8.2	320	330	24
2,4 DNT	1000	37	120	0.397 LT	350	95	12	79	570	330	54	640	120
2,6 DNT	1000	0.6 LT	32.3 LT	0.6 LT	60 LT	12 LT	12 LT	59 LT	60 LT	60 LT	60 LT	60 LT	60 LT
1,3,5 TNB	3.5	29	950	0.429 LT	490	800	320	3800	6300	95	3900	970	460
NB	3.5	0.682 LT	12.3 LT*	0.682 LT	68 LT*	14 LT*	0.682 LT	67 LT*	68 LT*	6.8 LT*	68 LT*	68 LT*	6.8 LT*
TETRYL	430	0.631 LT	6.3 LT	0.631 LT	31	95	5.66	310	130	39.9	3.71	63 LT	0.63 LT

Shaded area represents concentration above HAL
HAL: Health Advisory Level
LT: Less than
*: Concentration reported as "LT" due to interference during sample analysis.

Table 3-5. Groundwater Sampling Data for Area P: 1990-1994
Louisiana Army Ammunition Plant

Parameter	HAL	Upper Terrace Aquifer Wells											
		GO009		GO012		GO014		GO068		GO083		GO084	
		1990	1994	1990	1994	1990	1994	1990	1994	1990	1994	1990	1994
Units: ug/L													
RDX	2	568.2	430	2700	3100 LT*	33.8	14.4	6500	2500	2900	1200	290	120
HMX	400	48.3	26	82 LT	110	6.95	2.92	700	350 LT	350	99	11.8	14
2,4,6 TNT	2	55.6	28.3	760	3700	0.588 LT	0.426 LT	5100	3600	5300	3100	560	250
1,3 DNB	1	0.7	0.458 LT	42	35	0.519 LT	0.458 LT	60	82	0.519 LT	5.6	0.519 LT	0.46 LT
2,4 DNT	1000	2.4	37	40.2	120	0.612 LT	0.397 LT	100	350	29	95	3.06	12
2,6 DNT	1000	1.15 LT	0.6 LT	11.4	32.3 LT	1.15 LT	0.6 LT	58 LT	60 LT	58 LT	12 LT	58 LT	12 LT
1,3,5 TNB	3.5	31.1	29	67	950	0.626 LT	0.429 LT	310	490	730	800	550	320
NB	3.5	1.07 LT	0.682 LT	1.07 LT	12.3 LT*	1.07	0.682 LT	320	68 LT*	1.07 LT	14 LT*	1.07	0.682 LT
TETRYL	430	1.5	0.631 LT	0.556 LT	6.3 LT	0.556 LT	0.631 LT	28 LT	31	28 LT	95	28 LT	5.66

Shaded area represents concentration above HAL
HAL: Health Advisory Level
LT: Less than
*: Concentration reported as "LT" due to interference during sample analysis.

Table 3–5. Groundwater Sampling Data for Area P: 1990–1994
Louisiana Army Ammunition Plant (Cont.)

Parameter	HAL	Upper Terrace Aquifer Wells						Lower Terrace Aquifer Wells					
		G0085		GO104		GO109		GO105		G0106		GO110	
		1990	1994	1990	1994	1990	1994	1990	1994	1990	1994	1990	1994
Units: ug/L													
RDX	2	7600	3800	1900	8400	4200	3100	1300	330	2500	4100	3200	2800
HMX	400	1000	310 LT	910	370 LT	750	300	210	360	82 LT	53 LT	139.5	130
2,4,6 TNT	2	16000	4200	15000	11000	1800	3600	94	16.5	1300	8800	760	570
1,3 DNB	1	120	32	660	580	23	8.2	90	320	240	330	26 LT	24
2,4 DNT	1000	130	79	720	570	36.3	330	33	54	200	640	84	120
2,6 DNT	1000	58 LT	59 LT	58 LT	60 LT	58 LT	60 LT	6.32	60 LT	29.1	60 LT	58 LT	60 LT
1,3,5 TNB	3.5	7300	3800	6700	6300	28	95	1200	3900	370	970	420	460
NB	3.5	1.07 LT	67 LT*	4000	68 LT*	1.07 LT	6.8 LT*	600	68 LT*	1.07	68 LT*	1.07 LT	6.8 LT*
TETRYL	430	28 LT	310	28 LT	130	28 LT	39.9	0.556 LT	3.71	0.556 LT	63 LT	28 LT	0.63 LT

Shaded area represents concentration above HAL
HAL: Health Advisory Level
LT: Less than
*: Concentration reported as "LT" due to interference during sample analysis.

3.3.2 Upper Terrace Aquifer—Groundwater Sampling Results

Nine monitoring wells, screened in the Upper Terrace aquifer and located on and adjacent to Area P, were sampled by Science Applications International Corporation (SAIC) in 1994. These wells were installed between 1979 and 1986 (see Table 3-3). All nine COCs were detected in the Upper Terrace aquifer at Area P. The following sections discuss the analytical data for each COC detected in 1994 and compare this data to the concentrations detected in 1990. The 1994 nitrocompounds distribution in the Upper Terrace aquifer is shown in Figure 3-4.

3.3.2.1 RDX

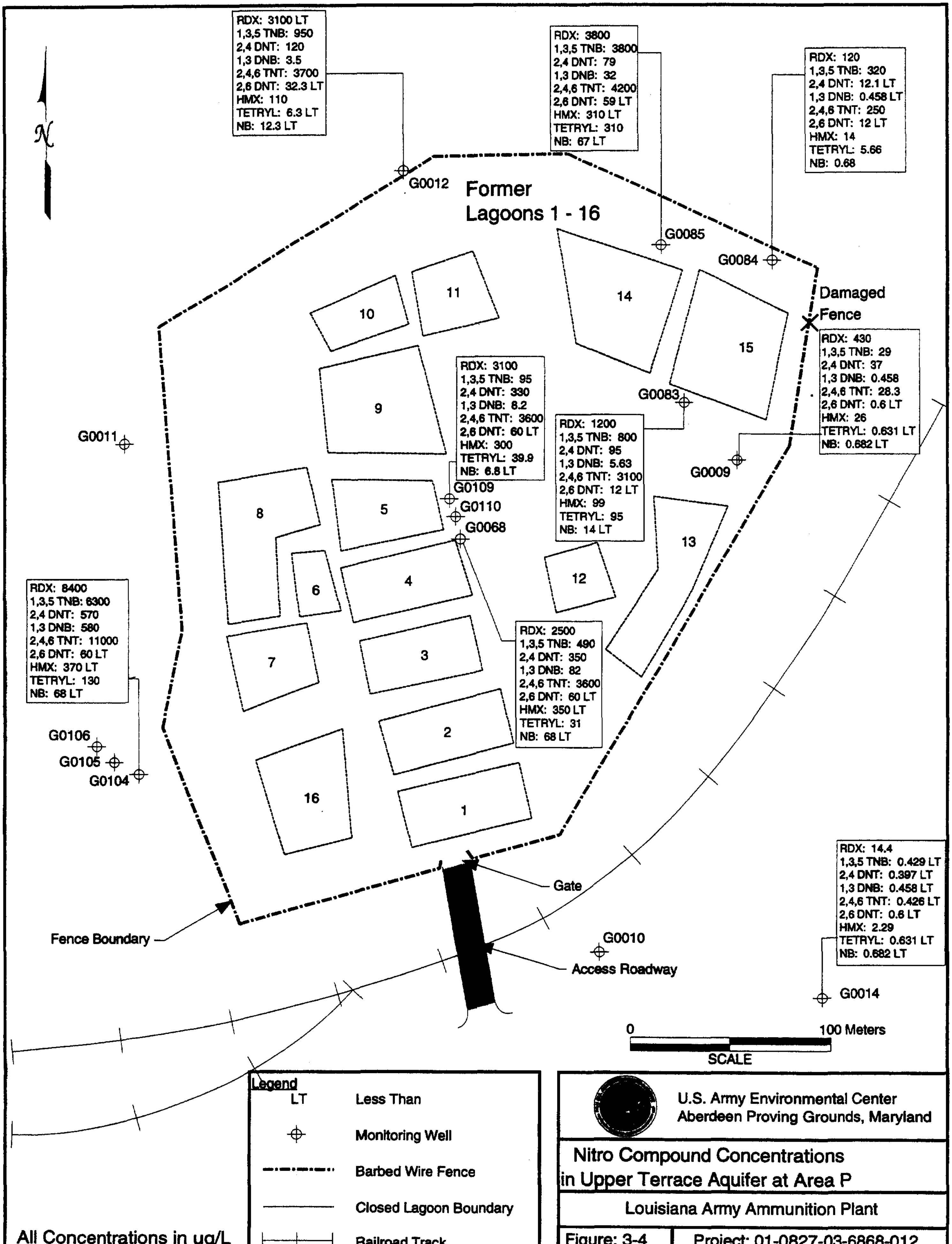
Analytical results of RDX in the Upper Terrace aquifer ranged from a minimum of 14.4 μg/L in well GO014 to 8,400 μg/L in well GO104 (see Table 3-4). The 1994 concentrations detected in all wells exceeded the HAL of 2.0 μg/L.

In 1990, levels of RDX in the Upper Terrace aquifer ranged from 33.8 μg/L in well GO014 to 7,600 μg/L in well GO085 (see Table 3-5). All wells sampled exceeded the HAL of 2.0 μg/L.

Higher levels of RDX were detected in samples collected from wells GO068, GO085, and GO109, located inside Area P, and wells GO012 and GO104, located west of Area P (see Figure 3-4). These wells are located in the general direction of groundwater flow in this area (see Figure 2-2). A similar trend was observed during the 1990 sampling event (ESE 1992). With the exception of well GO104 located west of Area P, the 1994 concentrations are lower than the 1990 concentrations. The historical data indicate that the maximum concentration of RDX was detected in well GO012 (43,200 μg/L) during the March 1985 sampling event.

3.3.2.2 HMX

Analytical results of HMX ranged from below detection limit (BDL) to 370 μg/L (see Table 3-4). The highest concentration of HMX was detected in well GO104 located west of Area P (see Figure 3-4). No samples collected during the 1994 sampling event exceeded the HAL of 400 μg/L.



N
Former Lagoons 1 - 16
RDX: 3100 LT
1,3,5 TNB: 950
2,4 DNT: 120
1,3 DNB: 3.5
2,4,6 TNT: 3700
2,6 DNT: 32.3 LT
HMX: 110
TETRYL: 6.3 LT
NB: 12.3 LT
G0012
RDX: 3800
1,3,5 TNB: 3800
2,4 DNT: 79
1,3 DNB: 32
2,4,6 TNT: 4200
2,6 DNT: 59 LT
HMX: 310 LT
TETRYL: 310
NB: 67 LT
G0085
RDX: 120
1,3,5 TNB: 320
2,4 DNT: 12.1 LT
1,3 DNB: 0.458 LT
2,4,6 TNT: 250
2,6 DNT: 12 LT
HMX: 14
TETRYL: 5.66
NB: 0.68
G0084
Damaged Fence
RDX: 430
1,3,5 TNB: 29
2,4 DNT: 37
1,3 DNB: 0.458
2,4,6 TNT: 28.3
2,6 DNT: 0.6 LT
HMX: 26
TETRYL: 0.631 LT
NB: 0.682 LT
G0009
G0083
RDX: 1200
1,3,5 TNB: 800
2,4 DNT: 95
1,3 DNB: 5.63
2,4,6 TNT: 3100
2,6 DNT: 12 LT
HMX: 99
TETRYL: 95
NB: 14 LT
RDX: 3100
1,3,5 TNB: 95
2,4 DNT: 330
1,3 DNB: 8.2
2,4,6 TNT: 3600
2,6 DNT: 60 LT
HMX: 300
TETRYL: 39.9
NB: 6.8 LT
G0109
G0110
G0068
G0011
RDX: 8400
1,3,5 TNB: 6300
2,4 DNT: 570
1,3 DNB: 580
2,4,6 TNT: 11000
2,6 DNT: 60 LT
HMX: 370 LT
TETRYL: 130
NB: 68 LT
G0106
G0105
G0104
RDX: 2500
1,3,5 TNB: 490
2,4 DNT: 350
1,3 DNB: 82
2,4,6 TNT: 3600
2,6 DNT: 60 LT
HMX: 350 LT
TETRYL: 31
NB: 68 LT
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Gate
Fence Boundary
Access Roadway
G0010
RDX: 14.4
1,3,5 TNB: 0.429 LT
2,4 DNT: 0.397 LT
1,3 DNB: 0.458 LT
2,4,6 TNT: 0.426 LT
2,6 DNT: 0.6 LT
HMX: 2.29
TETRYL: 0.631 LT
NB: 0.682 LT
G0014
0
100 Meters
SCALE
Legend
LT Less Than
Monitoring Well
Barbed Wire Fence
Closed Lagoon Boundary
Railroad Track
All Concentrations in ug/L
U.S. Army Environmental Center
Aberdeen Proving Grounds, Maryland
Nitro Compound Concentrations
in Upper Terrace Aquifer at Area P
Louisiana Army Ammunition Plant
Figure: 3-4
Project: 01-0827-03-6868-012

In 1990, levels of HMX ranged from BDL to 1,000 μg/L (see Table 3-5). Wells GO068, GO085, GO104, and GO109 exceeded the HALs in 1990. The 1994 concentrations are lower than the 1990 concentrations. The maximum concentration of HMX was detected in well GO012 (8,850 μg/L) in March 1983. In 1994, well GO012 had an HMX concentration of 110 μg/L.

3.3.2.3 2,4,6-TNT

In 1994, the concentration of 2,4,6-TNT ranged from BDL to 11,000 μg/L in well GO104 (see Table 3-4). All wells located in Area P and wells GO012 and GO104 located adjacent to Area P had concentrations exceeding the HAL of 2.0 μg/L. Wells GO012 and GO109 had higher concentrations in 1994 than in 1990.

In 1990, eight wells had concentrations above the HAL of 2.0 μg/L. The concentration levels ranged from 55.6 μg/L in well GO009 to 16,000.0 μg/L in well GO085. 2,4,6-TNT was detected in well GO104 at a concentration of 15,000 μg/L (see Table 3-5). In February 1988, well GO104 had 2,4,6-TNT concentrations of 25,000 μg/L.

3.3.2.4 1,3-DNB

Analytical results of 1,3-DNB ranged from BDL to 580 μg/L in well GO104. Wells GO009, GO012, GO068, GO083, GO085, GO104, and GO109 had concentrations above the HAL of 1.0 μg/L (see Table 3-4). The distribution of 1,3-DNB concentration is shown in Figure 3-4. Wells GO068 and GO083 had higher concentrations in 1994 than in 1990.

In 1990, the maximum concentration detected was 660 μg/L in well GO104. Wells GO012, GO068, GO085, GO104, and GO109 had concentrations above the HAL of 1.0 μg/L (see Table 3-5).

3.3.2.5 2,4-DNT

In 1994, the highest concentration of 2,4-DNT was found in well GO104 (570 μg/L). This concentration is below the HAL of 1,000 μg/L. In 1994, samples collected from wells

GO068 (350 μg/L) and GO109 (330 μg/L), located inside Area P, and well GO104 (570 μg/L), located west of Area P, had relatively higher levels of 2,4-DNT (see Figure 3-4). In 1990, the concentration ranged from 2.4 μg/L in well GO009 to 720.0 μg/L in well GO104 (see Table 3-5). In February 1988, well GO104 had a 2,4-DNT concentration of 770 μg/L. Historical data indicate that concentrations of 2,4-DNT has been below the HAL of 1,000 μg/L.

3.3.2.6 2,6-DNT

All sample results for 2,6-DNT in 1994 were below the instrument detection limit and the HAL of 1,000 μg/L (see Table 3-4). In 1990, none of the sampled wells exceeded the HAL (Table 3-5). The maximum concentration of 2,4-DNT was detected in well GO012 (400 μg/L) during the March 1983 sampling event. This level is below the HAL of 1,000 μg/L.

3.3.2.7 1,3,5-TNB

Analytical results of 1,3,5-TNB ranged from BDL to 6,300 μg/L. All wells in Area P and wells GO104 and GO012 located adjacent to Area P had concentrations exceeding the HAL of 3.5 μg/L (see Table 3-4). The maximum concentration was detected in well GO104 located west of Area P. Well GO085 located near the northern boundary of Area P had a concentration of 3,800 μg/L.

In 1990, the maximum concentration was detected in well GO085 (7,300 μg/L). Well GO104 had a concentration of 6,700 μg/L. All wells in Area P and wells GO104 and GO012 located adjacent to Area P had concentrations exceeding the HALs (see Table 3-5). The maximum concentration of 1,3,5-TNB was detected in July 1986 in well GO104 (7,700 μg/L).

3.3.2.8 NB

In 1994, sample results of NB for wells GO009, GO104, and GO084 had concentrations below the instrument detection limit and the HAL of 3.5 μg/L. Results of NB for wells GO012 (12.3 μg/L), GO068 (68 μg/L), GO083 (14 μg/L), GO085 (67 μg/L), GO104 (68 μg/L), and GO109 (6.8 μg/L) were affected by interferences during analysis. Therefore, the concentrations have been reported as "less than (LT)." Sample results from wells GO068 and GO104 were rejected due to low recoveries.

In 1990, wells GO068 (320 μg/L) and GO104 (4,000 μg/L) had concentrations above the HALs. These concentrations are significantly higher than the 1994 concentration of NB (see Table 3-4).

3.3.2.9 TETRYL

In 1994, the TETRYL concentration ranged from BDL to 310 μg/L in well GO085 (see Table 3-4). These concentrations were below the HAL of 430 μg/L. The distribution of TETRYL concentration is presented in Figure 3-4.

During the 1990 sampling event, only well GO009 had a detectable concentration of TETRYL (1.5 μg/L) (see Table 3-5). The maximum concentration of TETRYL was detected in well GO012 (1,500 μg/L) during the August 1983 sampling event.

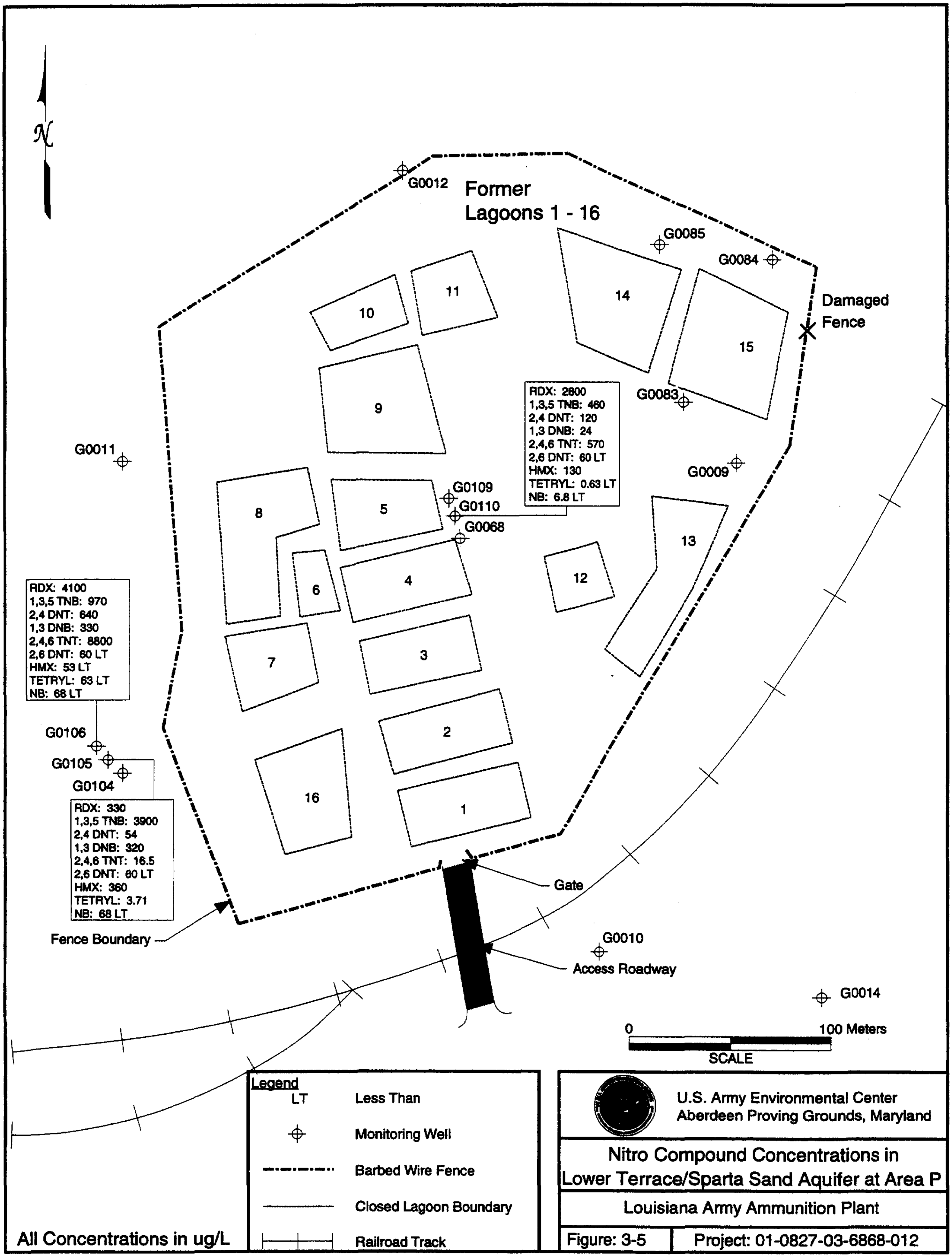
3.3.3 Lower Terrace/Sparta Sand Aquifer—Groundwater Sampling Results

Three monitoring wells, GO105, GO106, and GO110, screened in the Lower Terrace/Sparta Sand aquifer, were sampled in 1994 (see Figure 3-3). These wells were installed in 1986, and therefore, have limited historical sampling data. The COCs detected in the Lower Terrace at Area P are the same as those found in the Upper Terrace aquifer. The following section describes the concentration range of each COC detected in 1994 and compares the concentrations to the 1990 concentrations detected in wells GO105, GO106, and GO110. The COC distribution is shown in Figure 3-5.

3.3.3.1 RDX

Analytical results of RDX in the Lower Terrace aquifer ranged from 330 μg/L in well GO105 to 4,100 μg/L in well GO106 (see Table 3-4). All wells sampled had RDX concentrations exceeding the HAL of 2.0 μg/L. The distribution of RDX is shown in Figure 3-5.

In 1990, the levels of RDX in the Lower Terrace aquifer ranged from 1,300 μg/L in well GO105 to 3,200 μg/L in well GO110 (see Table 3-5). The 1994 concentration of RDX for well GO106 was higher than the 1990 concentration. This well is located west of Area P.


N
Former Lagoons 1 - 16
G0012
G0085
G0084
Damaged Fence
G0083
G0011
G0009
G0109
G0110
G0068
10
11
14
15
9
8
5
6
4
12
13
7
3
2
16
1
RDX: 2800
1,3,5 TNB: 460
2,4 DNT: 120
1,3 DNB: 24
2,4,6 TNT: 570
2,6 DNT: 60 LT
HMX: 130
TETRYL: 0.63 LT
NB: 6.8 LT
RDX: 4100
1,3,5 TNB: 970
2,4 DNT: 640
1,3 DNB: 330
2,4,6 TNT: 8800
2,6 DNT: 60 LT
HMX: 53 LT
TETRYL: 63 LT
NB: 68 LT
G0106
G0105
G0104
RDX: 330
1,3,5 TNB: 3900
2,4 DNT: 54
1,3 DNB: 320
2,4,6 TNT: 16.5
2,6 DNT: 60 LT
HMX: 360
TETRYL: 3.71
NB: 68 LT
Gate
Fence Boundary
G0010
Access Roadway
G0014
0
100 Meters
SCALE
All Concentrations in ug/L
Legend
LT Less Than
Monitoring Well
Barbed Wire Fence
Closed Lagoon Boundary
Railroad Track
U.S. Army Environmental Center
Aberdeen Proving Grounds, Maryland
Nitro Compound Concentrations in Lower Terrace/Sparta Sand Aquifer at Area P
Louisiana Army Ammunition Plant
Figure: 3-5
Project: 01-0827-03-6868-012

3.3.3.2 HMX

Analytical results of HMX ranged from BDL to 360 μg/L in well GO105 (see Table 3-4). In 1990, the maximum concentration of HMX was detected in well GO110 (139.5 μg/L) (see Table 3-5). No samples collected during the 1990 and 1994 sampling events exceeded the HAL of 400 μg/L.

3.3.3.3 2,4,6-TNT

In 1994, wells GO105 (17 μg/L), GO106 (8,800 μg/L), and GO110 (570 μg/L) had 2,4,6-TNT concentrations above the HAL of 2.0 μg/L.

In 1990, all three wells had concentrations exceeding the HAL of 2.0 μg/L. The concentration levels ranged from 94 μg/L in well GO105 to 1,300 μg/L in well GO106 (see Table 3-6). Well GO110 located on Area P had 2,4,6-TNT concentrations of 760 μg/L. The 1994 concentration of 2,4,6-TNT was generally higher than the 1990 concentration. The 1994 concentration of 2,4,6-TNT was generally higher than the 1990 concentration.

3.3.3.4 1,3-DNB

Analytical results of 1,3-DNB ranged from 24 μg/L in well GO110 to 330 μg/L in well GO104. All three wells sampled in 1994 had concentrations exceeding the HAL of 1.0 μg/L (see Table 3-4). In 1990, the concentrations ranged from less than 26 μg/L in well GO110 to 240 μg/L in well GO104 (see Table 3-5). The 1994 concentration of 1,3-DNB was generally higher than the 1990 concentration.

3.3.3.5 2,4-DNT

In 1994, no wells sampled in the Lower Terrace/Sparta Sand aquifer exceeded the HAL of 1,000 μg/L (see Table 3-4). The maximum concentration was detected in well GO106 (640 μg/L).

Table 3-6. Groundwater Data Available for Trend Analysis

Well No.	No. of Sampling Events	No. of COCs with Four or More Data Points
Upper Terrace Aquifer		
GO009	17	8
GO012	18	9
GO014	16	9
GO068	6	9
GO083	2	0
GO084	2	0
GO085	2	0
GO104	4	9
GO109	4	9
Lower Terrace/Sparta Sand Aquifer		
GO105	3	0
GO106	2	0
GO110	4	7

Note: Number of data sets with four or more data points: 60.

In 1990, the concentration level ranged from 33 μg/L in well GO105 to 200 μg/L in well GO106. The 1994 concentration of 2,4-DNT in the Lower Terrace aquifer was generally higher than the 1990 concentration.

3.3.3.6 2,6-DNT

All sample results for 2,6-DNT were below the instrument detection limit and the HAL of 1,000 μg/L (see Table 3-4). In 1990, none of the wells sampled exceeded the 2,6-DNT HALs.

3.3.3.7 1,3,5-TNB

Concentrations of 1,3,5-TNB ranged from 460 μg/L in well GO110 to 3,900 μg/L in well GO105 (see Table 3-4). These levels exceeded the HAL of 3.5 μg/L. In 1990, wells GO105, GO106, and GO110 had concentrations exceeding the HALs. The 1994 concentrations of 1,3,5-TNB in the Lower Terrace aquifer are higher than the 1990 concentrations.

3.3.3.8 NB

In 1994, the results for wells GO105 (68 μg/L), GO106 (68 μg/L), and GO110 (6.8 μg/L) were affected by interferences during analysis. Therefore, the concentrations have been reported as "less than LT." Sample results from well GO106 was rejected due to low recoveries.

3.3.3.9 TETRYL

In 1994, TETRYL concentrations ranged from BDL to 3.7 μg/L in well GO105. These concentrations are below the HAL of 430 μg/L. During the 1990 sampling event, concentrations of TETRYL were below the instrument detection limit and the HAL (see Table 3-5).

3.3.4 Summary of Groundwater Sampling Results

Nine wells screened in the Upper Terrace aquifer had concentrations of RDX, 1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, and NB above the HALs. Concentrations of 2,4-DNT, 2,6-DNT, and HMX were below the respective HALs. The maximum concentration of explosives was detected in well GO104 located southwest of Area P. Historical data indicate that the maximum COC concentrations were detected in well GO104. These concentrations were detected prior to implementation of the interim remedial action. The 1994 concentration of explosives in the Upper Terrace aquifer was lower than the 1990 concentration, indicating that the groundwater quality at Area P had improved since the remedial measure was completed.

Three wells screened in the Lower Terrace aquifer were sampled during the 1994 field investigation activities. As in the Upper Terrace aquifer, concentrations of RDX, 1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, and NB were above the HALs. Generally, the concentrations of the COCs in the Lower Terrace aquifer were less than the concentrations detected in the Upper Terrace aquifer. However, the 1994 concentrations in the Lower Terrace aquifer were higher than the 1990 concentrations for wells GO105 and GO106 located southwest of Area P. This increase in concentration can be attributed to the downward movement of contamination from the Upper Terrace aquifer. Groundwater quality simulation conducted at Area P by ETA in 1991 showed similar migration patterns.

3.4 TREND ANALYSIS IN GROUNDWATER MONITORING DATA AT AREA P

This section compares the groundwater monitoring data collected during the 1994 sampling effort with the historical data and discusses the trends in the groundwater quality. Statistical regression analysis was used to characterize temporal trends of COC concentrations measured in groundwater samples collected at Area P.

3.4.1 Objectives

The objectives for conducting the trend analysis in the groundwater monitoring data at Area P include:

- Conducting a review of the historical data and data collected during the Five-Year Review field investigation effort in order to identify the trends of groundwater quality at Area P
- Evaluating the effectiveness of the interim remedial action (IRA) on the groundwater quality.

3.4.2 Background

Groundwater data were reviewed for 12 monitoring wells located on and adjacent to Area P. Nine of these wells are screened in the Upper Terrace aquifer and the other three are screened in the Lower Terrace/Sparta Sand aquifer.

Upper Terrace Aquifer

- GO009
- GO012
- GO014
- GO068
- GO083
- GO084
- GO085
- GO104
- GO109

Lower Terrace/Sparta Sand Aquifer

- GO105
- GO106
- GO110

The nine COCs identified for groundwater at Area P are listed below:

- RDX
- HMX
- 1,3-DNB
- 2,4-DNT
- 2,6-DNT
- 1,3,5-TNB
- 2,4,6-TNT
- TETRYL
- NB.

Groundwater sampling data for Area P are available from January 1980 through March 1994. Groundwater monitoring data for each well are presented in Appendix C (Tables C-1 through C-12). Table 3-6 summarizes data available for groundwater trend analysis. For this study, a data set is composed of a COC and a monitoring well, and the sampling event represents the data points for this data set. Therefore, corresponding to the data set for 2,4-DNT in well GO009, the February 1994 and the July 1986 concentrations are two data points. For each well, the number of COCs with more than four data points also are presented. To provide an accurate representation of the trend, a minimum of four data points were selected to be considered a "valid data set." Two data points can yield a perfect linear fit (a straight line joining the two points), while three points can provide a perfect quadratic fit (a curve passing through the three points).

3.4.3 Approach

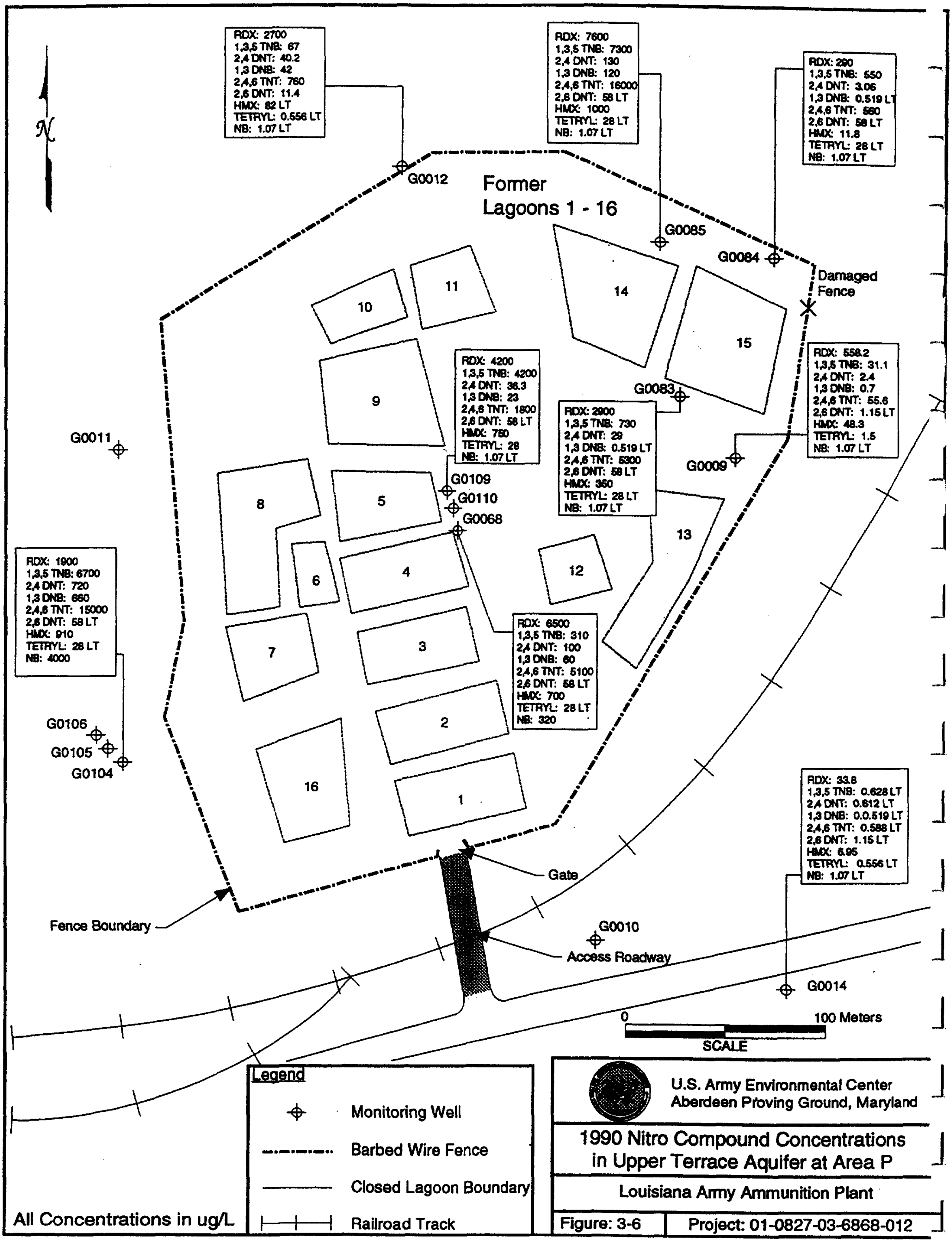
Statistical regression methods previously used at other sites to evaluate groundwater trends were used in this study (Lachance and Stoline 1993; Stoline, Passero, and Barcelona 1993). The primary objective of this regression analysis is to identify the trend in groundwater quality using the sampling data available from 1980 through 1994.

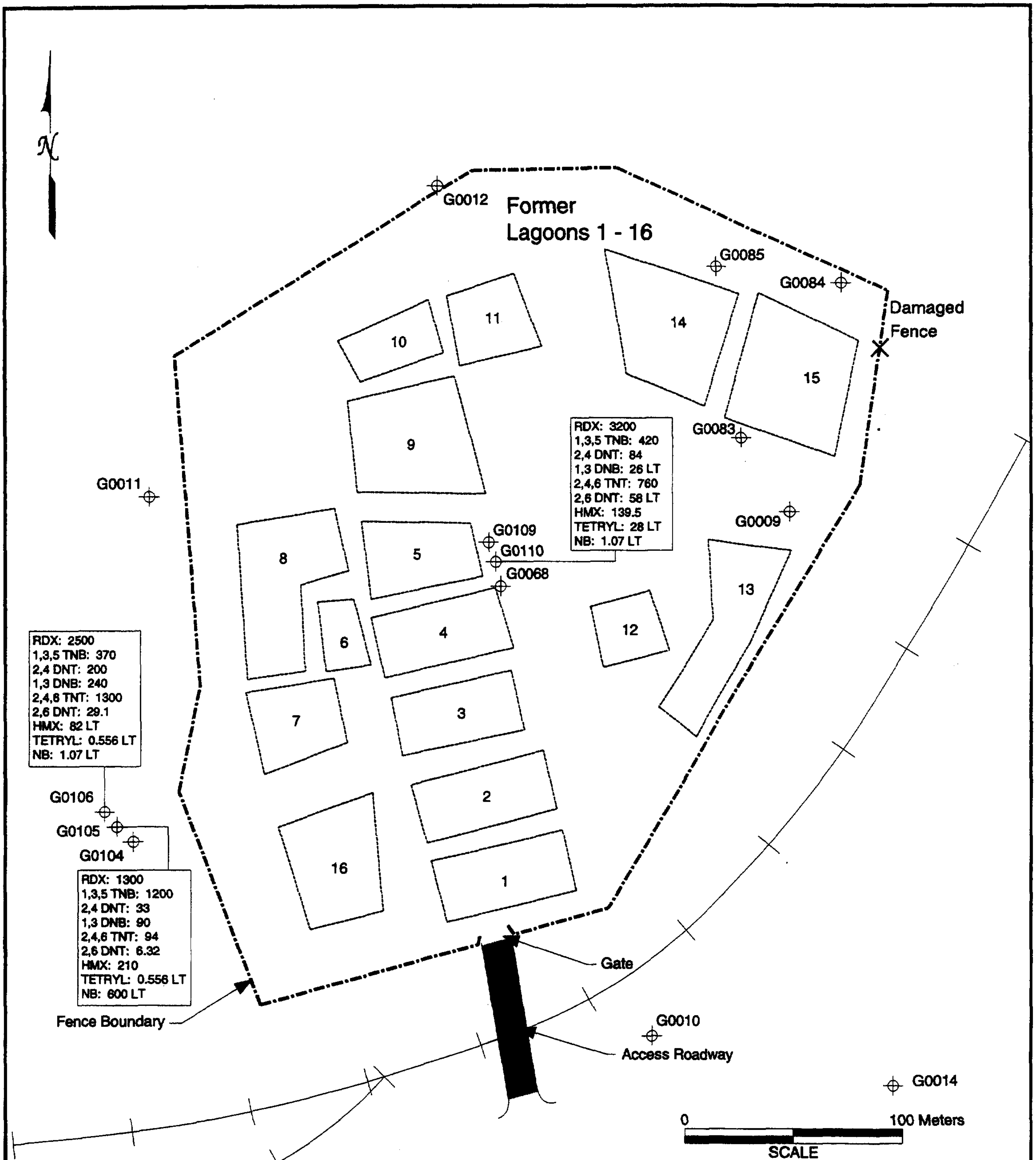
Two methods were used in evaluating well sampling data to identify the trends in groundwater quality. Bar charts were used to illustrate the available groundwater sampling data. These charts were used for the subjective assignment of trend categories and comparison with regression analysis. The subjective assignment was based on a visual interpretation of the groundwater data. A regression analysis was conducted on the available data to determine the trend in groundwater quality and the effectiveness of the IRA. The results from these approaches are presented in more detail in the following sections.

3.4.3.1 Bar Charts

Bar charts showing the concentration of COCs for each sampling event are presented for each well in Appendix C (Figures C-1 through C-18). These charts show the variation in concentrations of COCs over time at a particular well. Contaminants that were detected at concentrations below the HALs were not included in these bar charts.

Figure 3-6 shows the contaminant concentrations at the site in the Upper Terrace aquifer from the 1990 sampling event. The data for the Lower Terrace/Sparta Sand aquifer for this sampling event are shown in Figure 3-7. The contaminant concentrations for the 1986 sampling event are depicted in Figures 3-8 and 3-9 for the Upper Terrace and Lower Terrace/Sparta Sand aquifers, respectively. The data for the most recent sampling activity in 1994 are included in Section 3.3. These figures, along with the bar charts, were used for subjective assignment of trend categories.


RDX: 2700
1,3,5 TNB: 67
2,4 DNT: 40.2
1,3 DNB: 42
2,4,6 TNT: 760
2,6 DNT: 11.4
HMX: 82 LT
TETRYL: 0.556 LT
NB: 1.07 LT
RDX: 7600
1,3,5 TNB: 7300
2,4 DNT: 130
1,3 DNB: 120
2,4,6 TNT: 16000
2,6 DNT: 58 LT
HMX: 1000
TETRYL: 28 LT
NB: 1.07 LT
RDX: 290
1,3,5 TNB: 550
2,4 DNT: 3.06
1,3 DNB: 0.519 LT
2,4,6 TNT: 560
2,6 DNT: 58 LT
HMX: 11.8
TETRYL: 28 LT
NB: 1.07 LT
N
G0012
Former
Lagoons 1 - 16
G0085
G0084
Damaged
Fence
10
11
14
15
9
RDX: 4200
1,3,5 TNB: 4200
2,4 DNT: 36.3
1,3 DNB: 23
2,4,6 TNT: 1800
2,6 DNT: 58 LT
HMX: 750
TETRYL: 28
NB: 1.07 LT
G0083
RDX: 2900
1,3,5 TNB: 730
2,4 DNT: 29
1,3 DNB: 0.519 LT
2,4,6 TNT: 5300
2,6 DNT: 58 LT
HMX: 350
TETRYL: 28 LT
NB: 1.07 LT
RDX: 558.2
1,3,5 TNB: 31.1
2,4 DNT: 2.4
1,3 DNB: 0.7
2,4,6 TNT: 55.6
2,6 DNT: 1.15 LT
HMX: 48.3
TETRYL: 1.5
NB: 1.07 LT
G0011
G0009
8
5
G0109
G0110
G0068
13
RDX: 1900
1,3,5 TNB: 6700
2,4 DNT: 720
1,3 DNB: 660
2,4,6 TNT: 15000
2,6 DNT: 58 LT
HMX: 910
TETRYL: 28 LT
NB: 4000
6
4
12
7
3
RDX: 6500
1,3,5 TNB: 310
2,4 DNT: 100
1,3 DNB: 60
2,4,6 TNT: 5100
2,6 DNT: 58 LT
HMX: 700
TETRYL: 28 LT
NB: 320
G0106
G0105
G0104
2
16
1
RDX: 33.8
1,3,5 TNB: 0.628 LT
2,4 DNT: 0.612 LT
1,3 DNB: 0.0.519 LT
2,4,6 TNT: 0.588 LT
2,6 DNT: 1.15 LT
HMX: 6.95
TETRYL: 0.556 LT
NB: 1.07 LT
Gate
Fence Boundary
G0010
Access Roadway
G0014
0
100 Meters
SCALE
Legend
Monitoring Well
Barbed Wire Fence
Closed Lagoon Boundary
Railroad Track
All Concentrations in ug/L
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland
1990 Nitro Compound Concentrations
in Upper Terrace Aquifer at Area P
Louisiana Army Ammunition Plant
Figure: 3-6
Project: 01-0827-03-6868-012



All Concentrations in ug/L

Legend

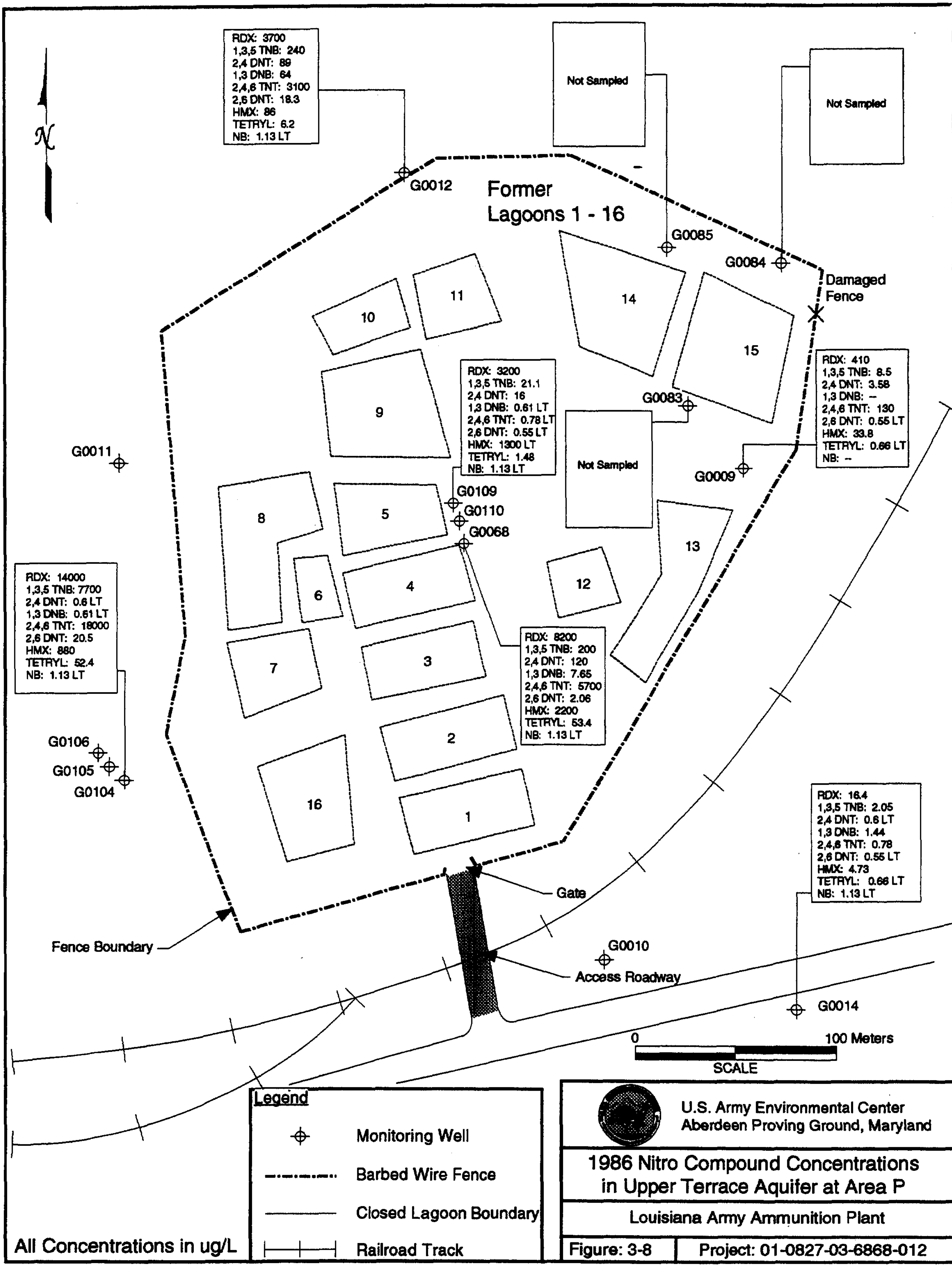
LT	Less Than
⊕	Monitoring Well
–·–·–·–	Barbed Wire Fence
———	Closed Lagoon Boundary
├──┼──┤	Railroad Track

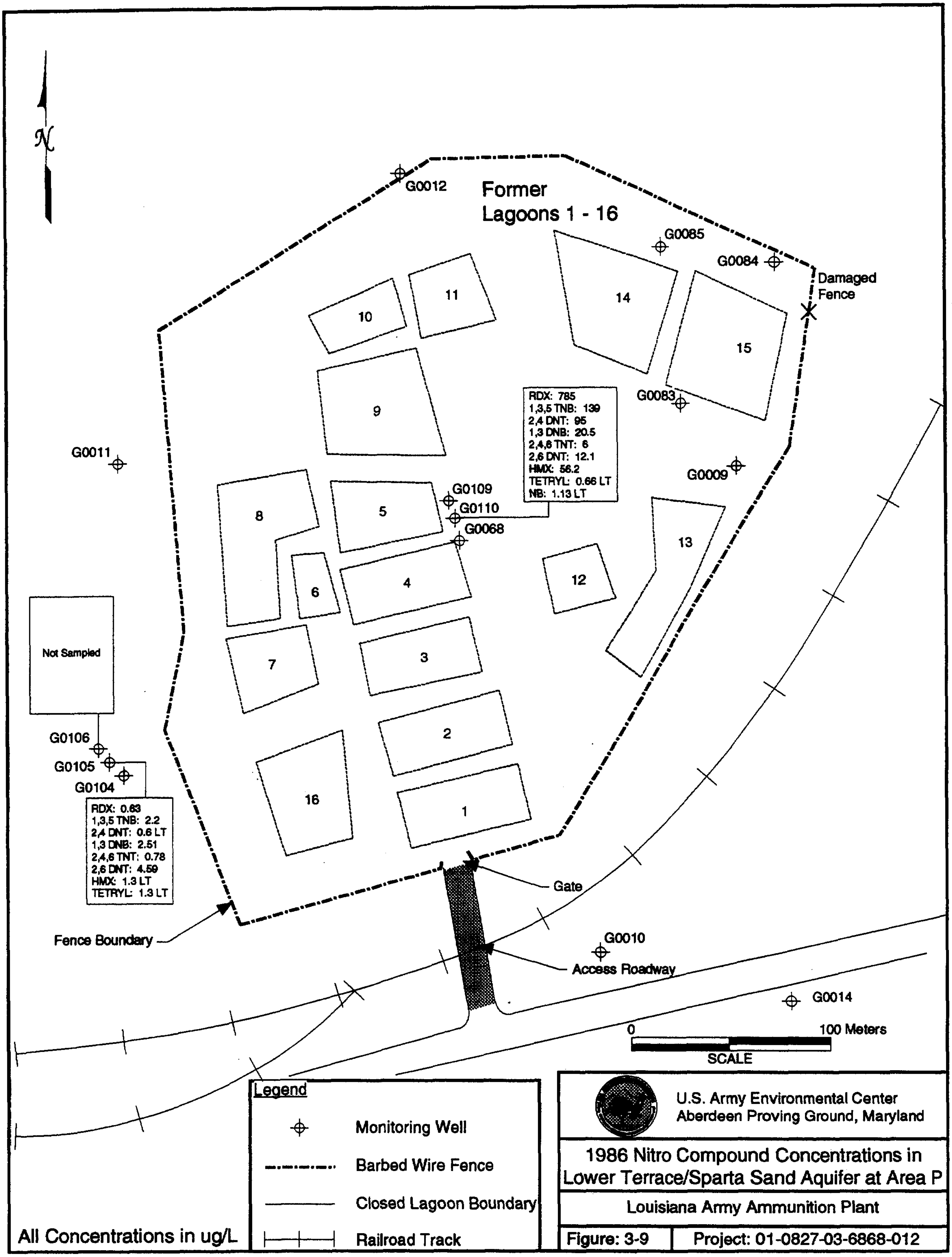
U.S. Army Environmental Center
Aberdeen Proving Grounds, Maryland

1990 Nitro Compound Concentrations in Lower Terrace/Sparta Sand Aquifer at Area P

Louisiana Army Ammunition Plant

Figure: 3-7 | Project: 01-0827-03-6868-012


N
RDX: 3700
1,3,5 TNB: 240
2,4 DNT: 89
1,3 DNB: 64
2,4,6 TNT: 3100
2,6 DNT: 18.3
HMX: 86
TETRYL: 6.2
NB: 1.13 LT
Not Sampled
Not Sampled
G0012
Former
Lagoons 1 - 16
G0085
G0084
Damaged
Fence
10
11
14
15
9
RDX: 3200
1,3,5 TNB: 21.1
2,4 DNT: 16
1,3 DNB: 0.61 LT
2,4,6 TNT: 0.78 LT
2,6 DNT: 0.55 LT
HMX: 1300 LT
TETRYL: 1.48
NB: 1.13 LT
G0083
RDX: 410
1,3,5 TNB: 8.5
2,4 DNT: 3.58
1,3 DNB: --
2,4,6 TNT: 130
2,6 DNT: 0.55 LT
HMX: 33.8
TETRYL: 0.66 LT
NB: --
G0011
Not Sampled
G0009
G0109
G0110
G0068
8
5
13
RDX: 14000
1,3,5 TNB: 7700
2,4 DNT: 0.6 LT
1,3 DNB: 0.61 LT
2,4,6 TNT: 18000
2,6 DNT: 20.5
HMX: 880
TETRYL: 52.4
NB: 1.13 LT
6
4
12
7
3
RDX: 8200
1,3,5 TNB: 200
2,4 DNT: 120
1,3 DNB: 7.65
2,4,6 TNT: 5700
2,6 DNT: 2.06
HMX: 2200
TETRYL: 53.4
NB: 1.13 LT
G0106
G0105
G0104
2
16
1
RDX: 16.4
1,3,5 TNB: 2.05
2,4 DNT: 0.6 LT
1,3 DNB: 1.44
2,4,6 TNT: 0.78
2,6 DNT: 0.55 LT
HMX: 4.73
TETRYL: 0.66 LT
NB: 1.13 LT
Gate
Fence Boundary
G0010
Access Roadway
G0014
0
100 Meters
SCALE
Legend
Monitoring Well
Barbed Wire Fence
Closed Lagoon Boundary
Railroad Track
All Concentrations in ug/L
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland
1986 Nitro Compound Concentrations
in Upper Terrace Aquifer at Area P
Louisiana Army Ammunition Plant
Figure: 3-8
Project: 01-0827-03-6868-012



U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

1986 Nitro Compound Concentrations in Lower Terrace/Sparta Sand Aquifer at Area P

Louisiana Army Ammunition Plant

Figure: 3-9 | Project: 01-0827-03-6868-012

3.4.3.2 Regression Analysis

A description of the regression analysis software used to identify the trend of groundwater quality is included in this section. The trends were identified on the basis of the curves generated by the regression software.

Regression Analysis Software—Groundwater monitoring results were plotted as a function of time using the Microsoft® Excel-Version 5.0. The plots are included in Appendix D. Each plot contains the following information:

- A line connecting the data points
- A line showing the regression fit with the linear equation ($y = a+bt$)
- A curve showing the regression fit with the quadratic equation ($y = a+bt+ct^2$)

where:

a, b, and c	=	constants
t	=	time
y	=	concentration.

Groundwater Quality Trend Categories—There are a total of 108 data sets (12 wells by 9 COCs), 60 of which are valid data sets (i.e., number of data sets with 4 or more data points). One of the eight trend categories identified in Table 3-7 was assigned to each of these data sets. The rules used for assigning trend categories are shown in Table 3-8 and are discussed below:

- Four observations were chosen as the minimum number of data points needed in order to attempt fitting the regression models. Therefore, if m (number of observations) is less than four, the model Z was selected.
- If at least four data points are available ($m \geq 4$), but all concentrations are below the detection limits, the model ND was selected.

Table 3-7. Groundwater Quality Trend Categories

Model Code	Trend Category	Regression Trend Model	Model
Z	Less than 4 data points	No model	none
ND	Nondetect or zero	No model	none
NM	No model fits data	No model	none
C	Constant	$y = c$	constant
ID	Increasing then decreasing	$y = a+bt+ct^2, c<0$	quadratic
DI	Decreasing then increasing	$y = a+bt+ct^2, c>0$	quadratic
I	Increasing	$y = a+bt, b>0$	linear
D	Decreasing	$y = a+bt, b<0$	linear

Table 3-8. Trend Model Selection Rules

Rule	Selection of Trend Category
Rule 1	If $m < 3$ or $m = 3$, the model Z is selected.
Rule 2	If $m > 3$ and no data point is a detectable value, the model ND is selected.
Rule 3	If $m > 3$ and at least one data point is a detectable value, the quadratic fit is attempted. If a maximum exists, ID is selected. If a minimum exists for the quadratic fit, DI is selected. If no point of inflection (maximum or minimum vertex) exists for the curve within the sampling period (1980 through 1994), a linear fit is selected.
Rule 4	If the linear fit has a positive slope, I is selected; for a negative slope, D is selected. For slope 0, C is selected.
Rule 5	If neither the quadratic nor linear regression models fit the data, NM is selected. The NM code was selected during subjective analysis only.

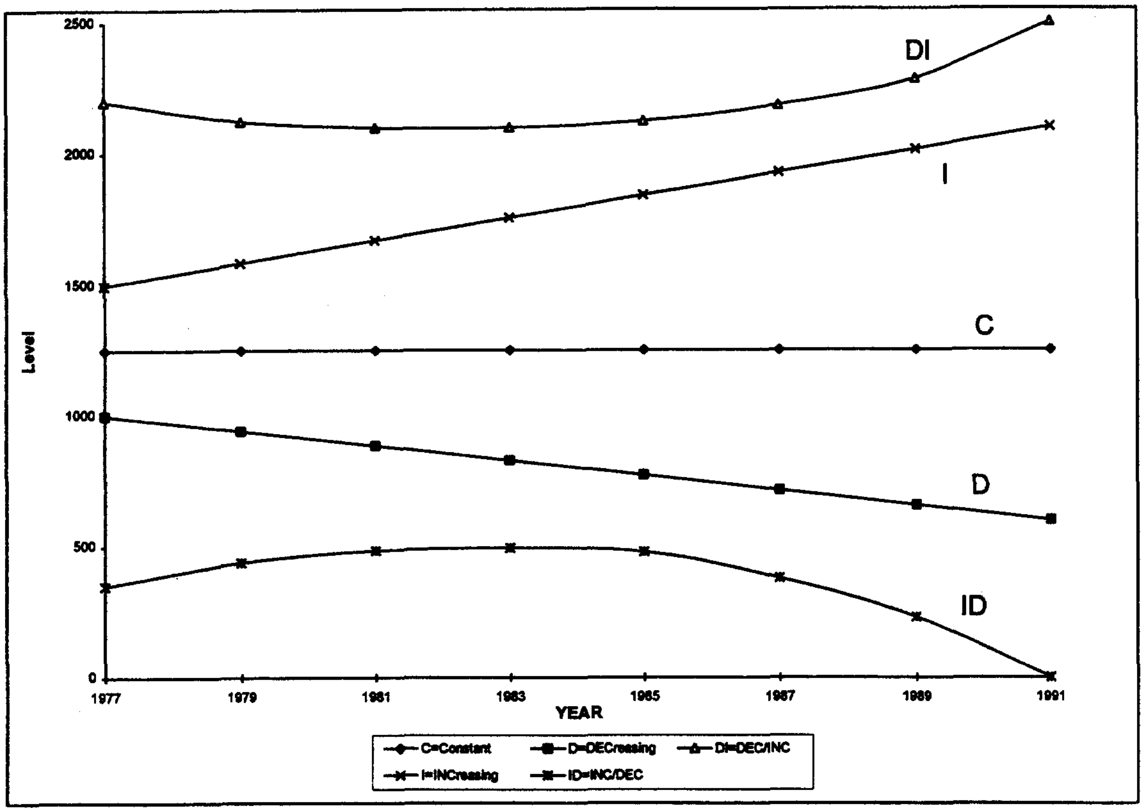
- When four data points are available and at least one of these points is a detectable value, the regression analysis software was first used to fit a quadratic curve. The nondetectable values were assigned a value of one-half the detection limit for that particular compound. The model code DI (decreasing then increasing) or ID (increasing then decreasing) was assigned to this quadratic curve if a minimum or a maximum value (i.e., a vertex) was observed within the sampling interval (1980 through 1994).
- If the quadratic curve had no point of inflection (maximum or minimum vertex) within the sampling interval evaluated, a linear fit was selected for the data set and a model code D, I, or C was assigned depending on the slope of the straight line.
- If no model could fit the data, the NM code was chosen to indicate that none of the trend models adequately characterize the data. The NM code was used during subjective analysis only.

Figure 3-10 shows typical examples of the quadratic and linear regression curves.

Groundwater Quality Trend Conditions—Four groundwater quality trend conditions were defined using the trend categories listed in Table 3-7. Those COCs, which either showed a decrease in the concentration level throughout all of the sampling events (D) or an initial increase, followed by a decrease in the concentration level during the latter sampling events (ID), are considered indicative of generally improving (IMP) groundwater quality. Contaminants showing a persistent increase in concentration during all sampling events (I), or those that showed an initial decrease in concentration followed by an increase in concentration during the latter sampling events (DI), are indicative of generally deteriorating (DET) groundwater quality. Similarly, the stabilized condition (STA) included the constant concentration (C) category. The NM, ND, and Z categories were grouped as unidentified (UNI). Table 3-9 shows the trend categories comprising each trend condition.

Table 3-9. Groundwater Quality Trend Conditions

Trend Condition	Trend Categories	Definition
IMP	D, ID	Improvement
DET	I, DI	Deterioration
STA	C	Stabilization
UNI	NM, ND, Z	Unidentified



U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Typical Examples of Groundwater Trend Categories

Louisiana Army Ammunition Plant

Figure: 3-10 | Project: 01-0827-03-6868-012

Groundwater Trend Index—For each well, a trend index (TI) was assigned and defined as:

$$TI = NIMP + NSTA - NDET$$

where:

NIMP, NSTA and NDET are numbers of trends classified as IMP, STA, and DET, respectively, for a given well. The STA trend was considered a positive TI because it indicated no deterioration in the groundwater quality. The UNI trends are not used in determining the TI. Clearly, a well with a larger TI value shows more evidence of improving groundwater quality than one with a smaller TI value. TI values were calculated for each individual well (based on the trends for the 9 COCs) and for each COC (based on the trends for the 12 wells). Calculations for the TIs are included in Appendix E. Table 3-10 shows the trend categories assigned to each of the 108 data sets. The sum of the individual TIs for all the wells in each aquifer yielded the overall trend index (OTI) for that aquifer. The TI for each well and the OTI values for the two aquifers are included in the table. In addition, the TI values for each well and the OTI also were determined for those data sets that had all concentration levels above the HALs. It is expected that these TI values (without HALs) will exclude any uncertainties in the trend analysis associated with the low concentration values (below HALs).

Effectiveness Assessment of the Area P Cap—In the evaluation of trend categories (ID, DI, I, D, and C), the trend category ID can be particularly useful in the assessment for the potential positive impact of the IRA upon groundwater quality trends. An ID trend shows evidence of recent improvement after an initial period of deterioration. The dates of maximum concentration were estimated from the plots (see Appendix D) and are included in Table 3-11. A comparison of the capping date with the estimated date of maximum contamination was used to support conclusions regarding the cap effectiveness.

The DI trend categories also were evaluated during the assessment of cap effectiveness to identify any negative impact of the IRA on the groundwater quality. The dates of the minimum vertex for the DI trends were compared to the period of remedial activity.

Subjective Determination of Trends—Using bar charts generated for the available data (concentration versus time), the trend fits were subjectively determined by qualitative evaluation of sampling data. The subjective approach was conducted to verify the objective findings made

Table 3-10. Computer-determined Trends in Groundwater Quality

Aquifer	Upper Terrace Aquifer									Lower Terrace/Sparta Sand Aquifer		
Contaminant/Well	009	012*	014*	068	083	084	085	104*	109	105*	106*	110
DNB	Z	D	ID	DI	Z	Z	Z	ID	ID	Z	Z	Z
2,4-DNT	DI	I	ID	DI	Z	Z	Z	ID	DI	Z	Z	ID
2,6-DNT	ID	ID	ND	DI	Z	Z	Z	I	ND	Z	Z	Z
HMX	D	D	D	D	Z	Z	Z	ID	ID	Z	Z	ID
Nitrobenzene	ND	ND	ND	ID	Z	Z	Z	ND	ND	Z	Z	Z
RDX	D	ID	ID	D	Z	Z	Z	ID	ID	Z	Z	ID
Tetryl	ID	ID	ND	NM	Z	Z	Z	DI	I	Z	Z	Z
1,3,5-TNB	DI	DI	ID	I	Z	Z	Z	DI	I	Z	Z	I
2,4,6-TNT	D	ID	ID	ID	Z	Z	Z	ID	I	Z	Z	ID
TI without HALs ALL DATA	 +1/3 +3/7	 +4/8 +4/8	 +3/3 +6/6	 0/6 +0/8	 0/0 0/0	 0/0 0/0	 0/0 0/0	 +2/7 +2/9	 0/4 -1/7	 0/0 0/0	 0/0 0/0	 +2/4 +3/5

Overall TI for Upper Terrace Aquifer
without HALs +10/30
All data +14/44

Overall TI for Lower Terrace
without HALs +2/4
All data +3/5

Note: Shaded areas indicate concentration levels for the contaminant in that monitoring well were below the HALs established for that contaminant at LAAP. Asterisk (*) denotes wells located outside the capped area. TI is presented for all data, and for data excluding the data sets with concentrations below HALs (without HALs).

Table 3-11. Estimated Dates of Maximum Concentration for ID Trends

Well No.	Contaminant	Estimated Maximum Concentration Date
GO009	2,6-DNT Tetryl	March 1982 January 1982
GO012*	2,6-DNT RDX Tetryl TNT	January 1982 July 1987 January 1983 August 1987
GO014*	DNB 2,4-DNT RDX TNB TNT	April 1984 December 1981 March 1987 November 1984 September 1984
GO068	Nitrobenzene TNT	January 1990 July 1989
GO083	None	None
GO084	None	None
GO085	None	None
GO104*	DNB 2,4-DNT HMX RDX TNT	January 1993 March 1991 December 1988 August 1989 March 1988
GO109	DNB HMX RDX	January 1991 August 1989 January 1990
GO105*	None	None
GO106*	None	None
GO110	2,4-DNT HMX RDX TNT	April 1988 September 1991 June 1991 May 1990

Note: * denote monitoring wells located outside the Area P cap.

by the computer based on the regression analysis. The subjective trends are included in Appendix E. These subjective findings were compared to the computer-determined trend types in Table 3-12. The computer-determined trends are those that were based on the regression analysis. The diagonal values indicate agreement of the subjective trends with the computer-determined trends. For example, out of a total of seven computer-determined I trends, one was subjectively assigned NM, one was assigned C, and the remaining five were assigned I. Therefore, five subjective-determined trends were in agreement with the seven computer-determined I trends.

Table 3-12. Subjective Versus Computer-determined Trend Types

Computer-determined Trend Type	Subjective-determined Trend Type						Total (Computer-determined Trends)
	UNI	C	I	D	ID	DI	
UNI	**55**	0	0	0	0	0	55
C	0	**0**	0	0	0	0	0
I	1	1	**5**	0	0	0	7
D	1	0	0	**3**	1	0	5
ID	2	0	0	0	**25**	0	27
DI	1	0	1	0	4	**8**	14
Total (Subjective Trends)	60	1	6	3	30	8	108
	Diagonal Total: 96/108						

Note: The UNI trend type includes Z, ND, and NM trend categories.

3.4.4 Discussion of Findings from Groundwater Trend Analysis

Groundwater sampling data collected over a period of 14 years (1980 through 1994) were evaluated for 12 monitoring wells and 9 COCs. Nine monitoring wells are screened in the Upper Terrace aquifer and the other three are screened in the Lower Terrace/Sparta Sand aquifer. At least four data points would be required to provide a more accurate representation of the data using the computer regression analysis for each data set for identifying the groundwater quality trends. Two data points can yield a perfect linear fit, whereas three points can provide a perfect quadratic fit; therefore, a minimum of four data points were selected for computer regression analysis. Out of the possible 108 data sets (12 wells x 9 contaminants), 60 sets have 4 or more data points and were used for trend analysis; 48 data sets had less than 4 data points. The following sections describe the findings from the trend analysis. Supporting data are included in Appendix E.

The 48 data sets that had less than 4 data points were assigned category Z. Out of the remaining 60 data sets, no contaminants were positively detected in 7 data sets. These seven data sets were, therefore, assigned ND. Groundwater quality trend categories were assigned to each of the 53 remaining valid data sets (46 for the Upper Terrace aquifer and 7 for the Lower Terrace/Sparta Sand aquifer) on the basis of the regression curves generated by the software.

Upper Terrace Aquifer—The quadratic fit was selected if there was a point of inflection (maximum or minimum value) for the curve within the sampling interval (1980 through 1994), and accordingly, a DI or ID category was assigned. Out of the 46 valid data sets for the Upper Terrace aquifer, 23 were ID and 13 were DI. No point of inflection was observed in 10 data sets; therefore, a linear model was selected. Using the linear model, four data sets were categorized as D, while six were found to be I.

The OTI for the wells sampled is +8 out of 46, which indicates that the groundwater quality condition in the Upper Terrace aquifer at Area P is generally improving. A positive TI was calculated for three wells (GO012, GO014, and GO104). Wells GO009 (TI = -1), GO068 (TI = -1), and GO109 (TI = -1) had negative TI values. GO109 and GO068 are located in the center of Area P inside the cap, adjacent to each other. GO009 is located close to these wells within the cap.

Among the COCs, RDX and TNT showed the greatest improving trend with an ID or D category for five of the six wells (with four or more sampling events). The contaminants 2,6-DNT, TETRYL, and 1,3,5-TNB showed an overall deteriorating trend (negative TI values) with increasing concentration levels. The contaminants 2,6-DNT and 1,3,5-TNB are possible degradation products of several other COCs.

In order to eliminate the uncertainty in the groundwater quality trends at lower concentrations, the 15 data sets comprising contaminant concentrations below the HALs were eliminated from the 46 valid data sets. No significant change was found in the conclusions from this trend analysis after removing the 15 data sets with concentrations below the HALs. The overall TI for Area P was +9 for the 31 data sets. GO009, GO068, and GO109 exhibited TI values of -1/3, 0/6, and 0/4, indicating that the conditions at these wells are either stable or deteriorating. Among the contaminants, 1,3,5-TNB showed deteriorating trends (increasing concentration levels). Similarly, there was no change in the improving trend in the case of RDX or TNT.

Lower Terrace/Sparta Sand Aquifer—Three wells, GO105, GO106, and GO110, sampled during the Area P Five-Year Review, are screened in the Lower Terrace/Sparta Sand aquifer. Wells GO105 and GO106 had less than four data points, and therefore, were categorized as Z. The overall trend in this aquifer based on well GO110 was found to be improving (TI = +3). The contaminants 1,3,5-TNB and 2,6-DNT had a deteriorating trend (DI or I). As observed in the case of the Upper Terrace aquifer, excluding the two data sets that had concentrations below the HALs did not affect the overall improving trend at the site.

Effectiveness of the Area P Cap—The data sets that exhibited ID trends based on the regression fits were used to assess the effectiveness of the cap. Twenty-seven data sets had ID trends; 23 of these data sets were in the Upper Terrace aquifer, while 4 were in the Lower Terrace/Sparta Sand aquifer (see Table 3-11). The date of the maximum concentration (maximum vertex) was estimated from the data plots for these data sets (Appendix D).

An evaluation of the dates of maximum concentration indicated two distinct periods of maximum concentration in the Upper Terrace aquifer, and one period for the Lower Terrace/Sparta Sand aquifer. For the Upper Terrace aquifer, 7 (of 23) maximum values were observed between 1982 and 1984. Use of the lagoons for disposal ceased in 1980; it is possible that concentration levels started decreasing after a reasonable lag time (2 to 4 years) after the inactivity. The other period when the maximum values occurred was between 1987 and 1991 (14 of 23 points). Excavation of contaminated soil took place from November 1988 through

August 1990. The Area P lagoons were capped in August 1990. After a reasonable lag time (0 to 3 years), the decrease in concentration levels after 1987 through 1991 could be attributed to the remediation activities.

For the Lower Terrace aquifer, the maximum values (four of four) were observed between 1988 and 1991, indicating that a downward trend in the concentration levels began during that time period. This downward trend in concentration levels also may be caused by the remediation activities at Area P assuming there was a time lag after the activity.

The DI trend categories were evaluated to identify any negative impact from the cap on the groundwater quality. The dates of the minimum vertex for DI trend categories are provided in Appendix E. Ten of the 14 lowest values were present between 1987 through 1991, which corresponds to the time of remediation activity and capping at Area P. However, no conclusion can be drawn from this observation because of the following uncertainties:

- Six data sets were subjectively assigned ID, I, and NM categories.
- Four data sets are for 1,3,5-TNB and TETRYL. The contaminant 1,3,5-TNB is a possible breakdown product, and therefore, had higher concentration levels after activities at the lagoons had ceased.
- Six data sets had concentration levels below the HALs.

On the basis of the above evaluation of the ID maximum values and the DI minimum values, results indicate that the cap and the remediation activity have resulted in an improvement of the groundwater quality at LAAP. However, due to the anomalies in computer regression and presence of breakdown products, some contaminants showed an increase in concentration levels during that period.

Precipitation data were evaluated for the period 1980 through 1994 to determine if there was any correlation between the precipitation and the groundwater concentration levels. A comparison of these data is presented in Appendix E. There was no specific correlation between the precipitation data and the nitro compounds concentration in the groundwater.

Comparison of the Computer-determined Trends with Subjective Trends—During the trend analysis, 108 data sets were assigned groundwater categories based on specific rules applied to computer-generated regression curves. A comparison of these trends with the subjective trends indicated that 96 data sets (89 percent) had similar trends. However, excluding the 55 data sets (which were either Z or ND), 41 data sets out of the remaining 53 (77 percent) had matching trends.

The highest discrepancy between the subjective and the computer determinations was in the DI trend category. Four of the 13 computer determined DI were subjectively assigned ID because of increase in concentration levels in the early sampling events. One computer-determined DI was subjectively assigned an I because the concentration levels were higher than the previous rounds. Due to the fluctuating trend, one computer-determined DI was assigned an NM (no model) during the subjective analysis.

The subjective trends in groundwater quality are provided in Appendix E. The TI values based on the subjective trends were higher than the TI values based on the computer-determined trends for the Upper Terrace Aquifer. All wells had a positive TI except GO109. The OTI for the Upper Terrace Aquifer was +18/46 (compared to the computer-generated OTI of +8/46). For the Lower Terrace Aquifer, the TI was lower for the subjective analysis because one computer-determined D trend was assigned a NM because of the fluctuations in concentration levels.

3.4.5 Conclusions

The conclusions drawn from the statistical groundwater trend analysis are summarized below.

Upper Terrace Aquifer

- The trend index of the wells sampled was +8, indicating the groundwater quality at Area P is improving. Of the 46 valid data sets, 23 were ID, 4 were D, 6 were I, and 13 were DI.
- RDX and TNT showed the best improving trend, whereas 2,6-DNT, TETRYL, and 1,3,5-TNB overall had a deteriorating trend.

- Excluding data sets with concentration below the HALs did not affect the overall improving trend at Area P.

Lower Terrace/Sparta Sand Aquifer

- Data sets from only one well (GO110) were available for trend analysis.
- The trend index of the wells sampled was +3, indicating that groundwater quality is improving.
- All contaminants had an improving trend except 1,3,5-TNB and 2,6-DNT.
- Excluding data sets with concentration below the HALs did not affect the overall trend conditions.

Assessment of Effectiveness of Cap

- Two distinct maximum periods of groundwater contamination were observed in the Upper Terrace aquifer. Seven (of 23) maximum values were observed between 1982 and 1984. The other period was between 1987 and 1991 (14 of 23 points). Remediation activities (1988 through 1990), followed by capping of the site in 1990, may possibly account for the decreasing concentration levels after that time period.
- In the Lower Terrace/Sparta Sand aquifer, 4 (of 4) maximum values were observed between 1988 and 1991. Decrease in concentration after 1991 can be attributed to the remediation activities that were conducted from November 1988 through August 1990.
- No conclusion can be drawn from the evaluation of the minimum values for the DI curves because of several uncertainties.

3.5 QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

A comprehensive quality assurance/quality control (QA/QC) program was followed during the Five-Year Review of Interim Remedial Action conducted for the LAAP former Area P Lagoons to ensure that the analytical results and the decisions based on these results are representative of the environmental conditions at the site. The objectives of the Five-Year Review of the Area P Lagoons was to evaluate the effectiveness of the interim remedial measure. The following documents were utilized during evaluation of the QC data: the *U.S. Army Toxic and Hazardous Material Agency (USATHAMA) Quality Assurance Program, PAM 11-41* (January 1990) for groundwater samples; QC requirements described in guidelines and specifications described in the Quality Assurance Project Plans (QAPPs) submitted as part of the project work plans prepared by SAIC, the *Installation Restoration Data Management Information System* (IRDMIS), *Volume II Data Dictionary, Potomac Research Institute (PRI) (1994.1), and Laboratory Data Validation Functional Guidelines for Evaluating Organics Analysis* (1988). The numbers of groundwater samples collected in addition to the numbers of field QC samples collected and selected laboratory QC (i.e., matrix spikes and matrix spike duplicates [MS/MSD]) samples analyzed, are summarized in Appendix F. The data review and validation worksheets are referenced within the subsection describing the applicable analysis. The QC checks and results are summarized below.

3.5.1 Data Quality Objectives

DQOs are quantitative and qualitative indicators of data quality. They are established based on the purpose of the project and the intended use of the data, human-based risk assessment requirements, and remedial design requirements. EPA has established the following primary analytical DQOs for environmental studies: precision, accuracy, representativeness, comparability, and completeness (PARCC).

3.5.1.1 Precision

Precision is defined as the reproducibility or degree of agreement among replicate measurements of the same quantity. Specifically, it is a quantitative measure of the variability of a group of measurements compared to their average value. The closer the numerical values of the measurements are to each other, the more precise the measurement is. Precision was expressed as the percentage of the difference between results of replicate samples for a given compound or element. Relative percent difference (RPD) was calculated using the equation given in Appendix F.

Precision was evaluated based on the analysis of three different types of QC samples: the U.S. Army Environmental Center (USAEC) Class 1 laboratory QC duplicate sample spike recoveries (laboratory control sample [LCS]), MS/MSD samples, and replicate field sample analyses. USAEC Class 1 laboratory QC duplicate sample spike recoveries are required as part of the USAEC analytical program for all methods and provide ongoing information on the performance of each lot for each analytical method in a standard matrix. For each analytical lot, the results of these sample spike recoveries were compiled on single-day and three-day control charts (i.e., X-bar and range) and submitted to the USAEC Chemistry Branch for approval. Upon final approval by the USAEC Chemistry Branch, the data within each lot was revised at Phase 3 in IRDMIS.

Same single-day (high spike concentration) control charts were outside QC criteria for: RDX, 1,3,5-TNB, 2,4,6-TNT, 2,4-dinitrotoluene (2,4-DNT), and NB for lots AIUD and AIWV; and RDX, 1,3,5-TNB, NB, and 2,4,6-TNT for lot AIYH and AJDT. Out-of-control situations in these lots are expected to have a negligible impact on data quality, and are discussed in Appendix F, Section F.3.1.

One sample per 20 collected samples was randomly selected to be spiked as an MS/MSD sample. MS/MSD analyses aided in detecting any systematic problems in the analysis and also helped determine how well the target analytes could be recovered from environmental matrices, identifying a matrix effect. Three aliquots were collected for the sample designated to be analyzed for MS/MSD. MS/MSD samples were prepared by routinely analyzing the first aliquot for the parameters of interest, while the remaining two aliquots were spiked with known quantities of the parameters of interest before analysis. The RPD between the two spike results (MS/MSD) was not calculated because background concentration was greater than the spike level.

Sample collection reproducibility and media variability were measured by the analysis of field replicates. Field replicates were collected using the same techniques as those used to collect the environmental samples. One sample in 10 was collected for each similar matrix. Sample collection reproducibility and media variability were evaluated based on the RPD values between the two replicate samples. The RPD between field replicates indicates that environmental conditions at the site are spatially and temporally variable. The data should be utilized with this consideration. No sample was qualified based on the results of these replicate samples since EPA has no guidelines for this QC parameter. However, the amount of heterogeneity of the matrices is shown by the number of times the replicate samples collected and calculated exceeded the selected control limits, based on EPA acceptance criteria.

Immediately after purging, all groundwater samples were collected from existing monitoring wells at LAAP using Teflon® bailers. The samples were shipped to DataChem Laboratories (DCL) for explosives-related compounds analysis. Field replicate RPD values were calculated only for compounds detected in concentrations greater than the certified reporting limits (CRLs) in both replicate pair samples. The explosive water field replicates did not exceed the control limit of 30 percent for RPD acceptance criteria. In general, the RPD between field replicates was low. Based on these RPD results and the acceptable laboratory QC results, the sample collection DQO for reproducibility is considered to have been met. A comprehensive discussion of all replicate sample results is presented in Appendix F, Section F.2.3.

The overall goal for analytical precision was greater than 95 percent of all data generated by field or laboratory methods within the contract-required or method-recommended (as defined by the appropriate USAEC method or SAIC standard operating procedure [SOP] control limits.

3.5.1.2 Accuracy

Accuracy, or the bias in a measurement system, is a measure of the closeness of a reported concentration to the true value. The closer the numerical value of the measurement approaches the true value or actual concentration, the more accurate the measurement is. Analytical accuracy is expressed as the percent recovery of a compound or element that has been added to the environmental sample at a known concentration before analysis. The percent recovery values were calculated using the equation given in Appendix F.

Analytical accuracy was determined through the use of Class 1 USAEC laboratory QC sample spike recoveries for explosives. The accuracy of the analysis and the matrix effect of the water samples upon the analytical methodology was determined through the use of MS/MSD analyses conducted on the environmental samples as described for precision determinations. The percent recoveries of the target compounds were calculated and used as an indication of the accuracy of the analyses performed.

One field sample was randomly selected to be spiked as an MS/MSD sample. The information gathered was not used to assess the effect of matrix on sample recovery. Recoveries were not calculated because background concentration was greater than the spiking level. The laboratory accuracy for this project was qualitatively assessed by evaluating the following laboratory QC information: method blank, initial calibration verification (ICV), continuing calibration verification (CCV), and USAEC Class 1 laboratory QC sample spike results calculated from all analyses conducted on environmental samples. Each type of spiked sample provided different information on the accuracy of the measurement system.

USAEC QC samples were used as the primary control of accuracy in the laboratory system. The contract laboratory plotted the mean percent recovery and range of percent recovery on control charts prepared for each control compound. The laboratory utilized the percent recovery of each compound in spiked QC samples, the average percent recovery, and the difference between the percent recovery of two high spiked samples in a continuous assessment of method accuracy. Thirty-two percent recovery values (of 135 values) were out-of-control. The flag code (i.e., "7") was applied to three RDX and five 2,4,6-TNT concentrations to indicate that the QC samples' low spike recovery was outside of QC criteria. The flag code (i.e., "L") was applied to six NB concentrations to indicate that NB data were rejected due to low recovery for the low spike. Despite these values, no systematic laboratory error was detected, and the results are considered to have little impact on the overall environmental data quality.

In addition, an analysis accuracy was calculated for method UW25 based on found versus recovered compounds. Analysis accuracies are reported with each applicable lot of data to USAEC. Concentrations reported in IRDMIS reflect the accuracy of the analytical method.

The general objective for analytical accuracy was to meet 100 percent of the calibration, internal standard, and surrogate recovery criteria, as defined by the USAEC procedure. The general objective for sample accuracy was that greater than 95 percent of the USAEC QC samples and MS/MSD analyses be within the USAEC required control limits or that matrix interferences could be demonstrated through MS/MSD results. Sampling accuracy was maximized by the adherence to the strict quality assurance (QA) program presented in the Five-Year Review of the Area P Lagoons Quality Assurance Project Plan (QAPP). All field procedures used during the investigation were documented as SOPs. Equipment rinsate blanks were prepared to assess any cross-contamination that may have occurred.

All supporting explosives QC information (i.e, method blanks, ICVs, and CCVs) was qualitatively evaluated with respect to the analytical accuracy DQO. The method blank results for groundwater were generally below the CRLs with one exception. Lot AIWV had a method blank with the concentration of 1,3,5-TNB above the CRL. As a result, 1,3,5-TNB concentrations in three field samples was flagged (i.e., "B") to indicate that this explosives-related compound was found in the associated method blank. Percent recovery results from the ICVs and CCVs were within the limits specified in DCL performance-demonstrated method UW25. The overall laboratory accuracy is acceptable, and as such, the analytical DQO for accuracy was met.

Sampling accuracy was maximized by the adherence to the strict quality assurance (QA) program presented in the Five-Year Review of the Area P Lagoons QAPP. All procedures (i.e., groundwater sample collection, equipment decontamination, and health monitoring equipment calibration and operation) used were documented as standard operating procedures (SOPs). Equipment rinsate blanks were prepared to ensure that all samples represent the particular site from which they were collected, assess any cross-contamination that may have occurred, and flag the associated analytical data accordingly.

The flag code (i.e., "G") was applied to the 1,3,5-TNB and RDX in SAIC01 Site ID GO009, SAIC04 Site ID GO083; SAIC02 and SAIC03 Site ID GO084 to indicate that these compounds were detected in the associated equipment rinsate blank.

Based on an evaluation of the explosives-related compounds detected in the equipment rinsate blanks, the overall field accuracy is acceptable. As a result, the field DQO for accuracy is considered to have been met. A comprehensive discussion of the field QC results is presented in Appendix F, Section F.2.

3.5.1.3 Representativeness

Representativeness was defined as the degree to which the data accurately and precisely represent a characteristic of a population, parameter variations at a sampling location, a process condition, or an environmental condition. Sample representativeness was ensured by collecting sufficient samples of a population medium, properly distributed with respect to location and time. Representativeness was assessed by reviewing sample collection methods, equipment, and sample containers, in addition to evaluating the RPD values from the field replicate samples and the concentrations of explosives-related compounds detected in the equipment rinsate blanks and method blanks. The reproducibility of a representative set of samples reflects the degree of heterogeneity of the sampled medium, as well as the effectiveness of the sample collection techniques.

Based on the evaluation of the factors described above and summarized in Appendix F, Section F.3, the samples collected are considered to be representative of the environmental conditions at LAAP.

3.5.1.4 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another, and is limited to the other PARCC parameters, because only when precision and accuracy are known can one data set be compared to another. The characteristic of comparability reflects the consistency of sample collection and handling procedures, analytical techniques, and expression of results in units consistent with other organizations reporting similar data. To optimize comparability, only the specific methods and protocols that were specified in the Five-Year Review of the Area P Lagoons QAPP, as required by the *USATHAMA Quality Assurance Program, PAM 11-41* (January 1990), were used to collect and analyze samples. By using consistent sampling and analysis procedures, all data sets were comparable within the sites at LAAP and between sites at the installation to ensure that decisions and priorities were based on a consistent data base. No changes to planned procedures were implemented that would affect data comparability. Comparability also was ensured by the analysis of USAEC reference materials, establishing that the analytical procedures used were generating valid data.

All groundwater samples collected for explosives analyses were analyzed using DCL performance-demonstrated method UW25. Based on the precision and accuracy assessment presented above, the data collected are considered to be comparable with the data collected during previous investigations.

3.5.1.5 Completeness

Completeness was defined as the percentage of valid data obtained from a measurement system. For data to be considered valid, they must have met all acceptance criteria, including accuracy and precision, as well as any other criteria specified by the analytical methods used. Project completeness was calculated using the equation given in Appendix F.

For analytical data to be considered usable, each data point must be satisfactorily validated. The completeness objective established for this project was 90 percent. Based on the evaluation of the field and laboratory QC results presented in Appendix F, Sections F.2 and F.3, 96.7 percent of the sample data collected for explosives analyses during the Five-Year Review of the Area P Lagoons were used as the basis for all recommendations presented in this report. All explosives analyses for groundwater and field QC samples were performed within the holding times.

Completeness of the data also was evaluated by comparing work plan sampling requirements to the completed chain-of-custody forms to establish that all samples required by the work plan were in fact collected. Upon completion of this process, analytical result in the IRDMIS data base and laboratory data packages were compared to those required by the chain-of-custody to establish that the results for all samples taken were in the data base.

3.5.2 Field Internal Quality Control Checks

Collection and analysis of source water samples, equipment rinsate blanks, and field replicates are provided as QC checks on the integrity of sample collection and handling and equipment decontamination procedures.

The following summarizes the field QC samples that were collected during the Five-Year Review at LAAP:

- Duplicate water samples were collected on October 12 and 13, 1993 from Well No. 6 (source water) on Post and the reagent-grade water used as the final rinse in the decontamination procedures and submitted to DataChem Laboratories (DCL) for analysis using DCL performance-demonstrated method UW25 for explosives. These samples were analyzed on October 22 and November 10, 1993. No explosive compounds were detected in the samples.
- One equipment rinsate blank was collected each day groundwater samples were collected by pouring USAEC-approved source or distilled water into, through, and/or over a clean piece of sampling equipment (e.g., bailers), and then dispensing the water into prepared sample bottles. These blanks were analyzed for explosive-related compounds by DCL performance-demonstrated method UW25.
- One field replicate was collected for every 10 groundwater samples collected. Two field replicates were collected during this field investigation. Field replicates were collected at the same time and in the same manner as the other samples. Field replicates are a separate sample, obtained from the same monitoring point. Results of the field replicate analyses are used to assess the precision of the field sampling techniques, not that of the analytical techniques.

Section 4.3 and Appendix F discuss the field QC sample analyses and their impact on the data quality.

3.5.3 Laboratory Quality Control Checks

In accordance with the *USATHAMA Quality Assurance Program, PAM 11-41 (January 1990)*, laboratory QC samples were analyzed with each lot of environmental samples. These QC samples monitor the performance of the analytical method by which a particular lot is being analyzed. The results (recoveries) of these QC samples are plotted on single-day and three-point moving average control charts. Control charts are used to monitor the variations in the precision and accuracy of routine analysis and detect trends in these variations. In addition to USAEC laboratory QC spike samples, MS/MSD samples were collected and analyzed to monitor analytical accuracy and precision.

3.5.3.1 Matrix Spike/Matrix Spike Duplicates

MS/MSDs were collected and analyzed to evaluate the accuracy and precision of the analysis and matrix effect of the sample on the analytical methodology. A pair of MS/MSD samples was analyzed for every 20 samples of similar matrix received at the laboratory. Samples identified as field QC samples (i.e., equipment rinsates and field replicates) were not used for MS/MSD analysis. Control limits of 75 to 125 percent were used for evaluating MS/MSD recoveries.

3.5.3.2 USAEC Class 1 Method - UW25

Groundwater and field QC samples were analyzed for explosives using DataChem Laboratories (DCL) performance-demonstrated method UW25. The following types of USAEC QC samples were included with each analytical lot:

- ***At least one standard matrix method blank.***
- ***Three standard matrix spike QC samples***—One spike at approximately 2 times and 2 spikes at 10 times the certified reporting limit (CRL). The standard matrix spike QC samples contained all control analytes, as specified in the DCL performance-demonstrated method UW25.

USAEC procedures require the use of control charts to monitor performance, accuracy, and precision during an analysis. For each lot, data from the spike QC sample at 2 times the CRL was plotted on the three-point x-bar and range control charts, while the data from the 2 spiked QC samples at 10 times the CRL were plotted on the single day x-bar and range control charts.

As analytical lots are analyzed, the data from the spiked QC samples within a lot are evaluated against the control chart limits to determine if that lot of samples is "in control." Each individual data point was tested as an outlier using Dixon's test at the 98 percent confidence level. Data points that fall outside of these control limits required immediate investigation, explanation, and/or corrective action. All QC data and control charts must be evaluated daily to ensure that an analytical method remains in control. Failure to do so may result in samples being reanalyzed and/or data being discarded.

3.5.3.3 Control Chart Review

Analysis of the QC results may result in the laboratory or SAIC applying a flagging code to a particular analyte(s) for all samples associated with that analytical lot. These flagging codes are assigned to indicate other-than-usual analytical conditions or results (e.g., high spike not within the control limits, result is unconfirmed). Upon receipt of the laboratory QA report and associated control charts, the USAEC Chemistry Branch reviews all QC data and determines whether or not the lots are in control, if the data are usable without qualifiers, or if the data are usable with a data qualifier applied.

4. CONCLUSIONS AND RECOMMENDATIONS

This section summarizes the principal findings of the Five-Year Review conducted at Area P. Recommendations for corrective actions and future Five-Year Reviews also are discussed.

4.1 EFFECTIVENESS OF INTERIM REMEDIAL ACTION

The groundwater sampling data for the Upper Terrace and Lower Terrace/Sparta Sand aquifers indicate that the concentrations of hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), 1,3,5-trinitrobenzene (1,3,5-TNB), 1,3-dinitrobenzene (1,3-DNB), 2,4,6-trinitrotoluene (2,4,6-TNT), and nitrobenzene (NB) are above the drinking water health advisory levels (HALs). However, these concentrations are lower than the 1990 concentrations, indicating that the groundwater quality at Area P has generally improved since the interim remedial measure was completed. This conclusion was supported by the statistical analysis conducted to evaluate trends in groundwater quality at Area P. Explosive concentrations were generally higher west of Area P for both the Upper Terrace and the Lower Terrace/Sparta Sand aquifers. Similar trends were observed when evaluating the 1990 groundwater sampling data.

The topographic survey of the cap indicates that no major subsidence has occurred at Area P. The surface drainage from the Area P cap is to the west and south, matching prevailing drainage in that area.

4.2 ACTIONS TAKEN OR PROPOSED ON THE BASIS OF THE FIVE-YEAR REVIEW

Damage to a portion of the fence by a fallen pine tree was identified during the Five-Year Review. The fence has since been repaired by Louisiana Army Ammunition Plant (LAAP) personnel. The cap inspection also identified sections of bare ground that were greater than 1 foot in area. It has been recommended that these areas be seeded and mulched to prevent erosion. According to the Maintenance Plan, such seeded areas should be checked monthly to ensure an erosion resistant grass cover has been established before returning to the quarterly inspection schedule.

Three ponded areas were identified during the Five-Year Review of Area P. Water tends to pond in these areas after periods of heavy precipitation. A ponded area was identified on the Area P cap near wells GO068, GO109, and GO110. This area, which is along the drainage pathway from the Area P cap, should be filled with soil and graded to blend smoothly with the surrounding area. The area should be seeded and mulched to prevent erosion. The ponding of the water observed in the southwest corner of the Area P cap after periods of heavy precipitation is a result of the surface drainage pattern from the cap. The ponded area south of well GO012 is outside the cap area. No maintenance is recommended for these two areas.

Wells GO010 and GO011, located south and west of Area P, respectively, and screened in the Upper Terrace aquifer, have a bent well casing. These wells cannot be sampled, and therefore, should be abandoned. Well GO011 installed in 1979 is one of the few wells at Area P that has good historical sample data. No well in the immediate vicinity can be used as a replacement for well GO011. Sample data from the new replacement well, if installed, can be used with the historical data from well GO011 to evaluate the groundwater contamination levels west of Area P. Therefore, it is recommended that a new well be installed to replace well GO011. Well GO014 can be substituted for well GO010 for the future Five-Year Review at Area P. Some of the wells at Area P were installed between 1979 and 1982. The integrity of these wells should be checked to evaluate their potential impact on sampling data.

4.3 SCOPE AND NATURE OF FUTURE REVIEWS

The present scope of field investigation activities should be continued during the next Five-Year Review of Area P scheduled for February 1999. In addition, the effectiveness of the cap should be measured using standard field techniques for measurement of infiltration rate (e.g., use of Double-Ring Infiltrometer, American Society for Testing and Materials [ASTM] Method D 5093-90). This test method is particularly useful for measuring liquid flow through soil moisture barriers, such as compacted clay cap.

This method produces a direct measurement of infiltration rate, not hydraulic conductivity. Although the units of infiltration rate and hydraulic conductivity are similar, there is a distinct difference between these two quantities. They cannot be directly related unless the hydraulic boundary conditions, such as hydraulic gradient and the extent of lateral flow of water, are known or can be reliably estimated.

The infiltration rate of water through soil is measured using a double-ring infiltrometer. The infiltrometer consists of an open outer and a sealed inner ring. The rings are embedded and sealed on the cap. Both rings are filled with water such that the inner ring is submerged. The rate of flow is measured by connecting a flexible bag filled with a known weight of water to a port on the inner ring. As water infiltrates into the ground from the inner ring, an equal amount of water flows into the inner ring from the flexible bag. After a known interval of time, the flexible bag is removed and weighed. The weight loss, converted to a volume, is equal to the amount of water that has infiltrated into the ground. An infiltration rate is then determined from this volume of water, the area of the inner ring, and the interval of time. This process is repeated and a plot of infiltration rate versus time is constructed (ASTM 1994).

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5. REFERENCES

ASTM (American Society for Testing and Materials). 1994. Annual Book of ASTM Standards, Section 4 Construction, Volume 04.09 Soil and Rock (II): D4943-Latest; Geosynthetic. April 1994.

EPA (U.S. Environmental Protection Agency). 1989. Office of Solid Waste and Emergency Response (OSWER) Directive 9320.2-03B, December 29, 1989.

EPA. 1991. *Structure and Component of Five-Year Review*, OSWER Directive 9355.7-02, May 23, 1991.

ESE (Environmental Science & Engineering, Inc.). 1992. *Louisiana Army Ammunition Plant Final Remedial Investigation Report, Vol. I*. Prepared for USATHAMA. Aberdeen Proving Ground, Maryland. February 1992.

ETA (Engineering Technologies Associates, Inc.). 1991. *Groundwater Model for Selected Sites at the Louisiana Army Ammunition Plant, Shreveport, Louisiana*. Prepared for USATHAMA. Contract No. DAAA15-89-D-0009. Aberdeen Proving Ground, Maryland. January 1991.

Lachance, A.D. and M.R. Stoline. 1993. The Application of a Statistical Trend Analysis Model to Groundwater Monitoring Data from Eight Western Michigan Solid Waste Landfills.

Martin, J.L., L.W. Hough, D.L. Raggio, and A.E. Sandberg. 1954. *Geology of Webster Parish*, State of Louisiana Department of Conservation, Geological Bulletin, No. 29.

Payne, J.N. 1975. *Hydrologic Significance of Lithofacies of the Sparta Sand in Arkansas, Louisiana, Mississippi, and Texas, Geohydrology of the Claiborne Group*. U.S. Geological Survey Professional Paper 569-D.

SAIC (Science Applications International Corporation). 1994. *Final, Field Sampling Design Plan, Five-Year Review of Interim Remedial Action at Former Area P Lagoons, Louisiana Army Ammunition Plant, Shreveport, Louisiana*. Prepared for U.S. Army Environmental Center. Contract No. DAAA15-91-D-0017. Aberdeen Proving Ground, Maryland. February 1994.

Stoline, M.R., R.N. Passero, and M.J. Barcelona. 1993. *Statistical Trends in Groundwater Monitoring Data at a Landfill Superfund Site*. A Case Study, Environmental Monitoring and Assessment, 27, 201-219.

USATHAMA (U.S. Army Toxic and Hazardous Materials Agency). 1990. *Standard Operating Procedures and Quality Assurance Program, PAM 11-41*, January 1990.

USATHAMA. 1992. *Maintenance Plan, Louisiana Army Ammunition Plant, Former Area P Lagoons*, September 1992.

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APPENDIX A

IRDMIS DATA

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Data Summary Table: Groundwater - Area P Lagoons, Groundwater and Associated Replicate Sample Results, Louisiana Army Ammunition Plant

Site ID	G0009	G0009	G0012	G0012	G0014
Field Sample Number	SAIC01	SAICRB02	SAIC01	SAICRB01	SAIC01
Site Type	WELL	RNSW	WELL	RNSW	WELL
Collection Date	2/25/94	2/25/94	2/24/94	2/24/94	2/24/94
Depth (ft)	18.19	0	19.76	0	14.86
Associated Field QC Sample - Site ID	G0009	N/A	G0012	N/A	G0012
Associated Field QC Sample - Field Sample No.	SAICRB02	N/A	SAICRB01	N/A	SAICRB01

Explosives (UW25)

Laboratory ID Number				UB01176				UB01175				UB01144				UB01143				UB01145		
Parameter	Units	CRL			FC	DQ			FC	DQ			FC	DQ			FC	DQ			FC	DQ
1,3,5-Trinitrobenzene	µg/L	0.21		29	UGB	I		0.42	CB	I		950	C		LT	0.21			LT	0.429	K	
1,3-Dinitrobenzene	µg/L	0.458	LT	0.458			LT	0.458				35	C		LT	0.458			LT	0.458		
2,4,6-Trinitrotoluene	µg/L	0.426		28.3	C7	JN	LT	0.426	7	JN		3700	C		LT	0.426			LT	0.426		
2,4-Dinitrotoluene	µg/L	0.397		37	UQ	N	LT	0.397		N		120	C		LT	0.397			LT	0.397		
2,6-Dinitrotoluene	µg/L	0.6	LT	0.6			LT	0.6			LT	32.3	K		LT	0.6			LT	0.6		
Cyclotetramethylenetetranitramine	µg/L	0.533		26	C		LT	0.533				110	C		LT	0.533				2.92	C	
Nitrobenzene	µg/L	0.682	LT	0.682				2.66	U		LT	12.3	K		LT	1.84	K		LT	0.682		
Hexahydro-1,3,5-trinitro-1,3,5-triazine	µg/L	0.416		430	CG			0.746	U		LT	3100	K7	J	LT	0.416	K7	J		14.4	C7	J
N-methyl-N,2,4,6,-tetranitroanaline	µg/L	0.631	LT	0.631			LT	0.631			LT	6.3	JI		LT	0.631			LT	0.631		

Data Summary Table: Groundwater - Area P Lagoons, Groundwater and Associated Replicate Sample Results, Louisiana Army Ammunition Plant (Continued)

Site ID	G0068	G0083	G0084	G0084	G0085
Field Sample Number	SAIC01	SAIC04	SAIC02	SAIC03	SAIC01
Site Type	WELL	WELL	WELL	WELL	WELL
Collection Date	3/1/94	2/25/94	2/25/94	2/25/94	3/3/94
Depth (ft)	16	19.8	21.6	21.6	20
Associated Field QC Sample - Site ID	GO-146	G0009	G0009	G0009	GO-150
Associated Field QC Sample - Field Sample No.	SAICRB04	SAICRB02	SAICRB02	SAICRB02	SAICRB06

Explosives (UW25)

Laboratory ID Number				UB01226				UB01179				UB01177				UB01178				UB01270		
Parameter	Units	CRL			FC	DQ			FC	DQ			FC	DQ			FC	DQ			FC	DQ
1,3,5-Trinitrobenzene	µg/L	0.21		490	C			800	UGB	I		320	UGB	I		310	DUG	I		3800	C	
1,3-Dinitrobenzene	µg/L	0.458		82	C			5.63	C		LT	0.458			LT	0.458	D			32	C	
2,4,6-Trinitrotoluene	µg/L	0.426		3600	C	J		3100	C7	JN		250	C7	JN		240	DC7	JN		4200	C	
2,4-Dinitrotoluene	µg/L	0.397		350	UQ	J		95	UQ	N		12.1	UQ	N		11.2	DUQ	N		79	C	J
2,6-Dinitrotoluene	µg/L	0.6	LT	60	JI		LT	12			LT	0.6			LT	12	D		LT	59	K	
Cyclotetramethylenetetranitramine	µg/L	0.533	LT	350	K			99	C			13.3	U			14	DUQ		LT	310	K	
Nitrobenzene	µg/L	0.682	LT	68	LJI	J	LT	14	JI		LT	0.682			LT	0.682	D		LT	67	K	
Hexahydro-1,3,5-trinitro-1,3,5-triazine	µg/L	0.416		2500	C			1200	CG			110	CG			120	DCG			3800	C	
N-methyl-N,2,4,6,-tetranitroanaline	µg/L	0.631		31	U			95	U			5.66	U			5.03	DU			310	C	

Data Summary Table: Groundwater - Area P Lagoons, Groundwater and Associated Replicate Sample Results, Louisiana Army Ammunition Plant (Continued)

Site ID	G0104	G0104	G0105	G0106	G0109
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC01	SAIC01
Site Type	WELL	WELL	WELL	WELL	WELL
Collection Date	3/2/94	3/2/94	2/28/94	3/1/94	2/28/94
Depth (ft)	18	18	25	57	23
Associated Field QC Sample - Site ID	GO-145	GO-145	G0110	GO-146	G0110
Associated Field QC Sample - Field Sample No.	SAICRB05	SAICRB05	SAICRB03	SAICRB04	SAICRB03

Explosives (UW25)

Laboratory ID Number				UB01242				UB01243				UB01192				UB01225				UB01193		
Parameter	Units	CRL			FC	DQ			FC	DQ			FC	DQ			FC	DQ			FC	DQ
1,3,5-Trinitrobenzene	µg/L	0.21		6000	C			6300	DC			3900	C			970	C			95	C	
1,3-Dinitrobenzene	µg/L	0.458		560	C			580	DC			320	UQ			330	C			8.21	UQ	
2,4,6-Trinitrotoluene	µg/L	0.426		11000	C	J		11000	DC	J		16.5	C			8800	C	J		3600	C	
2,4-Dinitrotoluene	µg/L	0.397		550	C	J		570	DC	J		54	C			640	C	J		330	C	
2,6-Dinitrotoluene	µg/L	0.6	LT	60	JI		LT	60	DJI		LT	60	JI		LT	60	JI		LT	60	JI	
Cyclotetramethylenetetranitramine	µg/L	0.533	LT	370	K		LT	310	DK			360	C		LT	53	JI			300	C	
Nitrobenzene	µg/L	0.682	LT	68	LJI	J	LT	68	DLJI	J	LT	68	JI		LT	68	LJI	J	LT	6.8	JI	
Hexahydro-1,3,5-trinitro-1,3,5-triazine	µg/L	0.416		7100	C			8400	DC			330	C			4100	C			3100	C	
N-methyl-N,2,4,6,-tetranitroanaline	µg/L	0.631		120	C			130	DC			3.71	U		LT	63	JI			39.9	U	

Data Summary Table: Groundwater - Area P Lagoons, Groundwater and Associated Replicate Sample Results, Louisiana Army Ammunition Plant (Continued)

Site ID	G0110	G0110	GO-145	GO-146	GO-150
Field Sample Number	SAIC01	SAICRB03	SAICRB05	SAICRB04	SAICRB06
Site Type	WELL	RNSW	RNSW	RNSW	RNSW
Collection Date	2/28/94	2/28/94	3/2/94	3/1/94	3/3/94
Depth (ft)	32	0	0	0	0
Associated Field QC Sample - Site ID	G0110	N/A	N/A	N/A	N/A
Associated Field QC Sample - Field Sample No.	SAICRB03	N/A	N/A	N/A	N/A

Explosives (UW25)

Laboratory ID Number				UB01191				UB01190				UB01240				UB01223				UB01267		
Parameter	Units	CRL			FC	DQ			FC	DQ			FC	DQ			FC	DQ			FC	DQ
1,3,5-Trinitrobenzene	µg/L	0.21		460	C		LT	0.21			LT	0.21			LT	0.21			LT	0.21		
1,3-Dinitrobenzene	µg/L	0.458		24	UQ		LT	0.458			LT	0.458			LT	0.458			LT	0.458		
2,4,6-Trinitrotoluene	µg/L	0.426		570	C		LT	0.426			LT	0.426		J	LT	0.426		J	LT	0.426		
2,4-Dinitrotoluene	µg/L	0.397		120	C		LT	0.397			LT	0.397		J	LT	0.397		J	LT	0.397		J
2,6-Dinitrotoluene	µg/L	0.6	LT	60	JI		LT	0.6			LT	0.6			LT	0.6			LT	0.6		
Cyclotetramethylenetetranitramine	µg/L	0.533		130	C		LT	0.533			LT	0.533				5.03	C		LT	0.533		
Nitrobenzene	µg/L	0.682	LT	6.8	JI			2.95	UQ		LT	0.682	L	J	LT	0.682	L	J	LT	0.682		
Hexahydro-1,3,5-trinitro-1,3,5-triazine	µg/L	0.416		2800	C		LT	0.416			LT	0.416			LT	0.416			LT	0.416		
N-methyl-N,2,4,6,-tetranitroanaline	µg/L	0.631	LT	0.631			LT	0.631			LT	0.631			LT	0.631			LT	0.631		

N/A - Not applicable
ID - Identification
QC - Quality Control
CRL - Certified reporting limit
LT - Less than
FC - Flagging codes:
- B - Analyte found in the method blank or QC blank as well as the sample
- C - Analysis confirmed
- D - Duplicate analysis
- G - Analyte found in rinse blank as well as field sample.
- I - Interferences in sample caused the quantitation and /or identification to be suspect
- J - Value is estimated
- K - Reported results affected by interferences or high background
- L - Out of control, data rejected due to low recoveries.
- Q - Sample interference obscured peak of interest
- U - Analysis is unconfirmed
- 7 - Low spike recovery is not within control limits

DQ - Data qualifiers:
- I - The low-spike recovery is high.
- J - The low-spike recovery is low.
- N - The high-spike recovery is low.

Final Documentation Appendix Report
Installation :Louisiana AAP, LA (LO)
File Type: CGW
Sampling Date Range: 01-SEP-93 27-JUN-94

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Meas. Bool.	Conc.	Unit Meas.	Flag Codes	Data Quals
TAPW	#6	SAIC01	0.0	12-OCT-93	UB	UA03229	UW25/W	06-20-2	2,6-Dinitrotoluene	LT	.6	UGL		
								18-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene	LT	.426	UGL		
								21-14-2	2,4-Dinitrotoluene	LT	.397	UGL		
								21-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT	.416	UGL		
								79-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT	.631	UGL		
								91-41-0	Cyclotetramethylenetetranitramine	LT	.533	UGL		
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT	.682	UGL		
								99-35-4	1,3,5-Trinitrobenzene	LT	.21	UGL	H	I
								99-65-0	1,3-Dinitrobenzene	LT	.458	UGL		
		SAIC02	0.0	12-OCT-93	UB	UA03228	UW25/W	06-20-2	2,6-Dinitrotoluene	LT	.6	UGL	D	
								18-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene	LT	.426	UGL	D	
								21-14-2	2,4-Dinitrotoluene	LT	.397	UGL	D	
								21-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT	.416	UGL	D	
								79-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT	.631	UGL	D	
								91-41-0	Cyclotetramethylenetetranitramine	LT	.533	UGL	D	
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT	.682	UGL	D	
								99-35-4	1,3,5-Trinitrobenzene	LT	.21	UGL	DH	I
								99-65-0	1,3-Dinitrobenzene	LT	.458	UGL	D	
WELL	G0009	SAIC01	18.2	25-FEB-94	UB	UB01176	UW25/W	06-20-2	2,6-Dinitrotoluene	LT	.6	UGL		
								18-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene		28.3	UGL	C7	JN
								21-14-2	2,4-Dinitrotoluene		37	UGL	UQ	N
								21-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *		430	UGL	C	
								79-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT	.631	UGL		
								91-41-0	Cyclotetramethylenetetranitramine		26	UGL	C	
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT	.682	UGL		
								99-35-4	1,3,5-Trinitrobenzene		29	UGL	U	I
								99-65-0	1,3-Dinitrobenzene	LT	.458	UGL		
	G0012	SAIC01	19.8	24-FEB-94	UB	UB01144	UW25/W	06-20-2	2,6-Dinitrotoluene	LT	32.3	UGL	K	
								18-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene		3700	UGL	C	
								21-14-2	2,4-Dinitrotoluene		120	UGL	C	
								21-82-4						

* - Analyte Description has been truncated. See Data Dictionary

Final Documentation Appendix Report
Installation :Louisiana AAP, LA (LO)
File Type: CGW
Sampling Date Range: 01-SEP-93 27-JUN-94

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Meas. Bool.	Conc.	Unit Meas.	Flag Codes	Data Quals
WELL	G0012	SAIC01	19.8	24-FEB-94	UB	UB01144	UW25/W	21-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT	3100	UGL	K7	J
								79-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT	6.3	UGL	JI	
								91-41-0	Cyclotetramethylenetetranitramine		110	UGL	C	
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT	12.3	UGL	K	
								99-35-4	1,3,5-Trinitrobenzene		950	UGL	C	
								99-65-0	1,3-Dinitrobenzene		35	UGL	C	
	G0014	SAIC01	14.9	24-FEB-94	UB	UB01145	UW25/W	06-20-2	2,6-Dinitrotoluene	LT	.6	UGL		
								18-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene	LT	.426	UGL		
								21-14-2	2,4-Dinitrotoluene	LT	.397	UGL		
								21-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *		14.4	UGL	C7	J
								79-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT	.631	UGL		
								91-41-0	Cyclotetramethylenetetranitramine		2.92	UGL	C	
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT	.682	UGL		
								99-35-4	1,3,5-Trinitrobenzene	LT	.429	UGL	K	
								99-65-0	1,3-Dinitrobenzene	LT	.458	UGL		
	G0068	SAIC01	16.0	01-MAR-94	UB	UB01226	UW25/W	06-20-2	2,6-Dinitrotoluene	LT	60	UGL	JI	
								18-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene		3600	UGL	C	J
								21-14-2	2,4-Dinitrotoluene		350	UGL	UQ	J
								21-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *		2500	UGL	C	
								79-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *		31	UGL	U	
								91-41-0	Cyclotetramethylenetetranitramine	LT	350	UGL	K	
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT	68	UGL	7JI	J
								99-35-4	1,3,5-Trinitrobenzene		490	UGL	C	
								99-65-0	1,3-Dinitrobenzene		82	UGL	C	
	G0083	SAIC04	19.8	25-FEB-94	UB	UB01179	UW25/W	06-20-2	2,6-Dinitrotoluene	LT	12	UGL		
								18-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene		3100	UGL	C7	JN
								21-14-2	2,4-Dinitrotoluene		95	UGL	UQ	N
								21-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *		1200	UGL	C	
								79-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *		95	UGL	U	
								91-41-0	Cyclotetramethylenetetranitramine		99	UGL	C	

* - Analyte Description has been truncated. See Data Dictionary

Final Documentation Appendix Report
Installation :Louisiana AAP, LA (LO)
File Type: CGW
Sampling Date Range: 01-SEP-93 27-JUN-94

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Meas. Bool.	Conc.	Unit Meas.	Flag Codes	Data Quals
WELL	G0083	SAIC04	19.8	25-FEB-94	UB	UB01179	UW25/W	98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT	14	UGL	JI	
								99-35-4	1,3,5-Trinitrobenzene		800	UGL	U	I
								99-65-0	1,3-Dinitrobenzene		5.63	UGL	C	
	G0084	SAIC02	21.6	25-FEB-94	UB	UB01177	UW25/W	06-20-2	2,6-Dinitrotoluene	LT	.6	UGL		
								18-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene		250	UGL	C7	JN
								21-14-2	2,4-Dinitrotoluene		12.1	UGL	UQ	N
								21-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *		110	UGL	C	
								79-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *		5.66	UGL	U	
								91-41-0	Cyclotetramethylenetetranitramine		13.3	UGL	U	
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT	.682	UGL		
								99-35-4	1,3,5-Trinitrobenzene		320	UGL	U	I
								99-65-0	1,3-Dinitrobenzene	LT	.458	UGL		
		SAIC03	21.6	25-FEB-94	UB	UB01178	UW25/W	06-20-2	2,6-Dinitrotoluene	LT	12	UGL	D	
								18-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene		240	UGL	DC7	JN
								21-14-2	2,4-Dinitrotoluene		11.2	UGL	DUQ	N
								21-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *		120	UGL	DC	
								79-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *		5.03	UGL	DU	
								91-41-0	Cyclotetramethylenetetranitramine		14	UGL	DUQ	
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT	.682	UGL	D	
								99-35-4	1,3,5-Trinitrobenzene		310	UGL	DU	I
								99-65-0	1,3-Dinitrobenzene	LT	.458	UGL	D	
	G0085	SAIC01	20.0	03-MAR-94	UB	UB01270	UW25/W	06-20-2	2,6-Dinitrotoluene	LT	59	UGL	K	
								18-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene		4200	UGL	C	
								21-14-2	2,4-Dinitrotoluene		79	UGL	C	J
								21-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *		3800	UGL	C	
								79-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *		310	UGL	C	
								91-41-0	Cyclotetramethylenetetranitramine	LT	310	UGL	K	
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT	67	UGL	K	
								99-35-4	1,3,5-Trinitrobenzene		3800	UGL	C	
								99-65-0	1,3-Dinitrobenzene		32	UGL	C	
	G0104	SAIC01	18.0	02-MAR-94	UB	UB01242	UW25/W	06-20-2	2,6-Dinitrotoluene	LT	60	UGL	JI	

* - Analyte Description has been truncated. See Data Dictionary

Final Documentation Appendix Report
Installation :Louisiana AAP, LA (LO)
File Type: CGW
Sampling Date Range: 01-SEP-93 27-JUN-94

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Meas. Bool.	Conc.	Unit Meas.	Flag Codes	Data Quals
WELL	G0104	SAIC01	18.0	02-MAR-94	UB	UB01242	UW25/W	18-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene		11000	UGL	C	J
								21-14-2	2,4-Dinitrotoluene		550	UGL	C	J
								21-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *		7100	UGL	C	
								79-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *		120	UGL	C	
								91-41-0	Cyclotetramethylenetetranitramine	LT	370	UGL	K	
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT	68	UGL	7JI	J
								99-35-4	1,3,5-Trinitrobenzene		6000	UGL	C	
								99-65-0	1,3-Dinitrobenzene		560	UGL	C	
						UB01243	UW25/W	06-20-2	2,6-Dinitrotoluene	LT	60	UGL	DJI	
								18-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene		11000	UGL	DC	J
								21-14-2	2,4-Dinitrotoluene		570	UGL	DC	J
								21-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *		8400	UGL	DC	
								79-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *		130	UGL	DC	
								91-41-0	Cyclotetramethylenetetranitramine	LT	310	UGL	DK	
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT	68	UGL	D7JI	J
								99-35-4	1,3,5-Trinitrobenzene		6300	UGL	DC	
								99-65-0	1,3-Dinitrobenzene		580	UGL	DC	
	G0105	SAIC01	25.0	28-FEB-94	UB	UB01192	UW25/W	06-20-2	2,6-Dinitrotoluene	LT	60	UGL	JI	
								18-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene		16.5	UGL	C	
								21-14-2	2,4-Dinitrotoluene		54	UGL	C	
								21-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *		330	UGL	C	
								79-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *		3.71	UGL	U	
								91-41-0	Cyclotetramethylenetetranitramine		360	UGL	C	
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT	68	UGL	JI	
								99-35-4	1,3,5-Trinitrobenzene		3900	UGL	C	
								99-65-0	1,3-Dinitrobenzene		320	UGL	UQ	
	G0106	SAIC01	57.0	01-MAR-94	UB	UB01225	UW25/W	06-20-2	2,6-Dinitrotoluene	LT	60	UGL	JI	
								18-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene		8800	UGL	C	J
								21-14-2	2,4-Dinitrotoluene		640	UGL	C	J
								21-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *		4100	UGL	C	

* - Analyte Description has been truncated. See Data Dictionary

Final Documentation Appendix Report
Installation :Louisiana AAP, LA (LO)
File Type: CGW
Sampling Date Range: 01-SEP-93 27-JUN-94

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Meas. Bool.	Conc.	Unit Meas.	Flag Codes	Data Quals
WELL	G0106	SAIC01	57.0	01-MAR-94	UB	UB01225	UW25/W	79-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT	63	UGL	JI	
								91-41-0	Cyclotetramethylenetetranitramine	LT	53	UGL	JI	
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT	68	UGL	7JI	J
								99-35-4	1,3,5-Trinitrobenzene		970	UGL	C	
								99-65-0	1,3-Dinitrobenzene		330	UGL	C	
	G0109	SAIC01	23.0	28-FEB-94	UB	UB01193	UW25/W	06-20-2	2,6-Dinitrotoluene	LT	60	UGL	JI	
								18-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene		3600	UGL	C	
								21-14-2	2,4-Dinitrotoluene		330	UGL	C	
								21-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *		3100	UGL	C	
								79-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *		39.9	UGL	U	
								91-41-0	Cyclotetramethylenetetranitramine		300	UGL	C	
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT	6.8	UGL	JI	
								99-35-4	1,3,5-Trinitrobenzene		95	UGL	C	
								99-65-0	1,3-Dinitrobenzene		8.21	UGL	UQ	
	G0110	SAIC01	32.0	28-FEB-94	UB	UB01191	UW25/W	06-20-2	2,6-Dinitrotoluene	LT	60	UGL	JI	
								18-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene		570	UGL	C	
								21-14-2	2,4-Dinitrotoluene		120	UGL	C	
								21-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *		2800	UGL	C	
								79-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT	.631	UGL		
								91-41-0	Cyclotetramethylenetetranitramine		130	UGL	C	
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT	6.8	UGL	JI	
								99-35-4	1,3,5-Trinitrobenzene		460	UGL	C	
								99-65-0	1,3-Dinitrobenzene		24	UGL	UQ	

** End of Report - 211 Records Found **

* - Analyte Description has been truncated. See Data Dictionary

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Chemical Quality Control Report

Installation: Louisiana AAP, LA

Analysis Date Range: 01-SEP-93 to 27-JUN-94

Non-Detected Compounds are included

Lab	Lot	Field Sample #	Analyte	QC Type	QC Spike	Media Type	Site Type	Site ID	Meth/ Matrix	Analysis Date	Measurement Bool	Measurement Value	Unit	Flag Codes	Data Quals	Prog
UB	AFGX		135TNB	M	.000	CQC			UW25/W	22-OCT-93		.27	UGL	H	I	LIT
			135TNB	S	.400	CQC			UW25/W	22-OCT-93		.713	UGL	H	I	LIT
			135TNB	S	16.000	CQC			UW25/W	22-OCT-93		12.4	UGL	H	I	LIT
			135TNB	S	16.000	CQC			UW25/W	22-OCT-93		12.8	UGL	H	I	LIT
			13DNB	M	.000	CQC			UW25/W	22-OCT-93	LT	.458	UGL			LIT
			13DNB	S	.000	CQC			UW25/W	22-OCT-93	LT	.458	UGL			LIT
			13DNB	S	.000	CQC			UW25/W	22-OCT-93	LT	.458	UGL			LIT
			13DNB	S	.000	CQC			UW25/W	22-OCT-93	LT	.458	UGL			LIT
			246TNT	M	.000	CQC			UW25/W	22-OCT-93	LT	.426	UGL			LIT
			246TNT	S	.800	CQC			UW25/W	22-OCT-93		.565	UGL			LIT
			246TNT	S	32.000	CQC			UW25/W	22-OCT-93		26	UGL			LIT
			246TNT	S	32.000	CQC			UW25/W	22-OCT-93		25.2	UGL			LIT
			24DNT	M	.000	CQC			UW25/W	22-OCT-93	LT	.397	UGL			LIT
			24DNT	S	.800	CQC			UW25/W	22-OCT-93		.59	UGL			LIT
			24DNT	S	16.000	CQC			UW25/W	22-OCT-93		11.3	UGL			LIT
			24DNT	S	16.000	CQC			UW25/W	22-OCT-93		12	UGL			LIT
			26DNT	M	.000	CQC			UW25/W	22-OCT-93	LT	.6	UGL			LIT
			26DNT	S	.000	CQC			UW25/W	22-OCT-93	LT	.6	UGL			LIT
			26DNT	S	.000	CQC			UW25/W	22-OCT-93	LT	.6	UGL			LIT
			26DNT	S	.000	CQC			UW25/W	22-OCT-93	LT	.6	UGL			LIT
			HMX	M	.000	CQC			UW25/W	22-OCT-93	LT	.533	UGL			LIT
			HMX	S	.000	CQC			UW25/W	22-OCT-93	LT	.533	UGL			LIT
			HMX	S	.000	CQC			UW25/W	22-OCT-93	LT	.533	UGL			LIT
			HMX	S	.000	CQC			UW25/W	22-OCT-93	LT	.533	UGL			LIT
			NB	M	.000	CQC			UW25/W	22-OCT-93	LT	.682	UGL			LIT
			NB	S	1.400	CQC			UW25/W	22-OCT-93		1.33	UGL			LIT
			NB	S	32.000	CQC			UW25/W	22-OCT-93		27.1	UGL			LIT
			NB	S	32.000	CQC			UW25/W	22-OCT-93		26.2	UGL			LIT
			RDX	M	.000	CQC			UW25/W	22-OCT-93	LT	.416	UGL			LIT
			RDX	S	.800	CQC			UW25/W	22-OCT-93		.644	UGL			LIT
			RDX	S	32.000	CQC			UW25/W	22-OCT-93		24.2	UGL			LIT
			RDX	S	32.000	CQC			UW25/W	22-OCT-93		26.5	UGL			LIT
			TETRYL	M	.000	CQC			UW25/W	22-OCT-93	LT	.631	UGL			LIT
			TETRYL	S	.000	CQC			UW25/W	22-OCT-93	LT	.631	UGL			LIT
			TETRYL	S	.000	CQC			UW25/W	22-OCT-93	LT	.631	UGL			LIT
			TETRYL	S	.000	CQC			UW25/W	22-OCT-93	LT	.631	UGL			LIT
UB	AFIO	SAIC01	135TNB	R	.000	CGW	RNSW	#6	UW25/W	10-NOV-93	LT	.21	UGL			MON
		SAIC01	13DNB	R	.000	CGW	RNSW	#6	UW25/W	10-NOV-93	LT	.458	UGL			MON
		SAIC01	246TNT	R	.000	CGW	RNSW	#6	UW25/W	10-NOV-93	LT	.426	UGL			MON
		SAIC01	24DNT	R	.000	CGW	RNSW	#6	UW25/W	10-NOV-93	LT	.397	UGL			MON
		SAIC01	26DNT	R	.000	CGW	RNSW	#6	UW25/W	10-NOV-93	LT	.6	UGL			MON
		SAIC01	HMX	R	.000	CGW	RNSW	#6	UW25/W	10-NOV-93	LT	.533	UGL			MON
		SAIC01	NB	R	.000	CGW	RNSW	#6	UW25/W	10-NOV-93	LT	.682	UGL			MON
		SAIC01	RDX	R	.000	CGW	RNSW	#6	UW25/W	10-NOV-93	LT	.416	UGL			MON
		SAIC01	TETRYL	R	.000	CGW	RNSW	#6	UW25/W	10-NOV-93	LT	.631	UGL			MON
		SAIC02	135TNB	R	.000	CGW	RNSW	#6	UW25/W	10-NOV-93	LT	.21	UGL	D		MON
		SAIC02	13DNB	R	.000	CGW	RNSW	#6	UW25/W	10-NOV-93	LT	.458	UGL	D		MON
		SAIC02	246TNT	R	.000	CGW	RNSW	#6	UW25/W	10-NOV-93	LT	.426	UGL	D		MON

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Chemical Quality Control Report

Installation: Louisiana AAP, LA

Analysis Date Range: 01-SEP-93 to 27-JUN-94

Non-Detected Compounds are included

Lab	Lot	Field Sample #	Analyte	QC Type	QC Spike	Media Type	Site Type	Site ID	Meth/ Matrix	Analysis Date	Measurement Bool	Measurement Value	Measurement Unit	Flag Codes	Data Quals	Prog
UB	AFIO	SAIC02	24DNT	R	.000	CGW	RNSW	#6	UW25/W	10-NOV-93	LT	.397	UGL	D		MON
		SAIC02	26DNT	R	.000	CGW	RNSW	#6	UW25/W	10-NOV-93	LT	.6	UGL	D		MON
		SAIC02	HMX	R	.000	CGW	RNSW	#6	UW25/W	10-NOV-93	LT	.533	UGL	D		MON
		SAIC02	NB	R	.000	CGW	RNSW	#6	UW25/W	10-NOV-93	LT	.682	UGL	D		MON
		SAIC02	RDX	R	.000	CGW	RNSW	#6	UW25/W	10-NOV-93	LT	.416	UGL	D		MON
		SAIC02	TETRYL	R	.000	CGW	RNSW	#6	UW25/W	10-NOV-93	LT	.631	UGL	D		MON
			135TNB	M	.000	CQC			UW25/W	10-NOV-93	LT	.21	UGL			LIT
			135TNB	S	.400	CQC			UW25/W	10-NOV-93		.398	UGL			LIT
			135TNB	S	16.000	CQC			UW25/W	10-NOV-93		16	UGL			LIT
			135TNB	S	16.000	CQC			UW25/W	10-NOV-93		16.5	UGL			LIT
			13DNB	M	.000	CQC			UW25/W	10-NOV-93	LT	.458	UGL			LIT
			13DNB	S	.000	CQC			UW25/W	10-NOV-93	LT	.458	UGL			LIT
			13DNB	S	.000	CQC			UW25/W	10-NOV-93	LT	.458	UGL			LIT
			13DNB	S	.000	CQC			UW25/W	10-NOV-93	LT	.458	UGL			LIT
			246TNT	M	.000	CQC			UW25/W	10-NOV-93	LT	.426	UGL			LIT
			246TNT	S	.800	CQC			UW25/W	10-NOV-93		.581	UGL			LIT
			246TNT	S	32.000	CQC			UW25/W	10-NOV-93		33.6	UGL			LIT
			246TNT	S	32.000	CQC			UW25/W	10-NOV-93		32.9	UGL			LIT
			24DNT	M	.000	CQC			UW25/W	10-NOV-93	LT	.397	UGL			LIT
			24DNT	S	.800	CQC			UW25/W	10-NOV-93		.588	UGL			LIT
			24DNT	S	16.000	CQC			UW25/W	10-NOV-93		14.5	UGL			LIT
			24DNT	S	16.000	CQC			UW25/W	10-NOV-93		14.2	UGL			LIT
			26DNT	M	.000	CQC			UW25/W	10-NOV-93	LT	.6	UGL			LIT
			26DNT	S	.000	CQC			UW25/W	10-NOV-93	LT	.6	UGL			LIT
			26DNT	S	.000	CQC			UW25/W	10-NOV-93	LT	.6	UGL			LIT
			26DNT	S	.000	CQC			UW25/W	10-NOV-93	LT	.6	UGL			LIT
			HMX	M	.000	CQC			UW25/W	10-NOV-93	LT	.533	UGL			LIT
			HMX	S	.000	CQC			UW25/W	10-NOV-93	LT	.533	UGL			LIT
			HMX	S	.000	CQC			UW25/W	10-NOV-93	LT	.533	UGL			LIT
			HMX	S	.000	CQC			UW25/W	10-NOV-93	LT	.533	UGL			LIT
			NB	M	.000	CQC			UW25/W	10-NOV-93	LT	.682	UGL			LIT
			NB	S	1.400	CQC			UW25/W	10-NOV-93		1.08	UGL			LIT
			NB	S	32.000	CQC			UW25/W	10-NOV-93		28.6	UGL			LIT
			NB	S	32.000	CQC			UW25/W	10-NOV-93		27.3	UGL			LIT
			RDX	M	.000	CQC			UW25/W	10-NOV-93	LT	.416	UGL			LIT
			RDX	S	.800	CQC			UW25/W	10-NOV-93		.704	UGL			LIT
			RDX	S	32.000	CQC			UW25/W	10-NOV-93		33.7	UGL			LIT
			RDX	S	32.000	CQC			UW25/W	10-NOV-93		32.5	UGL			LIT
			TETRYL	M	.000	CQC			UW25/W	10-NOV-93	LT	.631	UGL			LIT
			TETRYL	S	.000	CQC			UW25/W	10-NOV-93	LT	.631	UGL			LIT
			TETRYL	S	.000	CQC			UW25/W	10-NOV-93	LT	.631	UGL			LIT
			TETRYL	S	.000	CQC			UW25/W	10-NOV-93	LT	.631	UGL			LIT

Chemical Quality Control Report

Installation: Louisiana AAP, LA

Analysis Date Range: 01-SEP-93 to 27-JUN-94

Non-Detected Compounds are included

Lab	Lot	Field Sample #	Analyte	QC Type	QC Spike	Media Type	Site Type	Site ID	Meth/ Matrix	Analysis Date	Measurement Bool	Measurement Value	Unit	Flag Codes	Data Quals	Prog
UB	AIUD	SAICRB01	135TNB	R	.000	CGW	RNSW	G0012	UW25/W	02-MAR-94	LT	.21	UGL			MON
		SAICRB01	13DNB	R	.000	CGW	RNSW	G0012	UW25/W	02-MAR-94	LT	.458	UGL			MON
		SAICRB01	246TNT	R	.000	CGW	RNSW	G0012	UW25/W	02-MAR-94	LT	.426	UGL			MON
		SAICRB01	24DNT	R	.000	CGW	RNSW	G0012	UW25/W	02-MAR-94	LT	.397	UGL			MON
		SAICRB01	26DNT	R	.000	CGW	RNSW	G0012	UW25/W	02-MAR-94	LT	.6	UGL			MON
		SAICRB01	HMX	R	.000	CGW	RNSW	G0012	UW25/W	02-MAR-94	LT	.533	UGL			MON
		SAICRB01	NB	R	.000	CGW	RNSW	G0012	UW25/W	02-MAR-94	LT	1.84	UGL	K		MON
		SAICRB01	RDX	R	.000	CGW	RNSW	G0012	UW25/W	02-MAR-94	LT	.416	UGL	7	J	MON
		SAICRB01	TETRYL	R	.000	CGW	RNSW	G0012	UW25/W	02-MAR-94	LT	.631	UGL			MON
			135TNB	M	.000	CQC			UW25/W	02-MAR-94	LT	.21	UGL			LIT
			135TNB	S	.400	CQC			UW25/W	02-MAR-94		.439	UGL			LIT
			135TNB	S	16.000	CQC			UW25/W	02-MAR-94		14.5	UGL			LIT
			135TNB	S	16.000	CQC			UW25/W	02-MAR-94		13.9	UGL			LIT
			13DNB	M	.000	CQC			UW25/W	02-MAR-94	LT	.458	UGL			LIT
			13DNB	S	.000	CQC			UW25/W	02-MAR-94	LT	.458	UGL			LIT
			13DNB	S	.000	CQC			UW25/W	02-MAR-94	LT	.458	UGL			LIT
			13DNB	S	.000	CQC			UW25/W	02-MAR-94	LT	.458	UGL			LIT
			246TNT	M	.000	CQC			UW25/W	02-MAR-94	LT	.426	UGL			LIT
			246TNT	S	.800	CQC			UW25/W	02-MAR-94		.585	UGL			LIT
			246TNT	S	32.000	CQC			UW25/W	02-MAR-94		27.9	UGL			LIT
			246TNT	S	32.000	CQC			UW25/W	02-MAR-94		26.5	UGL			LIT
			24DNT	M	.000	CQC			UW25/W	02-MAR-94	LT	.397	UGL			LIT
			24DNT	S	.800	CQC			UW25/W	02-MAR-94		.625	UGL			LIT
			24DNT	S	16.000	CQC			UW25/W	02-MAR-94		13.8	UGL			LIT
			24DNT	S	16.000	CQC			UW25/W	02-MAR-94		12.6	UGL			LIT
			26DNT	M	.000	CQC			UW25/W	02-MAR-94	LT	.6	UGL			LIT
			26DNT	S	.000	CQC			UW25/W	02-MAR-94	LT	.6	UGL			LIT
			26DNT	S	.000	CQC			UW25/W	02-MAR-94	LT	.6	UGL			LIT
			26DNT	S	.000	CQC			UW25/W	02-MAR-94	LT	.6	UGL			LIT
			HMX	M	.000	CQC			UW25/W	02-MAR-94	LT	.533	UGL			LIT
			HMX	S	.000	CQC			UW25/W	02-MAR-94	LT	.533	UGL			LIT
			HMX	S	.000	CQC			UW25/W	02-MAR-94	LT	.533	UGL			LIT
			HMX	S	.000	CQC			UW25/W	02-MAR-94	LT	.533	UGL			LIT
			NB	M	.000	CQC			UW25/W	02-MAR-94	LT	.682	UGL			LIT
			NB	S	1.400	CQC			UW25/W	02-MAR-94		1.12	UGL			LIT
			NB	S	32.000	CQC			UW25/W	02-MAR-94		27.3	UGL			LIT

27-JUN-94 17:36:05

Chemical Quality Control Report

Installation: Louisiana AAP, LA

Analysis Date Range: 01-SEP-93 to 27-JUN-94

Non-Detected Compounds are included

Lab	Lot	Field Sample #	Analyte	QC Type	QC Spike	Media Type	Site Type	Site ID	Meth/ Matrix	Analysis Date	Measurement Bool	Measurement Value	Unit	Flag Codes	Data Quals	Prog
UB	AIUD		NB	S	32.000	CQC			UW25/W	02-MAR-94		25.2	UGL			LIT
			RDX	M	.000	CQC			UW25/W	02-MAR-94	LT	.416	UGL	7	J	LIT
			RDX	S	.800	CQC			UW25/W	02-MAR-94		.573	UGL	7	J	LIT
			RDX	S	32.000	CQC			UW25/W	02-MAR-94		31.3	UGL	7	J	LIT
			RDX	S	32.000	CQC			UW25/W	02-MAR-94		30.3	UGL	7	J	LIT
			TETRYL	M	.000	CQC			UW25/W	02-MAR-94	LT	.631	UGL			LIT
			TETRYL	S	.000	CQC			UW25/W	02-MAR-94	LT	.631	UGL			LIT
			TETRYL	S	.000	CQC			UW25/W	02-MAR-94	LT	.631	UGL			LIT
			TETRYL	S	.000	CQC			UW25/W	02-MAR-94	LT	.631	UGL			LIT
UB	AIWA	SAICRB03	135TNB	R	.000	CGW	RNSW	G0110	UW25/W	29-MAR-94	LT	.21	UGL			MON
		SAICRB03	13DNB	R	.000	CGW	RNSW	G0110	UW25/W	29-MAR-94	LT	.458	UGL			MON
		SAICRB03	246TNT	R	.000	CGW	RNSW	G0110	UW25/W	29-MAR-94	LT	.426	UGL			MON
		SAICRB03	24DNT	R	.000	CGW	RNSW	G0110	UW25/W	29-MAR-94	LT	.397	UGL			MON
		SAICRB03	26DNT	R	.000	CGW	RNSW	G0110	UW25/W	29-MAR-94	LT	.6	UGL			MON
		SAICRB03	HMX	R	.000	CGW	RNSW	G0110	UW25/W	29-MAR-94	LT	.533	UGL			MON
		SAICRB03	NB	R	.000	CGW	RNSW	G0110	UW25/W	29-MAR-94		2.95	UGL	UQ		MON
		SAICRB03	RDX	R	.000	CGW	RNSW	G0110	UW25/W	29-MAR-94	LT	.416	UGL			MON
		SAICRB03	TETRYL	R	.000	CGW	RNSW	G0110	UW25/W	29-MAR-94	LT	.631	UGL			MON
			135TNB	M	.000	CQC			UW25/W	29-MAR-94	LT	.21	UGL			LIT
			135TNB	S	.400	CQC			UW25/W	29-MAR-94		.497	UGL			LIT
			135TNB	S	16.000	CQC			UW25/W	29-MAR-94		15.5	UGL			LIT
			135TNB	S	16.000	CQC			UW25/W	29-MAR-94		15.3	UGL			LIT
			13DNB	M	.000	CQC			UW25/W	29-MAR-94	LT	.458	UGL			LIT
			13DNB	S	.000	CQC			UW25/W	29-MAR-94	LT	.458	UGL			LIT
			13DNB	S	.000	CQC			UW25/W	29-MAR-94	LT	.458	UGL			LIT
			13DNB	S	.000	CQC			UW25/W	29-MAR-94	LT	.458	UGL			LIT
			246TNT	M	.000	CQC			UW25/W	29-MAR-94	LT	.426	UGL			LIT
			246TNT	S	.800	CQC			UW25/W	29-MAR-94		.677	UGL			LIT
			246TNT	S	32.000	CQC			UW25/W	29-MAR-94		29.3	UGL			LIT
			246TNT	S	32.000	CQC			UW25/W	29-MAR-94		28.9	UGL			LIT
			24DNT	M	.000	CQC			UW25/W	29-MAR-94	LT	.397	UGL			LIT
			24DNT	S	.800	CQC			UW25/W	29-MAR-94		.681	UGL			LIT
			24DNT	S	16.000	CQC			UW25/W	29-MAR-94		14.3	UGL			LIT
			24DNT	S	16.000	CQC			UW25/W	29-MAR-94		13	UGL			LIT
			26DNT	M	.000	CQC			UW25/W	29-MAR-94	LT	.6	UGL			LIT
			26DNT	S	.000	CQC			UW25/W	29-MAR-94	LT	.6	UGL			LIT
			26DNT	S	.000	CQC			UW25/W	29-MAR-94	LT	.6	UGL			LIT
			26DNT	S	.000	CQC			UW25/W	29-MAR-94	LT	.6	UGL			LIT
			HMX	M	.000	CQC			UW25/W	29-MAR-94	LT	.533	UGL			LIT
			HMX	S	.000	CQC			UW25/W	29-MAR-94	LT	.533	UGL			LIT
			HMX	S	.000	CQC			UW25/W	29-MAR-94	LT	.533	UGL			LIT
			HMX	S	.000	CQC			UW25/W	29-MAR-94	LT	.533	UGL			LIT
			NB	M	.000	CQC			UW25/W	29-MAR-94	LT	.682	UGL			LIT
			NB	S	1.400	CQC			UW25/W	29-MAR-94		1.35	UGL			LIT
			NB	S	32.000	CQC			UW25/W	29-MAR-94		29.9	UGL			LIT
			NB	S	32.000	CQC			UW25/W	29-MAR-94		27.4	UGL			LIT
			RDX	M	.000	CQC			UW25/W	29-MAR-94	LT	.416	UGL			LIT
			RDX	S	.800	CQC			UW25/W	29-MAR-94		.746	UGL			LIT

Chemical Quality Control Report

Installation: Louisiana AAP, LA

Analysis Date Range: 01-SEP-93 to 27-JUN-94

Non-Detected Compounds are included

Lab	Lot	Field Sample #	Analyte	QC Type	QC Spike	Media Type	Site Type	Site ID	Meth/ Matrix	Analysis Date	Bool	Measurement Value	Unit	Flag Codes	Data Quals	Prog
UB	AIWA		RDX	S	32.000	CQC			UW25/W	29-MAR-94		33.5	UGL			LIT
			RDX	S	32.000	CQC			UW25/W	29-MAR-94		32.9	UGL			LIT
			TETRYL	M	.000	CQC			UW25/W	29-MAR-94	LT	.631	UGL			LIT
			TETRYL	S	.000	CQC			UW25/W	29-MAR-94	LT	.631	UGL			LIT
			TETRYL	S	.000	CQC			UW25/W	29-MAR-94	LT	.631	UGL			LIT
			TETRYL	S	.000	CQC			UW25/W	29-MAR-94	LT	.631	UGL			LIT
UB	AIWV	SAIC05	135TNB	N	16.000	CGW	WELL	G0083	UW25/W	16-MAR-94		830	UGL		I	MON
		SAIC05	13DNB	N	.000	CGW	WELL	G0083	UW25/W	16-MAR-94		4.73	UGL			MON
		SAIC05	246TNT	N	32.000	CGW	WELL	G0083	UW25/W	16-MAR-94		3200	UGL	7	JN	MON
		SAIC05	24DNT	N	16.000	CGW	WELL	G0083	UW25/W	16-MAR-94		140	UGL		N	MON
		SAIC05	26DNT	N	.000	CGW	WELL	G0083	UW25/W	16-MAR-94	LT	12	UGL	JI		MON
		SAIC05	HMX	N	.000	CGW	WELL	G0083	UW25/W	16-MAR-94		150	UGL			MON
		SAIC05	NB	N	32.000	CGW	WELL	G0083	UW25/W	16-MAR-94		24.2	UGL			MON
		SAIC05	RDX	N	32.000	CGW	WELL	G0083	UW25/W	16-MAR-94		1900	UGL			MON
		SAIC05	TETRYL	N	.000	CGW	WELL	G0083	UW25/W	16-MAR-94		88	UGL			MON
		SAIC06	135TNB	N	16.000	CGW	WELL	G0083	UW25/W	16-MAR-94		780	UGL	D	I	MON
		SAIC06	13DNB	N	.000	CGW	WELL	G0083	UW25/W	16-MAR-94		5.09	UGL	D		MON
		SAIC06	246TNT	N	32.000	CGW	WELL	G0083	UW25/W	16-MAR-94		3000	UGL	D7	JN	MON
		SAIC06	24DNT	N	16.000	CGW	WELL	G0083	UW25/W	16-MAR-94		130	UGL	D	N	MON
		SAIC06	26DNT	N	.000	CGW	WELL	G0083	UW25/W	16-MAR-94	LT	12	UGL	DJI		MON
		SAIC06	HMX	N	.000	CGW	WELL	G0083	UW25/W	16-MAR-94		130	UGL	D		MON
		SAIC06	NB	N	32.000	CGW	WELL	G0083	UW25/W	16-MAR-94		25	UGL	D		MON
		SAIC06	RDX	N	32.000	CGW	WELL	G0083	UW25/W	16-MAR-94		1600	UGL	D		MON
		SAIC06	TETRYL	N	.000	CGW	WELL	G0083	UW25/W	16-MAR-94		88	UGL	D		MON
		SAICRB02	135TNB	R	.000	CGW	RNSW	G0009	UW25/W	16-MAR-94		.42	UGL	C	I	MON
		SAICRB02	13DNB	R	.000	CGW	RNSW	G0009	UW25/W	16-MAR-94	LT	.458	UGL			MON
		SAICRB02	246TNT	R	.000	CGW	RNSW	G0009	UW25/W	16-MAR-94	LT	.426	UGL	7	JN	MON
		SAICRB02	24DNT	R	.000	CGW	RNSW	G0009	UW25/W	16-MAR-94	LT	.397	UGL		N	MON
		SAICRB02	26DNT	R	.000	CGW	RNSW	G0009	UW25/W	16-MAR-94	LT	.6	UGL			MON
		SAICRB02	HMX	R	.000	CGW	RNSW	G0009	UW25/W	16-MAR-94	LT	.533	UGL			MON
		SAICRB02	NB	R	.000	CGW	RNSW	G0009	UW25/W	16-MAR-94		2.66	UGL	U		MON
		SAICRB02	RDX	R	.000	CGW	RNSW	G0009	UW25/W	16-MAR-94		.746	UGL	U		MON
		SAICRB02	TETRYL	R	.000	CGW	RNSW	G0009	UW25/W	16-MAR-94	LT	.631	UGL			MON
			135TNB	M	.000	CQC			UW25/W	16-MAR-94		.304	UGL		I	LIT
			135TNB	S	.400	CQC			UW25/W	16-MAR-94		.578	UGL		I	LIT
			135TNB	S	16.000	CQC			UW25/W	16-MAR-94		16.7	UGL		I	LIT
			135TNB	S	16.000	CQC			UW25/W	16-MAR-94		15.5	UGL		I	LIT
			13DNB	M	.000	CQC			UW25/W	16-MAR-94	LT	.458	UGL			LIT
			13DNB	S	.000	CQC			UW25/W	16-MAR-94	LT	.458	UGL			LIT
			13DNB	S	.000	CQC			UW25/W	16-MAR-94	LT	.458	UGL			LIT
			13DNB	S	.000	CQC			UW25/W	16-MAR-94	LT	.458	UGL			LIT
			246TNT	M	.000	CQC			UW25/W	16-MAR-94	LT	.426	UGL	7	JN	LIT
			246TNT	S	.800	CQC			UW25/W	16-MAR-94		.46	UGL	7	JN	LIT
			246TNT	S	32.000	CQC			UW25/W	16-MAR-94		24.3	UGL	7	JN	LIT
			246TNT	S	32.000	CQC			UW25/W	16-MAR-94		25.3	UGL	7	JN	LIT
			24DNT	M	.000	CQC			UW25/W	16-MAR-94	LT	.397	UGL		N	LIT
			24DNT	S	.800	CQC			UW25/W	16-MAR-94		.49	UGL		N	LIT
			24DNT	S	16.000	CQC			UW25/W	16-MAR-94		11.4	UGL		N	LIT

Chemical Quality Control Report

Installation: Louisiana AAP, LA

Analysis Date Range: 01-SEP-93 to 27-JUN-94

Non-Detected Compounds are included

Lab	Lot	Field Sample #	Analyte	QC Type	QC Spike	Media Type	Site Type	Site ID	Meth/ Matrix	Analysis Date	Measurement Bool	Measurement Value	Unit	Flag Codes	Data Quals	Prog
UB	AIWV		24DNT	S	16.000	CQC			UW25/W	16-MAR-94		11	UGL		N	LIT
			26DNT	M	.000	CQC			UW25/W	16-MAR-94	LT	.6	UGL			LIT
			26DNT	S	.000	CQC			UW25/W	16-MAR-94	LT	.6	UGL			LIT
			26DNT	S	.000	CQC			UW25/W	16-MAR-94	LT	.6	UGL			LIT
			26DNT	S	.000	CQC			UW25/W	16-MAR-94	LT	.6	UGL			LIT
			HMX	M	.000	CQC			UW25/W	16-MAR-94	LT	.533	UGL			LIT
			HMX	S	.000	CQC			UW25/W	16-MAR-94	LT	.533	UGL			LIT
			HMX	S	.000	CQC			UW25/W	16-MAR-94	LT	.533	UGL			LIT
			HMX	S	.000	CQC			UW25/W	16-MAR-94	LT	.533	UGL			LIT
			NB	M	.000	CQC			UW25/W	16-MAR-94	LT	.682	UGL			LIT
			NB	S	1.400	CQC			UW25/W	16-MAR-94		1.04	UGL			LIT
			NB	S	32.000	CQC			UW25/W	16-MAR-94		24.1	UGL			LIT
			NB	S	32.000	CQC			UW25/W	16-MAR-94		24.8	UGL			LIT
			RDX	M	.000	CQC			UW25/W	16-MAR-94	LT	.416	UGL			LIT
			RDX	S	.800	CQC			UW25/W	16-MAR-94		.762	UGL			LIT
			RDX	S	32.000	CQC			UW25/W	16-MAR-94		30	UGL			LIT
			RDX	S	32.000	CQC			UW25/W	16-MAR-94		29.7	UGL			LIT
			TETRYL	M	.000	CQC			UW25/W	16-MAR-94	LT	.631	UGL			LIT
			TETRYL	S	.000	CQC			UW25/W	16-MAR-94	LT	.631	UGL			LIT
			TETRYL	S	.000	CQC			UW25/W	16-MAR-94	LT	.631	UGL			LIT
			TETRYL	S	.000	CQC			UW25/W	16-MAR-94	LT	.631	UGL			LIT
UB	AIYH	SAIC01	135TNB	R	.000	CGW	RNSW	GO-145	UW25/W	30-MAR-94	LT	.21	UGL			MON
		SAIC01	13DNB	R	.000	CGW	RNSW	GO-145	UW25/W	30-MAR-94	LT	.458	UGL			MON
		SAIC01	246TNT	R	.000	CGW	RNSW	GO-145	UW25/W	30-MAR-94	LT	.426	UGL		J	MON
		SAIC01	24DNT	R	.000	CGW	RNSW	GO-145	UW25/W	30-MAR-94	LT	.397	UGL		J	MON
		SAIC01	26DNT	R	.000	CGW	RNSW	GO-145	UW25/W	30-MAR-94	LT	.6	UGL			MON
		SAIC01	HMX	R	.000	CGW	RNSW	GO-145	UW25/W	30-MAR-94	LT	.533	UGL			MON
		SAIC01	NB	R	.000	CGW	RNSW	GO-145	UW25/W	30-MAR-94	LT	.682	UGL	7	J	MON
		SAIC01	RDX	R	.000	CGW	RNSW	GO-145	UW25/W	30-MAR-94	LT	.416	UGL			MON
		SAIC01	TETRYL	R	.000	CGW	RNSW	GO-145	UW25/W	30-MAR-94	LT	.631	UGL			MON
		SAICRB04	135TNB	R	.000	CGW	RNSW	GO-146	UW25/W	29-MAR-94	LT	.21	UGL			MON
		SAICRB04	13DNB	R	.000	CGW	RNSW	GO-146	UW25/W	29-MAR-94	LT	.458	UGL			MON
		SAICRB04	246TNT	R	.000	CGW	RNSW	GO-146	UW25/W	29-MAR-94	LT	.426	UGL		J	MON
		SAICRB04	24DNT	R	.000	CGW	RNSW	GO-146	UW25/W	29-MAR-94	LT	.397	UGL		J	MON
		SAICRB04	26DNT	R	.000	CGW	RNSW	GO-146	UW25/W	29-MAR-94	LT	.6	UGL			MON
		SAICRB04	HMX	R	.000	CGW	RNSW	GO-146	UW25/W	29-MAR-94		5.03	UGL	C		MON
		SAICRB04	NB	R	.000	CGW	RNSW	GO-146	UW25/W	29-MAR-94	LT	.682	UGL	7	J	MON
		SAICRB04	RDX	R	.000	CGW	RNSW	GO-146	UW25/W	29-MAR-94	LT	.416	UGL			MON
		SAICRB04	TETRYL	R	.000	CGW	RNSW	GO-146	UW25/W	29-MAR-94	LT	.631	UGL			MON
			135TNB	M	.000	CQC			UW25/W	29-MAR-94	LT	.21	UGL			LIT
			135TNB	S	.400	CQC			UW25/W	29-MAR-94		.371	UGL			LIT
			135TNB	S	16.000	CQC			UW25/W	29-MAR-94		16.5	UGL			LIT
			135TNB	S	16.000	CQC			UW25/W	29-MAR-94		14	UGL			LIT
			13DNB	M	.000	CQC			UW25/W	29-MAR-94	LT	.458	UGL			LIT
			13DNB	S	.000	CQC			UW25/W	29-MAR-94	LT	.458	UGL			LIT
			13DNB	S	.000	CQC			UW25/W	29-MAR-94	LT	.458	UGL			LIT
			13DNB	S	.000	CQC			UW25/W	29-MAR-94	LT	.458	UGL			LIT
			246TNT	M	.000	CQC			UW25/W	29-MAR-94	LT	.426	UGL		J	LIT

Chemical Quality Control Report

Installation: Louisiana AAP, LA

Analysis Date Range: 01-SEP-93 to 27-JUN-94

Non-Detected Compounds are included

Lab	Lot	Field Sample #	Analyte	QC Type	QC Spike	Media Type	Site Type	Site ID	Meth/ Matrix	Analysis Date	Measurement Bool	Measurement Value	Unit	Flag Codes	Data Quals	Prog
UB	AIYH		246TNT	S	.800	CQC			UW25/W	29-MAR-94		.481	UGL		J	LIT
			246TNT	S	32.000	CQC			UW25/W	29-MAR-94		27.2	UGL		J	LIT
			246TNT	S	32.000	CQC			UW25/W	29-MAR-94		26.3	UGL		J	LIT
			24DNT	M	.000	CQC			UW25/W	29-MAR-94	LT	.397	UGL		J	LIT
			24DNT	S	.800	CQC			UW25/W	29-MAR-94		.447	UGL		J	LIT
			24DNT	S	16.000	CQC			UW25/W	29-MAR-94		12.5	UGL		J	LIT
			24DNT	S	16.000	CQC			UW25/W	29-MAR-94		13.3	UGL		J	LIT
			26DNT	M	.000	CQC			UW25/W	29-MAR-94	LT	.6	UGL			LIT
			26DNT	S	.000	CQC			UW25/W	29-MAR-94	LT	.6	UGL			LIT
			26DNT	S	.000	CQC			UW25/W	29-MAR-94	LT	.6	UGL			LIT
			26DNT	S	.000	CQC			UW25/W	29-MAR-94	LT	.6	UGL			LIT
			HMX	M	.000	CQC			UW25/W	29-MAR-94	LT	.533	UGL			LIT
			HMX	S	.000	CQC			UW25/W	29-MAR-94	LT	.533	UGL			LIT
			HMX	S	.000	CQC			UW25/W	29-MAR-94	LT	.533	UGL			LIT
			HMX	S	.000	CQC			UW25/W	29-MAR-94	LT	.533	UGL			LIT
			NB	M	.000	CQC			UW25/W	29-MAR-94	LT	.682	UGL	7	J	LIT
			NB	S	1.400	CQC			UW25/W	29-MAR-94		.716	UGL	7	J	LIT
			NB	S	32.000	CQC			UW25/W	29-MAR-94		23.1	UGL	7	J	LIT
			NB	S	32.000	CQC			UW25/W	29-MAR-94		26.1	UGL	7	J	LIT
			RDX	M	.000	CQC			UW25/W	29-MAR-94	LT	.416	UGL			LIT
			RDX	S	.800	CQC			UW25/W	29-MAR-94		.727	UGL			LIT
			RDX	S	32.000	CQC			UW25/W	29-MAR-94		33.7	UGL			LIT
			RDX	S	32.000	CQC			UW25/W	29-MAR-94		29.8	UGL			LIT
			TETRYL	M	.000	CQC			UW25/W	29-MAR-94	LT	.631	UGL			LIT
			TETRYL	S	.000	CQC			UW25/W	29-MAR-94	LT	.631	UGL			LIT
			TETRYL	S	.000	CQC			UW25/W	29-MAR-94	LT	.631	UGL			LIT
			TETRYL	S	.000	CQC			UW25/W	29-MAR-94	LT	.631	UGL			LIT
UB	AJDT	SAICRB06	135TNB	R	.000	CGW	RNSW	GO-150	UW25/W	08-APR-94	LT	.21	UGL			MON
		SAICRB06	13DNB	R	.000	CGW	RNSW	GO-150	UW25/W	08-APR-94	LT	.458	UGL			MON
		SAICRB06	246TNT	R	.000	CGW	RNSW	GO-150	UW25/W	08-APR-94	LT	.426	UGL			MON
		SAICRB06	24DNT	R	.000	CGW	RNSW	GO-150	UW25/W	08-APR-94	LT	.397	UGL		J	MON
		SAICRB06	26DNT	R	.000	CGW	RNSW	GO-150	UW25/W	08-APR-94	LT	.6	UGL			MON
		SAICRB06	HMX	R	.000	CGW	RNSW	GO-150	UW25/W	08-APR-94	LT	.533	UGL			MON
		SAICRB06	NB	R	.000	CGW	RNSW	GO-150	UW25/W	08-APR-94	LT	.682	UGL			MON

27-JUN-94 17:36:05

Chemical Quality Control Report

Installation: Louisiana AAP, LA

Analysis Date Range: 01-SEP-93 to 27-JUN-94

Non-Detected Compounds are included

Lab	Lot	Field Sample #	Analyte	QC Type	QC Spike	Media Type	Site Type	Site ID	Meth/ Matrix	Analysis Date	Measurement Bool	Measurement Value	Unit	Flag Codes	Data Quals	Prog
UB	AJDT	SAICRB06	RDX	R	.000	CGW	RNSW	GO-150	UW25/W	08-APR-94	LT	.416	UGL			MON
		SAICRB06	TETRYL	R	.000	CGW	RNSW	GO-150	UW25/W	08-APR-94	LT	.631	UGL			MON
			135TNB	M	.000	CQC			UW25/W	08-APR-94	LT	.21	UGL			LIT
			135TNB	S	.400	CQC			UW25/W	08-APR-94		.359	UGL			LIT
			135TNB	S	16.000	CQC			UW25/W	08-APR-94		15.5	UGL			LIT
			135TNB	S	16.000	CQC			UW25/W	08-APR-94		14.9	UGL			LIT
			13DNB	M	.000	CQC			UW25/W	08-APR-94	LT	.458	UGL			LIT
			13DNB	S	.000	CQC			UW25/W	08-APR-94	LT	.458	UGL			LIT
			13DNB	S	.000	CQC			UW25/W	08-APR-94	LT	.458	UGL			LIT
			13DNB	S	.000	CQC			UW25/W	08-APR-94	LT	.458	UGL			LIT
			246TNT	M	.000	CQC			UW25/W	08-APR-94	LT	.426	UGL			LIT
			246TNT	S	.800	CQC			UW25/W	08-APR-94		.489	UGL			LIT
			246TNT	S	32.000	CQC			UW25/W	08-APR-94		28.9	UGL			LIT
			246TNT	S	32.000	CQC			UW25/W	08-APR-94		27.8	UGL			LIT
			24DNT	M	.000	CQC			UW25/W	08-APR-94	LT	.397	UGL		J	LIT
			24DNT	S	.800	CQC			UW25/W	08-APR-94		.431	UGL		J	LIT
			24DNT	S	16.000	CQC			UW25/W	08-APR-94		13.6	UGL		J	LIT
			24DNT	S	16.000	CQC			UW25/W	08-APR-94		13.1	UGL		J	LIT
			26DNT	M	.000	CQC			UW25/W	08-APR-94	LT	.6	UGL			LIT
			26DNT	S	.000	CQC			UW25/W	08-APR-94	LT	.6	UGL			LIT
			26DNT	S	.000	CQC			UW25/W	08-APR-94	LT	.6	UGL			LIT
			26DNT	S	.000	CQC			UW25/W	08-APR-94	LT	.6	UGL			LIT
			HMX	M	.000	CQC			UW25/W	08-APR-94	LT	.533	UGL			LIT
			HMX	S	.000	CQC			UW25/W	08-APR-94	LT	.533	UGL			LIT
			HMX	S	.000	CQC			UW25/W	08-APR-94	LT	.533	UGL			LIT
			HMX	S	.000	CQC			UW25/W	08-APR-94	LT	.533	UGL			LIT
			NB	M	.000	CQC			UW25/W	08-APR-94	LT	.682	UGL			LIT
			NB	S	1.400	CQC			UW25/W	08-APR-94		.997	UGL			LIT
			NB	S	32.000	CQC			UW25/W	08-APR-94		28	UGL			LIT
			NB	S	32.000	CQC			UW25/W	08-APR-94		27.4	UGL			LIT
			RDX	M	.000	CQC			UW25/W	08-APR-94	LT	.416	UGL			LIT
			RDX	S	.800	CQC			UW25/W	08-APR-94		.687	UGL			LIT
			RDX	S	32.000	CQC			UW25/W	08-APR-94		29	UGL			LIT
			RDX	S	32.000	CQC			UW25/W	08-APR-94		31.6	UGL			LIT
			TETRYL	M	.000	CQC			UW25/W	08-APR-94	LT	.631	UGL			LIT
			TETRYL	S	.000	CQC			UW25/W	08-APR-94	LT	.631	UGL			LIT
			TETRYL	S	.000	CQC			UW25/W	08-APR-94	LT	.631	UGL			LIT
			TETRYL	S	.000	CQC			UW25/W	08-APR-94	LT	.631	UGL			LIT

** End of Report - 9647 Records Found **

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APPENDIX B

WELL DEVELOPMENT AND SAMPLING FORMS

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WELL DEVELOPMENT FORMS

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Well Development Form
(Field Sheet)

Project Name and Number: LAAP FIVE-YEAR REVIEW

Well Number and Location: AREA P, 60009

Development Crew: J. Patel, C. Fontenberg, J. Rudd Driller (if applicable): N/A

Water Levels/Time: Initial: 18.42' BTOC Pumping: ______ Final: 18.19' BTOC

Total Well Depth: Initial: N/A Final: 22.8' BTOC

Date and Time: Begin: 2/24/94 1610 Completed: 2/25/94 1140

Development: Method(s): 2" SUBMERSIBLE REPLACED BY BAILING DUE TO LARGE % OF SUSPENDED SOLIDS

Total Quantity of Water Removed: 39 gals

Date/Time and Pump Setting	Discharge Rate* and Measurement Method	Field Measurements				Remarks (Including Sand Production)
		Temp °F	Specific Conductivity (umhos/cm)	pH (Standard Units)	Turbidity	
2/24/94 1640		69°	0.10X10	6.2	V. TURBID	LARGE % OF FINES
2/25/94 0945	BAILING	69	0.11X10	6.2	TURBID	
1110	BAILING	68°	0.10X10	5.7	PARTLY TURBID	
1230		69°F	0.10X10	4.43	PARTLY TURBID	% OF FINES GREATLY REDUCED

LARGE AMOUNT OF PARTICULATES IN H_2O OBTAINED FROM WELL, UNABLE TO USE THE SUBMERSIBLE PUMP TO PURGE WELL FOR LARGE AMOUNT OF H_2O REMOVED. BAILER USED TO REMOVE ~39 GALLONS FROM WELL

*gallons per minute or bailer capacity

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Well Development Form
(Field Sheet)

Project Name and Number: LAAP FIVE-YEAR REVIEW

Well Number and Location: 60012, SAIC01

Development Crew: C. FONTANA Driller (if applicable): N/A

Water Levels/Time: Initial: 17.12' BTOC Pumping: ______ Final: ______

Total Well Depth: Initial: 25.0' BTOC Final: ______

Date and Time: Begin: 2/23/94 1640 Completed: 2/24/94 1255

Development: Method(s): WELL BAILED, INITIAL PUMPING NOT ABLE TO CLEAR SEDIMENT THROUGH PUMP.

Total Quantity of Water Removed: 50 GALLONS REMOVED W/ BAILER gals

Date/Time and Pump Setting	Discharge Rate* and Measurement Method	Field Measurements				Remarks (Including Sand Production)
		Temp °F	Specific Conductivity (umhos/cm)	pH (Standard Units)	Turbidity	
2/23/94 1640	BAILING	70°F	0.31x10	6.9	MUDDY/V. CLOUDY	CHRIS TO BAIL WELL DUE TO LARGE AMNT OF SOLIDS.
1710	BAILING	68°F	0.25x10	6.6	CLOUDY	
1740	BAILING	64 F	0.2 x10	6.5	CLOUDY	
1800	BAILING	62°F	0.11x10	6.2	P. CLOUDY	
2/24/94 1030	BAILING	62°F	0.11x10	6.2	P. CLOUDY	
1050	BAILING	62°F	0.10x10	6.35	P. CLOUDY	
1130	BAILING	63°F	0.11x10	6.30	P. CLOUDY	
1210	BAILING	62°F	0.12x10	6.14	CLEAR	H_2O HAS CLEARED UP - STILL SMALL % SUSPENDED SOLIDS

*gallons per minute or bailer capacity

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Well Development Form
(Field Sheet)

Project Name and Number: LAAP FIVE YEAR REVIEW

Well Number and Location: G0014

Development Crew: J. Pendleton, C. Fontana Driller (if applicable): N/A

Water Levels/Time: Initial: 11.81' BLS Pumping: ______ Final: NR

Total Well Depth: Initial: ______ Final: ______

Date and Time: Begin: 2/23/94 0902 Completed: 2/24/94 1430

Development: Method(s): PUMPING WITH 2" SUBMERSIBLE PUMP,

Total Quantity of Water Removed: 24 gals

Date/Time and Pump Setting	Discharge Rate* and Measurement Method	Field Measurements				Remarks (Including Sand Production)
		Temp (°C)	Specific Conductivity (umhos/cm)	pH (Standard Units)	Turbidity	
2/23/94 0905	~2 gal/min	56°C	0.62x10	5.90	V. TURBID	
0928	"	61.2°C	0.38x10	6.48	"	
0948	"	59.0	0.37x10	6.50	PARTLY TURBID	
1420	"	57.1	0.37x10	6.45	"	"
2/24/94 0920	"	49.0	1.14x10	6.44	"	"
1010	"	50.0	1.15x10	6.47	"	"
1410	"	50.0	1.12x10	6.45	PARTLY TURBID	

GROUNDWATER NEVER TRULY BECAME CLEAR; HOWEVER PARAMETERS STABILIZED AND FIVE TIMES WELL VOLUME CRITERIA WAS MET. WELL RECHARGES SLOW. SAMPLE WILL BE FILTERED DURING EXPLOSIVES ANALYSIS.

*gallons per minute or bailer capacity

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Well Development Form
(Field Sheet)

Project Name and Number: LAAP FIVE-YEAR REVIEW

Well Number and Location: AREA P, WELL 60068

Development Crew: W. STONER, C. FONTANA Driller (if applicable): N/A

Water Levels/Time: Initial: 19.2 BTOC 0932 Pumping: ______ Final: ~~NR~~ 16' BTOC

Total Well Depth: Initial: 36.02 BTOC Final: ______

Date and Time: Begin: 2/28/94 0932 Completed: 3/1/94 1645

Development: Method(s): BAILER USED TO PURGE WELL

Total Quantity of Water Removed: ~70 gals

Date/Time and Pump Setting	Discharge Rate* and Measurement Method	Field Measurements				Remarks (Including Sand Production)
		Temp (°F)	Specific Conductivity (umhos/cm)	pH (Standard Units)	Turbidity	
2/28/94 1244		65	3.7 x 10	7.8	V. TURBID	
3/1/94 1650		62.4	3.62 x 10	7.66	CLOUDY	
1320		62.0	3.6 x 10	7.61	P. CLOUDY	
1645		61.0	3.62 x 10	7.8	CLEAR	

*gallons per minute or bailer capacity

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Well Development Form
(Field Sheet)

Project Name and Number: LAAP FIVE YEAR REVIEW

Well Number and Location: AREA P, WELL 60083

Development Crew: C. FONTANA, J. PENDLETON Driller (if applicable): N/A

Water Levels/Time: Initial: 19.76 BTOC Pumping: Final: N/R

Total Well Depth: Initial: Final:

Date and Time: Begin: 1132 2/24/94 Completed:

Development: Method(s): 2" SUBMERSIBLE PUMP (REDIFLO 2)

Total Quantity of Water Removed: 55 gals

Date/Time and Pump Setting	Discharge Rate* and Measurement Method	Field Measurements				Remarks (Including Sand Production)
		Temp (°F)	Specific Conductivity (umhos/cm)	pH (Standard Units)	Turbidity	
2/24/94 1134		63°	0.12x10	7.55	CLEAR	
1156		63.5	0.12x10	6.55	V. CLEAR	
1530		64.8	0.11x10	5.43	CLEAR	(pH METER NOT OPERATING WELL)
1545		62.4	0.11x10	NR	CLEAR	
1620		62.0	0.11x10	4.6	P. CLOUDY	
2/25/94 0832		55.4	0.18x10	5.4	P. CLOUDY	
0836		53.7	0.15x10	4.93	CLEAR	
0940		55.0	0.10x10	NR	CLEAR	
1340		55.2	0.10x10	5.36	CLEAR	
1343		55.1	0.10x10	5.32	CLEAR	

WELL 60083 PUMPED DRY SIX TIMES OVER COURSE OF TWO DAYS. H2O CLEAR DURING PURGING

*gallons per minute or bailer capacity

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Well Development Form
(Field Sheet)

Project Name and Number: LAAP FIVE-YEAR REVIEW

Well Number and Location: AREA P 60084

Development Crew: J. PENDLETON, C. FONTANA Driller (if applicable): N/A

Water Levels/Time: Initial: 19.75 Pumping: ______ Final: ~~N/R 35~~ 21.6' BTOC

Total Well Depth: Initial: 35.62 Final: ______

Date and Time: Begin: 2/24/94 1722 Completed: 2/25/94 1300

Development: Method(s): 2" SUBMERSIBLE PUMP (REDIFLO 2)

Total Quantity of Water Removed: ~35 gals

Date/Time and Pump Setting	Discharge Rate* and Measurement Method	Field Measurements				Remarks (Including Sand Production)
		Temp (°F) ~~(°C)~~	Specific Conductivity (umhos/cm)	pH (Standard Units)	Turbidity	
2/24/94 1722		62.5	9.4 x 10	4.3	V. CLEAR	RECHARGE V. SLOW
2/25/94 0850		52.8	1.0 x 100	5.74	CLEAR	RECHARGE V. SLOW
0856		52.4	1.0 x 100	5.7	CLEAR	
1300		52.0	1.0 x 100	5.1	CLEAR	RECHARGE SLOW

RECHARGE OF WELL 60084 WAS VERY SLOW, UNABLE TO PURGE CALCULATED TOTAL, 5 TIMES THE WELL VOLUME. USE 85% RULE (WELL DOESN'T RECHARGE 85% IN AN HOUR). DUPLICATE SAMPLE TAKEN AT WELL 60084

*gallons per minute or bailer capacity

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Well Development Form
(Field Sheet)

Project Name and Number: LAAP FIVE YEAR REVIEW

Well Number and Location: AREA P, 60085

Development Crew: Wayne Stoner, Chris Fortune Driller (if applicable): N/A

Water Levels/Time: Initial: 18.38' BTOC Pumping: ________ Final: 20' BTOC

Total Well Depth: Initial: 35.23' BTOC Final: ________

Date and Time: Begin: 3/2/94 1730 Completed: 3/3/94 0931

Development: Method(s): 2" SUBMERSIBLE GRUNDFOS PUMP (REDIFLO 2)

Total Quantity of Water Removed: APPROX. 53 gals

Date/Time and Pump Setting	Discharge Rate* and Measurement Method	Field Measurements				Remarks (Including Sand Production)
		Temp (°C)	Specific Conductivity (umhos/cm)	pH (Standard Units)	Turbidity	
3/2/94	~2 gal/min	62.7 °F	7.70×10	NR	P. TURBID	
	~2 gal/min	57.2	12.57×100	NR	" "	
3/3/94 0823	~1 gal./min (BUCKET/WATCH)	12.9	11.53×10	NR	P. TURBID	
0825	~1 gal/min	14.7	12.55×10	NR	P. TURBID	
0833	~.8 gal/min	16.1	12.87×10	NR	CLEAR	
0845		15.9	11.95×10	NR	CLEAR	
0905	~1 gal/min	18.7	12.27×10	NR	CLEAR	
0925		20.3	12.45×10	NR	CLEAR	

*gallons per minute or bailer capacity

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Well Development Form
(Field Sheet)

Project Name and Number: LAAP FIVE YEAR REVIEW

Well Number and Location: AREA P, WELL 60 104

Development Crew: J. PENDLETON, W. STOVER Driller (if applicable): N/A

Water Levels/Time: Initial: 14.47 BTOC Pumping: ______ Final: 18' BTOC

Total Well Depth: Initial: 35.44' Final: ______

Date and Time: Begin: 3/2/94 0905 Completed: 3/2/94 1230

Development: Method(s): 2" SUBMERSIBLE PUMP (REDIFLO 2)

Total Quantity of Water Removed: 100 gals

Date/Time and Pump Setting	Discharge Rate* and Measurement Method	Field Measurements				Remarks (Including Sand Production)
		Temp (°C)	Specific Conductivity (umhos/cm)	pH (Standard Units)	Turbidity	
3/2/94 0905	~ 2gal/min	62.3	4.32 x100		P. CLOUDY	
1210		66.5	4.47 x100		CLEAR	
1220	~ 2gal/min	62.1	4.32x100		CLEAR	
1225		62.7	4.31 x100		〃	
1227	~2gal/min	62.3	4.25x100		CLEAR	

*gallons per minute or bailer capacity

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Well Development Form
(Field Sheet)

Project Name and Number: LAAP FIVE - YEAR REVIEW

Well Number and Location: AREA P, WELL 60105

Development Crew: J. PENDLETON, C. FONTANA Driller (if applicable): N/A

Water Levels/Time: Initial: 17.16 BTOC 1630 Pumping: ________ Final: ~~NR~~ 25 BTOC

Total Well Depth: Initial: 56.20 Final: ________

Date and Time: Begin: 2/28/94 1640 Completed: 2/28/94 1735

Development: Method(s): 2" SUBMERSIBLE PUMP (REDIFLO 2)

Total Quantity of Water Removed: 160 gals

Date/Time and Pump Setting	Discharge Rate* and Measurement Method	Field Measurements				Remarks (Including Sand Production)
		Temp (~~°C~~)	Specific Conductivity (umhos/cm)	pH (Standard Units)	Turbidity	
2/28/94 1640	PUMP OPERATING AT ~ 2.5 GAL/MIN	76.0	4.16x100	6.8	CLEAR	GREENISH-YELLOW TINT TO H_2O
1700		72.7	4.96x100	6.88	CLEAR	
1710		64.6	4.35x100	6.89	CLEAR	
1721		65.0	4.19x100	6.94	CLEAR	

*gallons per minute or bailer capacity

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Well Development Form
(Field Sheet)

Project Name and Number: LAAP FIVE-YEAR REVIEW

Well Number and Location: AREA P, WELL 60 106

Development Crew: C. FONTANA, J. PENDLETON Driller (if applicable): N/A

Water Levels/Time: Initial: 16.49 BTOC 1630 Pumping: ______ Final: ~57' BTOC

Total Well Depth: Initial: 64.44 Final: ______

Date and Time: Begin: 2/28/94 1715 Completed: 3/1/94 ~~1715~~ 1630

Development: Method(s): 2" SUBMERSIBLE PUMP (REDIFLO 2)

Total Quantity of Water Removed: 95 gals

Date/Time and Pump Setting	Discharge Rate* and Measurement Method	Field Measurements				Remarks (Including Sand Production)
		Temp (°C)	Specific Conductivity (umhos/cm)	pH (Standard Units)	Turbidity	
2/28/94 1721	PUMP OPERATING AT ~1.5 GAL/min	64.9	3.21 x/000	NR	CLEAR	GREENISH/YELLOW TINT TO H_2O
1746		56.4				
3/1/94						
0905	1.5 GAL/min	54.2	4.5 X 100	7.07	CLEAR	
0925	1.5 GAL/min	62.5	7.35 X 100	NOT FUNCTIONAL	CLEAR	GREENISH YELLOW TINT TO H_2O
1620	1.0 GAL/min	62.4	7.4 X 100	"	"	
1630	1.0 GAL/min	62.0	7.6 X 100	"	"	"

FIVE WELL VOLUMES WERE NOT RECOVERED FROM WELL. WELL WAS RECOVERING TO SLOWLY TO OBTAIN 5 TIMES THE VOLUME OF H_2O WHICH WAS ORIGINALLY IN THE WELL.

*gallons per minute or bailer capacity

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Well Development Form
(Field Sheet)

Project Name and Number: LAAP FIVE-YEAR REVIEW

Well Number and Location: AREA P, WELL 60109

Development Crew: W. STOVER, C. FONTANA Driller (if applicable): N/A

Water Levels/Time: Initial: 19.1 BTOC 0854 Pumping: ______ Final: ~~NR~~ 23' BTOC

Total Well Depth: Initial: ______ Final: ______

Date and Time: Begin: 2/25/94 1400 Completed: 2/28/94 1320

Development: Method(s): 2" SUBMERSIBLE PUMP (REDIFLO 2)

Total Quantity of Water Removed: 42 gals

Date/Time and Pump Setting	Discharge Rate* and Measurement Method	Field Measurements				Remarks (Including Sand Production)
		Temp (°C)	Specific Conductivity (umhos/cm)	pH (Standard Units)	Turbidity	
2/25/94		52	0.10 x 10	6.1	P. TURBID	
2/28/94 0854		67	0.10 x 10	6.1	" "	
		67.8	0.10 x 10	6.09	P. TURBID	
1248		68.0	0.10 x 10	6.08	CLEAR	
1320						

*gallons per minute or bailer capacity

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Well Development Form
(Field Sheet)

Project Name and Number: LAAP FIVE-YEAR REVIEW

Well Number and Location: AREA P, WELL 60110

Development Crew: J. PENDLETON, C. FONTANA Driller (if applicable): N/A

Water Levels/Time: Initial: 25.83 Pumping: ______ Final: 32' BTOC

Total Well Depth: Initial: 86.09 BTOC Final: ______

Date and Time: Begin: 2/28/94 0927 Completed: 2/28/94 1232

Development: Method(s): 2" SUBMERSIBLE PUMP SET AT ~45' BTOC

Total Quantity of Water Removed: 155 gals

Date/Time and Pump Setting	Discharge Rate* and Measurement Method	Field Measurements				Remarks (Including Sand Production)
		Temp (°C)	Specific Conductivity (umhos/cm)	pH (Standard Units)	Turbidity	
2/28/94 0927	~2 GAL/MIN	54.4	0.1 X 10	6.55	P. CLOUDY	
1020	~3 GAL/MIN	71° F	0.1 X 10	6.50	" "	
1110		68	0.1 X 10	6.48	" "	
1232		67.6	0.1 X 10	6.47	CLEAR	

DEEP WELL IN LOWER TERRACE/SPARTA SAND AQUIFER
PARAMETER READINGS CONSISTENT THROUGHOUT PURGING

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SAMPLING FORMS

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Sampling Form
(Field Sheet)

Project Name and Number: LAAP FIVE-YEAR REVIEW
Sampling Crew: CHRIS FONTANA, JOHN PENDLETON
Sampling Point Number: G0009
Sampling Location: MONITOR WELL G0009
Sample Type: ☒ GW ☐ SW ☐ Soil ☐ SED ☐ Other:
Date and Time Sample Collected: 2/25/94 12:17
Weather Conditions: CLEAR & SUNNY, STRONG WIND ~ 10-15 mph FROM NORTH

Purging Information (if applicable):
Method: SUBMERSIBLE AND BAILING (LARGE % OF FINES IN H_2O)
Quantity of Water Purged: 39 GALLONS
Disposition of Purge Water: H_2O VERY TURBID AT BEGINNING OF THE PURGING PROCESS THEN BECAME ALMOST CLEAR
Date and Time of Purging: Start: 2/24/94 1610 End: 2/25/94 1140
Comments: H_2O STILL PARTLY CLOUDY AT THE END OF PURGING

Groundwater:
Date and Time Collected: 2/25/94 1217
Sampling Depth: ~ 18' TO BOTTOM
Water Level: ~ 18' BTOC
Sampling Method/Equipment: BOTTOM FILLING TEFLON BAILER
Field Measurements: pH ~~0.10x10~~ Temp: 68° Cond: 0.10x10 Alkalinity:
Date and Time Filtered (if applicable): N/A
Comments: H_2O STILL W/ % OF FINES SUSPENDED IN SOLN. RINSATE BLANK TAKEN AT THIS WELL

Surface Water:
Date and Time Collected:
Collection Method: N/A
Date and Time Filtered (if applicable):
Field Measurements: pH ____ Temp: ____ Cond: ____ Turbidity: ____
Comments:

Soils/Sediment Sampling:
Date and Time Collected: N/A
Sampling Depth:
Sampling Method:
Comments:

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Sampling Form
(Field Sheet)

Project Name and Number: LAAP FIVE-YEAR REVIEW
Sampling Crew: CHRIS FONTANA, JOHN PENDLETON
Sampling Point Number: G0012, SAIC01
Sampling Location: MONITOR WELL G0012
Sample Type: ☒ GW ☐ SW ☐ Soil ☐ SED ☐ Other
Date and Time Sample Collected: FEB. 24, 1994 1255
Weather Conditions: SUNNY & CLEAR, TEMP. HIGH 40'S, CALM

Purging Information (if applicable):

Method: BAILING WITH BOTTOM FILLING BAILER
Quantity of Water Purged: APPROX. 50 GALLONS
Disposition of Purge Water: PARTLY TURBID, SMALL PERCENT OF RED CLAY SUSPENDED IN SOLUTION.
Date and Time of Purging: *Start:* 2/23/94 1650 End: 2/24/94 1245
Comments: BAILING USED INITIALLY TO REMOVE SUSPENDED AND SETTLED CLAY PARTICLES, H_2O BECOMES CLEAR WITH REMOVAL.

Groundwater:

Date and Time Collected: FEB. 24, 1994 1255
Sampling Depth: 20' TO BOTTOM
Water Level: 19.76' BTOC
Sampling Method/Equipment: DISPOSABLE BAILER
Field Measurements: pH 6.14 Temp: 62 Cond: 1.2X Alkalinity:
Date and Time Filtered (if applicable): N/A
Comments: ~~RINSATE BLANK TAKEN AT THIS WELL PRIOR TO SAMPLING~~

Surface Water:

Date and Time Collected:
Collection Method:
Date and Time Filtered (if applicable)
Field Measurements: pH Temp: Cond: Turbidity:
Comments:

N/A

Soils/Sediment Sampling:

Date and Time Collected:
Sampling Depth:
Sampling Method:
Comments:

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Sampling Form
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Project Name and Number: LAAP FIVE YEAR REVIEW
Sampling Crew: CHRIS FONTANA, JOHN PENDLETON
Sampling Point Number: G0014, SAIC01
Sampling Location: MONITOR WELL G0014
Sample Type: ☒ GW ☐ SW ☐ Soil ☐ SED ☐ Other ______
Date and Time Sample Collected: FEB. 24, 1994
Weather Conditions: SUNNY & CLEAR, TEMP. IN HIGH 50's

Purging Information (if applicable):

Method: 2" SUBMERSIBLE PUMP
Quantity of Water Purged: APPROX. OF 25 GAL.
Disposition of Purge Water: PARTLY TURBID WITH LARGE PERCENT OF SUSPENDED SOLIDS
Date and Time of Purging: *Start:* 2/24/94 0920 *End:* 2/24/94 1430
Comments: WELL IS VERY SLOW RECHARGER, UNABLE TO RECOVER 5 TIMES THE WELL VOLUME.

Groundwater:

Date and Time Collected: FEB. 24, 1994
Sampling Depth: APPROX. 15 TO BOTTOM
Water Level: 14.86' BTOC
Sampling Method/Equipment: DISPOSABLE BAILER
Field Measurements: pH 6.45 Temp: 50° Cond: 1.12 Alkalinity: ______
Date and Time Filtered (if applicable): N/A
Comments: ______

Surface Water:

Date and Time Collected: ______
Collection Method: ______
Date and Time Filtered (if applicable) ______
Field Measurements: pH ______ Temp: ______ Cond: ______ Turbidity: ______
Comments: ______

N/A

Soils/Sediment Sampling:

Date and Time Collected: ______
Sampling Depth: ______
Sampling Method: ______
Comments: ______

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Sampling Form
(Field Sheet)

Project Name and Number: LAAP FIVE-YEAR REVIEW
Sampling Crew: C. FONTANA, J. PENDLETON
Sampling Point Number: 60068
Sampling Location: MONITOR WELL 60068
Sample Type: ☒ GW ☐ SW ☐ Soil ☐ SED ☐ Other:
Date and Time Sample Collected: 3/1/94 1648
Weather Conditions: RAINING WITH TEMPERATURE IN LOW 50S, WIND APPROX 5 mph FROM NORTH

Purging Information (if applicable):
Method: BAILER USED TO PURGE WELL
Quantity of Water Purged: 70 GALLONS
Disposition of Purge Water: INITIALLY VERY TURBID HOWEVER H2O DID CLEAR UP DURING PURGING PROCESS
Date and Time of Purging: Start: 2/28/94 0932 End: 3/1/94 1645
Comments:

Groundwater:
Date and Time Collected: 3/1/94 16:48
Sampling Depth: 16' BTOC TO BOTTOM OF WELL
Water Level: ~16' BTOC
Sampling Method/Equipment: BOTTOM FILLING TEFLON BAILER
Field Measurements: pH 7.8 Temp: 61°F Cond: 3.62x10 Alkalinity: NR
Date and Time Filtered (if applicable): N/A
Comments:

Surface Water:
Date and Time Collected:
Collection Method:
Date and Time Filtered (if applicable):
Field Measurements: pH Temp: Cond: Turbidity:
Comments:

N/A

Soils/Sediment Sampling:
Date and Time Collected:
Sampling Depth:
Sampling Method:
Comments:

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Sampling Form
(Field Sheet)

Project Name and Number: LAAP FIVE YEAR REVIEW
Sampling Crew: CHRIS FONTANA, JOHN PENDLETON
Sampling Point Number: G0083, SAIC01
Sampling Location: MONITOR WELL G0083
Sample Type: ☒ GW ☐ SW ☐ Soil ☐ SED ☐ Other ______
Date and Time Sample Collected: 2/25/94 ~~1355~~ 13:43
Weather Conditions: CLEAR & SUNNY, LIGHT WIND

Purging Information (if applicable):
Method: 2" SUBMERSIBLE PUMP
Quantity of Water Purged: APPROX. 55 GALLONS PURGED
Disposition of Purge Water: PARTLY TURBID, SMALL PERCENT OF RED CLAY SUSPENDED IN SOLUTION. INITIAL PUMP HAD CLEAR WATER
Date and Time of Purging: *Start:* 2-24-94 11:32 *End:* 2-25-94 13:50
Comments: WELL HAD A SLOW RECHARGE TIME

Groundwater:
Date and Time Collected: ~~2-24-94~~ — ~~2-25~~ 2-25-94 13:50
Sampling Depth: 19.8 TO BOTTOM OF WELL
Water Level: 19.76 BTOC
Sampling Method/Equipment: 2" SUBMERSIBLE PUMP
Field Measurements: pH 5.36 Temp: 55.4 Cond: 101 x10umhos Alkalinity: NR
Date and Time Filtered (if applicable): N/A
Comments: MS/MSD TAKEN FROM THIS WELL ON 2/25/94, 6 LITERS OF SAMPLE (TOTAL) TAKEN FROM WELL

Surface Water:
Date and Time Collected:
Collection Method:
Date and Time Filtered (if applicable)
Field Measurements: pH ______ Temp: ______ Cond: ______ Turbidity: ______
Comments:

N/A

Soils/Sediment Sampling:
Date and Time Collected:
Sampling Depth:
Sampling Method:
Comments:

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Sampling Form
(Field Sheet)

Project Name and Number: LAAP FIVE YEAR REVIEW
Sampling Crew: JOHN PENDLETON, CHRIS FONTANA
Sampling Point Number: G0084, SAIC01
Sampling Location: MONITOR WELL G0084
Sample Type: ☒ GW ☐ SW ☐ Soil ☐ SED ☐ Other ______
Date and Time Sample Collected: 2-25-94 13:10
Weather Conditions: CLEAR & SUNNY, STRONG WIND 10-15 mph FROM N

Purging Information **(if applicable):**

Method: 2" SUBMERSIBLE PUMP
Quantity of Water Purged: ~35 GALLONS RECOVERED FROM WELL
Disposition of Purge Water: WATER IS CLEAR

Date and Time of Purging: Start: 2-24-94 17:20 End: 2/25/94 08:57
Comments: WELL IS A VERY SLOW RECHARGER

Groundwater:

Date and Time Collected: 2-25-94 13:10
Sampling Depth: 21.6 TO BOTTOM OF WELL
Water Level: 19.75 BTOC
Sampling Method/Equipment: BOTTOM FILLING TEFLON BAILER
Field Measurements: pH 5.74 Temp: 52.8 Cond: 0.10x10 umhs Alkalinity: N/R
Date and Time Filtered (if applicable): N/A
Comments: DUPLICATE SAMPLE TAKEN AT THIS WELL, 4 LITER (TOTAL) OF SAMPLE COLLECTED FROM WELL.

Surface Water:

Date and Time Collected:
Collection Method:
Date and Time Filtered (if applicable)
Field Measurements: pH Temp: Cond: Turbidity:
Comments:

N/A

Soils/Sediment Sampling:

Date and Time Collected:
Sampling Depth:
Sampling Method:
Comments:

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Sampling Form
(Field Sheet)

Project Name and Number: LAAP FIVE - YEAR REVIEW
Sampling Crew: C. FONTANA, W. STONER, JOHN PENDLETON
Sampling Point Number: 60085
Sampling Location: MONITOR WELL 60085
Sample Type: ☒ GW ☐ SW ☐ Soil ☐ SED ☐ Other:
Date and Time Sample Collected: 3/3/94 0955
Weather Conditions: SUNNY WITH TEMPERATURE IN HIGH 30'S, CALM

Purging Information (if applicable):
Method: 2" SUBMERSIBLE PUMP (REDIFLO 2)
Quantity of Water Purged: 53 GALLONS
Disposition of Purge Water: H_2O CLEAR
Date and Time of Purging: Start: 3/2/94 1730 End: 3/3/94 0931
Comments:

Groundwater:
Date and Time Collected: 3/3/94 0955
Sampling Depth: 20' TO BOTTOM OF WELL
Water Level: ~ 19' BTOC
Sampling Method/Equipment: BOTTOM FILLING TEFLON BAILER
Field Measurements: pH NR Temp: 67°F Cond: 10.07×10 Alkalinity: NR
Date and Time Filtered (if applicable): N/A
Comments:

Surface Water:
Date and Time Collected:
Collection Method:
Date and Time Filtered (if applicable):
Field Measurements: pH Temp: Cond: Turbidity:
Comments:

N/A

Soils/Sediment Sampling:
Date and Time Collected:
Sampling Depth:
Sampling Method:
Comments:

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Sampling Form
(Field Sheet)

Project Name and Number: LAAP FIVE-YEAR REVIEW
Sampling Crew: J. Pendleton, C. Fonteno, W. Stover
Sampling Point Number: 60104
Sampling Location: MONITORING WELL 60104
Sample Type: ☒ GW ☐ SW ☐ Soil ☐ SED ☐ Other:
Date and Time Sample Collected: 3/2/94 12:40
Weather Conditions: OVERCAST W. TEMPERATURE IN MID. 40's, WIND FROM NORTH UP TO ~15mph.

Purging Information (if applicable):
Method: 2" SUBMERSIBLE GRUNDFOS PUMP (REDIFLO 2)
Quantity of Water Purged: ~100 GALLONS
Disposition of Purge Water: CLEAR W. GREENISH YELLOW COLOR
Date and Time of Purging: Start: 3/2/94 0905 End: 3/2/94 1230
Comments: WELL PURGED QUICKLY & RECHARGE WAS PROBABLY BEST OF AREA P WELLS.

Groundwater:
Date and Time Collected: 3/2/94 1240
Sampling Depth: ~18' ~~BTOC~~ TO BOTTOM BTOC
Water Level: ~17' BTOC
Sampling Method/Equipment: BOTTOM FILLING TEFLON BAILER
Field Measurements: pH NR Temp: 62.3 Cond: 425x100 Alkalinity:
Date and Time Filtered (if applicable): N/A
Comments: WATER OBSERVED TO HAVE A GREENISH YELLOW COLOR.

Surface Water:
Date and Time Collected:
Collection Method:
Date and Time Filtered (if applicable): N/A
Field Measurements: pH Temp: Cond: Turbidity:
Comments:

Soils/Sediment Sampling:
Date and Time Collected:
Sampling Depth:
Sampling Method: N/A
Comments:

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Sampling Form
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Project Name and Number: LAAP FIVE YEAR REVIEW
Sampling Crew: WAYNE STOWER, JOHN PENDELTON, CHRIS FONTANA
Sampling Point Number: G0105, SAIC01
Sampling Location: MONITORING WELL G0105
Sample Type: ☒ GW ☐ SW ☐ Soil ☐ SED ☐ Other ______
Date and Time Sample Collected: 2-28-94 17:55
Weather Conditions: SUNNY & CLEAR

Purging Information **(if applicable):**

Method: 2" SUBMERSIBLE PUMP
Quantity of Water Purged: 160 GALLONS
Disposition of Purge Water: YELLOWISH CLEAR FLUID

Date and Time of Purging: *Start:* 2-28-94 16:40 *End:* 2-28-94 17:46
Comments:

Groundwater:

Date and Time Collected: 2-28-94 17:55
Sampling Depth: 25 FT TO BOTTOM OF WELL
Water Level: 17.16 BTOC
Sampling Method/Equipment: 2" SUBMERSIBLE PUMP
Field Measurements: pH 11.737 Temp: 56.4 Cond: .11×10 Alkalinity:
Date and Time Filtered (if applicable): N/A
Comments:

Surface Water:

Date and Time Collected:
Collection Method:
Date and Time Filtered (if applicable)
Field Measurements: pH Temp: Cond: Turbidity:
Comments:

N/A

Soils/Sediment Sampling:

Date and Time Collected:
Sampling Depth:
Sampling Method:
Comments:

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Sampling Form
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Project Name and Number: LAAP FIVE-YEAR REVIEW
Sampling Crew: CHRIS FONTANA, JOHN PENDLETON
Sampling Point Number: G0106, SAIC 01
Sampling Location: MONITORING WELL G0106
Sample Type: ☒ GW ☐ SW ☐ Soil ☐ SED ☐ Other:
Date and Time Sample Collected: 3/1/94 16:35
Weather Conditions: RAINING WITH TEMPERATURES IN LOW 50'S
WIND ~ 5mph from North

Purging Information (if applicable):
Method: 2" SUBMERSIBLE PUMP (GRUNDFOS REDIFLO 2)
Quantity of Water Purged: ~ 95 GALLONS
Disposition of Purge Water: CLEAR WITH GREENISH YELLOW TINT
JP
Date and Time of Purging: Start: 2/28/94 1715 End: 3/1/94 ~~1715~~ 1630
Comments: WELL PURGED EASILY, RECHARGED ~~QUICKLY~~ SLOWLY, GREENISH YELLOW COLOR OBSERVED DURING PURGING.

Groundwater:
Date and Time Collected: 3/1/94 16:35
Sampling Depth: ~57' BTOC
Water Level: ~56' BTOC
Sampling Method/Equipment: BOTTOM FILLING TEFLON BAILER
Field Measurements: pH NR Temp: 62°F Cond: 7.6x100 Alkalinity:
Date and Time Filtered (if applicable): N/A
Comments: GREENISH YELLOW TINT OBSERVED THROUGHOUT PURGING ACTIVITY

Surface Water:
Date and Time Collected: N/A
Collection Method:
Date and Time Filtered (if applicable):
Field Measurements: pH Temp: Cond: Turbidity:
Comments:

Soils/Sediment Sampling:
Date and Time Collected: N/A
Sampling Depth:
Sampling Method:
Comments:

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Sampling Form
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Project Name and Number: LAAP FIVE YEAR REVIEW
Sampling Crew: WAYNE STONER, JOHN PENDELTON, CHRIS FONTANA
Sampling Point Number: 60109, SAIC 01
Sampling Location: ~~66~~ MONITORING WELL 60109
Sample Type: ☑ GW ☐ SW ☐ Soil ☐ SED ☐ Other
Date and Time Sample Collected: 2-28-94 1410
Weather Conditions: CLEAR + SUNNY

Purging Information (if applicable):

Method: 2" SUBMERSIBLE
Quantity of Water Purged: 42 GALLONS
Disposition of Purge Water: CLEAR

Date and Time of Purging: *Start:* 2-28-94 11:20 *End:* 2-28-94 13:20
Comments: SLOW RECHARGING WELL

Groundwater:

Date and Time Collected: 2-28-94 14:10
Sampling Depth: 23 FEET
Water Level: 24.27 FEET
Sampling Method/Equipment: 2" SUBMERSIBLE PUMP
Field Measurements: pH 6.08 Temp: 68 Cond: 0.10x10^10 Alkalinity: NR
Date and Time Filtered (if applicable): N/A
Comments:

Surface Water:

Date and Time Collected:
Collection Method:
Date and Time Filtered (if applicable)
Field Measurements: pH Temp: Cond: Turbidity:
Comments:

N/A

Soils/Sediment Sampling:

Date and Time Collected:
Sampling Depth:
Sampling Method:
Comments:

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Sampling Form
(Field Sheet)

Project Name and Number: LAAP FIVE YEAR REVIEW

Sampling Crew: WAYNE STONER, JOHN PENDELTON, CHRIS FONTANA

Sampling Point Number: G0110, SAIC01

Sampling Location: MONITORING WELL G0110

Sample Type: ☒ GW ☐ SW ☐ Soil ☐ SED ☐ Other

Date and Time Sample Collected: 2-28-94 14:25

Weather Conditions: CLEAR + SUNNY

Purging Information (if applicable):

Method: 2" SUBMERSIBLE PUMP

Quantity of Water Purged: 155 GALLONS

Disposition of Purge Water: PARTLY TURBID TO CLEAR

Date and Time of Purging: *Start:* 2-28-94, 0927 *End:* 2-28-94 1234

Comments: WATER RECOVERED QUICKLY FROM WELL, RECHARGE VERY GOOD.

Groundwater:

Date and Time Collected: 2-28-94 14:25

Sampling Depth: 32 FT. TO BOTTOM OF WELL

Water Level: ~~22.85~~ 32.85 BTOC

Sampling Method/Equipment: 2" SUBMERSIBLE PUMP

Field Measurements: pH 6.47 Temp: ~~[illegible]~~ 67.6 Cond: 0.10 [illegible] Alkalinity: N.R.

Date and Time Filtered (if applicable):

Comments: RINSATE BLANK RECOVERED FROM WELL 110, PRIOR TO SAMPLE COLLECTION

Surface Water:

Date and Time Collected:

Collection Method:

Date and Time Filtered (if applicable):

Field Measurements: pH Temp: Cond: Turbidity:

Comments: N/A

Soils/Sediment Sampling:

Date and Time Collected:

Sampling Depth:

Sampling Method:

Comments:

DRILLING LOGS

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US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

PROJECT Monitoring Well Installa tion DATE 30 Sep 79

LOCATION LAAP DRILLERS Smithson

DRILL RIG Small Trailer Mounted Drill Rig BORE HOLE BH 9

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
		Yellow-Red Clay-Silt	WT=15.5' - 2 Oct TD=22 ft
		Gray Sandy Silt and Red Clay (Marbled appearance)	
5			
		Red Clay, Moist	
10			
15		Red-Orange Silty Sand	

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

PROJECT Monitoring Well Installation DATE 30 Sept 79

LOCATION LAAP DRILLERS Smithson

DRILL RIG Small Trailer Mounted Drill Rig BORE HOLE BH 9

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
15			
20			MW 9' from GL to sand pack 10' of screen 21.5' Bottom of well
			Total Depth 22 ft

HSHB-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

PROJECT Monitoring Well Installatin DATE 30 Sep 79

LOCATION LAAP DRILLERS Smithson

DRILL RIG Small Trailer Mounted Drill Rig BORE HOLE BH10

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
		Yellow Tan Silty Clay	WT = 13' 3" - 2 Oct TD = 24 ft
		Very Hard Gray Silty Sand (Moist) 50/50 Mix	
5		Light Red-Orange Clay, Some Gray Sand Silt (Very moist)	
		Gray Sandy Silt	
		Thin Alternating Layers of 5' and 6' Material	
10		Orangish Red Sand & Silt	MW
		Orange Fine Sand, Some Silt with a Dark Brown Sand	8' from GL to sand pack
		Orangish Pink Sandy Silt	10' of screen
		- - - - - - - -	20.5' Bottom of well
15			

USAEHA Form 95, 12 Aug 74

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

PROJECT Monitoring Well Installation DATE 30 Sep 79

LOCATION LAAP DRILLERS Smithson

DRILL RIG Small Trailer Mounted Drill Rig BORE HOLE BH10

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
20			
23–24		Red Clay, Dense	Total Depth 24 ft
25			

USAEHA Form 95, 12 Aug 74

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

PROJECT Monitoring Well Installation DATE 1 Oct 79

LOCATION LAAP DRILLERS Smithson

DRILL RIG Small Trailer Mounted Drill Rig BORE HOLE BH11

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
		Grass, Tan Silt, Moist	WT = 14 ft TD = 21 ft
		Tan Silty Clay (Perched Water)	
5			
		Very Fine Gray Sand & Silt	
10			MW 5' from GL to sand pack 10' of screen 20' Bottom of well
			WT 14 ft ▼
15			

USAEHA Form 95, 12 Aug 74

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

PROJECT Monitoring Well Installation DATE 1 Oct 79

LOCATION LAAP DRILLERS Smithson

DRILL RIG Small Trailer Mounted Drill Rig BORE HOLE BH11

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
		Red Clay	
20		Gray Sand & Yellow Silt	Total Depth 21 ft
25			

USAEHA Form 95, 12 Aug 74

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

PROJECT Monitoring Well Installation DATE 1 Oct 79

LOCATION LAAP DRILLERS Smithson

DRILL RIG Small Trailer Mounted Drill Rig BORE HOLE BH12

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
		Red Clay, Part of Man Made Levy	WT = 16' 6" - 2 Oct TD = 26 ft
5		Dark Gray Silty Sand	
		Tan Very Fine Sand & Silt	
10			MW 9.5' from GL to sand pack 10' of screen 25' Bottom of well
		Gray Silty Sand, Very Dense	
15		Gray Fine Sand, Little Fines Moist	

USAEHA Form 95, 12 Aug 74

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

PROJECT Monitoring Well Installation DATE 1 Oct 79

LOCATION LAAP DRILLERS Smithson

DRILL RIG Small Trailer Mounted Drill Rig BORE HOLE BH12

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
			WT 16' 6" ▽
20		Tan Medium Sand, Very Wet	
		Gray Silty Sand, Like at 12'	
25			
			Total Depth 26'

USAEHA Form 95, 12 Aug 74

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

PROJECT Monitoring Well Installation DATE 30 Sep 79

LOCATION LAAP DRILLERS Smithson

DRILL RIG Small Trailer Mounted Drill Rig BORE HOLE BH13

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
		Top Soil, Red Clay with Some Organics	WT = 2' 6" - 2 Oct
		Tan Silty Clay	TD = 21 ft
			WT 2' 6" ▼
		Very Wet	
5			
		White Sand Silt & Red Clay (Marble cake appearance)	
10			MW 2' to sand 10' of screen 20.5' Bottom of well
15			

USAEHA Form 95, 12 Aug 74

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

PROJECT Monitoring Well Installation DATE 30 Sep 79

LOCATION LAAP DRILLERS Smithson

DRILL RIG Small Trailer Mounted Drill Rig BORE HOLE BH13

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
20		Hard Dense Red Clay	Total Depth 21'
25			

USAEHA Form 95, 12 Aug 74

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

PROJECT Monitoring Well Installation DATE 29 Sep 79

LOCATION LAAP DRILLERS Smithson

DRILL RIG Small Trailer Mounted Drill Rig BORE HOLE BH14

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
		Top Soil, Silty Loam	WT = 14' - 9 Oct
		Yellowish Silty Clay	TD = 30 ft
		Light Red Clay	
5			
		Gray Fine Sandy Silt, Yellow Red Silty Clay (Marble cake appearance)	MW
10		Bright Light Red Clay	14' from GL to sand pack 10' of screen
		Light Pink Silty Fine Sand	30' Bottom of well
		Very Moist	WT 14' ▼
15			

USAEHA Form 95, 12 Aug 74

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

PROJECT Monitoring Well Installation DATE 29 Sep 79

LOCATION LAAP DRILLERS Smithson

DRILL RIG Small Trailer Mounted Drill Rig BORE HOLE BH14

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
		Dense Red Clay	
20			
25			
30			Total Depth 30'

USAEHA Form 95, 12 Aug 74

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

PROJECT: Monitoring Well Installation
DATE: 29 Sep 79

LOCATION: LAAP
DRILLERS: Smithson

DRILL RIG: Small Trailer Mounted Drill Rig
BORE HOLE: BH15

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
		Top Soil, Sandy Silt	WT = 15.5' - 1 Oct
		Reddish-Light-Brown-Silty Slay	TD - 22.5 ft
		Yellowish-Orange Clay Silt, Some Fine Sand	
5			
		Light Orangish-Red Silty Clay	
10			MW 1' to sand 10' of screen 22.5' Botton of well
15			

USAEHA Form 95, 12 Aug 74

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

PROJECT Monitoring Well Installation DATE 29 Sep 79

LOCATION LAAP DRILLERS Smithson

DRILL RIG Small Trailer Mounted Drill Rig BORE HOLE BH15

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
			WT 15.5' ▽
		Pinkish Fine Sand, Some Silts & Clays	
20			
			Very hard drilling at 21'
			Total Depth 22.5'
25			

USAEHA Form 95, 12 Aug 74

BORING LOG

PAGE 1 OF 2 PAGE

PROJECT La. Arry Ammo. Plant

BORING NO G-68

DRILLING CONTRACTOR SPT

FIRST ENCOUNTERED WATER DEPTH 19.0

DRILLER S NAME D. Kraft

DATE ENCOUNTERED 10-8-81

GEOLOGIST NAME D. Sneed

GROUND ELEVATION

RIG MAKE/ MODEL CME/55

GEOLOGIST S SIGNATURE

DATE BORING STARTED 10-8-81

DATE BORING COMPLETED 10-8-81

ELEV.	DEPTH	LEGEND	CLASSIFATION OF MATERIALS	% CORE RECOVERY	BOX OR SAMPLE NO	REMARKS
		GM	Reddish tan silty sandy clayey gravel with organics. Topsoil	12/12	S1	Sample taken from Auger.
			Sharp			Depths - Drilled - ft. Sample - in. Recovery - in./in.
		CL	Strong brown with red sandy clay, jointed, stiff. 5 2.5 yr - /6 2.5 yr - 4/8 Moist with no free water. Fluvial. No apparent bedding		4	Sampler - S.S. - Split Spoon S.T. - Shelby Tube
	5				S2	S.S. All samples in plastic bags except as noted.
					5.5	Hole drilled with H.S.A.
		ML	Transitional Red clayey silt firm slightly moist. No free water. No apparent bedding. 2.5 yr - 4/8 Fluvial clays - 25%		9	
	10			18/18	S3	S.S.
					10.5	
					14	
	15			18/18	S4	S.S.
					15.5	
					19	Could not obtain sample with S.S. from 19-20.5 Sample taken from Auger.
	20				S5	

PROJECT

BORING

BORING LOG

PROJECT La. Army Ammo. Plant
BORING NO G-68

DRILLING CONTRACTOR SPT
FIRST ENCOUNTERED WATER DEPTH 19.0

DRILLER S NAME D. Kraft
DATE ENCOUNTERED 10-8-81

GEOLOGIST NAME B. Sneed
GROUND ELEVATION

RIG MAKE/ MODEL CME/55
GEOLOGIST S SIGNATURE

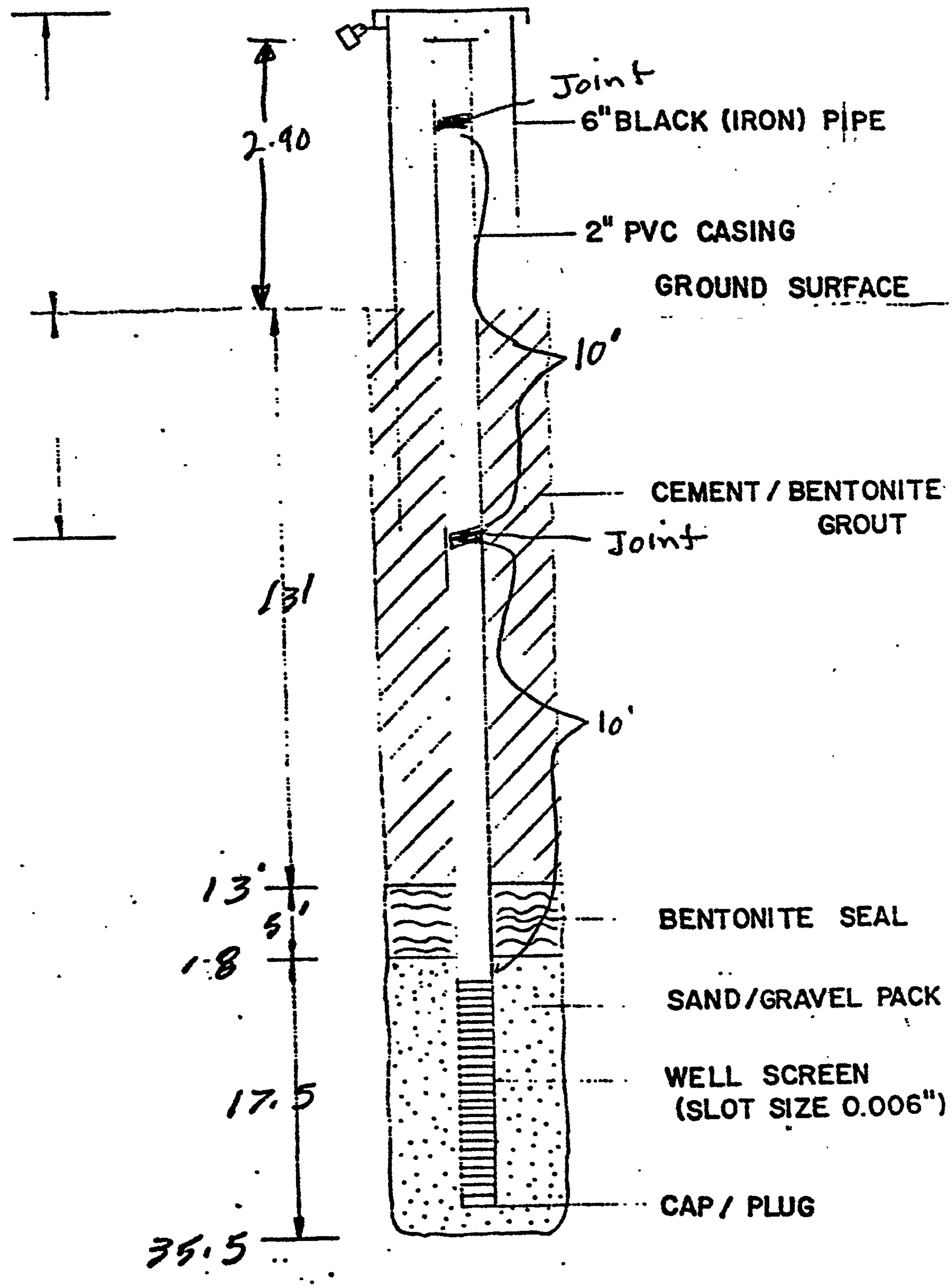
DATE BORING STARTED 10-8-81
DATE BORING COMPLETED 10-8-81

ELEV	DEPTH	LEGEND	CLASSIFATION OF MATERIALS	% CORE RECOVERY	BOX OR SAMPLE NO	REMARKS
	25			18/18	24 S6 25.5	Undisturbed sample from 24-25.5 S.T.
	30	CH	Red plastic clay stiff to very stiff 2.5 yr - 4/6 Fluvial No bedding apparent.	18/18	29 S7 30.5	
	35	ML	Red clayey silt firm with free water. 2.5 yr 4/8 No bedding apparent. Fluvial Clays - 25 6/10 T.D. 35.5		34 S8 35.5	S.S.

PROJECT
BORING

MONITOR WELL INSTALLATION

G-68



MONITOR WELL REPORT

PROJECT: LAAP, Pink Water Lagoon

LOCATION: Shreveport, LA

Date Completed: 9-29-82 Original Depth: 29.0 ft

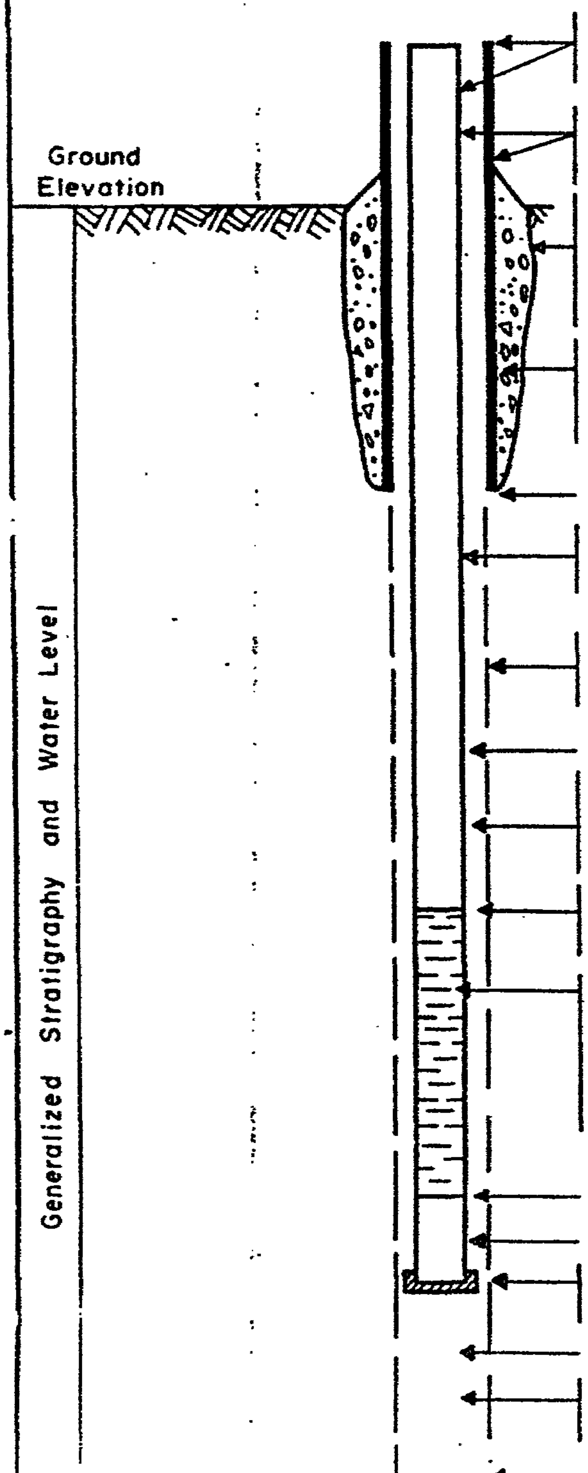
Inspected By: D. Primeaux Date: 9-29-82

Checked By: ______ Date: ______

Well No. G-83

Aquifer ______

Depth Interval ______

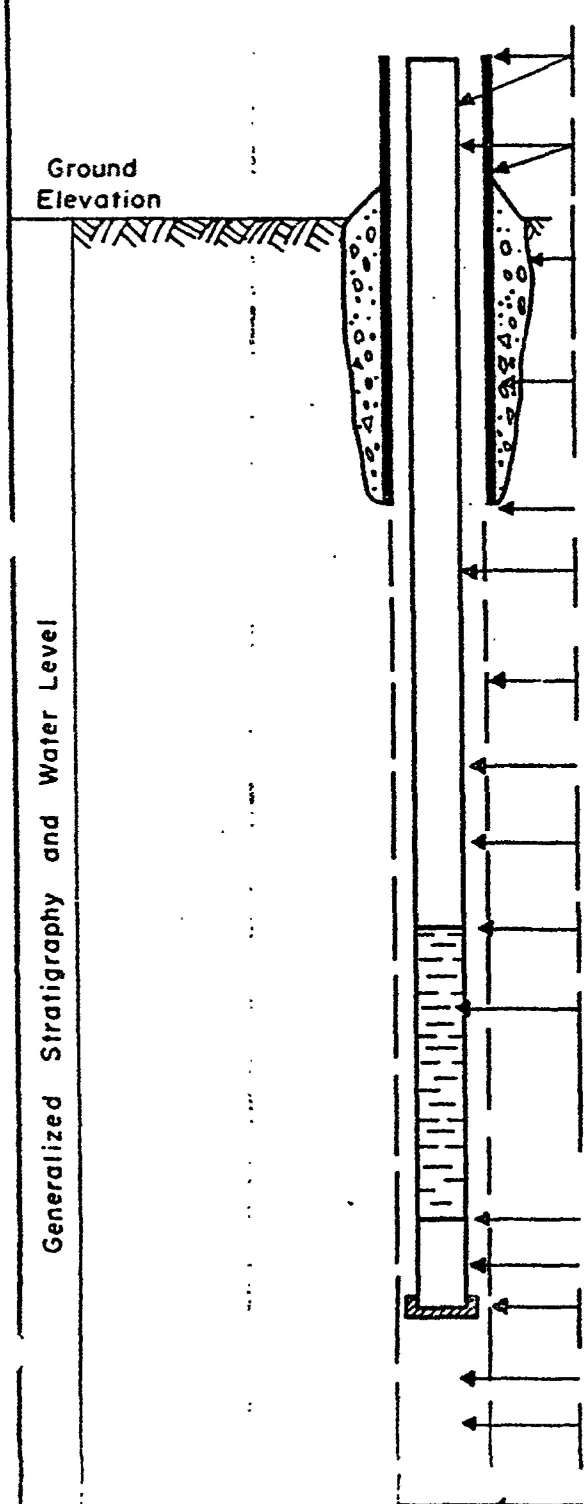


Elevation of top of surface casing / riser pipe.	N/A
Height of top of surface casing/ riser pipe above ground surface	3.5 ft
Depth of surface seal below ground surface	1.5 ft
Type of surface seal: Sac-crete	
I.D. of surface casing.	6 inch
Type of surface casing: Steel	
Depth of surface casing below ground	1.5 ft
I. D. of riser pipe.	3.0 inch
Type of riser pipe: Sched 40 PVC	
Diameter of borehole	6 inch
Depth of borehole	29.0
Type of backfill: Cement Bentonite Grout	
Elev./depth top of seal.	
Type of seal: Bentonite	
Elev./depth bottom of seal.	17.3
Type of sand pack. No. 375 Sand	
Depth of top of sand pack.	18.5
Elev./depth top of screened section.	19.0
Type of screened section: Sched 40 PVC	
Discribe openings 10 slot manufactured screen	
I.D. of screened section.	3.0 inch
Elev./depth bottom of screened section.	29.0 ft
Length of blank section.	0.0 ft
Elev./depth bottom of plugged blank section.	29.0 ft
Elev./depth bottom of sand column.	N/A
Type of backfill below observation pipe. N/A	
Elev /depth of hole.	29.0 ft

MONITOR WELL REPORT

PROJECT: LAAP, Pink Water Lagoon
LOCATION: Shreveport, LA
Date Completed: 9-28-82 Original Depth: 32.5 feet
Inspected By: D. Primeaux Date: 9-28-82
Checked By: ______ Date: ______

Page 2 of 3
Well No. G-34
Aquifer: ______
Depth Interval: ______



Elevation of top of surface casing / riser pipe.	N/A
Height of top of surface casing / riser pipe above ground surface	3.2 ft
Depth of surface seal below ground surface	1.8 ft
Type of surface seal: Sac-crete	
I.D. of surface casing.	6 inch
Type of surface casing: Steel	
Depth of surface casing below ground	1.8 ft
I.D. of riser pipe.	3.0 inch
Type of riser pipe: Sched 40 PVC	
Diameter of borehole	6 inch
Depth of borehole	32.5
Type of backfill: Cement Bentonite	
Elev./depth top of seal.	18.5
Type of seal: Bentonite Pi Pellets	
Elev./depth bottom of seal.	19.5
Type of sand pack. No. 375 Sand	
Depth of top of sand pack.	21.5 ft
Elev./depth top of screened section.	22.5
Type of screened section: Sched 40 PVC	
Discribe openings 6 slot manufactured screen	
I.D. of screened section.	3.0 inch
Elev./depth bottom of screened section.	32.5 ft
Length of blank section.	0.0 ft
Elev./depth bottom of plugged blank section.	32.5 ft
Elev./depth bottom of sand column.	N/A
Type of backfill below observation pipe. N/A	
Elev./depth of hole.	32.5 ft

MONITOR WELL REPORT

PROJECT: LAAP Pink Water Lagoon

LOCATION: Shreveport, LA

Date Completed: 9/28/82 Original Depth: 32.5 feet

Inspected By: D. Primeaux Date: 9/28/82

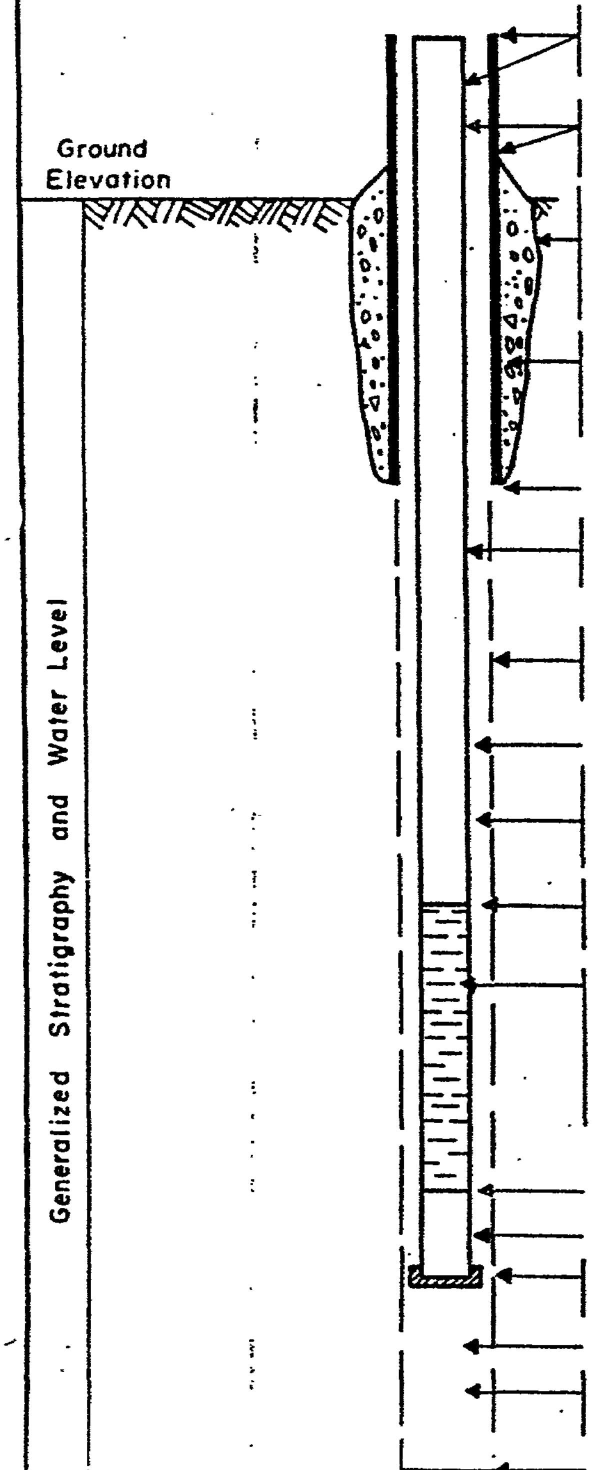
Checked By: ______ Date: ______

Page 1 of 3

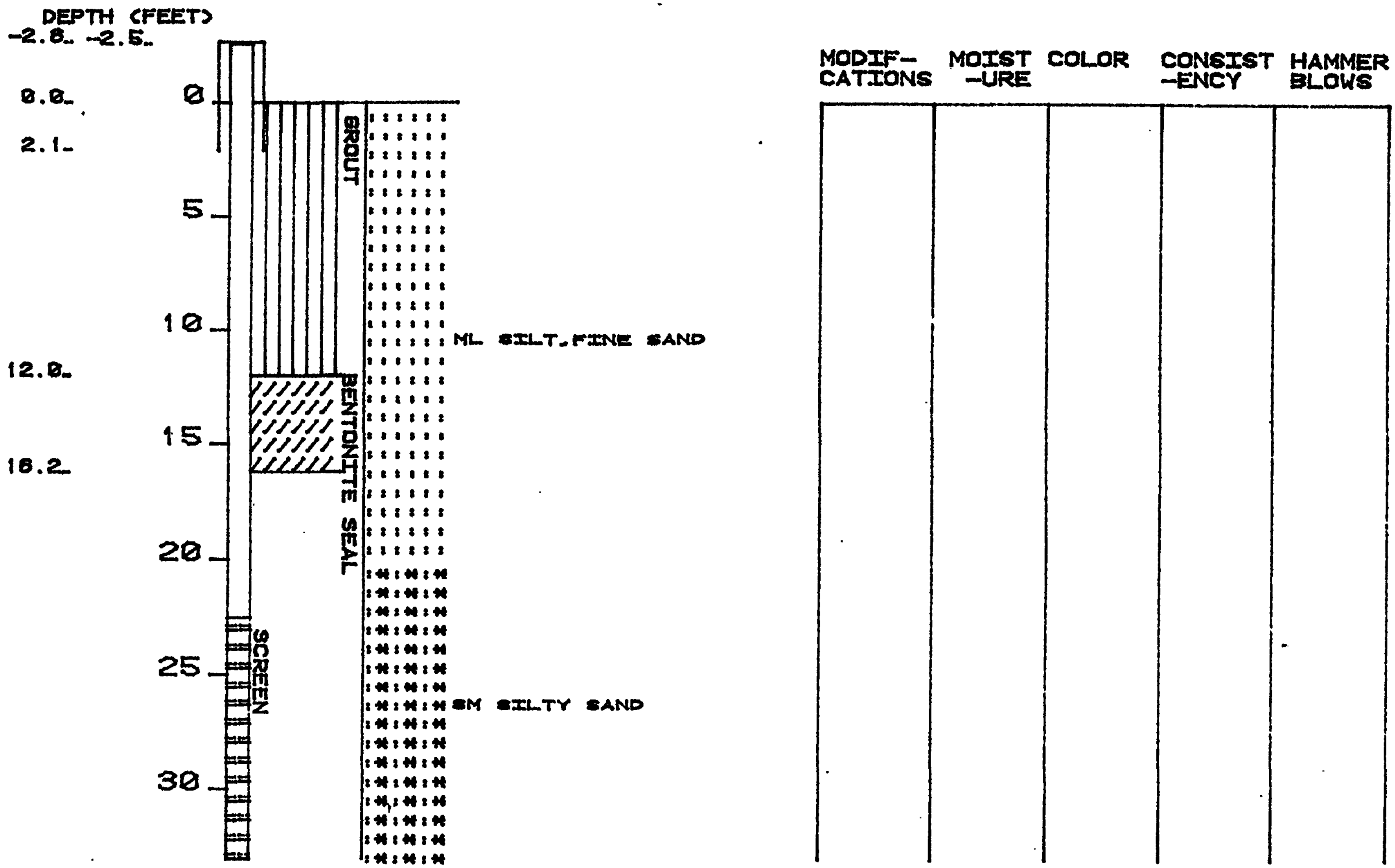
Well No. G-85

Aquifer ______

Depth Interval ______

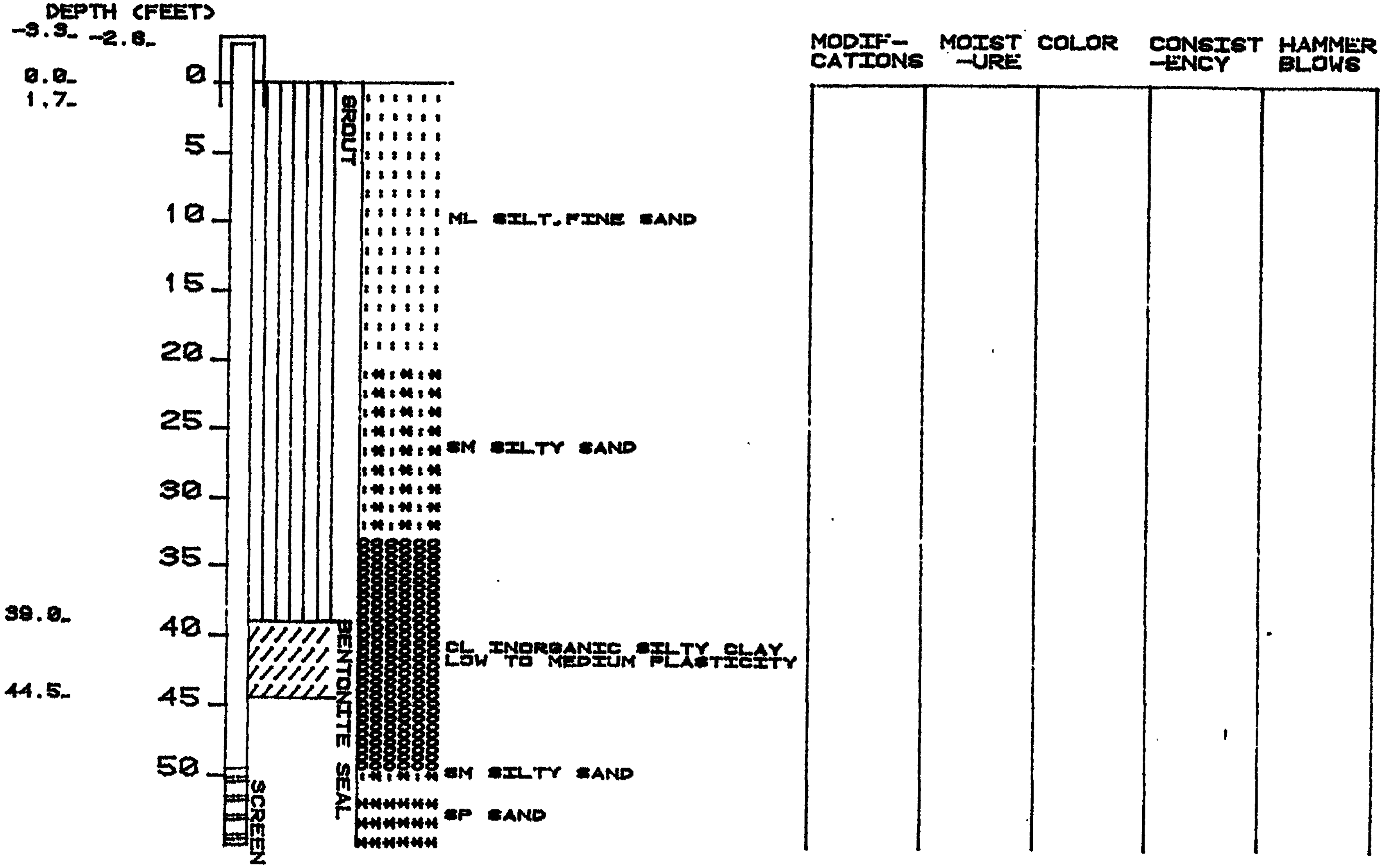


Elevation of top of surface casing / riser pipe.	N/A
Height of top of surface casing / riser pipe above ground surface	2.8 ft
Depth of surface seal below ground surface	2.2 ft
Type of surface seal: Sac-crete	
I.D. of surface casing.	6 inch
Type of surface casing: Steel	
Depth of surface casing below ground	2.2 ft
I.D. of riser pipe.	3 inch
Type of riser pipe: Sched 40 PVC	
Diameter of borehole	6 inch
Depth of borehole	32.5 ft
Type of backfill: Cement Bentonite	
Elev./depth top of seal.	18.0
Type of seal: Bentonite Pi Pellets	
Elev./depth bottom of seal.	19.0
Type of sand pack. No. 375 Sand	
Depth of top of sand pack.	21.0 ft
Elev./depth top of screened section.	22.5 ft
Type of screened section: Sched 40 PVC	
Discribe openings 10 Slot manufactured Screen	
I.D. of screened section.	3 inch
Elev./depth bottom of screened section.	32.5 ft
Length of blank section.	0.0 ft
Elev./depth bottom of plugged blank section.	32 ft
Elev./depth bottom of sand column.	N/A
Type of backfill below observation pipe. N/A	
Elev./depth of hole.	32.5 ft



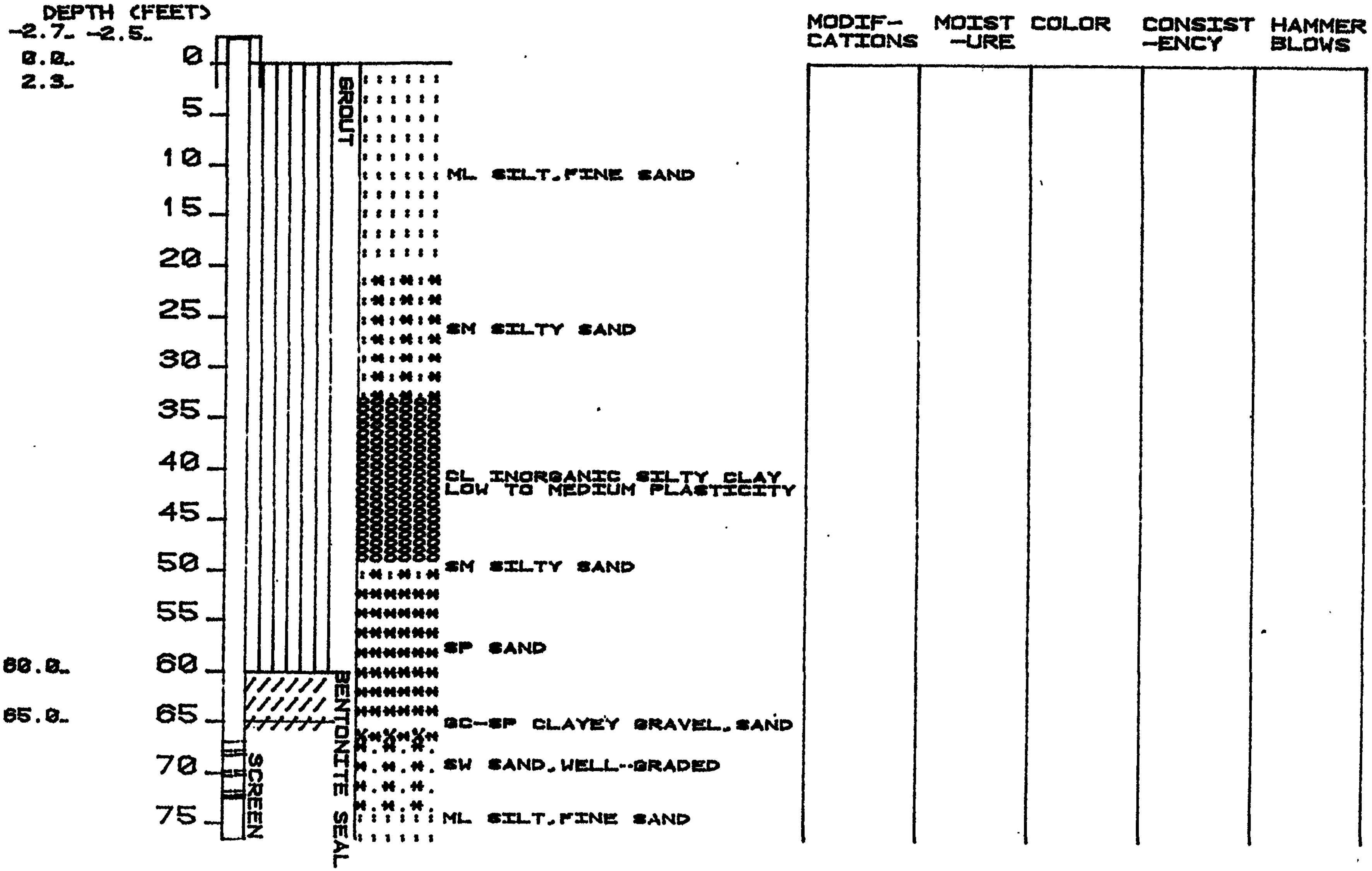
FIELD BORING PROFILE FOR STATION: LOG0104

DATE COMPLETED: 4/29/86
WELL DIAMETER: 4"
DRILLING METHOD: ROTARY
DEVELOPEMENT:



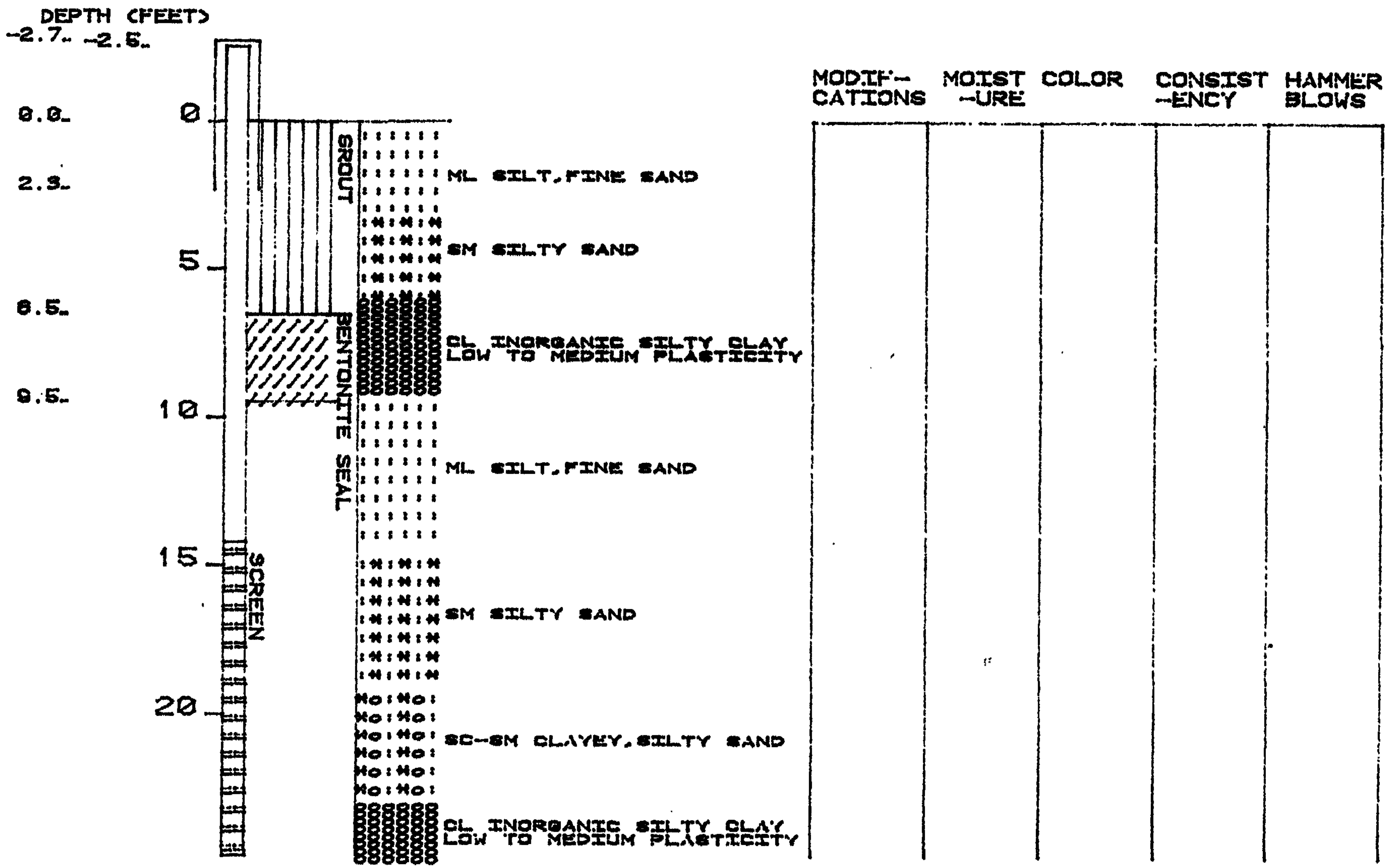
FIELD BORING PROFILE FOR STATION: LOG0105

DATE COMPLETED: 4/28/86
WELL DIAMETER: 4"
DRILLING METHOD: ROTARY
DEVELOPEMENT:



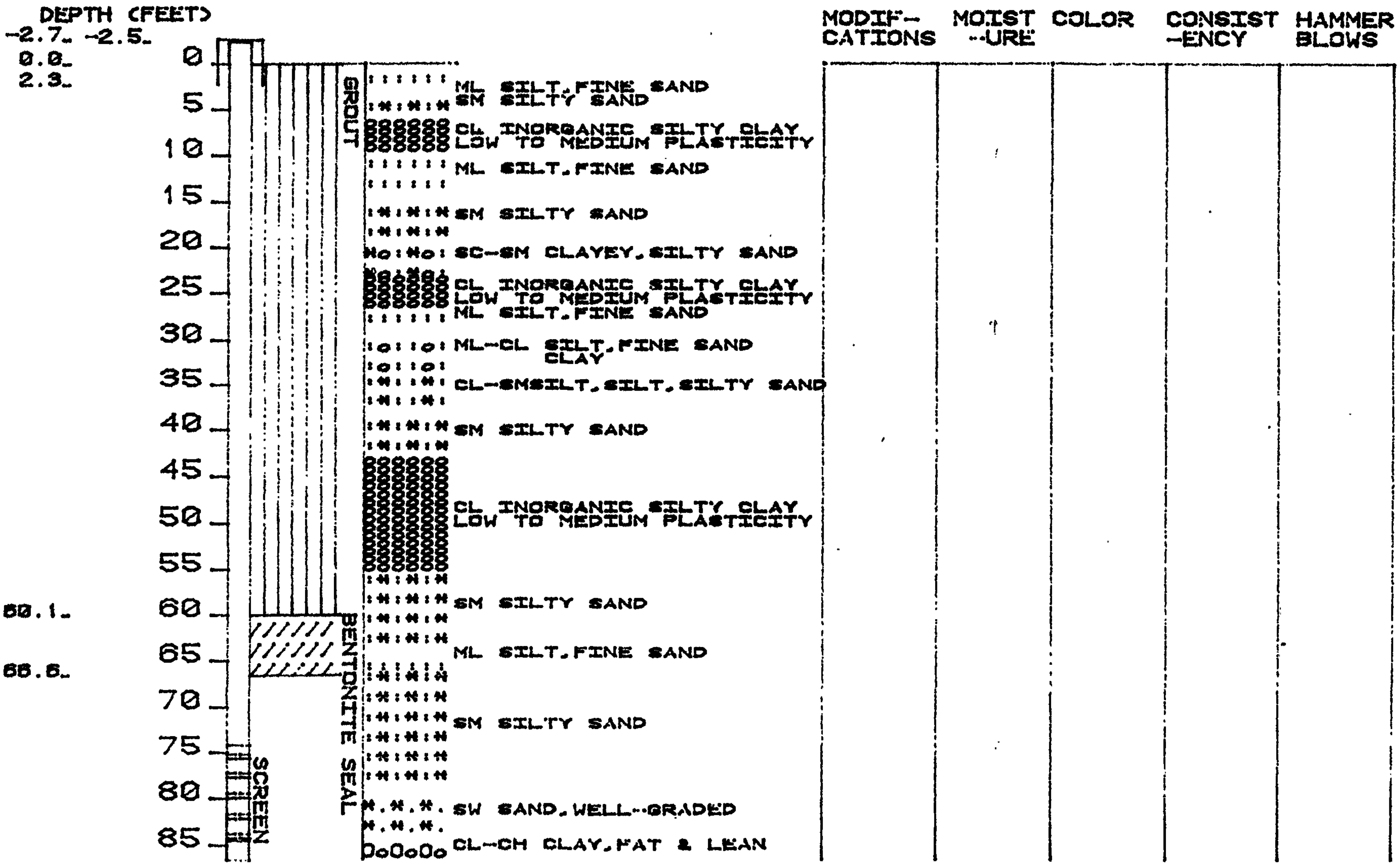
FIELD BORING PROFILE FOR STATION: LOG0106

DATE COMPLETED: 4/26/86
WELL DIAMETER: 4"
DRILLING METHOD: ROTARY
DEVELOPEMENT:



FIELD BORING PROFILE FOR STATION: LOG0109

DATE COMPLETED: 4/16/86
WELL DIAMETER: 4"
DRILLING METHOD: ROTARY
DEVELOPEMENT:



FIELD BORING PROFILE FOR STATION: LOG0110

DATE COMPLETED: 4/15/86
WELL DIAMETER: 4"
DRILLING METHOD: ROTARY
DEVELOPEMENT:

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CHAIN-OF-CUSTODY FORMS

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SAIC Science Applications International Corporation
An Employee-Owned Company

Chain of Custody Record

Date 10/12/93 Page 1 of 1

Shipment No. 001

Name John Pendleton
Address 1710 Goodridge Dr. McLean VA
Phone Number (703) 556-7038 x2011
Project Manager J. Petel
Project Name LAAD
Job/P.O. No.
Sampler (Signature) John D Pendleton (Printed Name) John Pendleton

Laboratory Name Data Chem
Address 960 West LeVoy Dr. Salt Lake City Utah 84123
Phone (801) 266-7700
Contact Name Kevin Griffith

Requested Parameters: SW 8330

Laboratory No.	Matrix	Sample No.	Date	Time	Site/Zone	SW 8330	NO. OF CONTAINERS	OBSERVATIONS, COMMENTS, SPECIAL INSTRUCTIONS
	WA	SAIC02	10/12	1510	#6	X	1	Flagging code = D
	WA	SAIC02	10/12	1510	#6	X	1	Flagging code = D
	WA	SAIC01	10/12	1645	#6	X	1	
	WA	SAIC01	10/12	1645	#6	X	1	
		CB-01					1	Coolant Blank
		CB-02					1	
						Additional sampling		Temp. = 4°C
						info attached		
								Note: No preservative

Relinquished by: John D. Pendleton (Signature)
Printed Name: John D. Pendleton
Company: SAIC
Date: 10/12/93 Time: 1800

Received by:
Signature
Printed Name
Company
Date
Time

Relinquished by
Signature
Printed Name
Company
Date
Time

Received by
Signature
Printed Name
Company
Date
Time

Total Number of Containers: 6

Shipment Method: Fed. Ex.

Instructions
1. Fill out form completely except for shaded areas (lab use only).
2. Complete in ballpoint pen. Draw one line through errors and initial.
3. Request analyses using EPA method numbers only. Consult the project QAPP for instructions. Complete as shown.
4. Reference all field QC samples to the applicable site or zone.
5. Note all applicable preservatives.
6. Group all sample containers and requested analyses from one sampling location together. Do not list individually.

SAIC Location (circle)

Washington, D.C. 1710 Goodridge Dr., McLean, VA 22102 (703) 734-2500
Oak Ridge 800 Oak Ridge Tnpk., Oak Ridge, TN 37830 (615) 482-9031
Paramus One Sears Drive, Paramus, NJ 07652 (201) 599-0100
Denver 1626 Cole Boulevard, Suite 270, Golden, CO 80401 (303) 231-9094
Seattle 13400B Northup Way, S38, Bellevue, WA 98005 (206) 747-7899
San Diego 4224 Campus Point, Building 3, San Diego, CA 92121 (619) 535-7438

Chain of Custody Record

SAIC Science Applications International Corporation
An Employee-Owned Company

Date 10/13/93 Page 1 of 1

Shipment No. 002

Name: John Pendleton
Address: 1710 Goodridge Dr. McLean Va. 22011
Phone Number: (703) 556-7038
Project Manager: J. PATEL
Project Name: LAAP
Job/P.O. No.:

Sampler (Signature): John D. Pendleton (Printed Name): John D. Pendleton

Laboratory Name: DATA CHEM
Address: 760 West Levoy Dr. Salt Lake City Utah 8412[illegible]
Phone: (801) 266-7700
Contact Name: KEVIN GRIFFITH

Requested Parameters: UW32; TEMP.

Laboratory No.	Matrix	Sample No.	Date	Time	Site/Zone	UW32	TEMP.	No. of Containers	Observations, Comments, Special Instructions
	WA	SAIC01	10/13	0645		X		2	
	WA	SAIC02	10/13	[illegible]		X		2	FLAGGING CODE = D
	WA	CB-03					X	1	TEMP. 4 °C
	WA	CB-04					X	1	

[illegible]

Total Number of Containers: 6

Shipment Method: FED. EXPRESS

Relinquished by	Date	Received by	Date
Signature: John D. Pendleton Printed Name: John D. Pendleton Company: SAIC	10/13/93 Time: 2730	Signature: Printed Name: Company:	Date: Time:
Relinquished by Signature: Printed Name: Company:	Date Time	Received by Signature: Printed Name: Company:	Date Time

Instructions

1. Fill out form completely except for shaded areas (lab use only).
2. Complete in ballpoint pen. Draw one line through errors and initial.
3. Request analyses using EPA method numbers only. Consult the project QAPP for instructions. Complete as shown.
4. Reference all field QC samples to the applicable site or zone.
5. Note all applicable preservatives.
6. Group all sample containers and requested analyses from one sampling location together. Do not list individually.

SAIC Location (circle)

Washington, D.C. (circled)
1710 Goodridge Dr., McLean, VA 22102
(703) 734-2500

Oak Ridge
800 Oak Ridge Tnpk., Oak Ridge, TN 37830
(615) 482-9031

Paramus
One Sears Drive, Paramus, NJ 07652
(201) 599-0100

Denver
1626 Cole Boulevard, Suite 270, Golden, CO 80401
(303) 231-9094

Seattle
13400B Northup Way, S38, Bellevue, WA 98005
(206) 747-7899

San Diego
4224 Campus Point, Building 3, San Diego, CA 92121
(619) 535-7438

SAIC Science Applications International Corporation
An Employee-Owned Company

Chain of Custody Record

Date 2/24/94 Page 1 of 1

Shipment No. L001

Name SAIC
Address 1710 Goodridge Drive, McLean VA 22102
Phone Number 703-719-8903
Project Manager J. Patel
Project Name Louisianna Army Ammunition Plant
Job/P.O. No. 01-0827-03-6868-008
Sampler (Signature) SAM 2/24/94 (Printed Name) SAM 2/24/94

Laboratory Name Data Chem
Address 560 West Le Voy Drive Salt Lake City, Utah 84123-2547
Phone 801-266-7700
Contact Name K. Griffith

Laboratory No.	~~Matrix~~ Site Type	Sample No.	Date	Time	~~Site/Zone~~ Field ID	Requested Parameters: Explosives-W+ (8330, Semi)												NO. OF CONTAINERS	OBSERVATIONS, COMMENTS, SPECIAL INSTRUCTIONS
	RNSW	SAIC66-01	2/24/94	9:44	#12	2												2	Matrix = WA, Depth = 0, QC Test Code = [illegible]
	WELL	SAIC01	2/24/94	12:55	G0012	2												2	Depth = 19.76
	WELL	SAIC01	2/24/94	14:35	G0014	2												2	Depth = 14.86
																			Coolant Blank Temp = 6°C

Relinquished by
Sheila Maguire
Signature
Sheila Maguire
Printed Name
SAIC
Company

Date 2/24/94
Time 6:45PM

Received by
Signature
Printed Name
Company

Date
Time

Relinquished by
Signature
Printed Name
Company

Date
Time

Received by
Signature
Printed Name
Company

Date
Time

Total Number of Containers: 6

Instructions

1. Fill out form completely except for shaded areas (lab use only).
2. Complete in ballpoint pen. Draw one line through errors and initial.
3. Request analyses using EPA method numbers only. Consult the project QAPP for instructions. Complete as shown.
4. Reference all field QC samples to the applicable site or zone.
5. Note all applicable preservatives.
6. Group all sample containers and requested analyses from one sampling location together. Do not list individually.

Shipment Method:

SAIC Location (circle)

Washington, D.C.
1710 Goodridge Dr., McLean, VA 22102
(703) 734-2500

Oak Ridge
800 Oak Ridge Tnpk., Oak Ridge, TN 37830
(615) 482-9031

Paramus
One Sears Drive, Paramus, NJ 07652
(201) 599-0100

Denver
1626 Cole Boulevard, Suite 270, Golden, CO 80401
(303) 231-9094

Seattle
13400B Northup Way, S38, Bellevue, WA 98005
(206) 747-7899

San Diego
4224 Campus Point, Building 3, San Diego, CA 92121
(619) 535-7438

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White: Laboratory *Pink: Project Manager* *Yellow: Project QAO* *Goldenrod: Field Project Manager*

Chain of Custody Record

SAIC

COC No.: L002

Page 1 of 1 Date: 2/25/94

Name Science Applications International Corporation
Address 1710 Goodridge Dr., McLean, VA 22102
Phone Number (703)-749-8903
Project Manager Janardan Patel
Project Name Louisiana Army Ammunition Plant
Job/P.O. No. 01-0827-03-6868-008
Sampler (Signature) (Printed Name) Janardan Patel

Laboratory Name DATACHEM LABORATORIES
Address 960 West LeVoy Drive
Salt Lake City, Utah 84123-2547
Phone (801)-266-7700
Fax (801)-268-9992
Contact Kevin Griffith

Requested Parameters

Laboratory No.	Site ID	Field Sample #	Site Type	Depth	Date	Time	Matrix	Exp-WA (1)(A)	NO. OF CONTAINERS	OBSERVATIONS, COMMENTS SPECIAL INSTRUCTIONS
	#9	SAICRB-02	RNSW	0	2/25/94	9:15	WA	2	2	QC Test Code = R
	G0009	SAIC01	WELL	18.19	2/25/94	12:17	WA	2	2	
	G0084	SAIC01	WELL	21.6	2/25/94	13:17	WA	2	2	Flagging Code = D
	G0084	SAIC01	WELL	21.6	2/25/94	13:10	WA	2	2	
	G0083	SAIC01	WELL	19.8	2/25/94	13:43	WA	4	4	QC Test Code = N (MS/MSD)
	G0083	SAIC01	WELL	19.8	2/25/94	13:43	WA	2	2	

Total Number of Containers: 14

Relinquished by	Date	Received by	Date
Signature: Sheila Maguire	2/25/94	Signature:	
Printed Name: Sheila Maguire	Time: 1515	Printed Name:	Time:
Company: SAIC		Company:	
Relinquished by	Date	Received by	Date
Signature:		Signature:	
Printed Name:	Time:	Printed Name:	Time:
Company:		Company:	

Notes:
1. UW25, UW27

A. Cool 4°

Instructions:
Shaded areas to be completed by lab

Shipment Method: Federal Express
Airbill No.: 4214010360
Custody Seal 1 No.: L002A
Custody Seal 2 No.: L002B
Field COC No.s: NA
NA
NA
NA
NA
NA

Temperature Blank
Field: 5 °C
Lab:

SAIC Location
Washington, D.C.
1710 Goodridge Drive, McLean, VA 22102
(703) 827-4856

Chain of Custody Record

SAIC

COC No.: L003

Page 1 of 1 Date: 2/28/94

Name Science Applications International Corporation
Address 1710 Goodridge Dr., McLean, VA 22102
Phone Number (703)-749-8903
Project Manager Janardan Patel
Project Name Louisiana Army Ammunition Plant
Job/P.O. No. 01-0827-03-6868-008
Sampler (Signature) [signature] (Printed Name) John D. Pendleton

Laboratory Name DATACHEM LABORATORIES
Address 960 West LeVoy Drive
Salt Lake City, Utah 84123-2547
Phone (801)-266-7700
Fax (801)-268-9992
Contact Kevin Griffith

Requested Parameters

Laboratory No.	Site ID	Field Sample #	Site Type	Depth	Date	Time	Matrix	Exp-WA (1)(A)	TEMP. JDP	No. of Containers	Observations, Comments, Special Instructions
	G0110	SAICRB-03	WELL	0	2/28/94	13:37	WA	2		2	QC Test Code=R
	G0110	SAIC01	WELL	32	2/28/94	14:34	WA	2		2	
	G0105	SAIC01	WELL	25	2/28/94	17:55	WA	2		2	
	G0109	SAIC01	WELL	23	2/28/94	14:10	WA	2		2	
									JDP X	1	
											TEMP-JDP
											9

Total Number of Containers: ~~8~~ 9 JDP

Relinquished by	Date	Received by	Date
Signature: [signature]	2/28/94	Signature:	
Printed Name: John D Pendleton	Time: 1910	Printed Name:	Time:
Company: SAIC		Company:	

Relinquished by	Date	Received by	Date
Signature:		Signature:	
Printed Name:	Time:	Printed Name:	Time:
Company:		Company:	

Notes:
1. UW25, UW27

A. Cool 4°

Instructions:
Shaded areas to be completed by lab

Shipment Method: Federal Express
Airbill No.: 4214010371
Custody Seal 1 No.: L003A
Custody Seal 2 No.: L003B
Field COC No.s: NA
NA
NA
NA
NA
NA

Temperature Blank
Field: 5 °C
Lab:

SAIC Location
Washington, D.C.
1710 Goodridge Drive, McLean, VA 22102
(703) 827-4856

Science Applications International Corporation *White: Laboratory* *Pink: Project Manager* *Yellow: Project QAO* *Goldenrod: Field Project Manager*

Chain of Custody Record

SAIC

COC No.: L004

Page 1 of 1 Date: 3/1/94

Name Science Applications International Corporation
Address 1710 Goodridge Dr., McLean, VA 22102
Phone Number (703)-749-8903
Project Manager Janardan Patel
Project Name Louisiana Army Ammunition Plant
Job/P.O. No. 01-0827-03-6868-008

Sampler (Signature) [signature] (Printed Name) John D. Pendleton

Laboratory Name DATACHEM LABORATORIES
Address 960 West LeVoy Drive
Salt Lake City, Utah 84123-2547
Phone (801)-266-7700
Fax (801)-268-9992
Contact Kevin Griffith

Requested Parameters

Laboratory No.	Site ID	Field Sample #	Site Type	Depth	Date	Time	Matrix	Exp-WA (1)(A)	TEMP.	NO. OF CONTAINERS	OBSERVATIONS, COMMENTS SPECIAL INSTRUCTIONS
	GO-146	SAICRB-004	RSNW	0	3/1/94	14:10	WA	2		2	QC Test Code=R
	GO-146	SAIC01	WELL	22	3/1/94	14:46	WA	2		2	
	G0106	SAIC01	WELL	57	3/1/94	16:35	WA	2		2	
	G0068	SAIC01	WELL	16	3/1/94	16:48	WA	2		2	
	CB-08				3/1/94		WA		1	1	

Total Number of Containers: 9

Relinquished by	Date	Received by	Date
Signature: [signature]	3/1/94	Signature:	
Printed Name: John D. Pendleton	Time: 1930	Printed Name:	Time:
Company: SAIC		Company:	

Relinquished by	Date	Received by	Date
Signature:		Signature:	
Printed Name:	Time:	Printed Name:	Time:
Company:		Company:	

Notes:
1. UW25, UW27

A. Cool 4°

Instructions:
Shaded areas to be completed by lab

Shipment Method: Federal Express
Airbill No.: 4214010570
Custody Seal 1 No.: L004A
Custody Seal 2 No.: L004B
Field COC No.s: NA
NA
NA
NA
NA
NA

Temperature Blank
Field: 3 °C
Lab:

SAIC Location
Washington, D.C.
1710 Goodridge Drive, McLean, VA 22102
(703) 827-4856

Chain of Custody Record

SAIC

COC No.: L005

 Date: 3/2/94

Name Science Applications International Corporation
Address 1710 Goodridge Dr., McLean, VA 22102
Phone Number (703)-749-8903
Project Manager Janardan Patel
Project Name Louisiana Army Ammunition Plant
Job/P.O. No. 01-0827-03-6868-008
Sampler (Signature) [signature] (Printed Name) John D. Pendleton

Laboratory Name DATACHEM LABORATORIES
Address 960 West LeVoy Drive
Salt Lake City, Utah 84123-2547
Phone (801)-266-7700
Fax (801)-268-9992
Contact Kevin Griffith

Laboratory No.	Site ID	Field Sample #	Site Type	Depth	Date	Time	Matrix	Exp-WA (1)(A)	TEMP	No. of Containers	Observations, Comments, Special Instructions
	GO-145	SAIC01	RSNW	0	3/2/94	12:15	WA	2		2	QC Test Code = R
	GO-145	SAIC01	WELL	20	3/2/94	12:25	WA	2		2	
	G0104	SAIC01	WELL	18	3/2/94	12:40	WA	2		2	
	G0104	SAIC01	WELL	18	3/2/94	12:40	WA	2		2	Flagging Code = D
		CB-09		~~18~~ 0 JDP 3/2/94	3/2/94		WA		1	1	

Total Number of Containers: 9

Relinquished by	Date	Received by	Date
Signature: [signature]	3/2/94	Signature:	
Printed Name: John D. Pendleton	Time: 1910	Printed Name:	Time:
Company: SAIC		Company:	

Relinquished by	Date	Received by	Date
Signature:		Signature:	
Printed Name:	Time:	Printed Name:	Time:
Company:		Company:	

Notes:
1. UW25, ~~UW27~~ JDP 3/2/94

A. Cool 4°

Instructions:
Shaded areas to be completed by lab

Shipment Method: Federal Express
Airbill No.: 4214010592
Custody Seal 1 No.: L005A
Custody Seal 2 No.: L005B
Field COC No.s: NA
NA
NA
NA
NA
NA

Temperature Blank
Field: 5 °C
Lab:

SAIC Location
Washington, D.C.
1710 Goodridge Drive, McLean, VA 22102
(703) 827-4856

Science Applications International Corporation *White: Laboratory* *Pink: Project Manager* *Yellow: Project QAO* *Goldenrod: Field Project Manager*

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SAIC

Chain of Custody Record

COC No.: L006

Page 1 of 1 Date: 3/3/94

Name Science Applications International Corporation
Address 1710 Goodridge Dr., McLean, VA 22102
Phone Number (703)-749-8903
Project Manager Janardan Patel
Project Name Louisiana Army Ammunition Plant
Job/P.O. No. 01-0827-03-6868-008

Sampler (Signature) John D. Pendleton (Printed Name) John D. Pendleton

Laboratory Name DATACHEM LABORATORIES
Address 960 West LeVoy Drive
Salt Lake City, Utah 84123-2547
Phone (801)-266-7700
Fax (801)-268-9992
Contact Kevin Griffith

Requested Parameters

Laboratory No.	Site ID	Field Sample #	Site Type	Depth	Date	Time	Matrix	Exp-WA (1)(A)	TEMP	NO. OF CONTAINERS	OBSERVATIONS, COMMENTS SPECIAL INSTRUCTIONS
	GO-150	SAICRB-006	RSNW	0	3/3/94	15:05	WA	2		2	QC Test Code = R
	GO-150	SAIC01	WELL	14	3/3/94	15:15	WA	2		2	
	GO-151	SAIC01	WELL	15	3/3/94	16:30	WA	2		2	
	G0085	SAIC01	WELL	20	3/3/94	9:55	WA	2		2	
		CB-10			3/3/94		WA		1	1	

Total Number of Containers: 9

Relinquished by	Date	Received by	Date
Signature: John D. Pendleton	3/3/94	Signature:	
Printed Name: John D. Pendleton	Time: 1950	Printed Name:	Time:
Company: SAIC		Company:	

Relinquished by	Date	Received by	Date
Signature:		Signature:	
Printed Name:	Time:	Printed Name:	Time:
Company:		Company:	

Notes:
1. UW25, ~~UW27~~ 3/3/94 JDP

A. Cool 4°

Instructions:
Shaded areas to be completed by lab

Shipment Method: Federal Express
Airbill No.: 4214010485
Custody Seal 1 No.: L006A
Custody Seal 2 No.: L006B
Field COC No.s: NA
NA
NA
NA
NA
NA

Temperature Blank
Field: 4 °C
Lab:

SAIC Location
Washington, D.C.
1710 Goodridge Drive, McLean, VA 22102
(703) 827-4856

Science Applications International Corporation *White: Laboratory* *Pink: Project Manager* *Yellow: Project QAO* *Goldenrod: Field Project Manager*

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APPENDIX C

GROUNDWATER CONCENTRATION DATA TABLES AND BAR CHARTS

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APPENDIX C

GROUNDWATER CONCENTRATION DATA TABLES AND BAR CHARTS

This appendix contains groundwater concentration data tables for the sampling events from January 1980 through March 1994. Data are presented for the following nine contaminants of concern (COCs):

- RDX
- HMX
- 2,4,6-trinitrotoluene (2,4,6-TNT)
- 1,3-dinitrobenzene (1,3-DNB)
- 2,4-dinitrotoluene (2,4-DNT)
- 2,6-dinitrotoluene (2,6-DNT)
- 1,3,5-trinitrobenzene (1,3,5-TNB)
- nitrobenzene (NB), and
- Tetryl.

The health advisory level (HAL) for each of these COCs is included in these tables. The concentration levels below the instrument detection limits (IDLs) are shaded in the tables.

Bar charts are provided for those COCs that exceed the HALs. For the sake of clarity, each bar chart was limited to around 35 data points (number of sampling events times number of COCs). For example, GO009 has 17 sampling events; therefore, only two COCs were presented on one bar chart. Also, COCs with similar concentration ranges were grouped together and presented on the same bar chart for better definition of concentration levels. Some of the COCs had data for selected sampling events; these COCs were presented together also. A sampling event was not included in the bar charts if no contaminants were detected during that event.

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TABLE C–1
Groundwater Sampling Data for Area P, LAAP
Concentration in Upper Terrace Aquifer
Units: ug/L

07–Jul–94

Analyte	Health Advisory Level	GO009 (Jan 1980)	GO009 (Dec 1981)	GO009 (July 1982)	GO009 (Aug 1982)	GO009 (Dec 1982)	GO009 (Feb 1983)	GO009 (June 1983)	GO009 (Aug 1983)	GO009 (Dec 1983)	GO009 (Mar. 1984)	GO009 (June 1984)	GO009 (Aug. 1984)	GO009 (Dec 1984)	GO009 (Mar. 1985)	GO009 (July 1986)	GO009 (Oct 1990)	GO009 (Feb 1994)
RDX	2	1580	1720	3460	3540	4900	1660	908	800	380	730	670	390	440	2560	410	558.2	430
HMX	400	--	--	168	--	240	110	100	100	100	300	100	100	100	100	33.8	48.3	26
1,3,5 TNB	3.5	--	90.6	--	--	--	--	--	--	--	--	--	--	--	--	8.5	31.1	29
2,4 DNT	1000	9	6.32	50	47	100	100	100	100	100	10	6	8	7	6	3.58	2.4	37
1,3 DNB	1	--	5	--	--	--	--	--	--	--	--	--	--	--	--	--	0.7	0.46
2,6 DNT	1000	3	1.6	50	8	100	100	100	100	100	100	1	1	1	1	0.55	1.15	0.6
2,4,6 TNT	2	200	273	690	870	410	200	290	260	195	220	200	302	220	192	130	55.6	28
TETRYL	430	5	22.8	50	--	100	100	100	100	100	50	10	10	16	15	0.66	1.5	0.63
NB	3.5	--	2.1	--	--	--	--	--	--	--	--	--	--	--	--	--	1.07	0.68

Note: Shaded areas represent instrument detection limit (LT)

TABLE C-2
Groundwater Sampling Data for Area P, LAAP
Concentration in Upper Terrace Aquifer
Units: ug/L

Analyte	Health Advisory Level	GO-012 (Jan 1980)	GO-012 (Dec 1981)	GO-012 (July 1982)	GO-012 (Aug 1982)	GO-012 (Dec 1982)	GO-012 (Mar. 1983)	GO-012 (May 1983)	GO-012 (Aug 1983)	GO-012 (Dec 1983)	GO-012 (Mar 1984)	GO-012 (June 1984)	GO-012 (Aug 1984)	GO-012 (Dec 1984)	GO-012 (Mar 1985)	GO-012 (July 1986)	GO-012 (Oct 1990)	GO-012 (Feb 1994)
RDX	2	10500	4500 52	5650	3670	2500	1960	7600	5500	100	14500	7740	5200	13600	43200	3700	2700	3100
HMX	400	--	--	153	110	100	8850	100	100	100	220	280	250	523	680	86	82	110
1,3,5 TNB	3.5	--	146 109	--	--	--	--	--	--	--	--	--	--	--	--	240	67	950
2,4 DNT	1000	183	105 102.73	97	84	100	100	100	130	100	76	210	137	349	337	89	40.2	120
1,3 DNB	1	--	135 65 10	--	--	--	--	--	--	--	--	--	--	--	--	64	42	35
2,6 DNT	1000	48	43.2 10	50	120	100	400	100	200	18.3	271	62	32	32	44	18.3	11.4	32.3
2,4,6 TNT	2	4460	2436.97 92	2540	1430	850	10700	2230	2600	100	6220	6230	2630	10600	12700	3100	760	3700
TETRYL	430	15	6.6	160	100	100	100	100	1500	100	50	10	10	--	38	6.2	0.556	6.3
NB	3.5	--	2.1	--	--	--	--	--	--	--	--	--	--	--	--	1.13	1.07	12.3

Note: Shaded areas represent instrument detection limit (LT)

TABLE C-3
Groundwater Sampling Data for Area P, LAAP
Concentration in Upper Terrace Aquifer
Units: ug/L

07-Jul-94

Analyte	Health Advisory Level	GO014 (Jan 1980)	GO014 (Dec 1981)	GO014 (June 1982)	GO014 (Aug 1982)	GO014 (Dec 1982)	GO014 (Mar 1983)	GO014 (June 1983)	GO014 (Aug 1983)	GO014 (Feb 1984)	GO014 (May 1984)	GO014 (Sep 1984)	GO014 (Nov 1984)	GO014 (Mar 1985)	GO014 (July 1986)	GO014 (Oct 1990)	GO014 (Feb 1994)
RDX	2	50	53.4	100	100	100	110	877	1500	57	300	170	150	1300	16.4	33.8	14.4
HMX	400	--	--	--	--	100	100	665	100	100	100	203	100	100	4.73	6.95	2.92
1,3,5 TNB	3.5	--	2.5	--	--	--	--	--	--	--	--	--	--	--	2.05	0.626	0.429
2,4 DNT	1000	1	1.1	1	1	100	100	100	100	3	10	1	1	1	0.6	0.612	0.397
1,3 DNB	1	--	2	--	--	--	--	--	--	--	--	--	--	--	1.44	0.519	0.458
2,6 DNT	1000	1	1.6	1	1	100	100	100	100	1	10	1	1	1	0.55	1.15	0.6
2,4,6 TNT	2	1	2.5	1	2	100	100	100	100	3	10	1	20	14	0.78	0.588	0.426
TETRYL	430	5	6	--	--	100	100	100	100	10	10	10	10	10	0.66	0.556	0.631
NB	3.5	--	2.1	--	--	--	--	--	--	--	--	--	--	--	1.13	1.07	0.682

Note: Shaded area represent instrument detection limit (LT).

TABLE C–4
Groundwater Sampling Data for Area P, LAAP
Concentration in Upper Terrace Aquifer 07–Jul–94
Units: ug/L

Analyte	Health Advisory Level	GO068 (Nov 16 1981)	GO068 (Nov 19 1981)	GO068 (July 1986)	GO068 (Feb 1988)	GO068 (Oct 1990)	GO068 (Feb 1994)
RDX	2	17800	50	8200	9800	6500	2500
HMX	400	--	--	2200	1200	700	350
1,3,5 TNB	3.5	70.4 4	--	200	110	310	490
2,4 DNT	1000	55 61	--	4.81	120	100	350
1,3 DNB	1	41 62.7	--	7.65	71	60	82
2,6 DNT	1000	28 23.3	--	2.06	5.5	58	60
2,4,6 TNT	2	260 3610	--	5700	7400	5100	3600
TETRYL	430	15	--	53.4	6.6	28	31
NB	3.5	2.1	--	1.13	--	320	68

Note: Shaded areas represent instrument detection limit (LT).

TABLE C–5
Groundwater Sampling Data for Area P, LAAP
Concentration in Upper Terrace Aquifer
Units: ug/L 07–Jul–94

Analyte	Health Advisory Level	GO083 (Oct 1990)	GO083 (Feb 1994)
RDX	2	2900	1200
HMX	400	350	99
1,3,5 TNB	3.5	730	800
2,4 DNT	1000	29	95
1,3 DNB	1	0.519	5.6
2,6 DNT	1000	58	12
2,4,6 TNT	2	5300	3100
TETRYL	430	28	95
NB	3.5	1.07	14

Note: Shaded areas represent instrument detection limit (LT).

TABLE C–6
Groundwater Sampling Data for Area P, LAAP
Concentration in Upper Terrace Aquifer
Units: ug/L 23–Jun–94

Analyte	Health Advisory Level	GO084 (Oct 1990)	GO084 (Feb 1994)
RDX	2	290	120
HMX	400	11.8	14
1,3,5 TNB	3.5	550	320
2,4 DNT	1000	3.06	12
1,3 DNB	1	0.519	0.46
2,6 DNT	1000	58	12
2,4,6 TNT	2	560	250
TETRYL	430	28	5.7
NB	3.5	1.07	0.68

Note: Shaded areas represent instrument detection limit.

TABLE C–7
Groundwater Sampling Data for Area P, LAAP
Concentration in Upper Terrace Aquifer
Units: ug/L

23–Jun–94

Analyte	Health Advisory Level	GO085 (Oct 1990)	GO085 (Feb 1994)
RDX	2	7600	3800
HMX	400	1000	310
1,3,5 TNB	3.5	7300	3800
2,4 DNT	1000	130	79
1,3 DNB	1	120	32
2,6 DNT	1000	58	59
2,4,6 TNT	2	16000	4200
TETRYL	430	28	310
NB	3.5	1.07	67

Note: Shaded areas represent instrument detection limit (LT).

TABLE C-8
Groundwater Sampling Data for Area P, LAAP
Concentration in Upper Terrace Aquifer
Units: ug/L

07-Jul-94

Analyte	Health Advisory Level	GO104 (July 1986)	GO104 (Feb 1988)	GO104 (Oct 1990)	GO104 (Feb 1994)
RDX	2	14000	27000	19000 12000	8400
HMX	400	880	1100	910 750	370
1,3,5 TNB	3.5	7700	4800	6700 6100	6300
2,4 DNT	1000	0.6	770	720 660	570
1,3 DNB	1	0.61	7.8	660 660	580
2,6 DNT	1000	20.5	55	58 58	60
2,4,6 TNT	2	18000	25000	15000 15000	11000
TETRYL	430	52.4	66	28 28	130
NB	3.5	1.13	11.3	4000 3800	68

Note: Shaded areas represent instrument detection limit (LT).

TABLE C–9
Groundwater Sampling Data for Area P, LAAP
Concentration in Lower Terrace/Sparta Sand Aquifer
Units: ug/L

23–Jun–94

Analyte	Health Advisory Level	GO105 (July 1986)	GO105 (Jan 1988)	GO105 (Sep 1990)	GO105 (Feb 1994)
RDX	2	0.63	18.4	1300	330
HMX	400	1.3	2.89	210	360
1,3,5 TNB	3.5	2.2	0.56	1200	3900
2,4 DNT	1000	0.6	0.6	33	54
1,3 DNB	1	2.51	0.61	90	320
2,6 DNT	1000	4.59	2.5	6.32	60
2,4,6 TNT	2	0.78	0.78	94	17
NB	3.5	1.13	1.13	600	68
TETRYL	430	0.66	0.66	0.556	3.7

Note: Shaded areas represent instrument detection limit.

TABLE C–10
Groundwater Sampling Data for Area P, LAAP
Concentration in Lower Terrace/Sparta Sand Aquifer
Units: ug/L

07–Jul–94

Analyte	Health Advisory Level	GO106 (Oct 1990)	GO106 (Feb 1994)
RDX	2	2500	4100
HMX	400	82	53
1,3,5 TNB	3.5	370	970
2,4 DNT	1000	200	640
1,3 DNB	1	240	330
2,6 DNT	1000	29.1	60
2,4,6 TNT	2	1300	8800
TETRYL	430	0.556	63
NB	3.5	1.07	68

Note: Shaded areas represent instrument detection limit.

TABLE C-11
Groundwater Sampling Data for Area P, LAAP
Concentration in Upper Terrace Aquifer
Units: ug/L

23-Jun-94

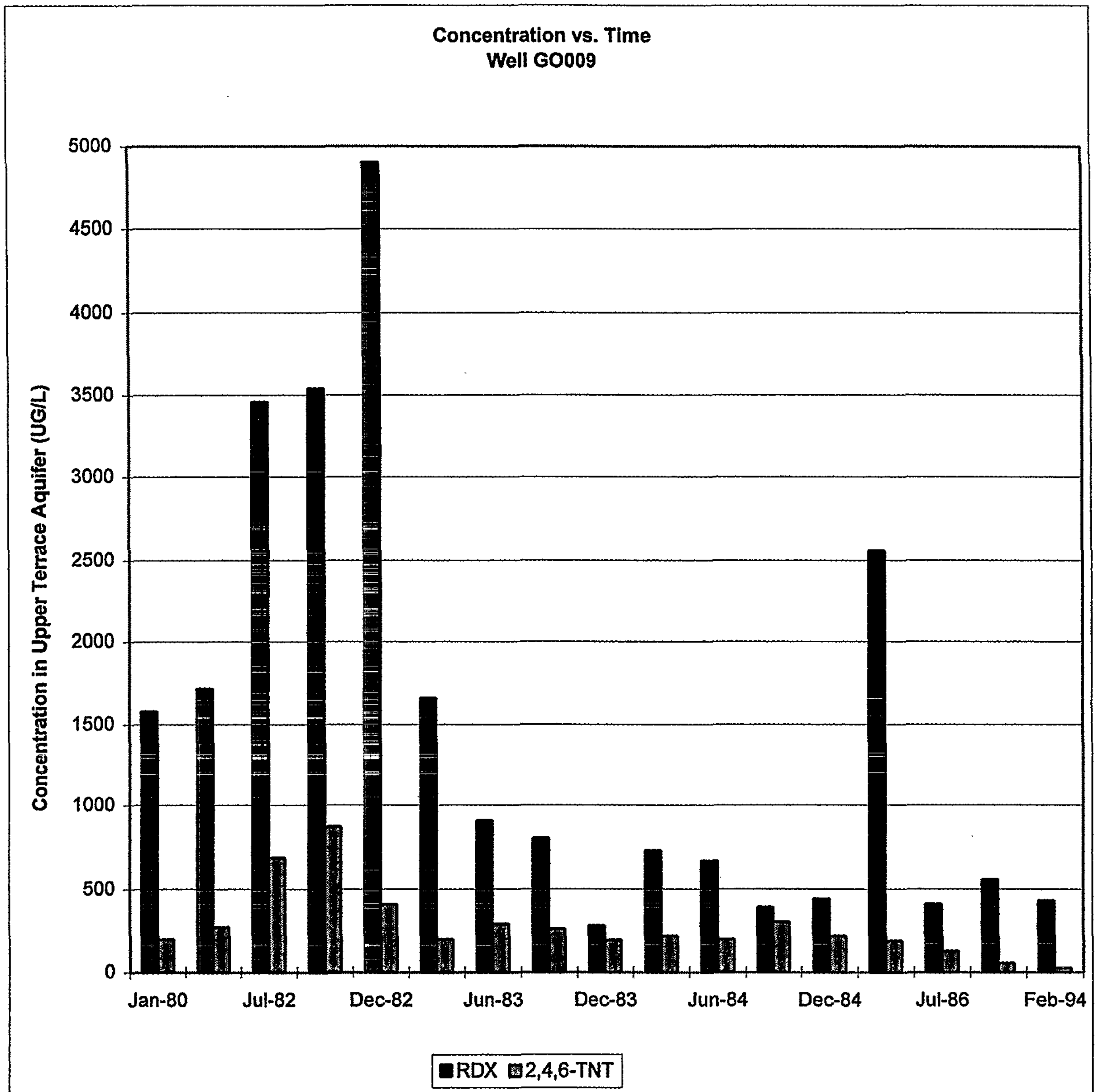
Analyte	Health Advisory Level	GO109 (July 1986)	GO109 (Jan. 1988)	GO109 (Oct 1990)	GO109 (Feb 1994)
RDX	2	3200	5600	4200	3100
HMX	400	1300	120	750	300
1,3,5 TNB	3.5	21.1	28	73	95
2,4 DNT	1000	16	19	36.3	330
1,3 DNB	1	0.61	2.05	23	8.2
2,6 DNT	1000	0.55	5.5	58	60
2,4,6 TNT	2	0.78	2900	1800	3600
TETRYL	430	1.48	6.6	28	40
NB	3.5	1.13	1.13	1.07	6.8

Note: Shaded areas represent instrument detection limit.

TABLE C–12
Groundwater Sampling Data for Area P, LAAP
Concentration in Lower Terrace/Sparta Sand Aquifer 08–Jul–94
Units: ug/L

Analyte	Health Advisory Level	GO110 (July 1986)	GO110 (Jan 1988)	GO110 (Oct 1990)	GO110 (Feb 1994)
RDX	2	785	3110	3200	2800
HMX	400	56.2	111	139.5	130
1,3,5 TNB	3.5	139	103	420	460
2,4 DNT	1000	95	226	84	120
1,3 DNB	1	20.5	49	26	24
2,6 DNT	1000	12.1	8.3	58	60
2,4,6 TNT	2	6	2060	760	570
TETRYL	430	--	--	28	0.63
NB	3.5	--	--	1.07	6.8

Note: Shaded areas represent instrument detection limit (LT)



	RDX	2,4,6-TNT
HAL	2	2
Jan-80	1580	200
Dec-81	1720	273
Jul-82	3460	690
Aug-82	3540	870
Dec-82	4900	410
Feb-83	1660	200
Jun-83	908	290
Aug-83	800	260
Dec-83	280	195
Mar-84	730	220
Jun-84	670	200
Aug-84	390	302
Dec-84	440	220
Mar-85	2560	192
Jul-86	410	130
Oct-90	558.2	55.6
Feb-94	430	28

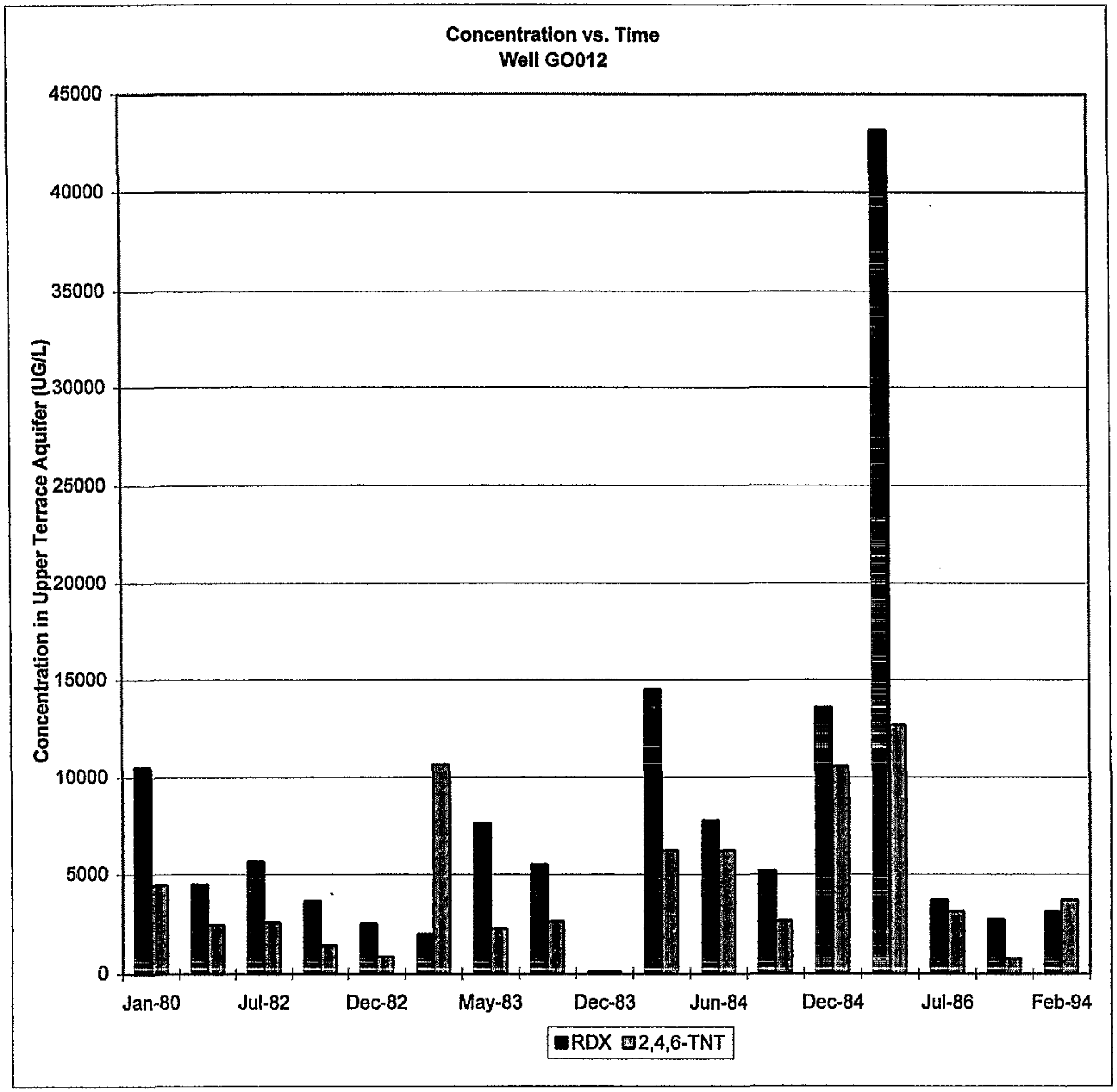
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Concentration vs. Time
Well GO009

Louisiana Army Ammunition Plant

Figure: C-1 | Project: 01-0827-03-6868-012

C-15



	RDX	2,4,6-TNT
HA	2	2
Jan-80	10500	4460
Dec-81	4500	2436.97
Jul-82	5650	2540
Aug-82	3670	1430
Dec-82	2500	850
Mar-83	1960	10700
May-83	7600	2230
Aug-83	5500	2600
Dec-83	100	100
Mar-84	14500	6220
Jun-84	7740	6230
Aug-84	5200	2630
Dec-84	13600	10600
Mar-85	43200	12700
Jul-86	3700	3100
Oct-90	2700	760
Feb-94	3100	3700

Note: Shaded area represents concentrations below detection limits.

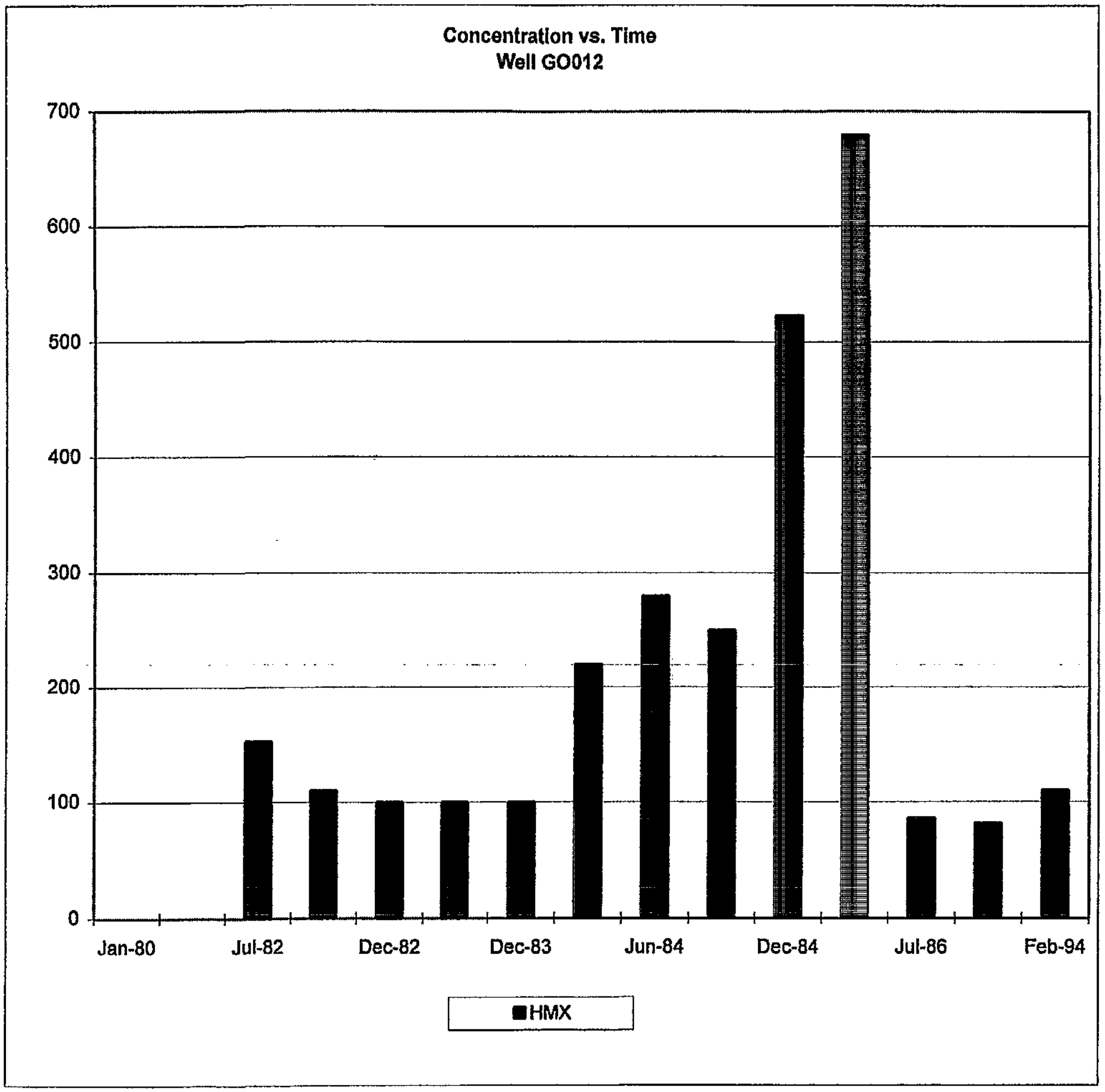
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Concentration vs. Time
Well GO012

Louisiana Army Ammunition Plant

Figure: C-3 | Project: 01-0827-03-6868-012

C-16



[illegible]	HMX [illegible]
Jan-80	NR
Dec-81	NR
Jul-82	153
Aug-82	110
Dec-82	100
May-83	100
Dec-83	100
Mar-84	220
Jun-84	280
Aug-84	250
Dec-84	523
Mar-85	680
Jul-86	86
Oct-90	82
Feb-94	110

NR - Not Reported.

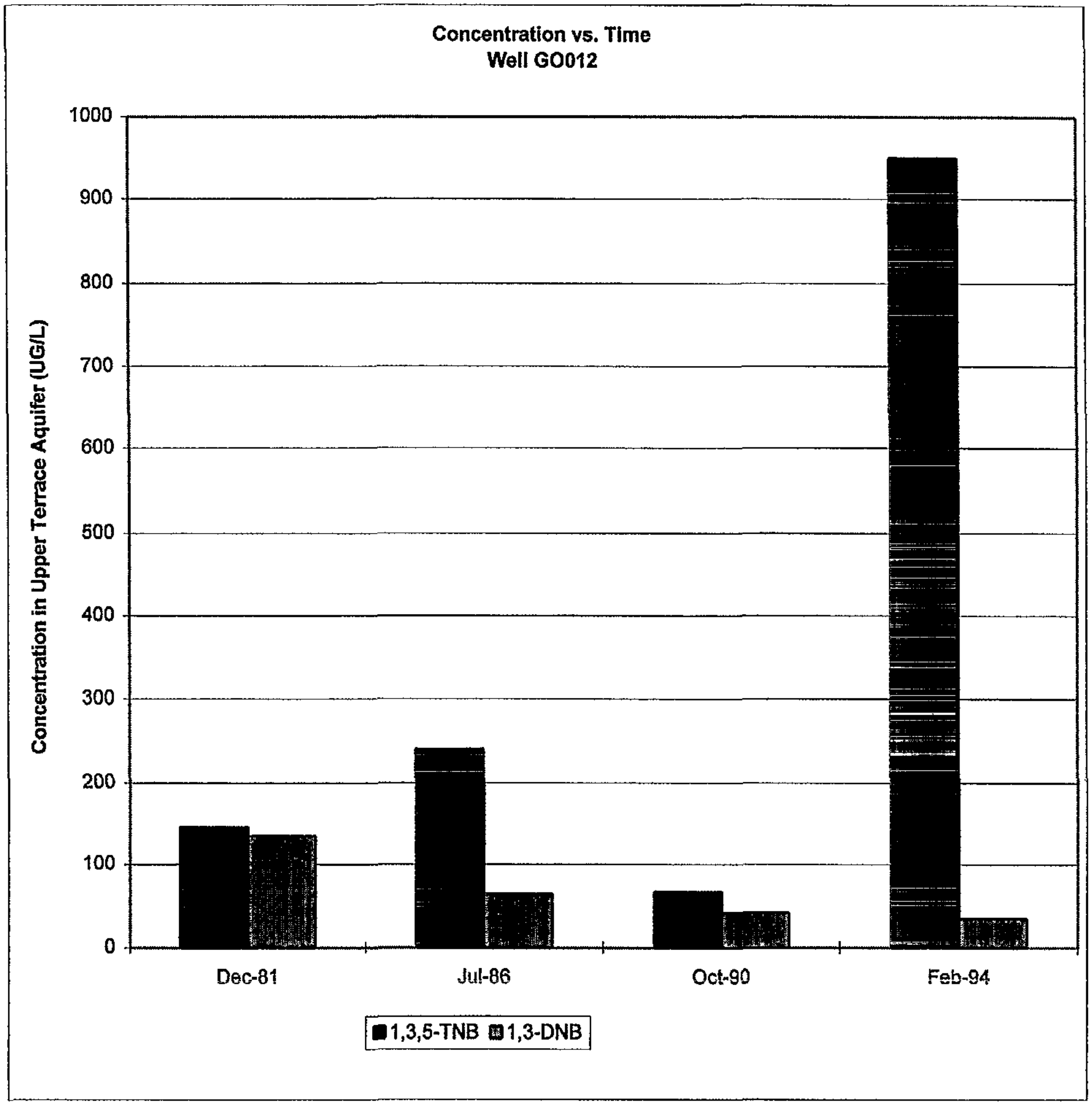
Note: Shaded area represents concentrations below detection limits. March 1983 and August 1983 data not included

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Concentration vs. Time
Well GO105

Louisiana Army Ammunition Plant

Figure: C-4 | Project: 01-0827-[illegible]-6368-[illegible]



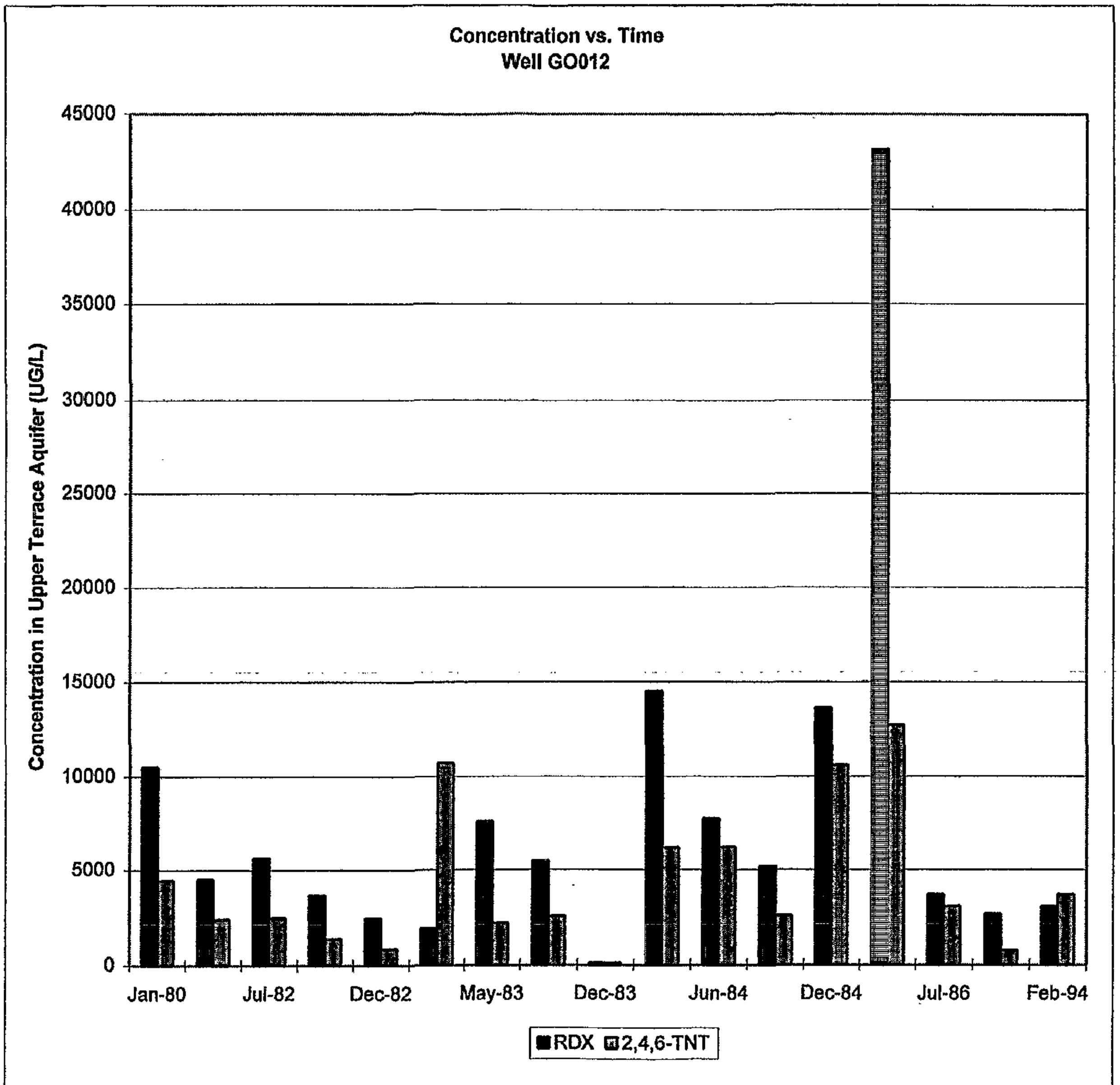
	1,3,5-TNB	1,3-DNB
HAL	3.5	[illegible]
Dec-81	146	135
Jul-86	240	64
Oct-90	67	42
Feb-94	950	35

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Concentration vs. Time
Well GO012

Louisiana Army Ammunition Plant

Figure: C-5 | Project: 01-0827-03-6868-012



[illegible]	RDX	HMX
HAL	2	400
Jan-80	50	NR
Dec-81	53.4	NR
Jun-82	100	NR
Aug-82	100	NR
Dec-82	100	100
Mar-83	110	100
Jun-83	877	665
Aug-83	1500	100
Feb-84	57	100
May-84	300	100
Sep-84	170	203
Nov-84	150	100
Mar-85	1300	100
Jul-86	16.4	4.73
Oct-90	33.8	6.95
Feb-94	14.4	2.92

Note: Shaded area represents concentrations below detection limits.

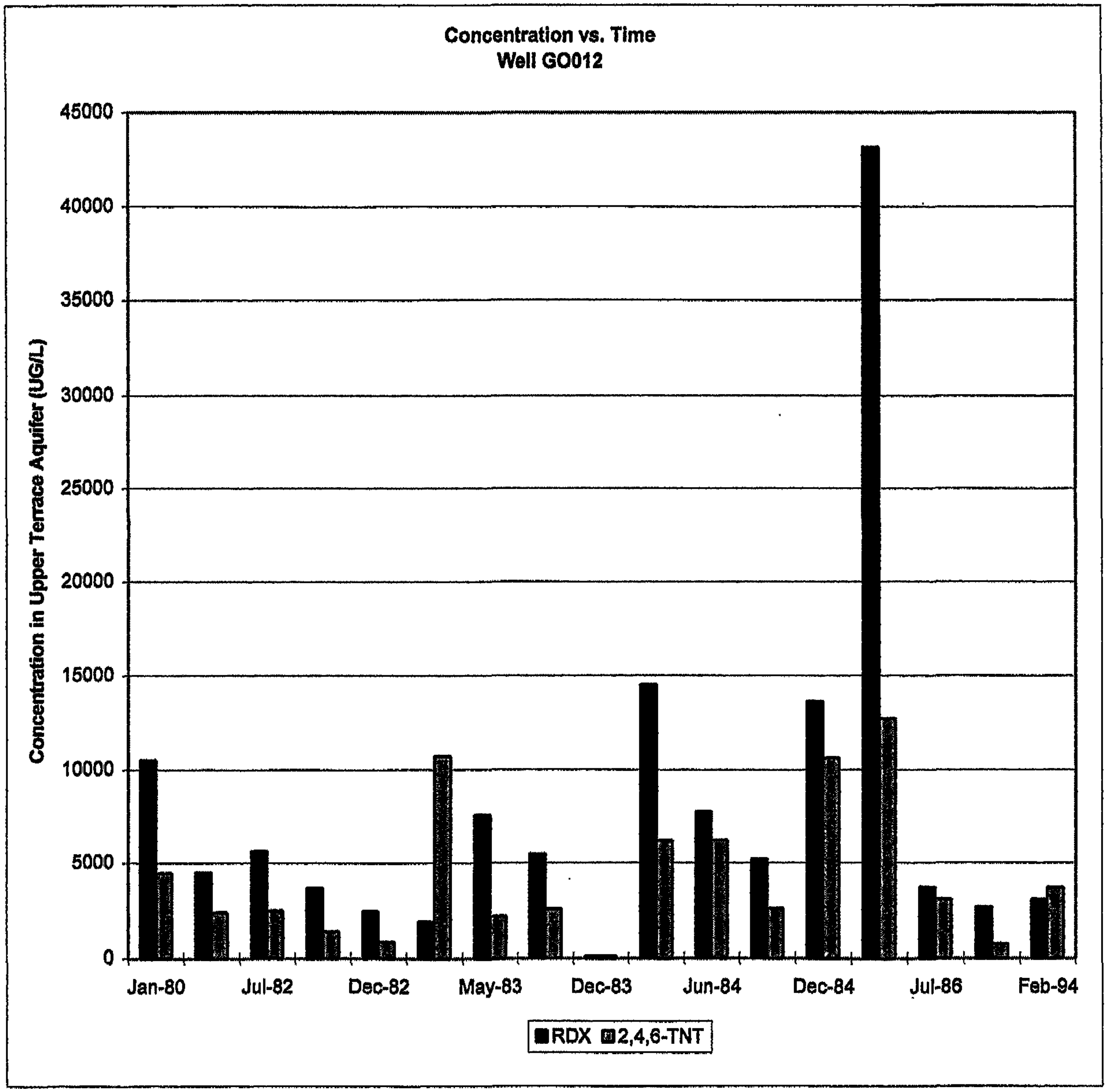
NR: Not Reported

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Concentration vs. Time
Well GO012

Louisiana Army Ammunition Plant

Figure: C-6 | Project: 01-0827-03-6868-010



	RDX	HMX
HAL	2	400
Jan-80	50	NR
Dec-81	53.4	NR
Jun-82	100	NR
Aug-82	100	NR
Dec-82	100	100
Mar-83	110	100
Jun-83	877	665
Aug-83	1500	100
Feb-84	57	100
May-84	300	100
Sep-84	170	203
Nov-84	150	100
Mar-85	1300	100
Jul-86	16.4	4.73
Oct-90	33.8	6.95
Feb-94	14.4	2.92

Note: Shaded area represents concentrations below detection limits.

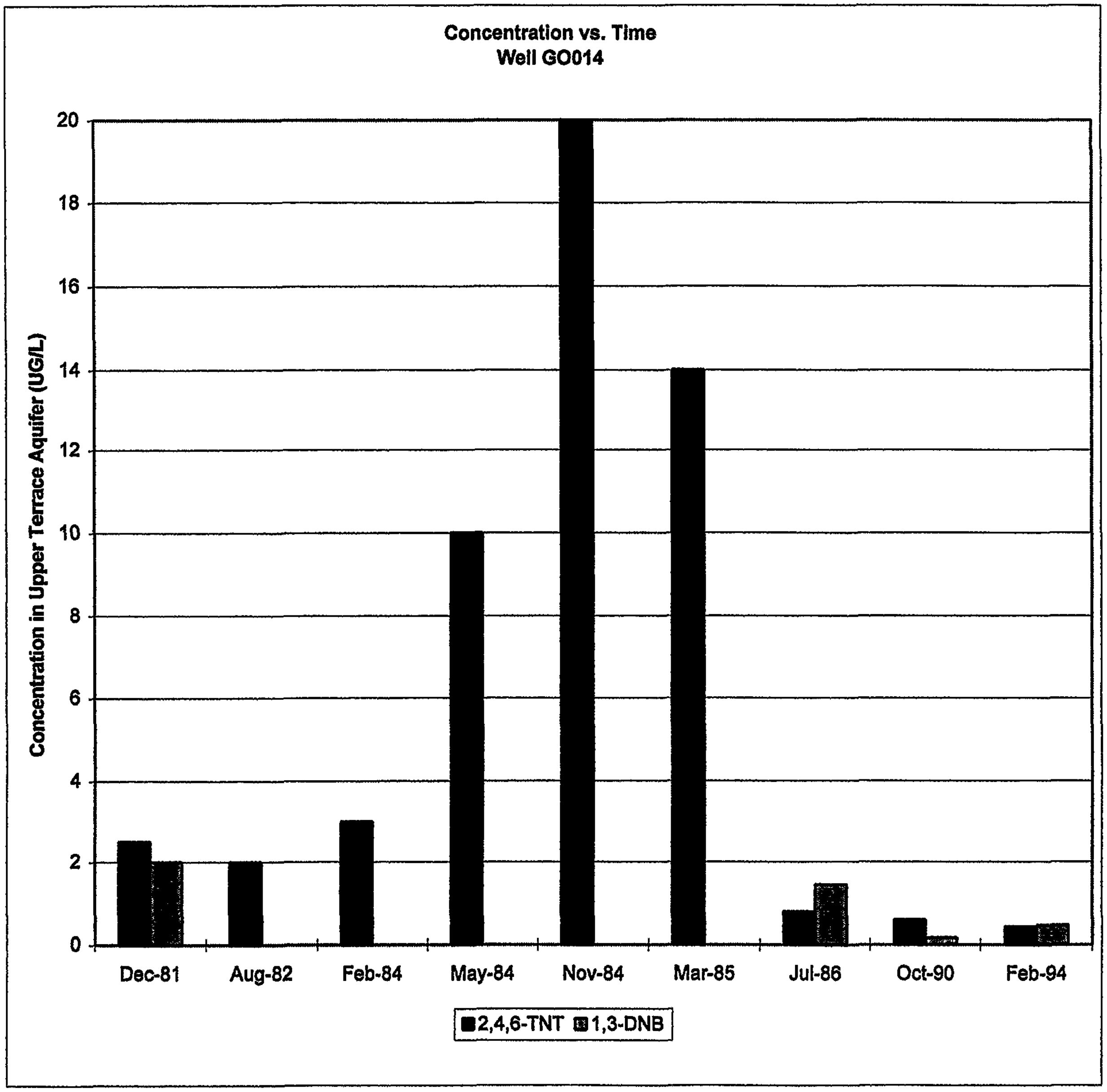
NR: Not Reported

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Concentration vs. Time
Well GO012

Louisiana Army Ammunition Plant

Figure: C-6 | Project: 01-0827-02-6868-019-



	2,4,6-TNT	1,3-DNB
DWEL	2	1
Dec-81	2.5	2
Aug-82	2	NR
Feb-84	3	NR
May-84	10	NR
Nov-84	20	NR
Mar-85	14	NR
Jul-86	0.78	1.44
Oct-90	0.588	0.159
Feb-94	0.426	0.458

NR - Not Reported.

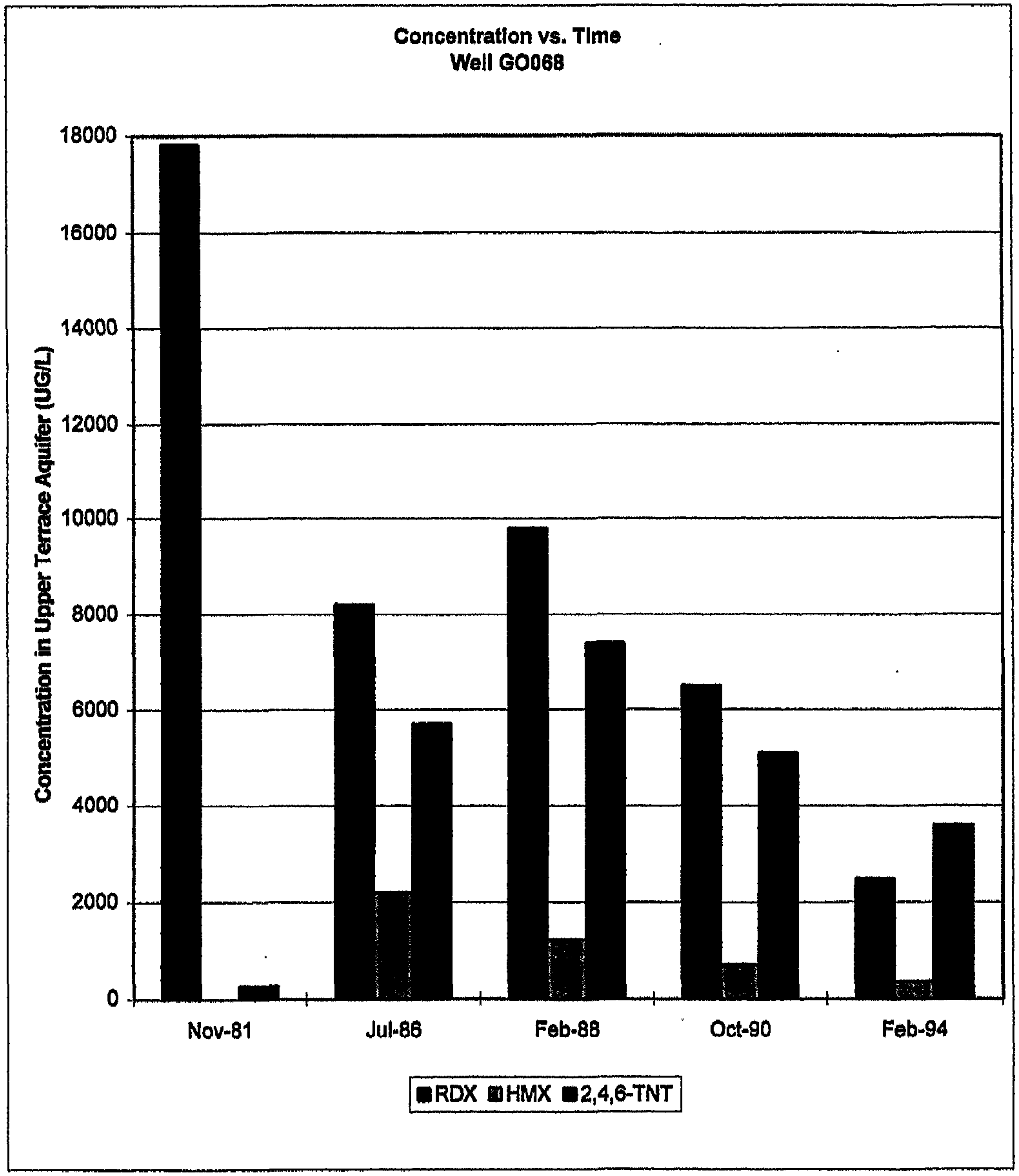
Note: Shaded area represents concentrations below detection limits.

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Concentration vs. Time
Well GO014

Louisiana Army Ammunition Plant

Figure: C-7 | Project: 01-0827-03-6868-012



	RDX	HMX	2,4,6-TNT
HA	2	400	2
Nov-81	17800	NR	260
Jul-86	8200	2200	5700
Feb-88	9800	1200	7400
Oct-90	6500	700	5100
Feb-94	2500	350	3600

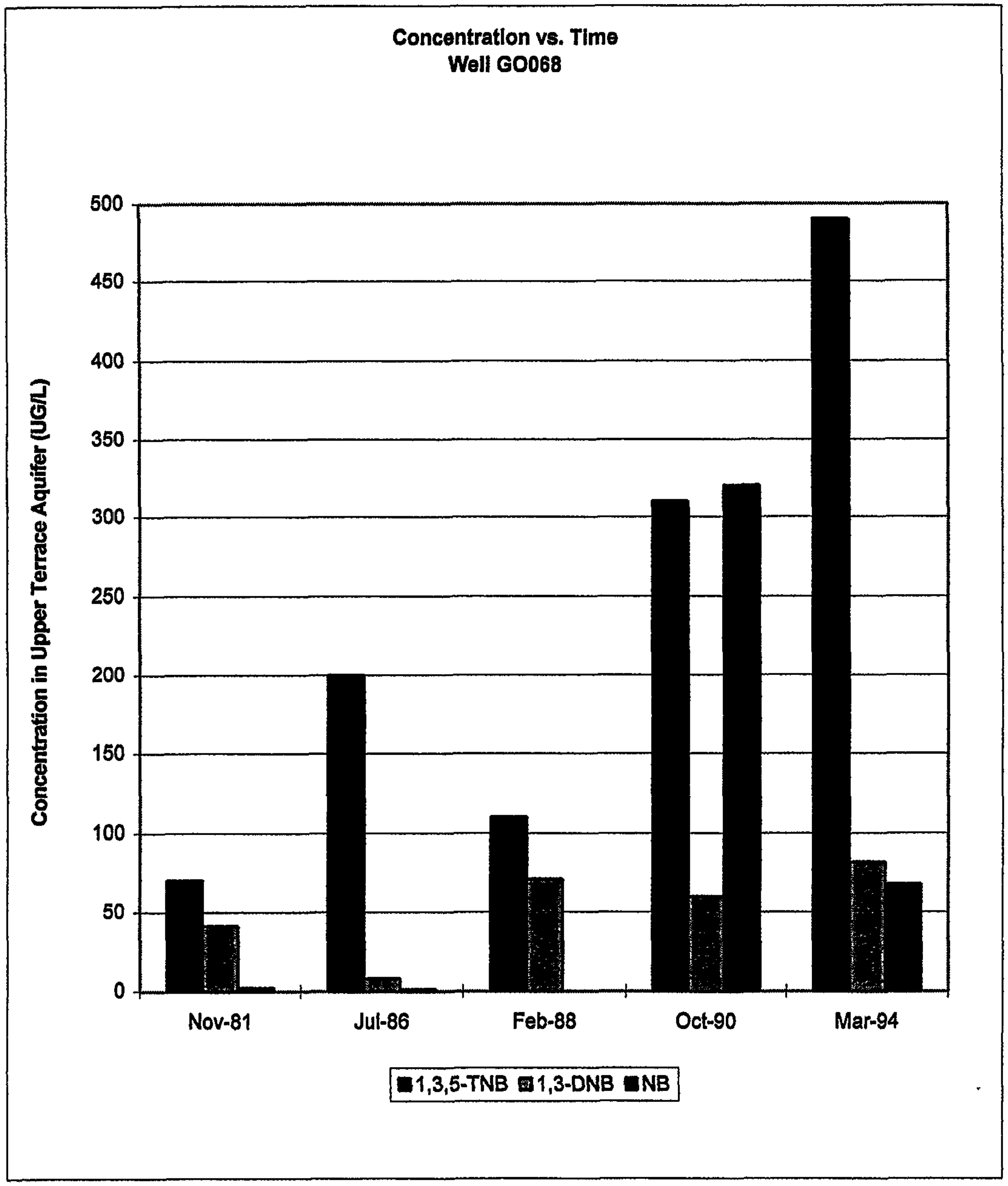
NR - Not Reported.

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Concentration vs. Time
Well GO068

Louisiana Army Ammunition Plant

Figure: C-8 | Project: 01-0827-00-6868-010



	1,3,5-TNB	1,3-DNB	NB
HAL	[illegible]	[illegible]	[illegible]
Nov-81	70.4	41	2.1
Jul-86	200	7.65	1.13
Feb-88	110	71	NR
Oct-90	310	60	320
Mar-94	490	82	68

NA - Not Available.

NR - Not Reported

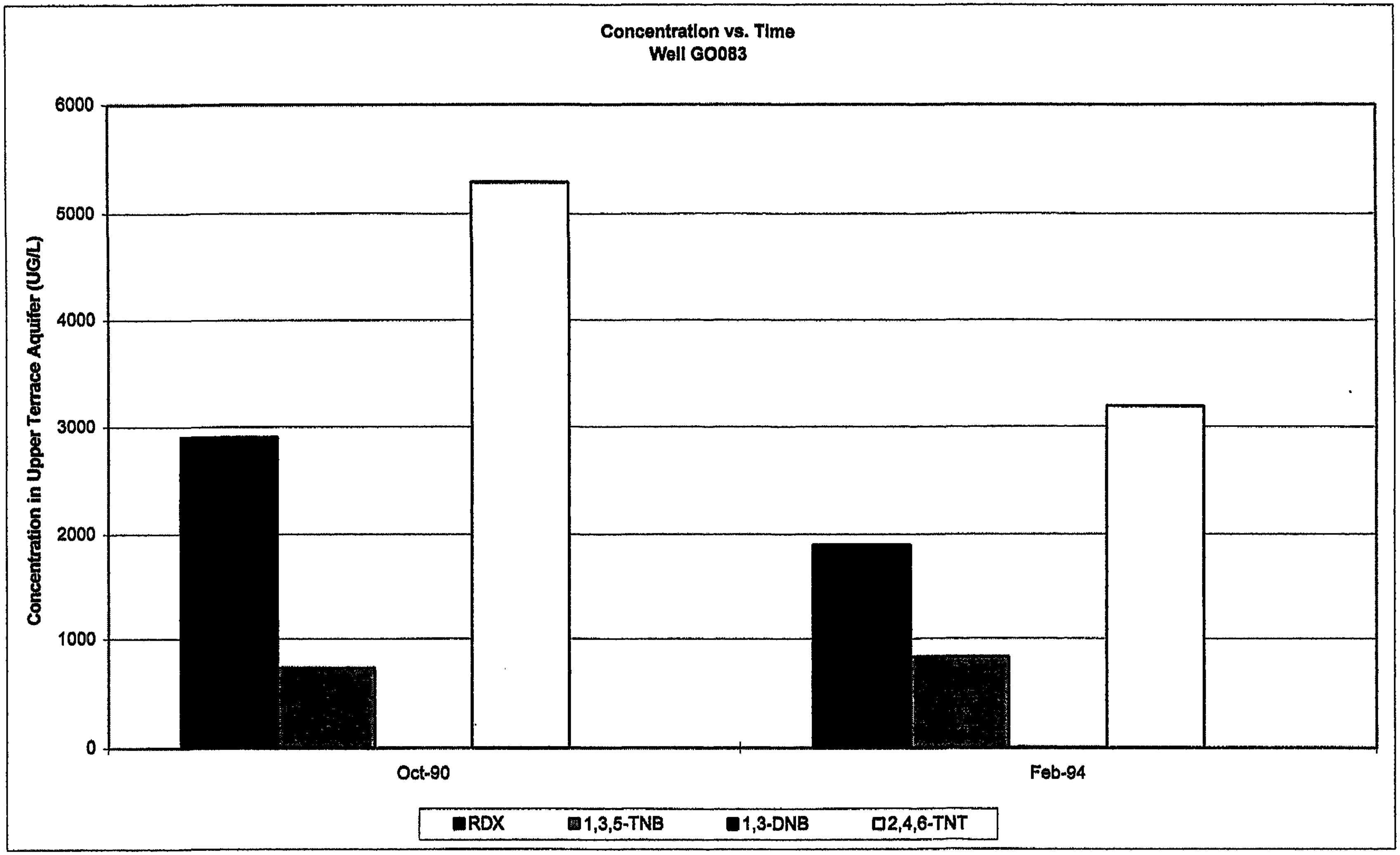
Note: Shaded area represents concentrations below detection limits.

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Concentration vs. Time
Well GO068

Louisiana Army Ammunition Plant

Figure: C-9 | Project: 01-0827-03-6868-012



	RDX	1,3,5-TNB	1,3-DNB	2,4,6-TNT
HAL	2	[illegible]	1	2
Oct-90	2900	730	0.519	5300
Feb-94	1900	830	5.6	3200

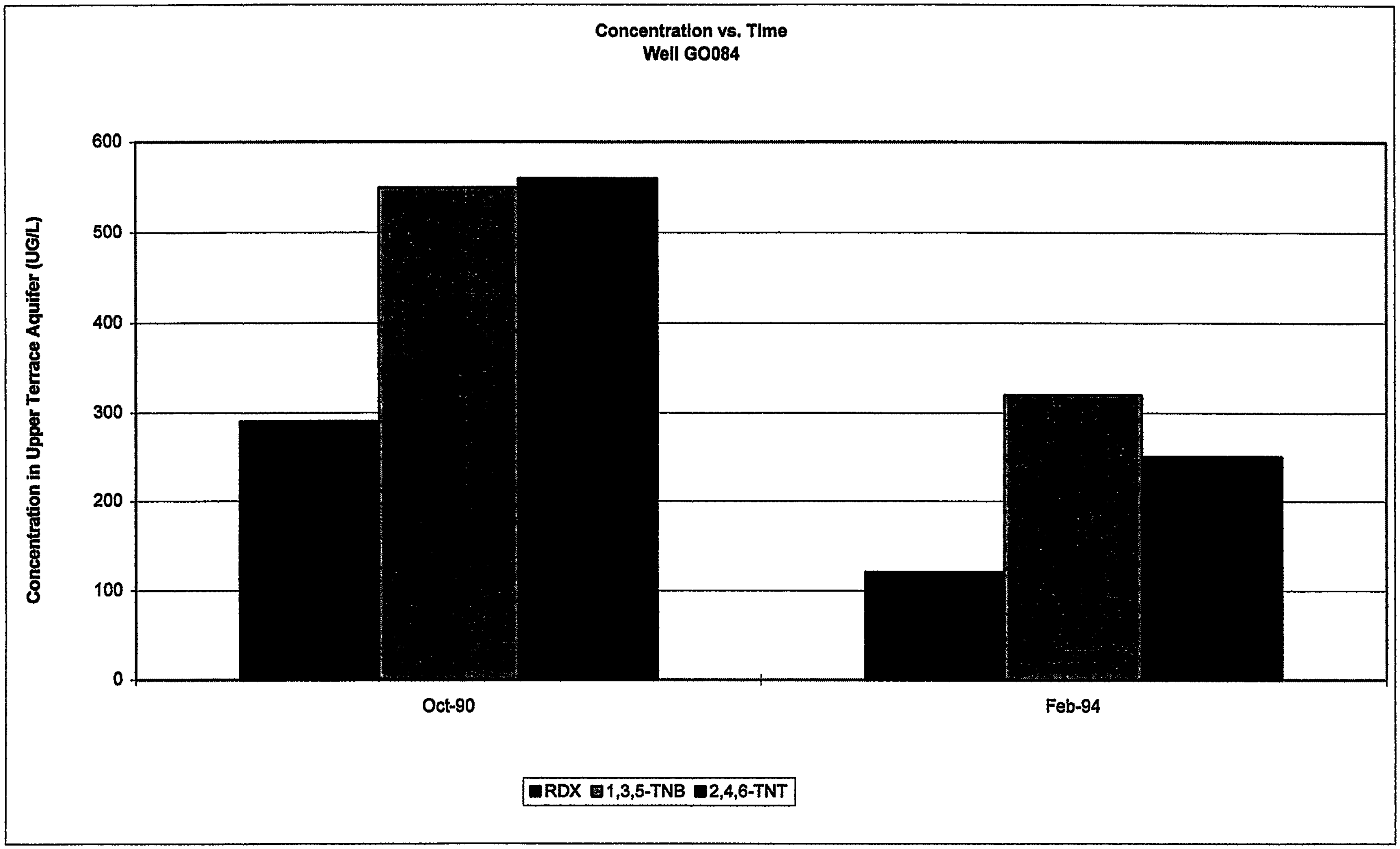
Note: Shaded area represents concentrations below detection limits.

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Concentration vs. Time
Well GO083

Louisiana Army Ammunition Plant

Figure C-10 | Project 01-0827-[illegible]868-[illegible]



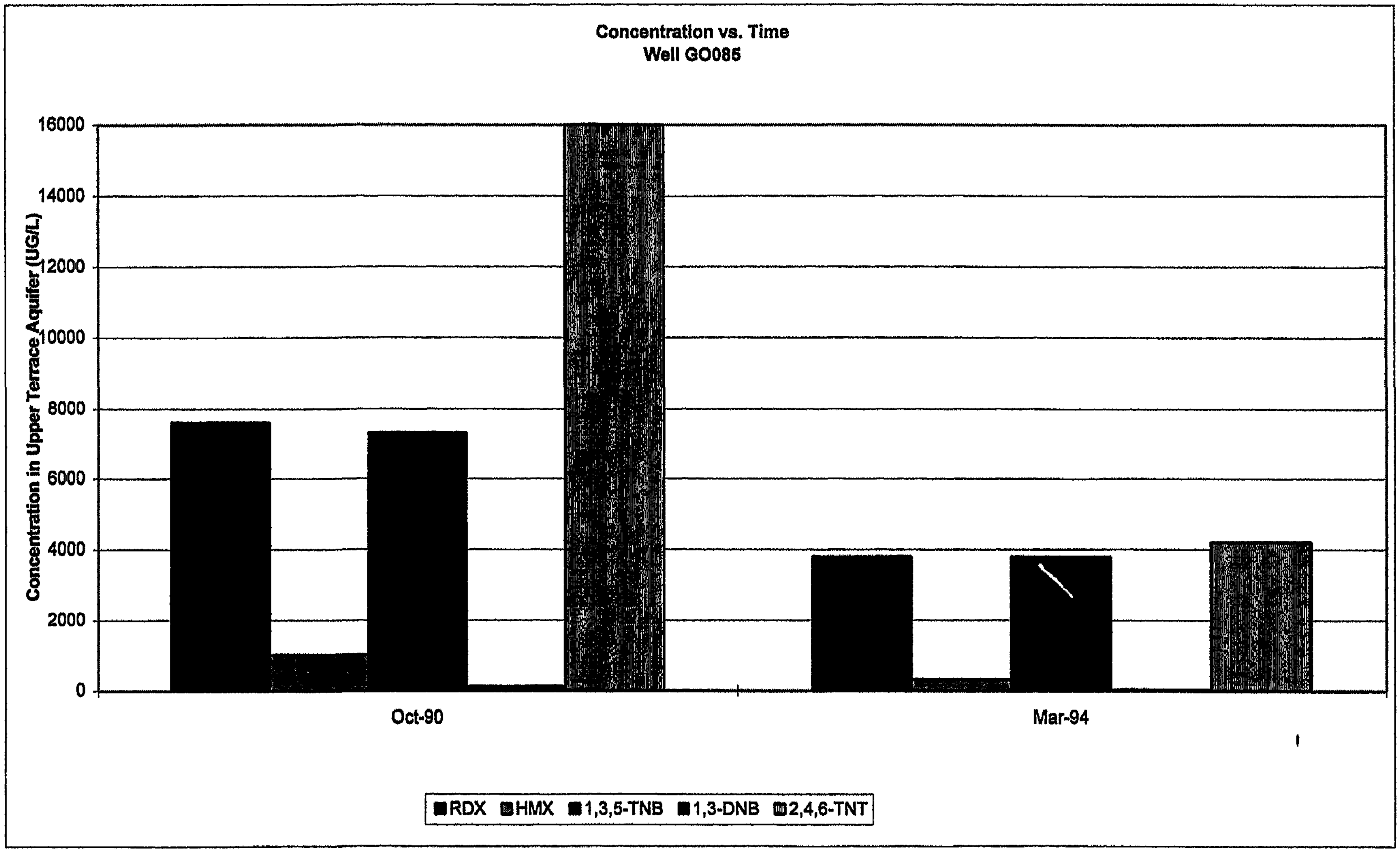
	RDX	1,3,5-TNB	2,4,6-TNT
HAL	[illegible]	[illegible]	[illegible]
Oct-90	290	550	560
Feb-94	120	320	250

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Concentration vs. Time
Well GO084

Louisiana Army Ammunition Plant

Figure: C-11 | Project: 01-0827-03-6868-012



	RDX	HMX	1,3,5-TNB	1,3-DNB	2,4,6-TNT
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Oct-90	7600	1000	7300	120	16000
Mar-94	3800	310	3800	32	4200

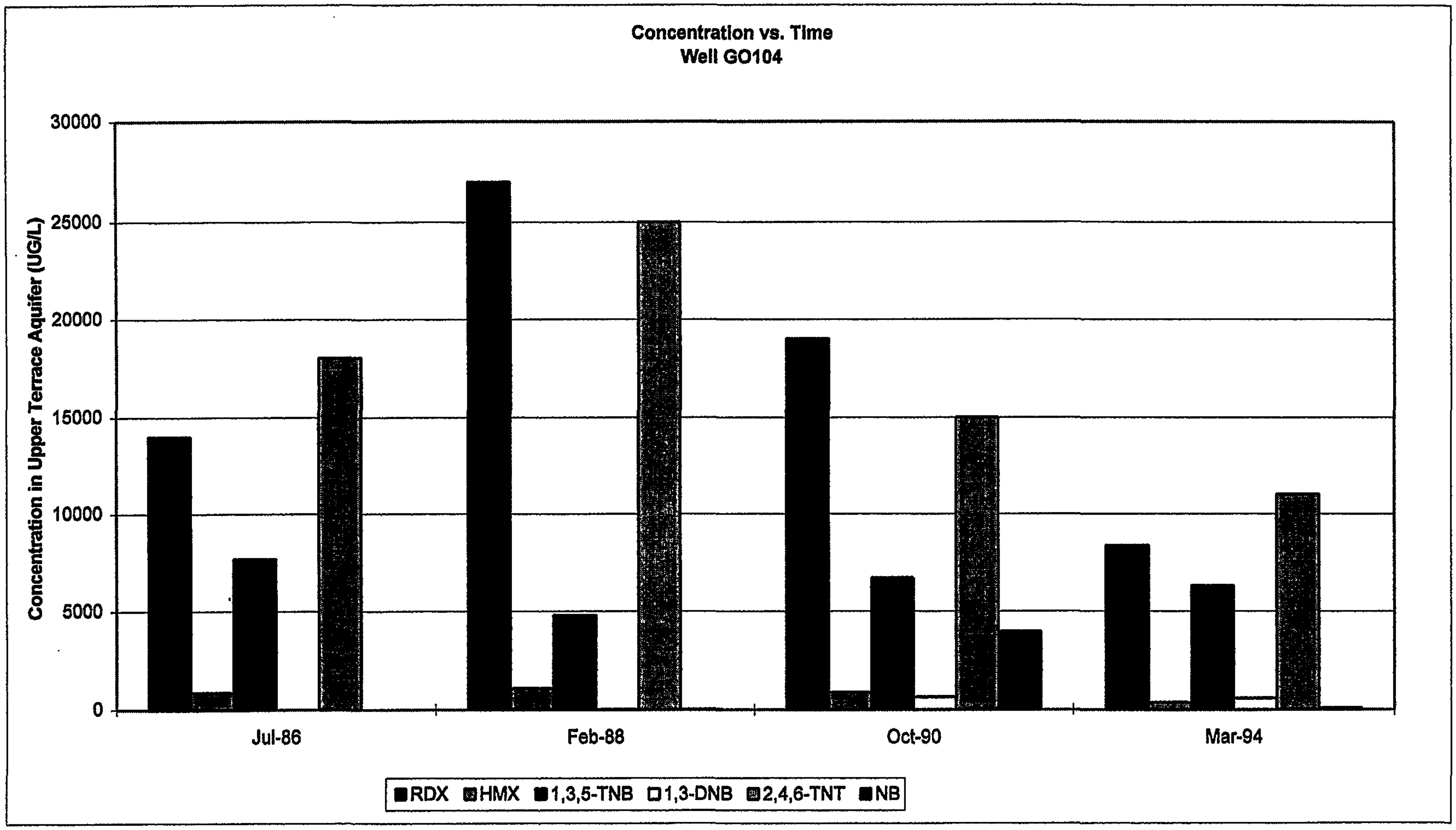
Note: Shaded area represents concentrations below detection limits.

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Concentration vs. Time
Well GO085

Louisiana Army Ammunition Plant

Figu[illegible]-12 | [illegible]roject[illegible]0827[illegible]868-[illegible]



	RDX	HMX	1,3,5-TNB	1,3-DNB	2,4,6-TNT	NB
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jul-86	14000	880	7700	0.61	18000	1.13
Feb-88	27000	1100	4800	7.8	25000	11.3
Oct-90	19000	910	6700	660	15000	4000
Mar-94	8400	370	6300	580	11000	68

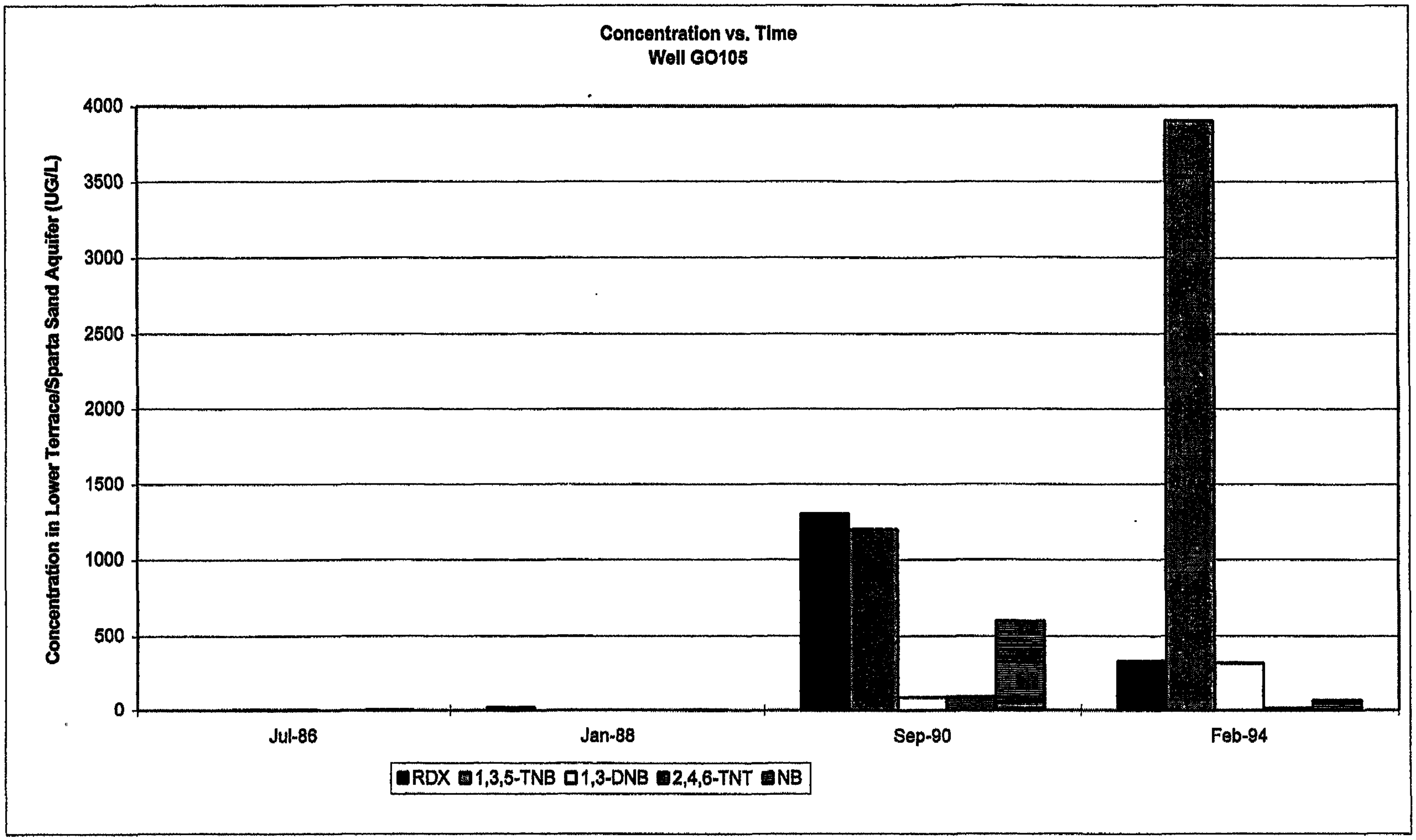
Note: Shaded area represents concentrations below detection limits.

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Concentration vs. Time
Well GO104

Louisiana Army Ammunition Plant

Figure: C-13 | Project: 01-0827-03-6868-012



	RDX	1,3,5-TNB	1,3-DNB	2,4,6-TNT	NB
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jul-86	0.63	2.2	2.51	0.78	1.13
Jan-88	18.4	0.56	0.61	0.78	1.13
Sep-90	1300	1200	90	94	600
Feb-94	330	3900	320	17	68

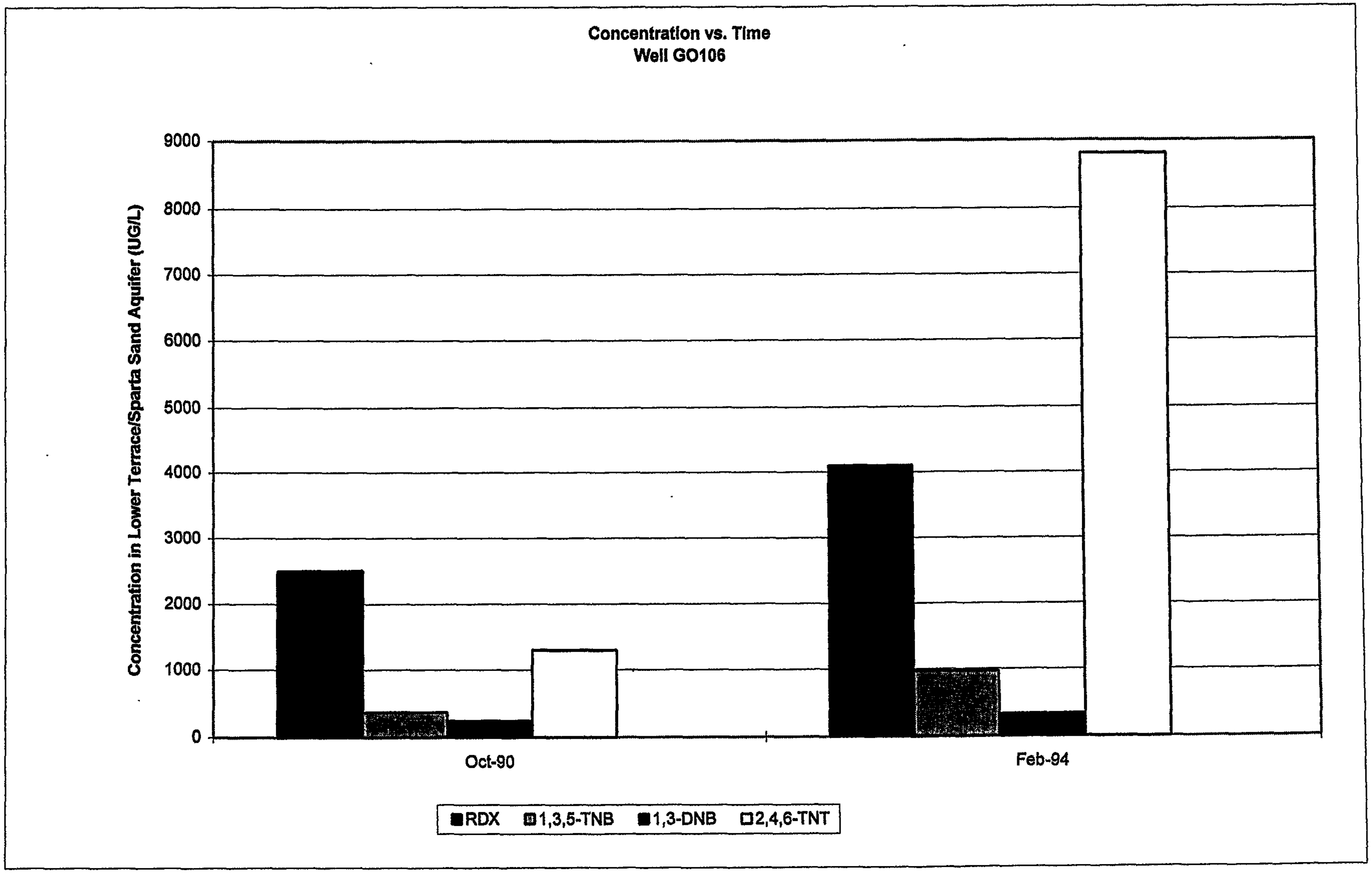
Note: Shaded area represents concentrations below detection limits.

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Concentration vs. Time
Well GO105

Louisiana Army Ammunition Plant

Figure: C-14 | Project: 01-0827-03-6868-012



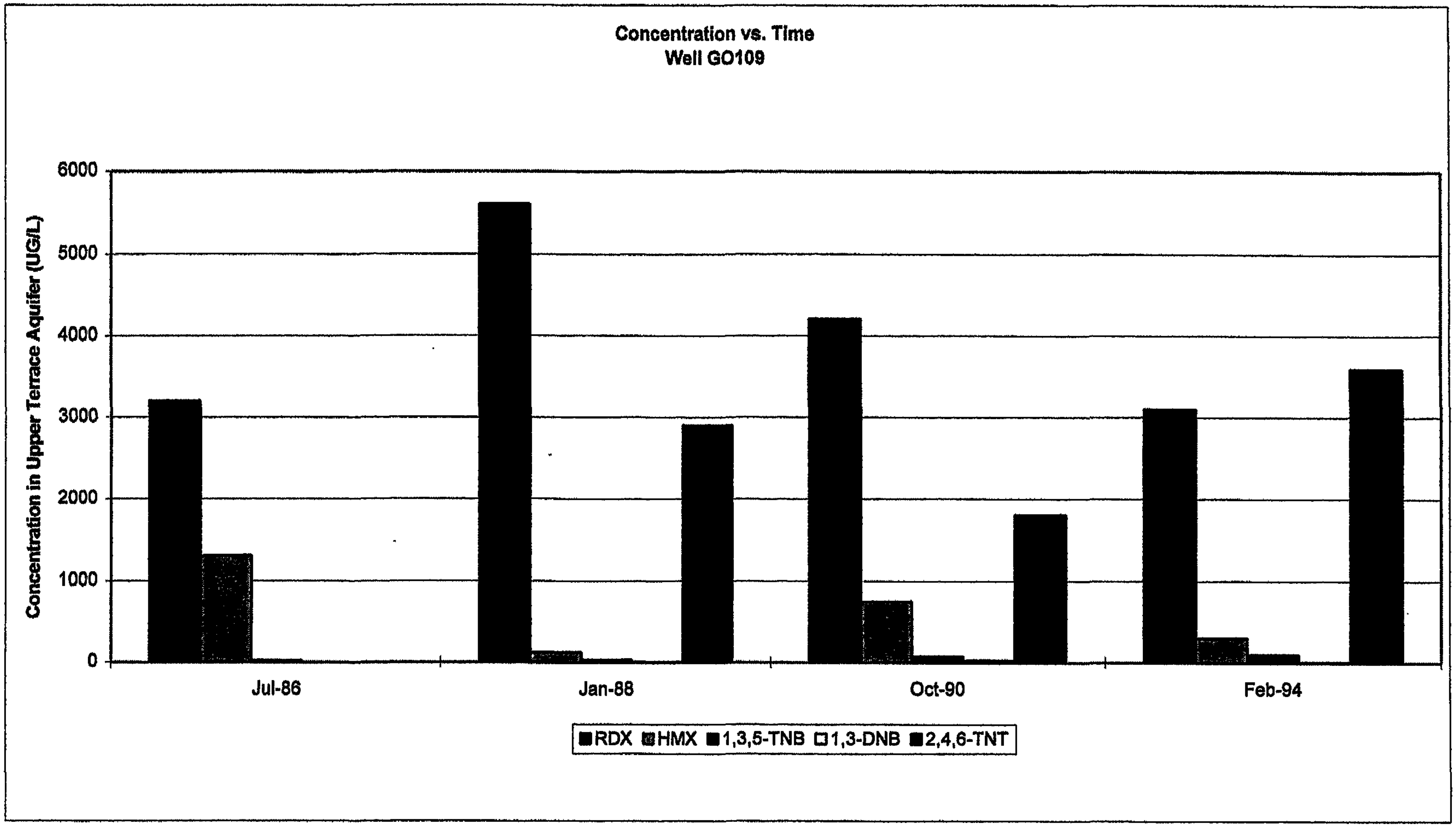
	RDX	1,3,5-TNB	1,3-DNB	2,4,6-TNT
HAL	2	[illegible]	[illegible]	2
Oct-90	2500	370	240	1300
Feb-94	4100	970	330	8800

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Concentration vs. Time
Well GO106

Louisiana Army Ammunition Plant

Figure: C-15 | Project: 01-0827-03-6868-012



[illegible]	RDX	HMX	1,3,5-TNB	1,3-DNB	2,4,6-TNT
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jul-86	3200	1300	21.1	0.61	0.78
Jan-88	5600	120	28	2.05	2900
Oct-90	4200	750	73	23	1800
Feb-94	3100	300	95	8.2	3600

Note: Shaded area represents concentrations below detection limits.

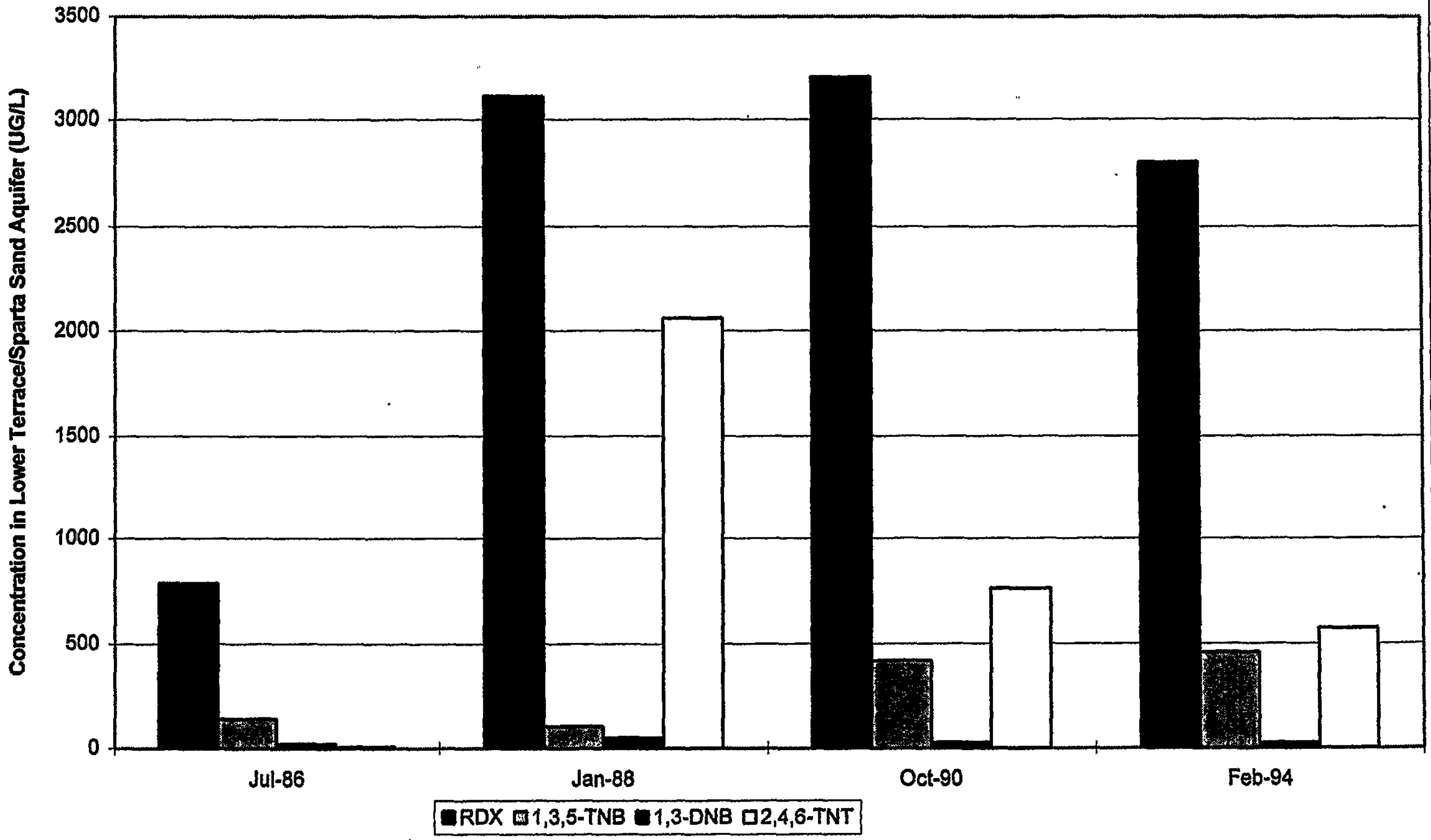
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Concentration vs. Time
Well GO109

Louisiana Army Ammunition Plant

Figure: C-16 | Project: 01-0827-02-6368-[illegible]

Concentration vs. Time
Well GO110



	RDX	1,3,5-TNB	1,3-DNB	2,4,6-TNT
HAL	2	3.5	1	2
Jul-86	785	139	20.5	6
Jan-88	3110	103	49	2060
Oct-90	3200	420	26	760
Feb-94	2800	460	24	570

Note: Shaded area represents concentrations below detection limits.

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Concentration vs. Time
Well GO110

Louisiana Army Ammunition Plant

Figure: C-17 | Project: 01-0827-03-6868-012

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APPENDIX D

GROUNDWATER CONCENTRATION REGRESSION ANALYSIS PLOTS

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APPENDIX D

GROUNDWATER CONCENTRATION REGRESSION ANALYSIS PLOTS

This appendix contains the groundwater concentration regression analysis plots. These plots present the variation of concentration with time. The plots are presented for each of the 53 data sets (well and COC), which were "valid data sets", with four or more data points (concentration levels) and at least one data point above the instrument detection limit.

Data are presented for the following nine contaminants of concern (COCs):

- RDX
- HMX
- 2,4,6-trinitrotoluene (2,4,6-TNT)
- 1,3-dinitrobenzene (1,3-DNB)
- 2,4-dinitrotoluene (2,4-DNT)
- 2,6-dinitrotoluene (2,6-DNT)
- 1,3,5-trinitrobenzene (1,3,5-TNB)
- nitrobenzene (NB), and
- Tetryl.

For each plot, a line joining each of the data points (Series 1), and the computer-determined regression curve which best fits the data (Series 1 linear or 2nd order quadratic) is shown. Both the computer-determined and subjective trends (D, ID, I, DI, or C) selected for that data set are provided. The no model (NM) was selected for the subjective determination only. An equation for each of the regression curves is provided also.

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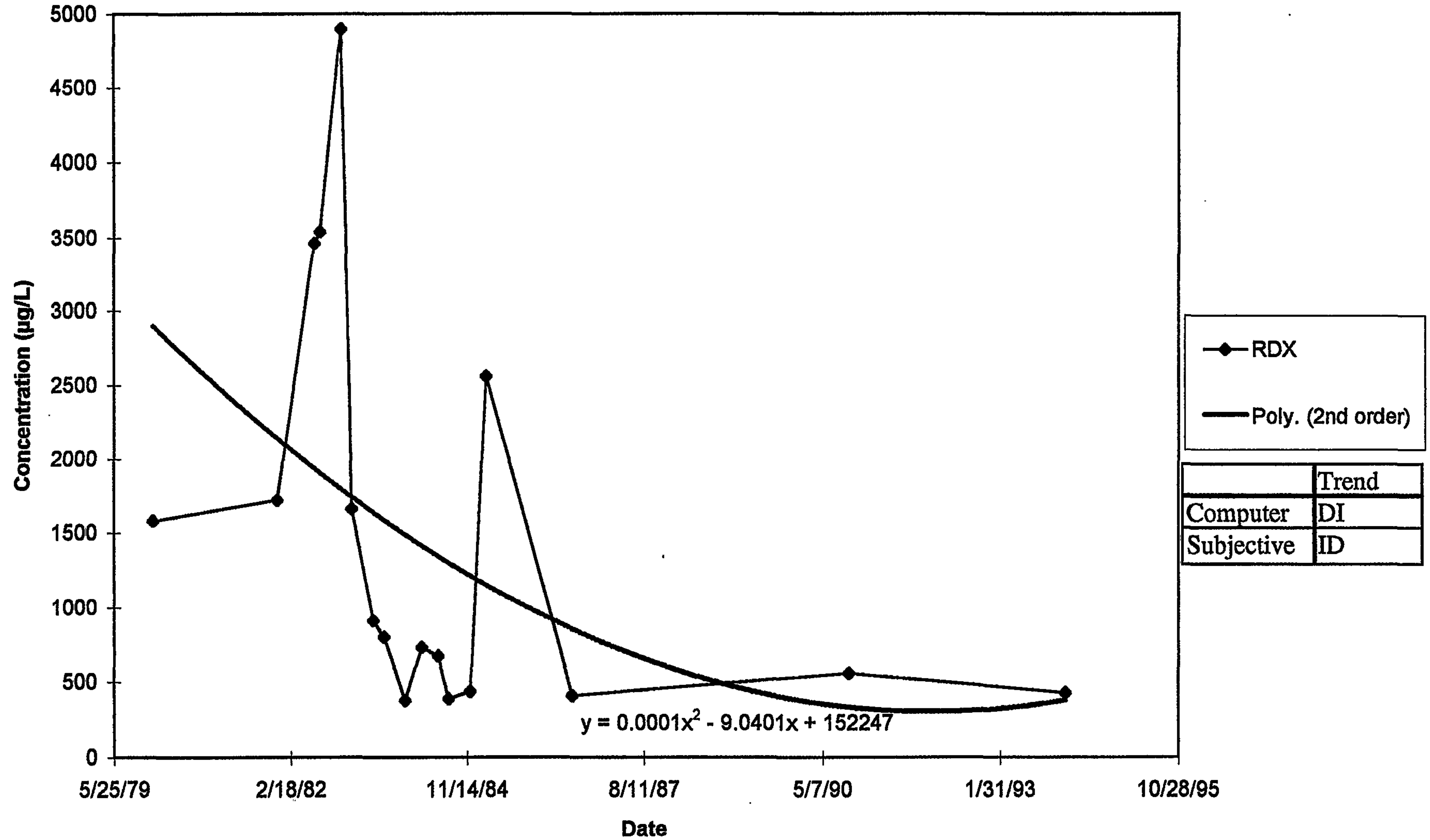
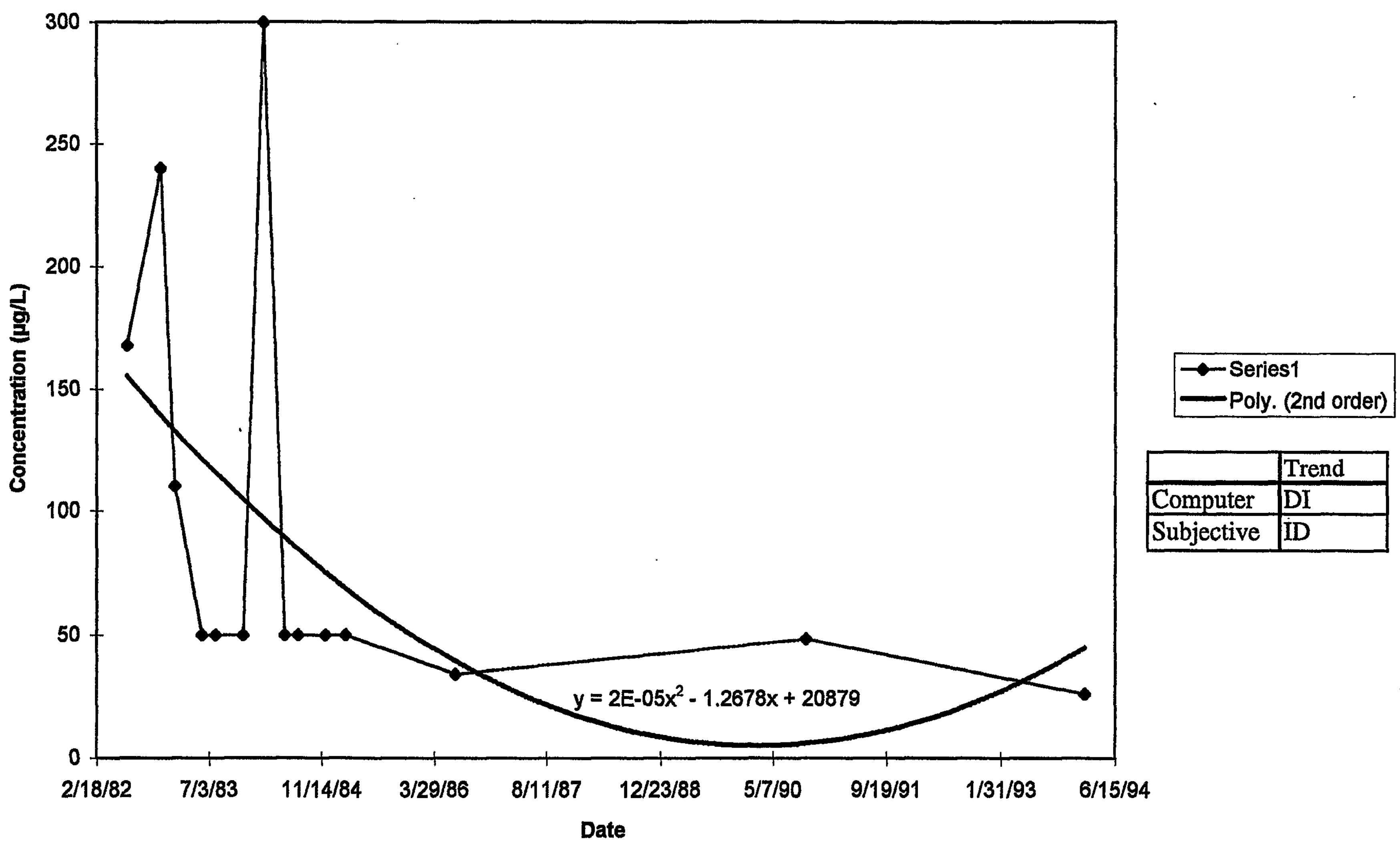
Statistical Trend Analysis: RDX - Well G0009



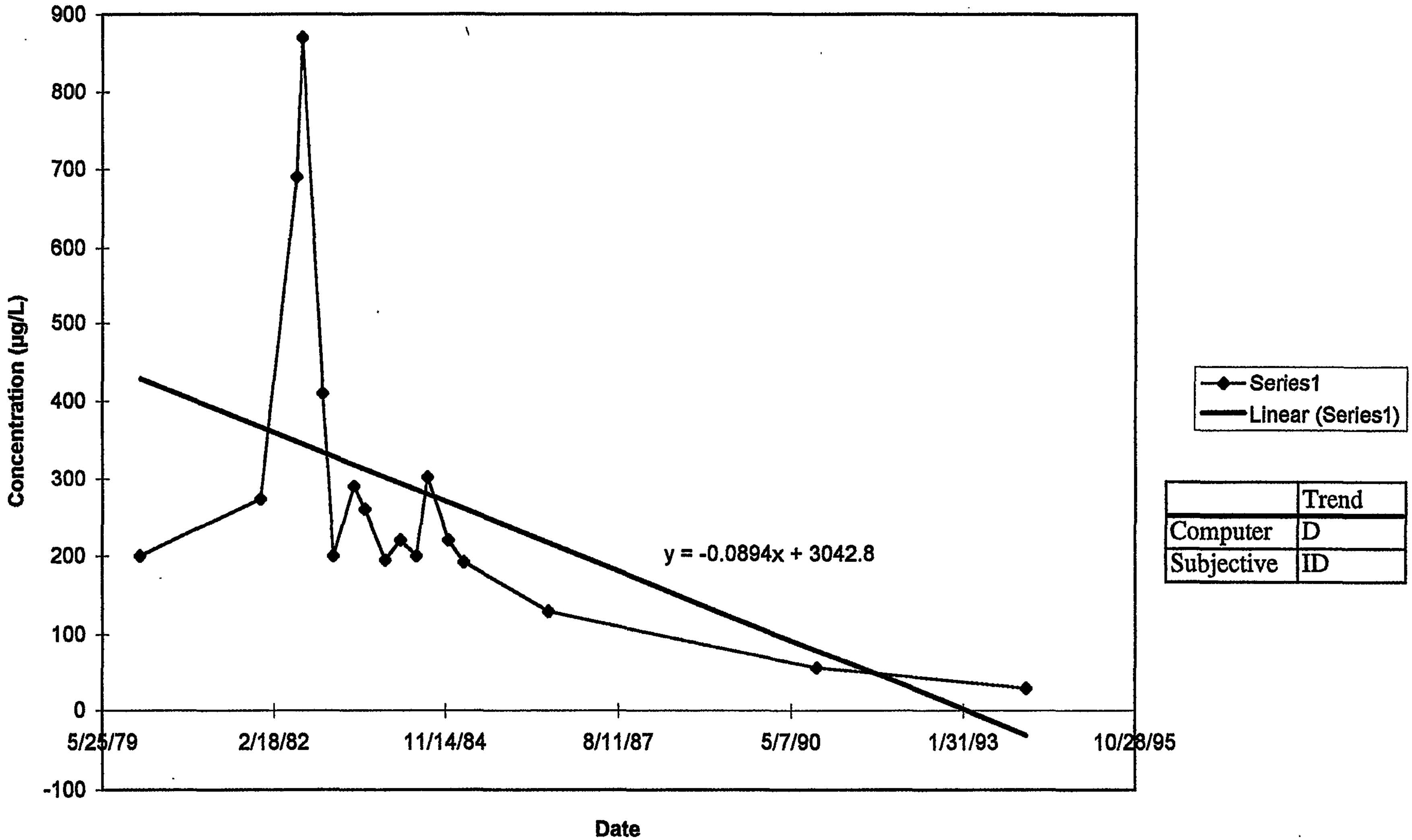
	Trend
Computer	DI
Subjective	ID

Statistical Trend Analysis: HMX - Well G0009



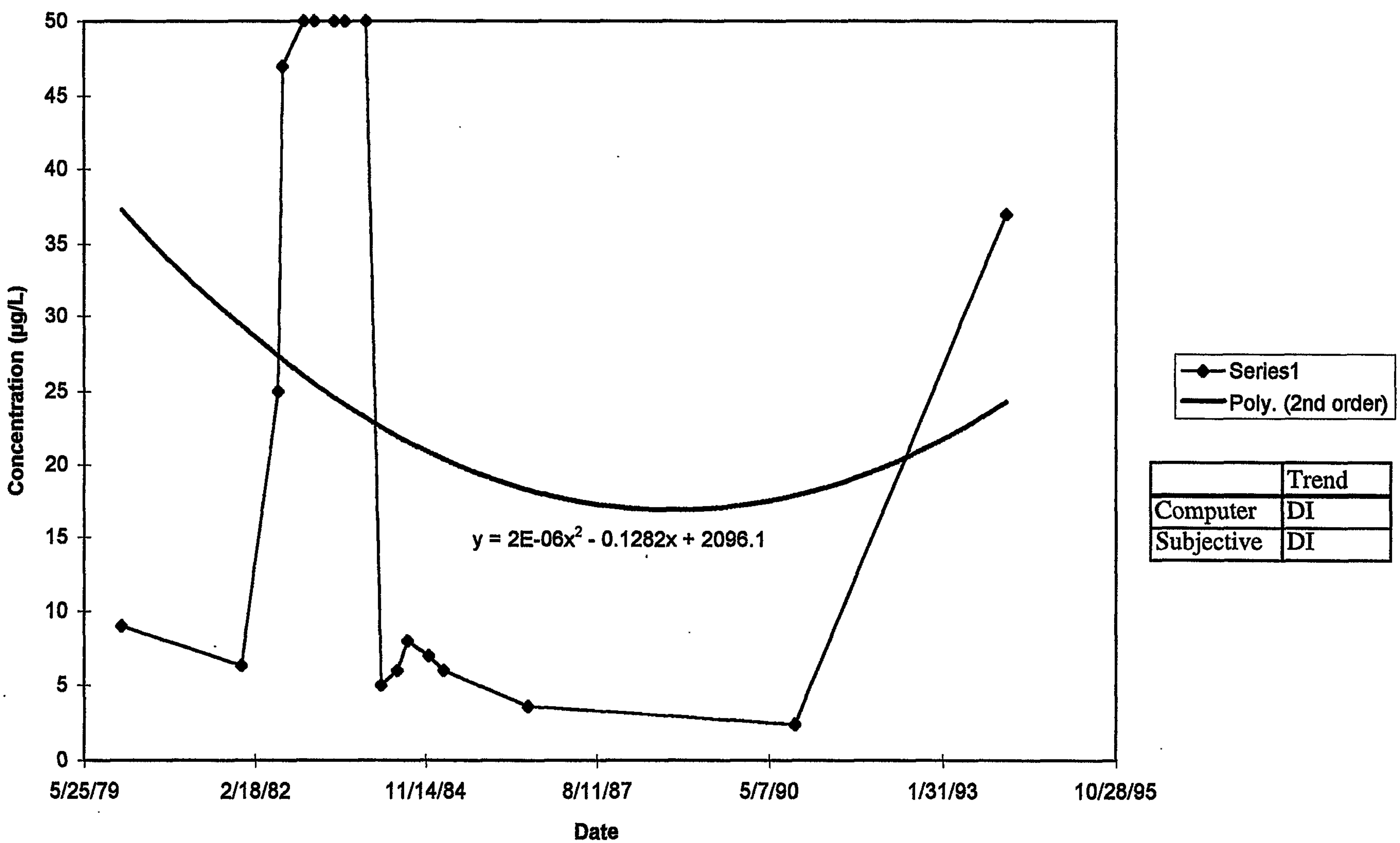
	Trend
Computer	DI
Subjective	ID

Statistical Trend Analysis: 2,4,6-TNT - Well G0009



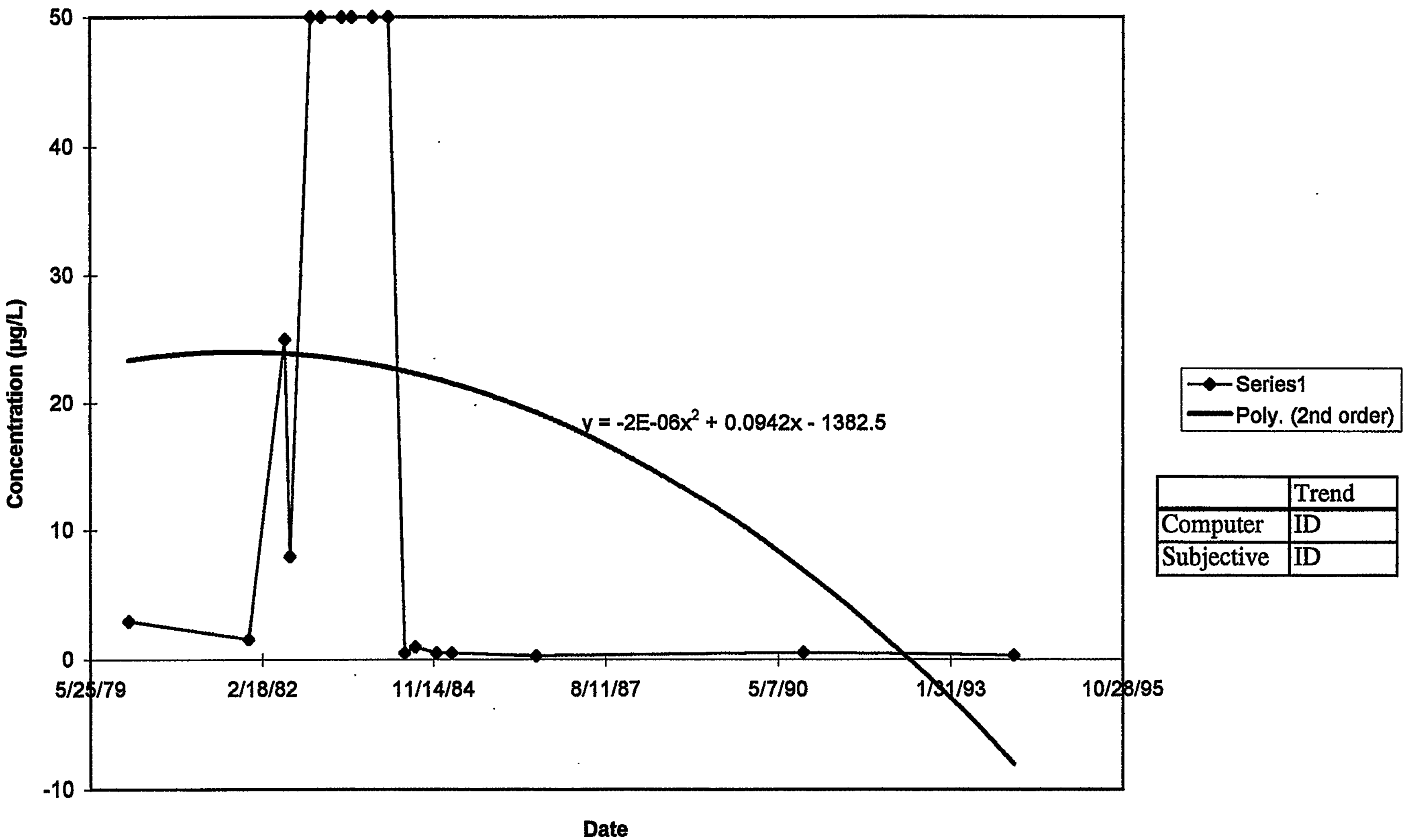
	Trend
Computer	D
Subjective	ID

Statistical Trend Analysis: 2,4-DNT - Well G0009



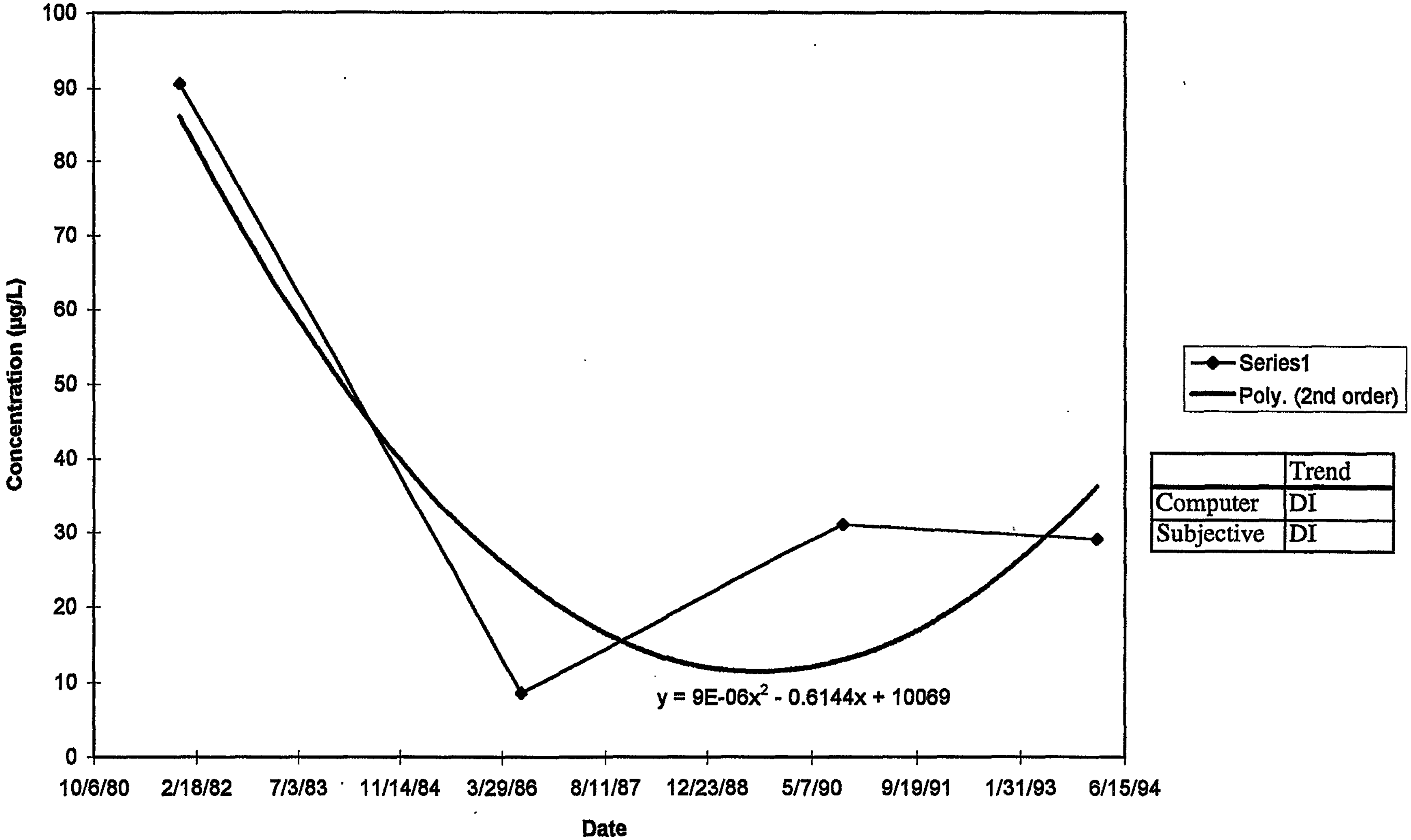
	Trend
Computer	DI
Subjective	DI

Statistical Trend Analysis: 2,6-DNT - Well G0009



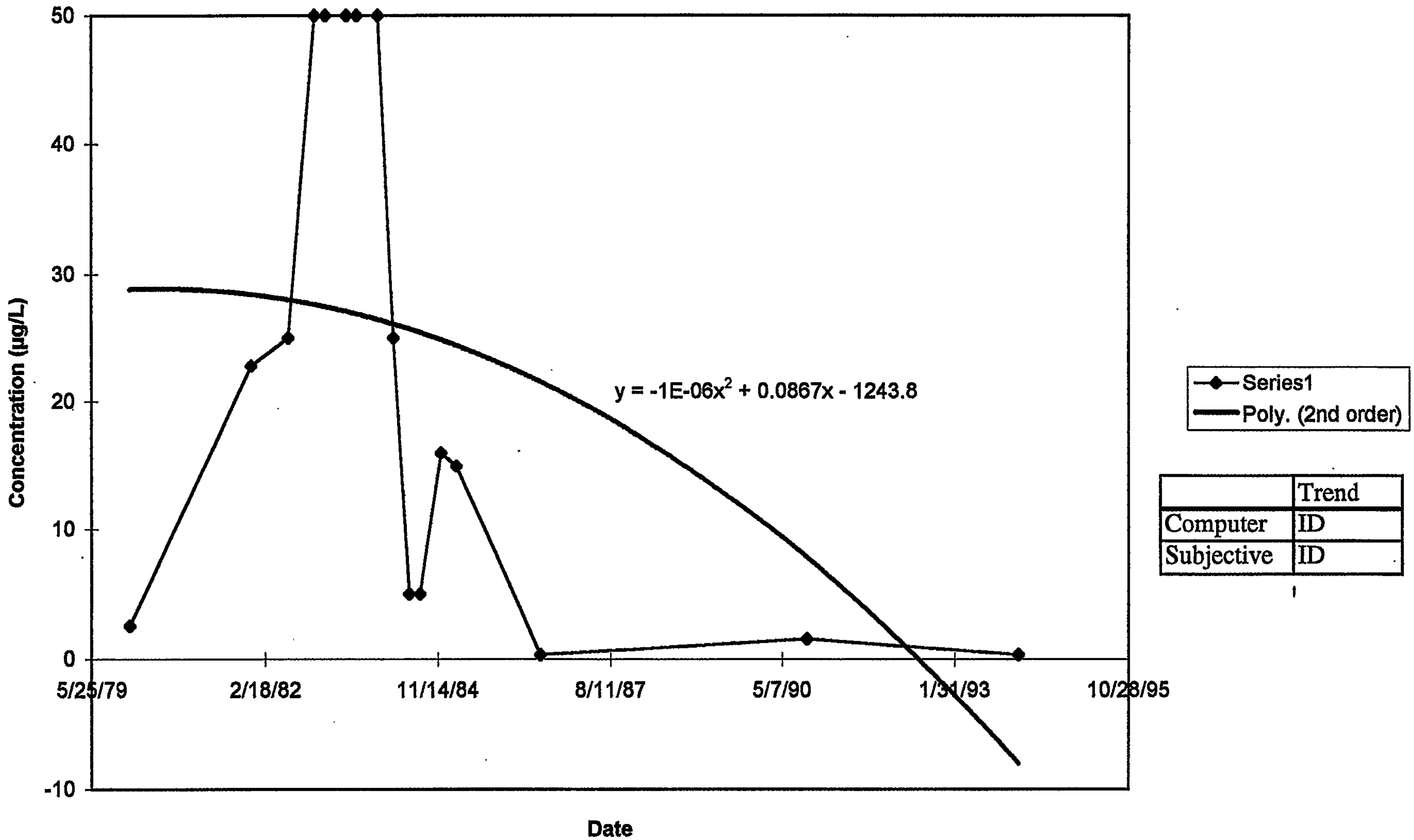
	Trend
Computer	ID
Subjective	ID

Statistical Trend Analysis: 1,3,5-TNB - Well G0009



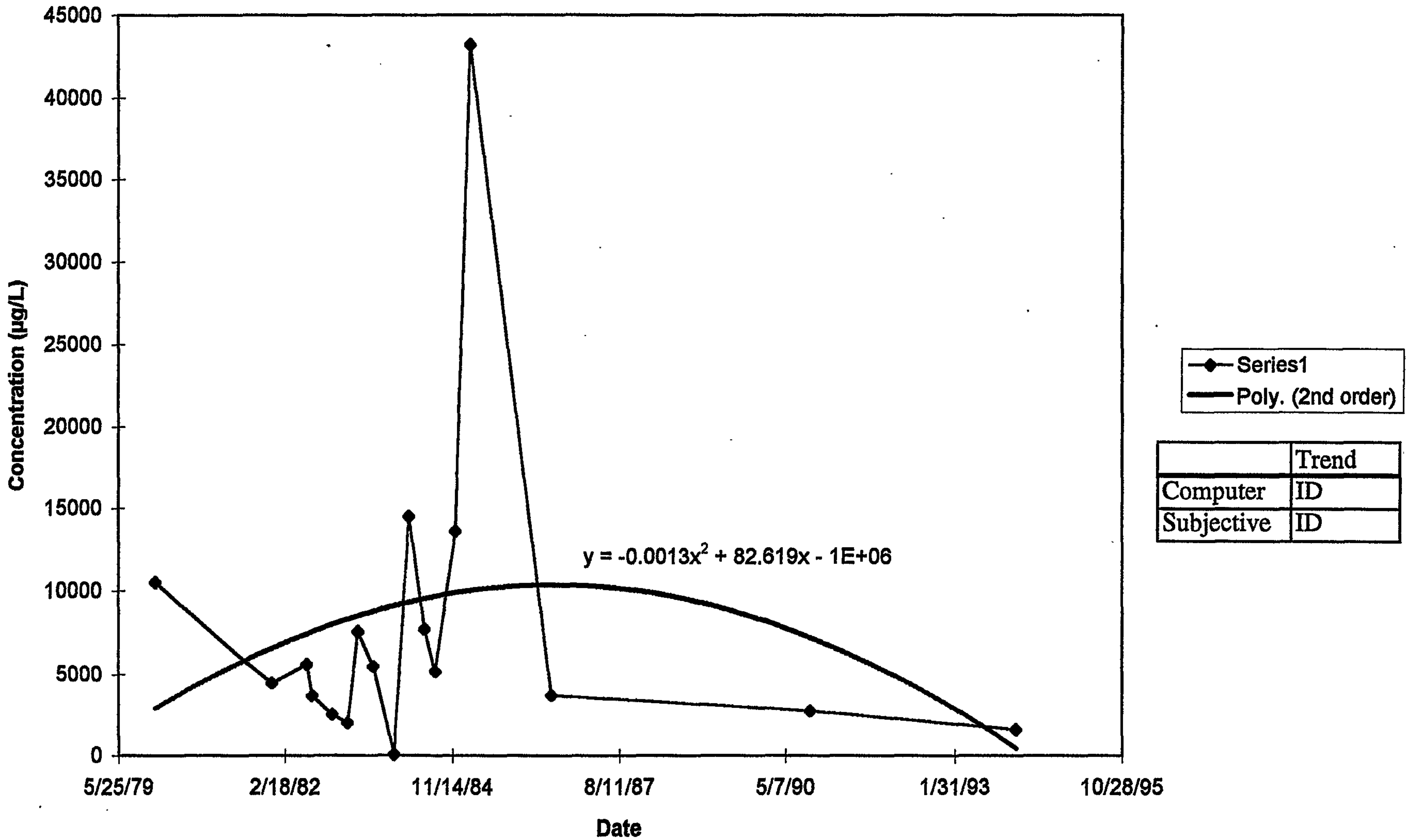
	Trend
Computer	DI
Subjective	DI

Statistical Trend Analysis: Tetryl - Well G0009



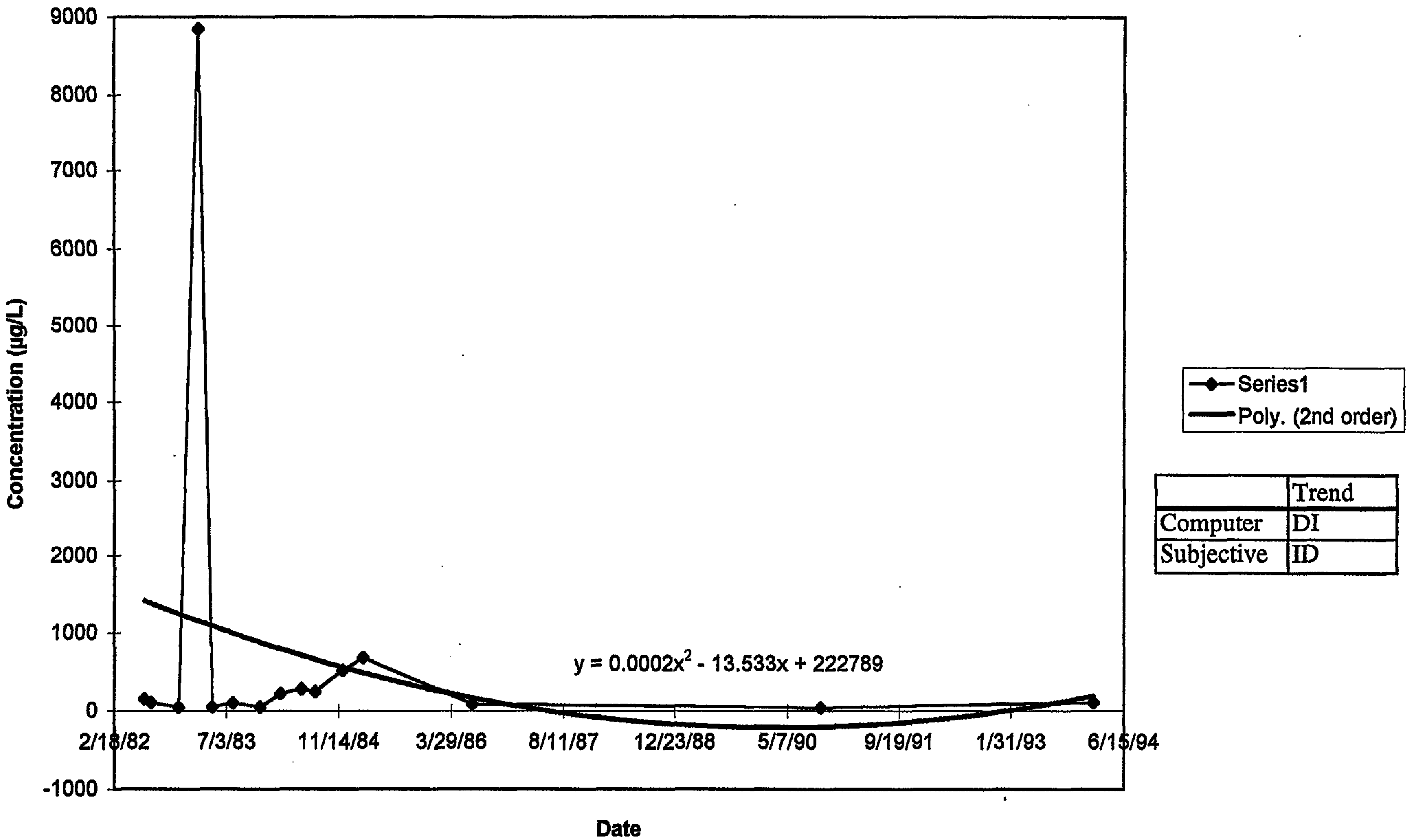
	Trend
Computer	ID
Subjective	ID

Statistical Trend Analysis: RDX - Well G0012



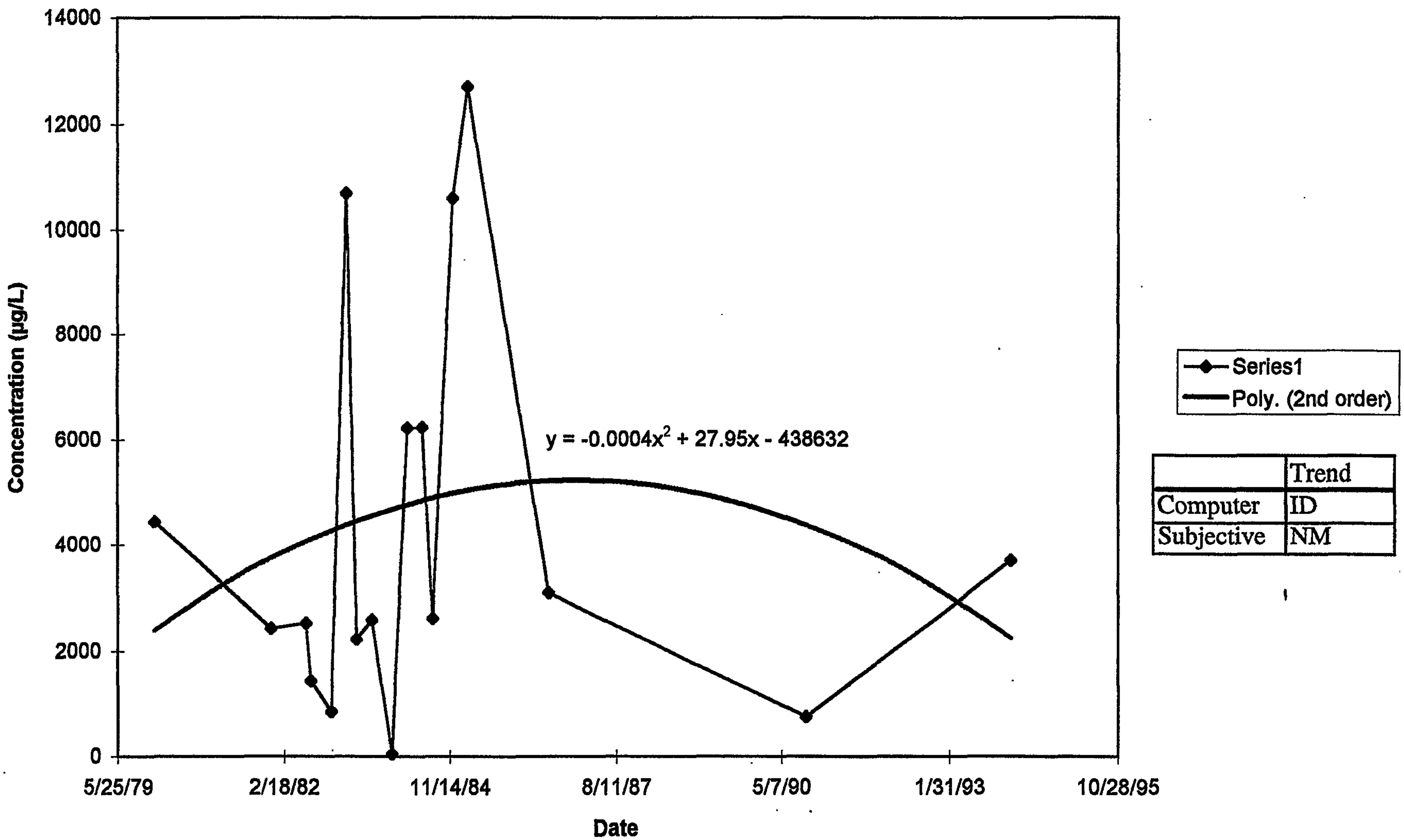
	Trend
Computer	ID
Subjective	ID

Statistical Trend Analysis: HMX - Well G0012



	Trend
Computer	DI
Subjective	ID

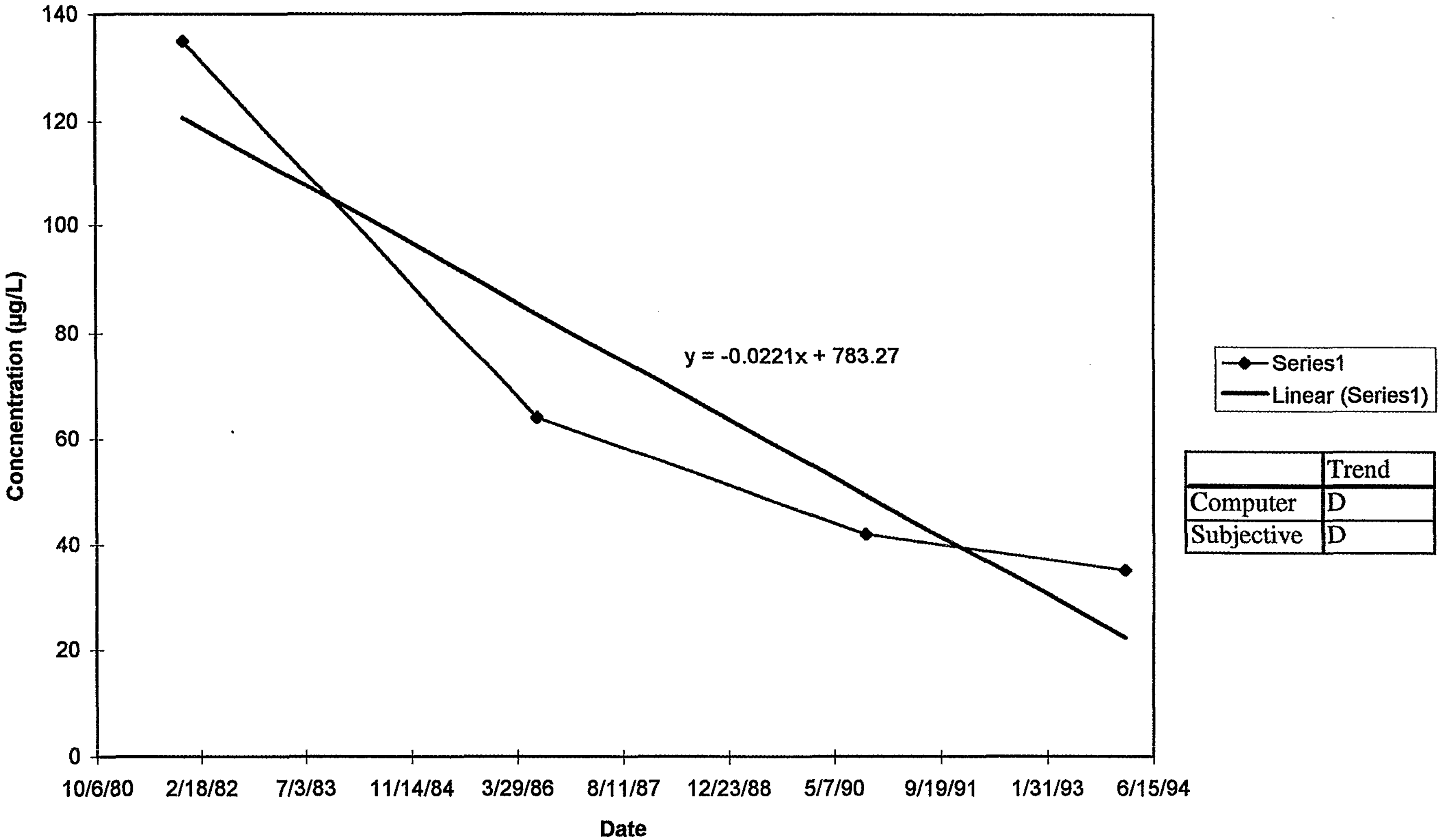
Statistical Trend Analysis: 2,4,6-TNT - Well G0012



$y = -0.0004x^2 + 27.95x - 438632$

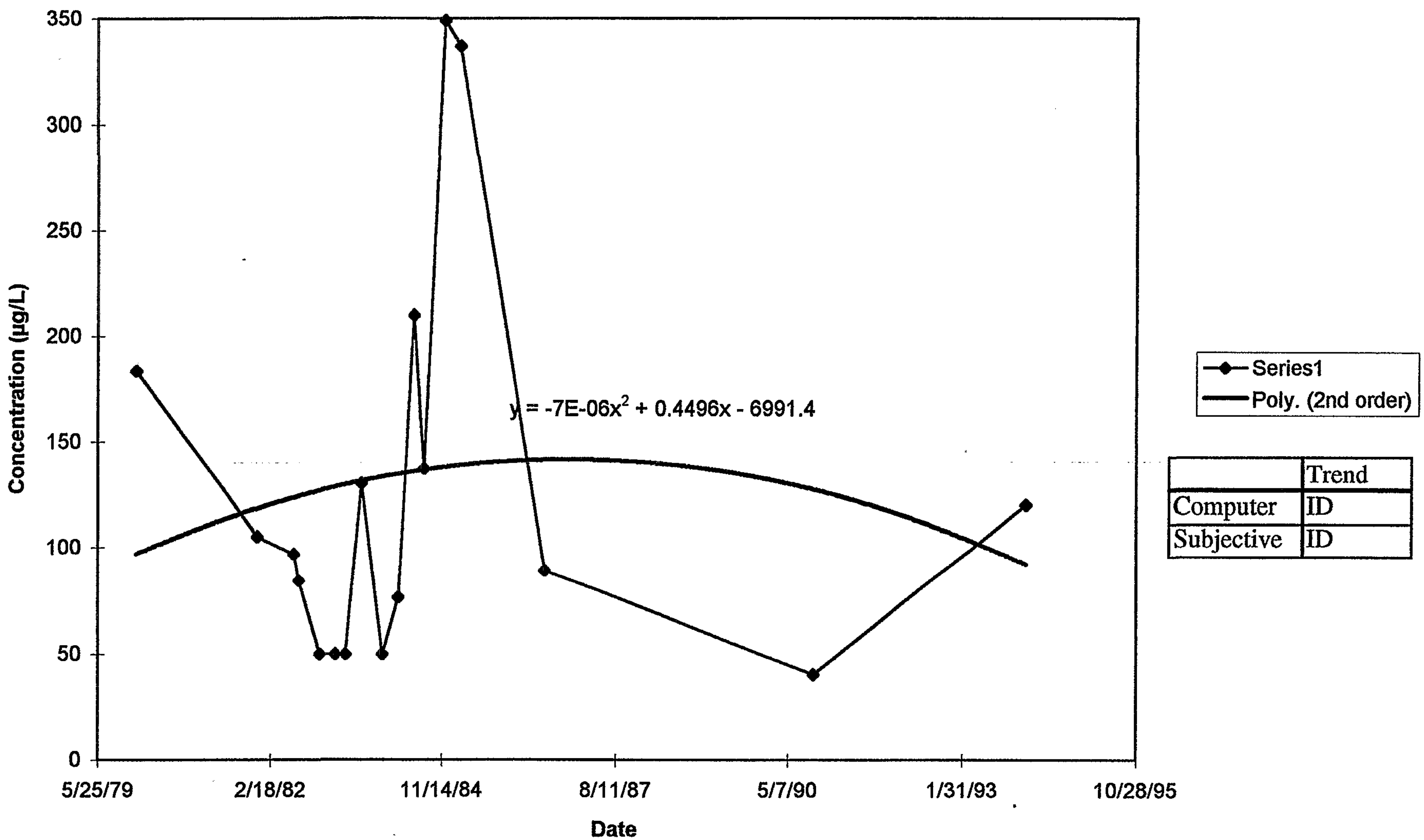
	Trend
Computer	ID
Subjective	NM

Statistical Trend Analysis: 1,3-DNB - Well G0012



	Trend
Computer	D
Subjective	D

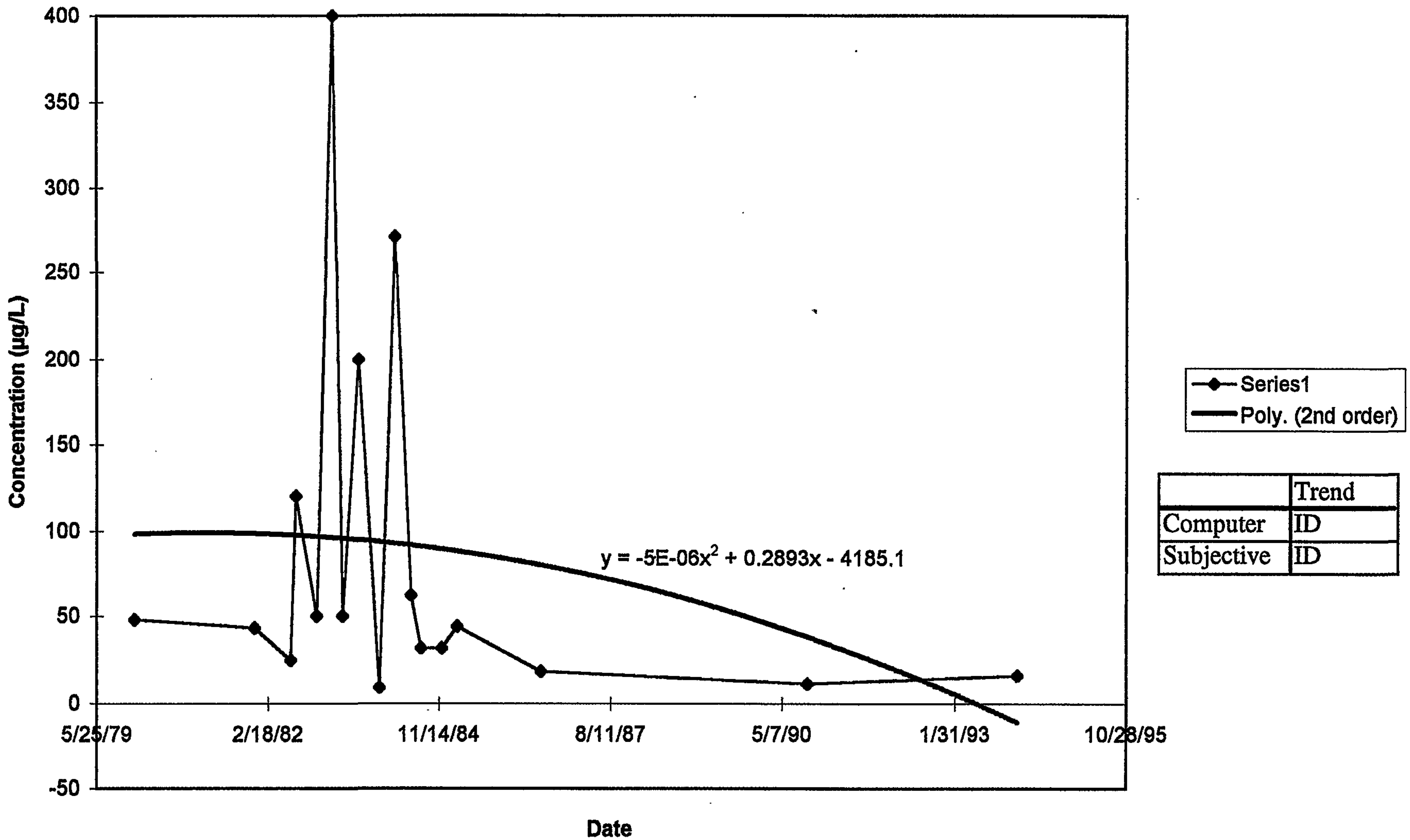
Statistical Trend Analysis: 2,4-DNT - Well G0012



	Trend
Computer	ID
Subjective	ID

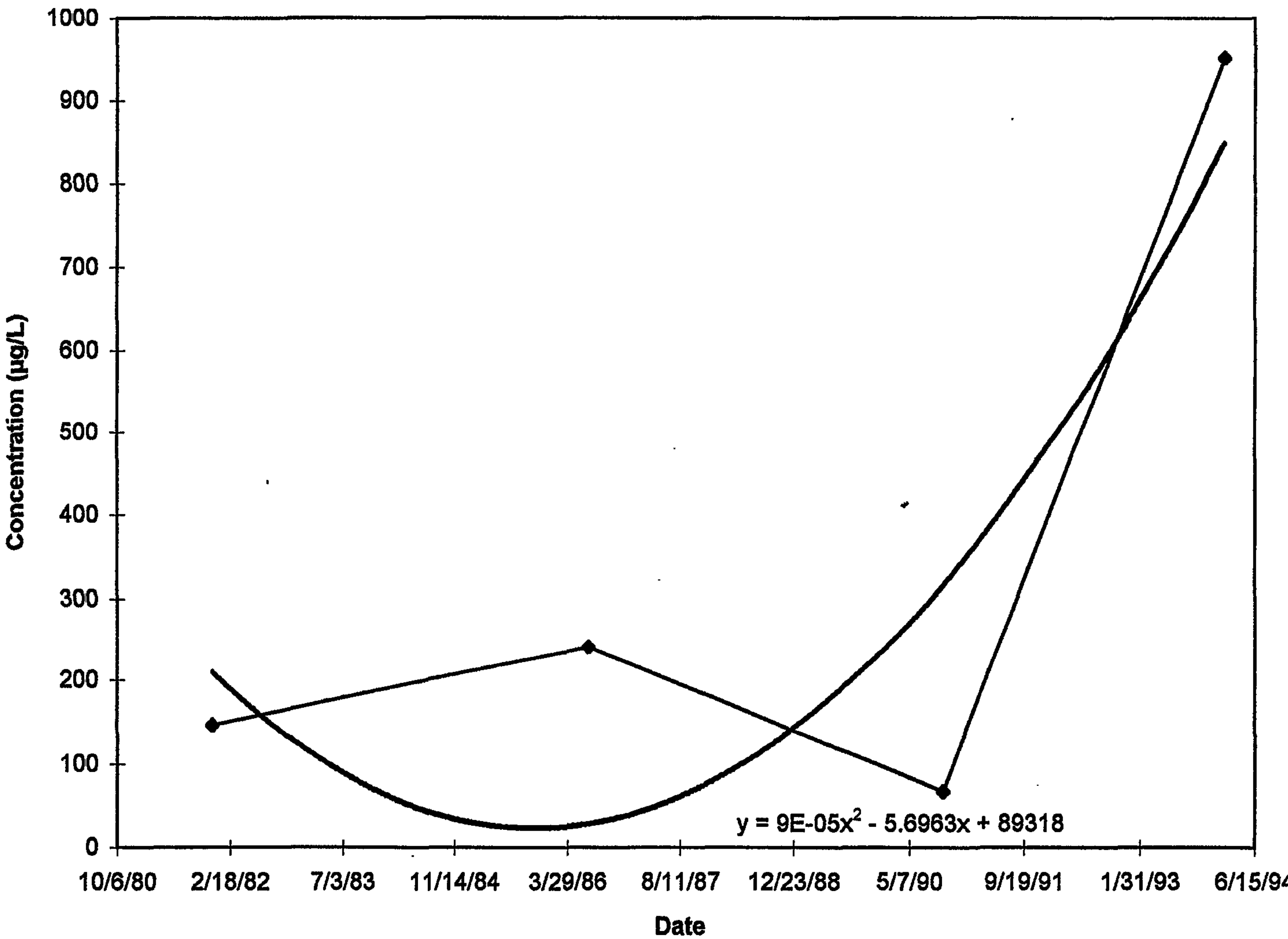
[redacted]

Statistical Trend Analysis: 2,6-DNT - Well G0012



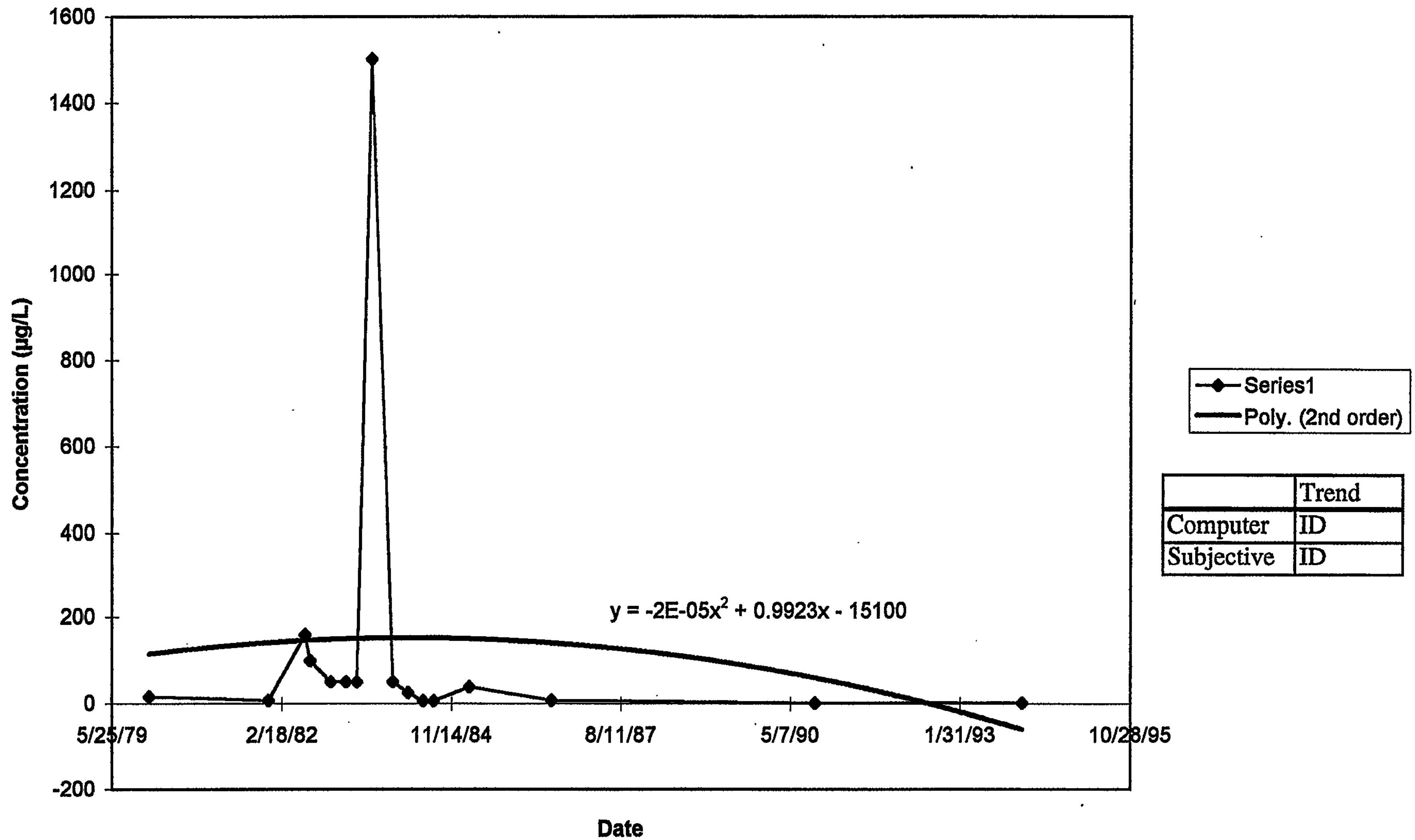
	Trend
Computer	ID
Subjective	ID

Statistical Trend Analysis: 1,3,5-TNB - Well G0012



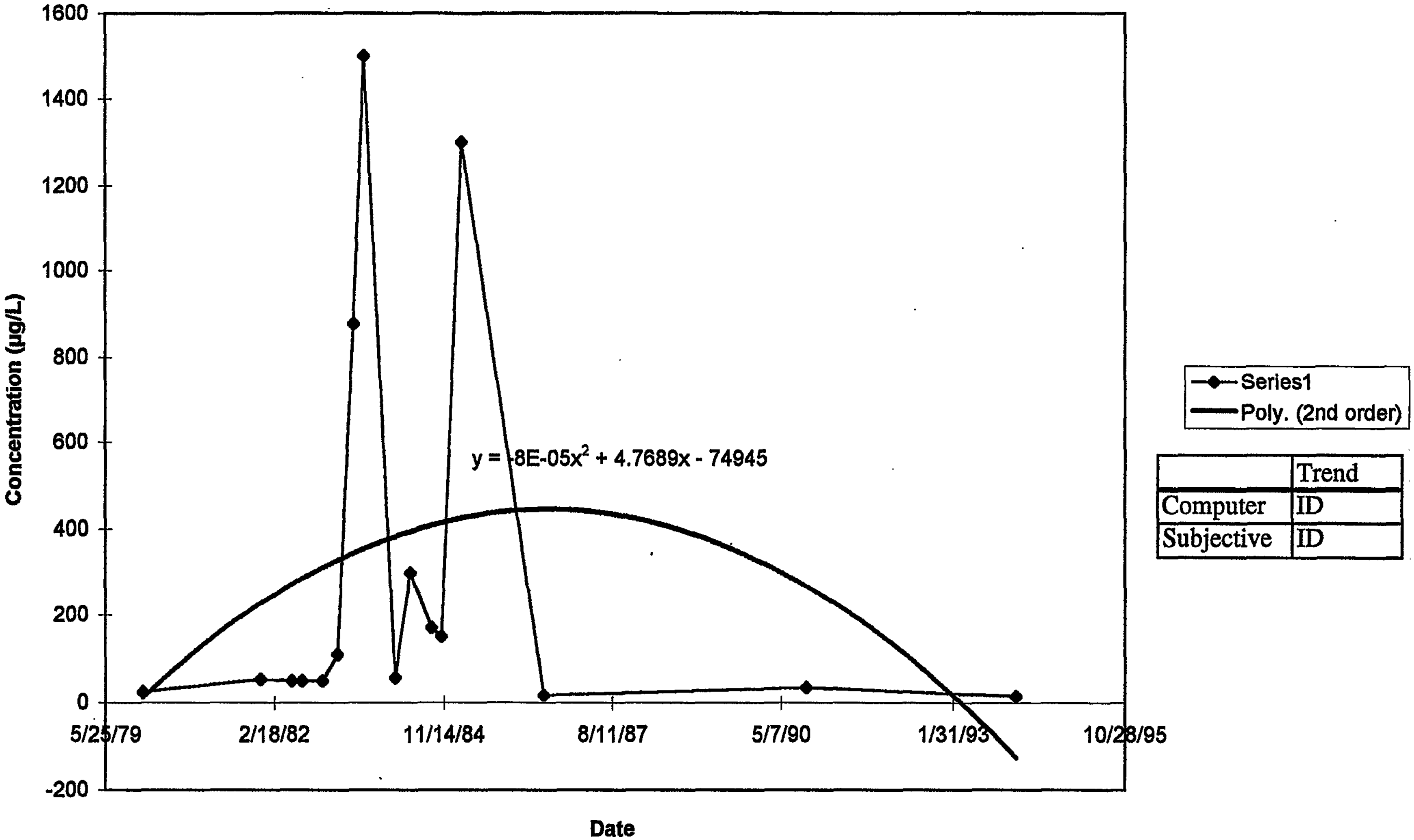
	Trend
Computer	DI
Subjective	DI

Statistical Trend Analysis: Tetryl - Well G0012



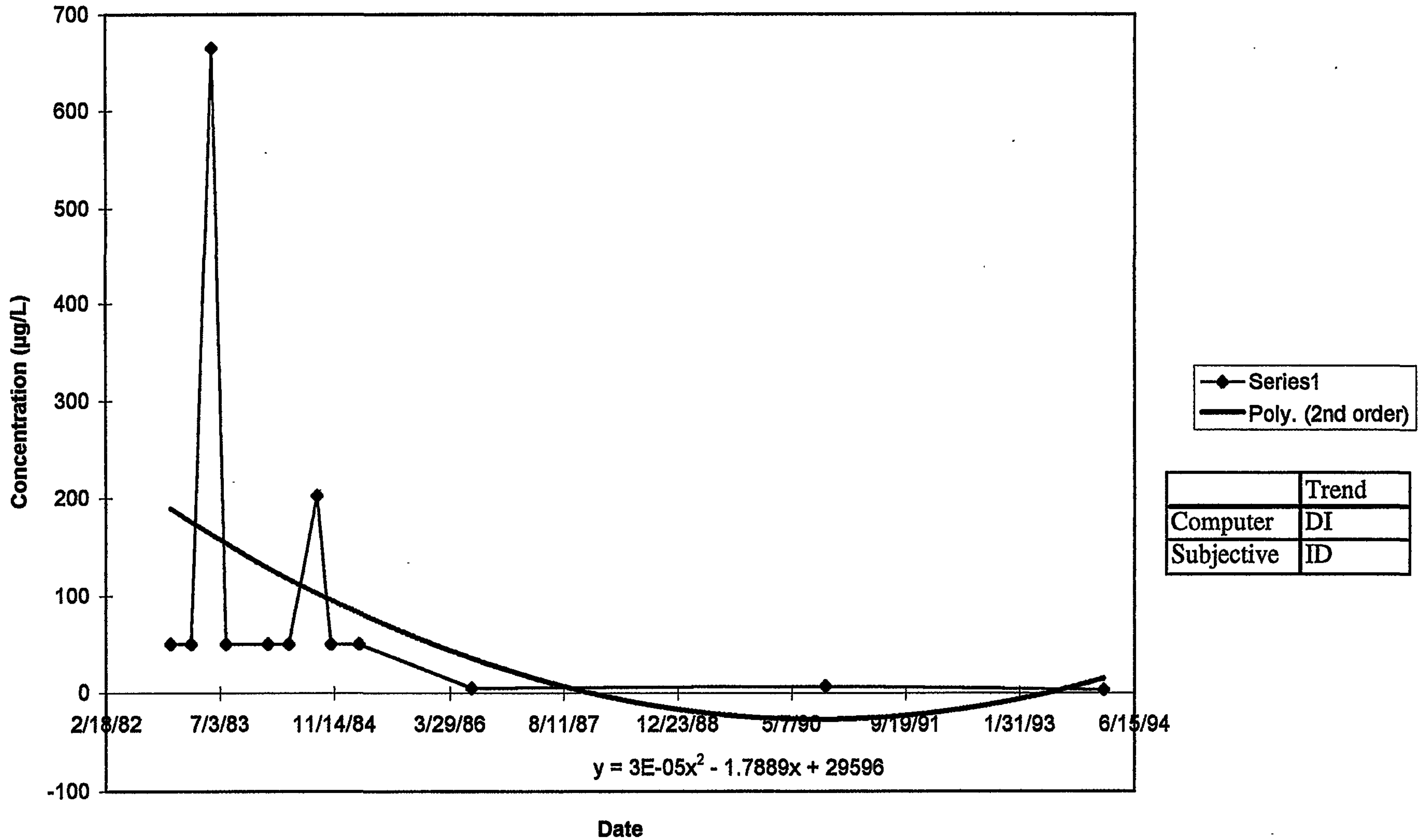
	Trend
Computer	ID
Subjective	ID

Statistical Trend Analysis: RDX - G0014



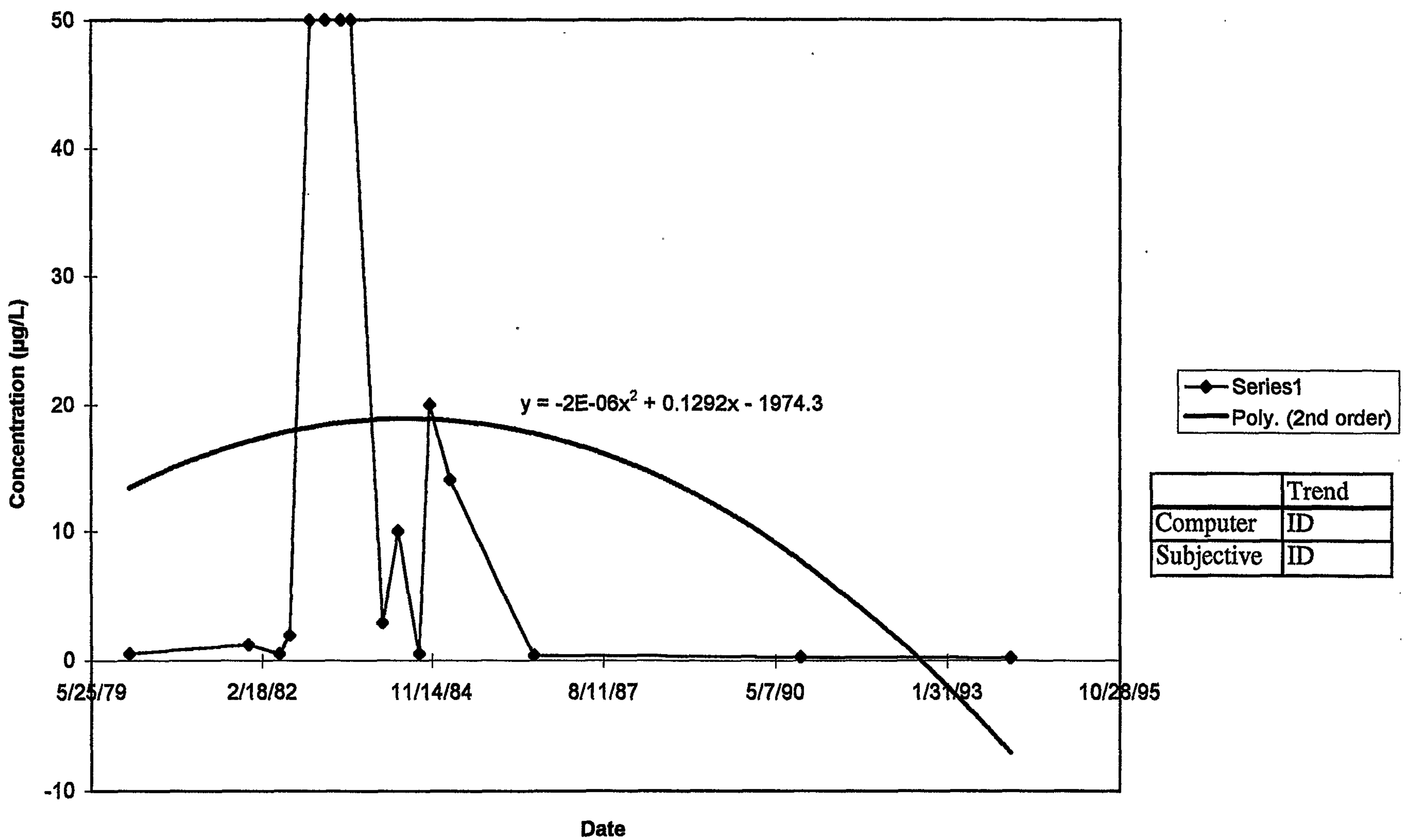
	Trend
Computer	ID
Subjective	ID

Statistical Trend Analysis: HMX - Well G0014



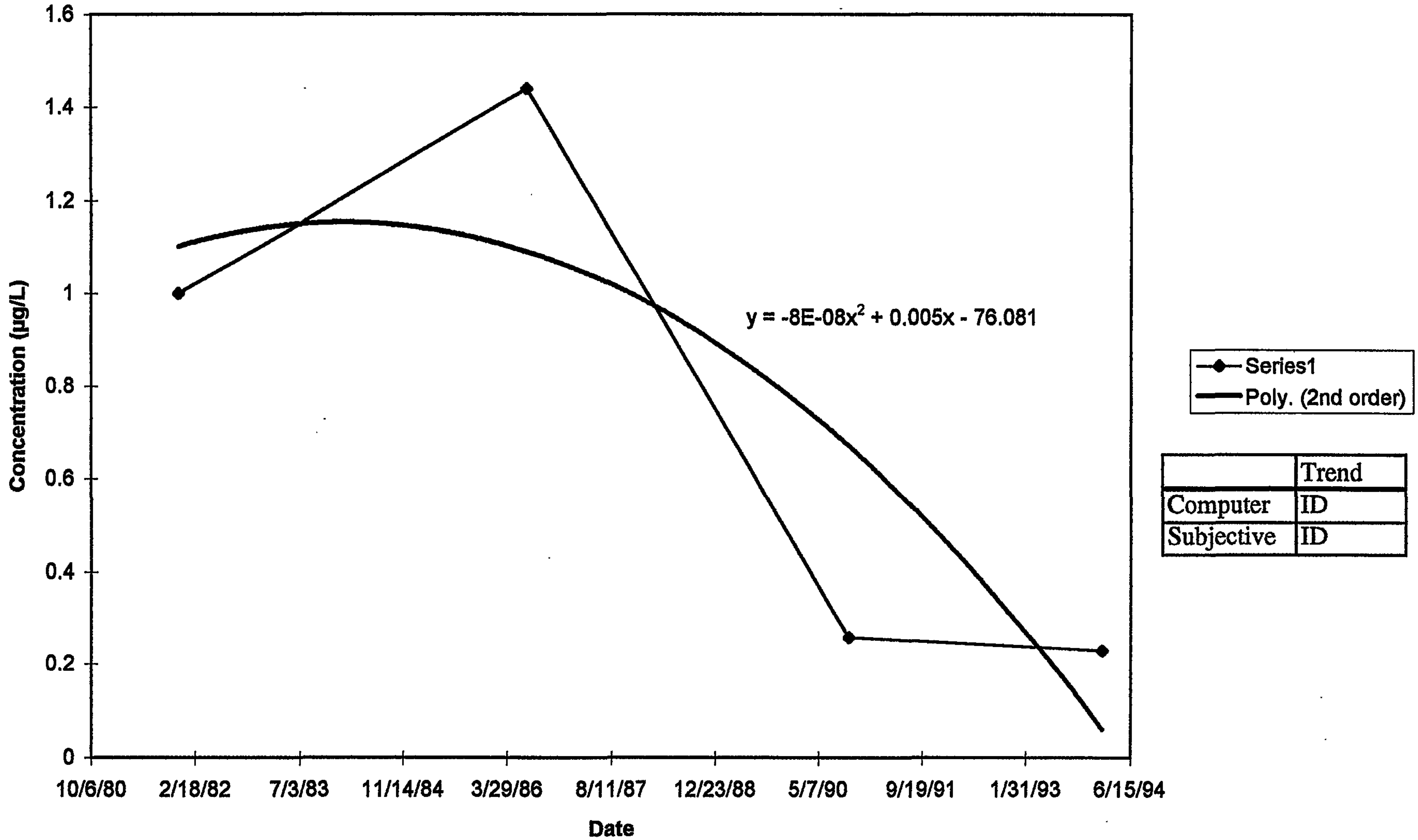
	Trend
Computer	DI
Subjective	ID

Statistical Trend Analysis: 2,4,6-TNT - Well G0014

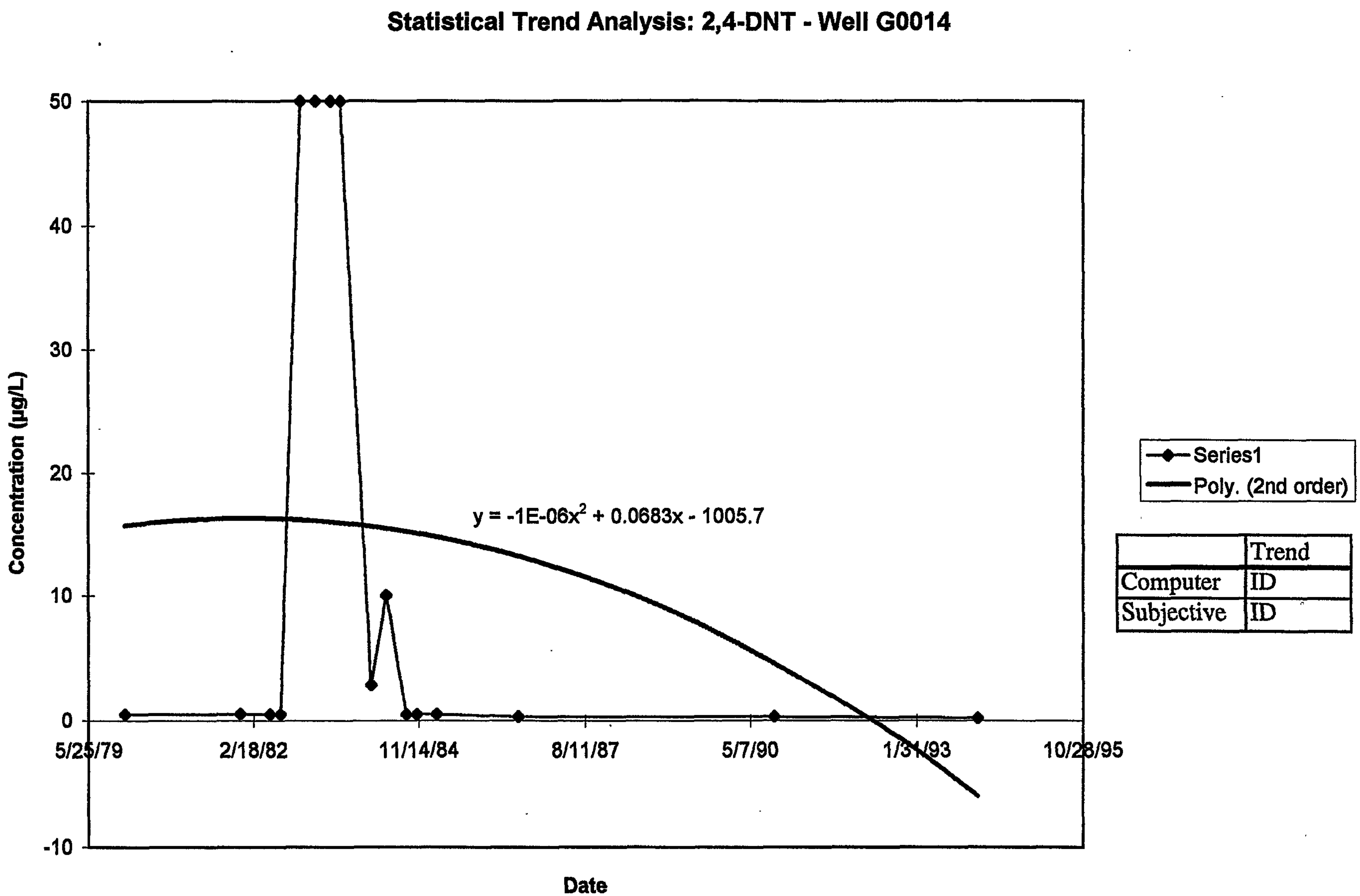


	Trend
Computer	ID
Subjective	ID

Statistical Trend Analysis: 1,3-DNB - Well G0014

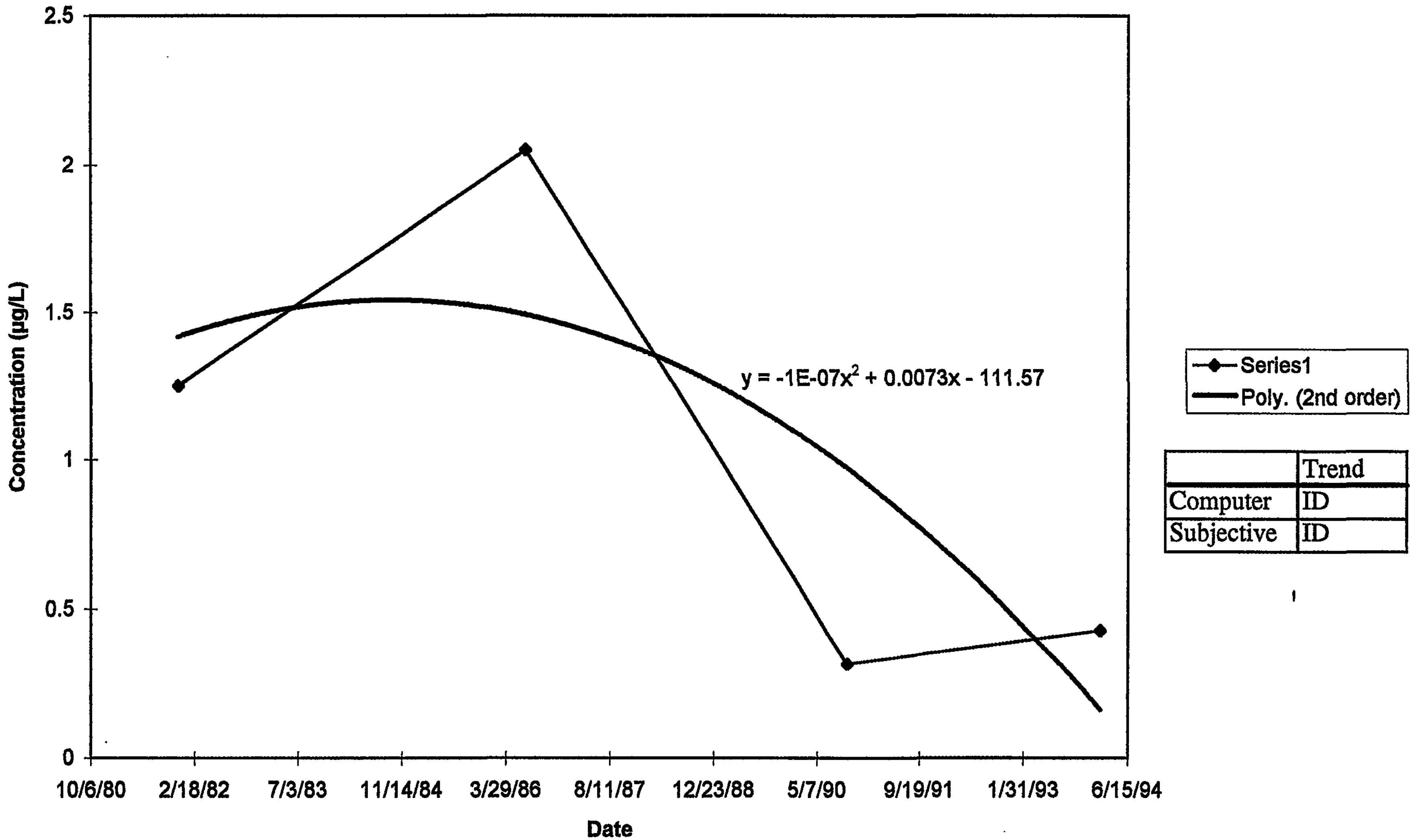


	Trend
Computer	ID
Subjective	ID



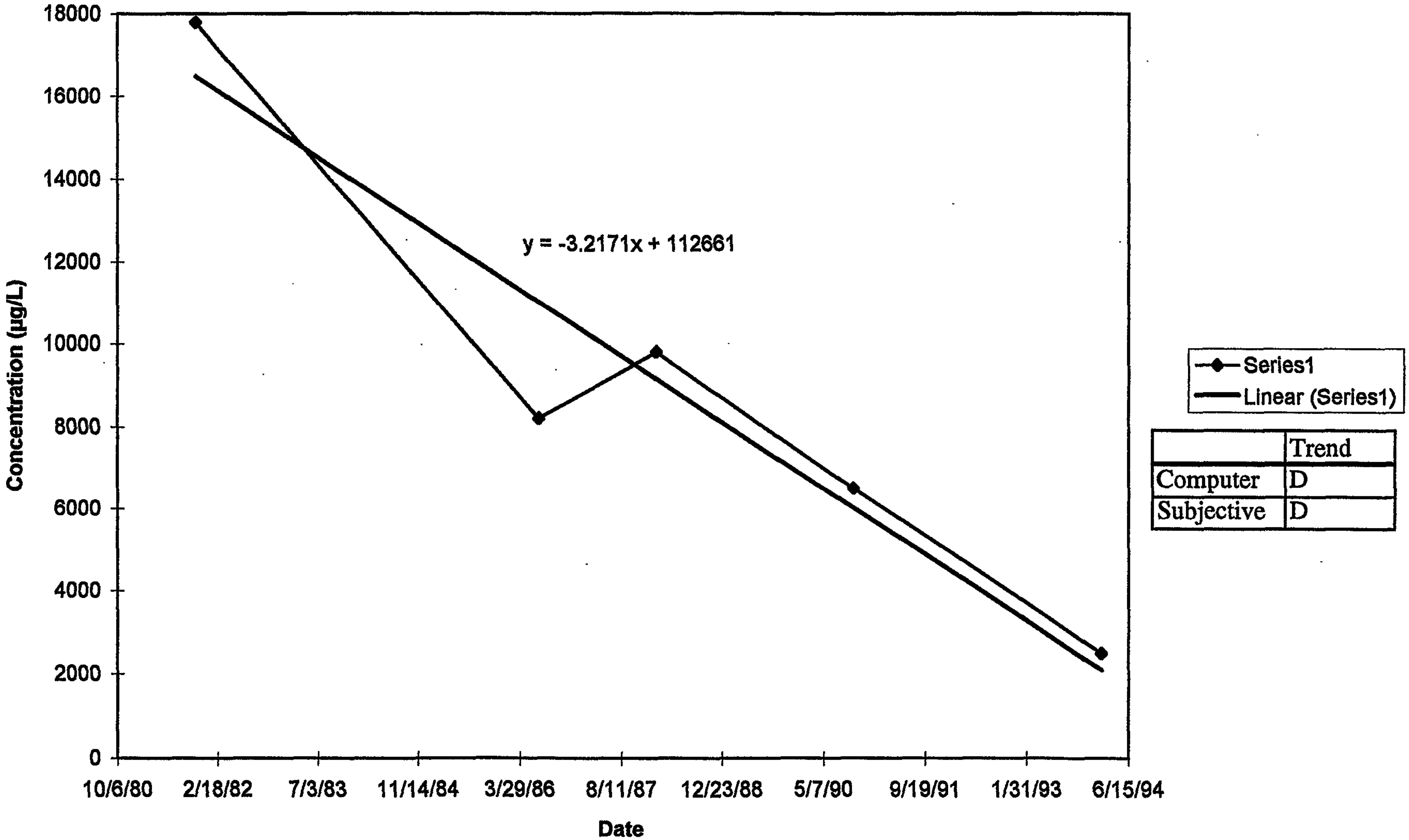
	Trend
Computer	ID
Subjective	ID

Statistical Trend Analysis: 1,3,5-TNB - Well G0014



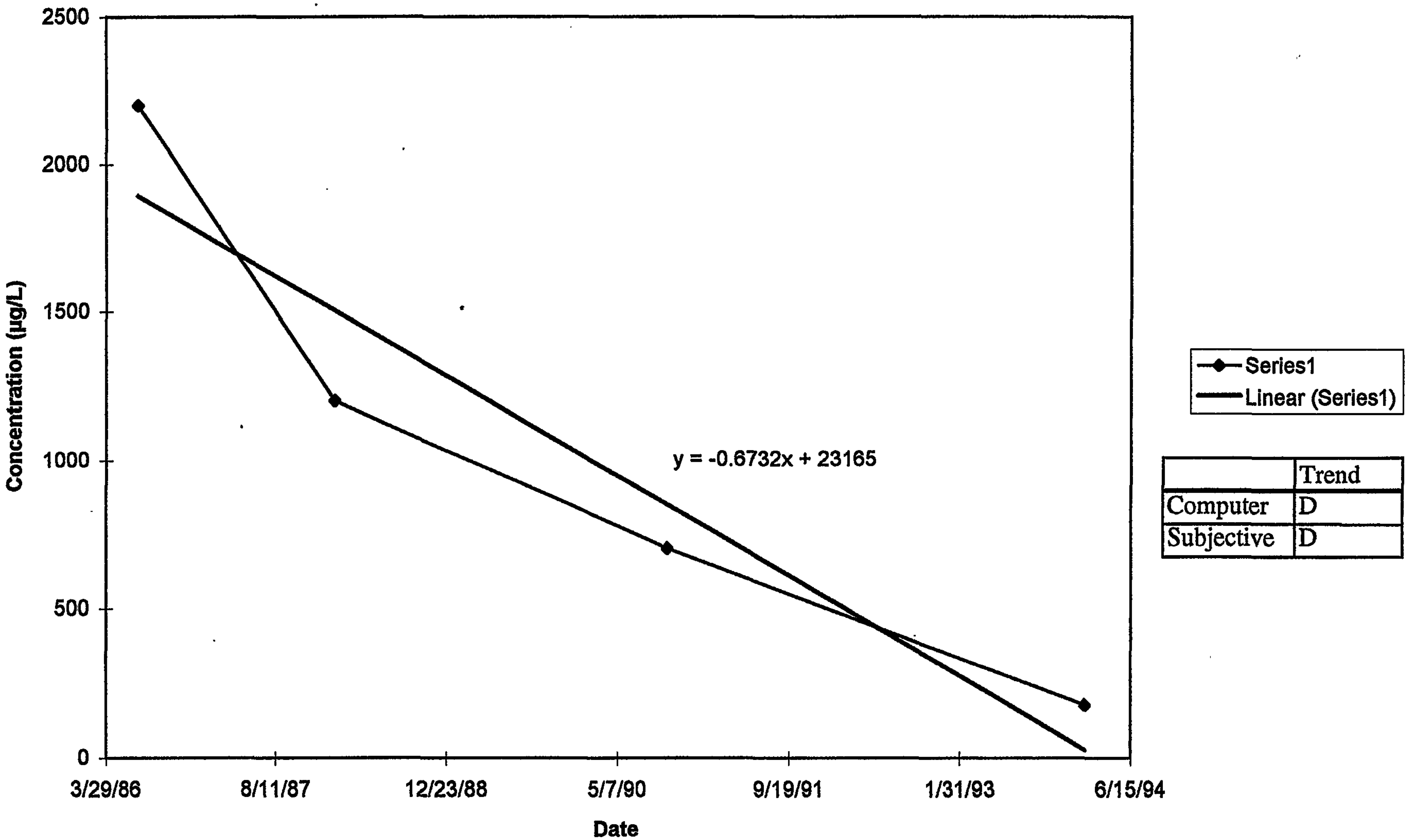
	Trend
Computer	ID
Subjective	ID

Statistical Trend Analysis: RDX - G0068



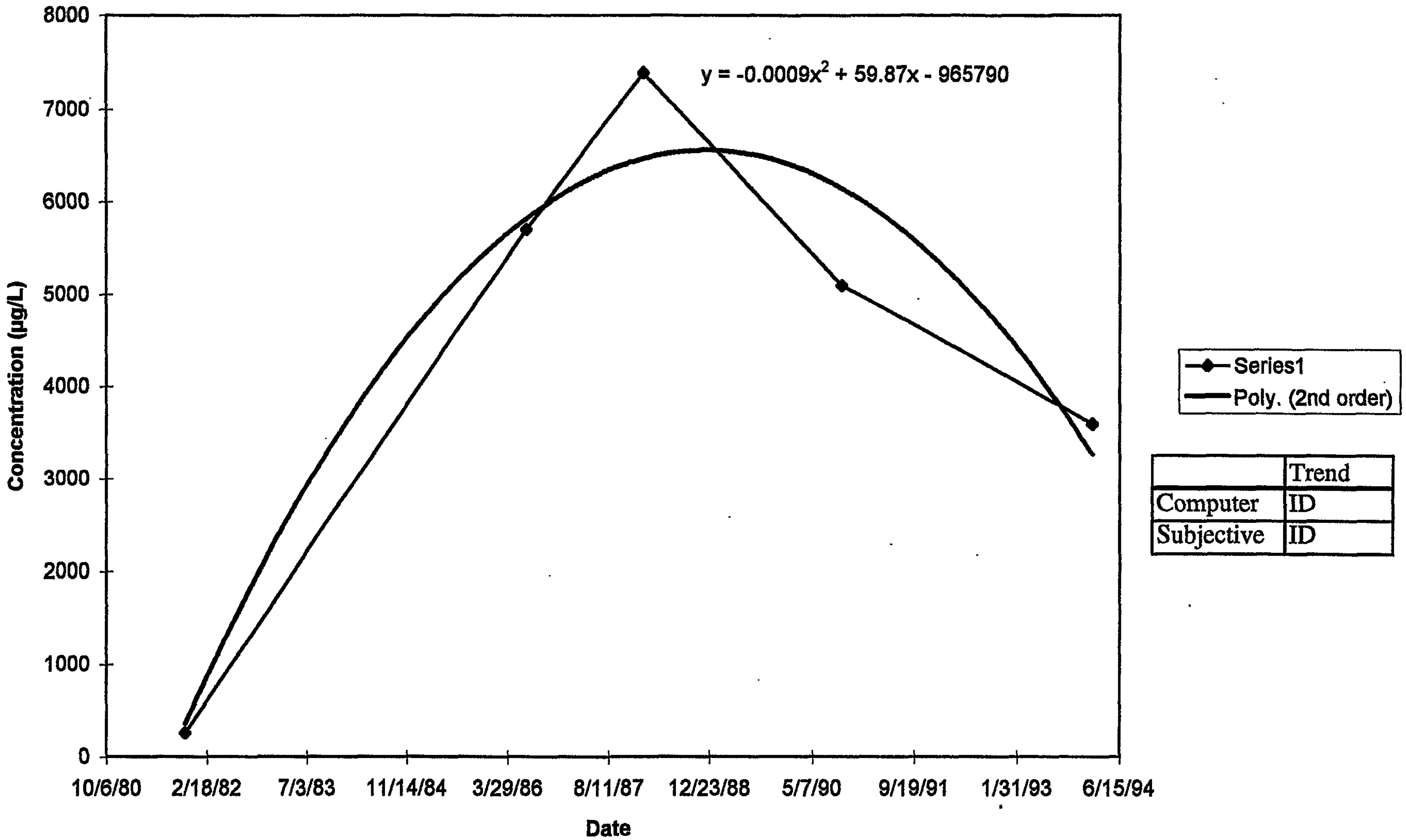
	Trend
Computer	D
Subjective	D

Statistical Trend Analysis: HMX - Well G0068



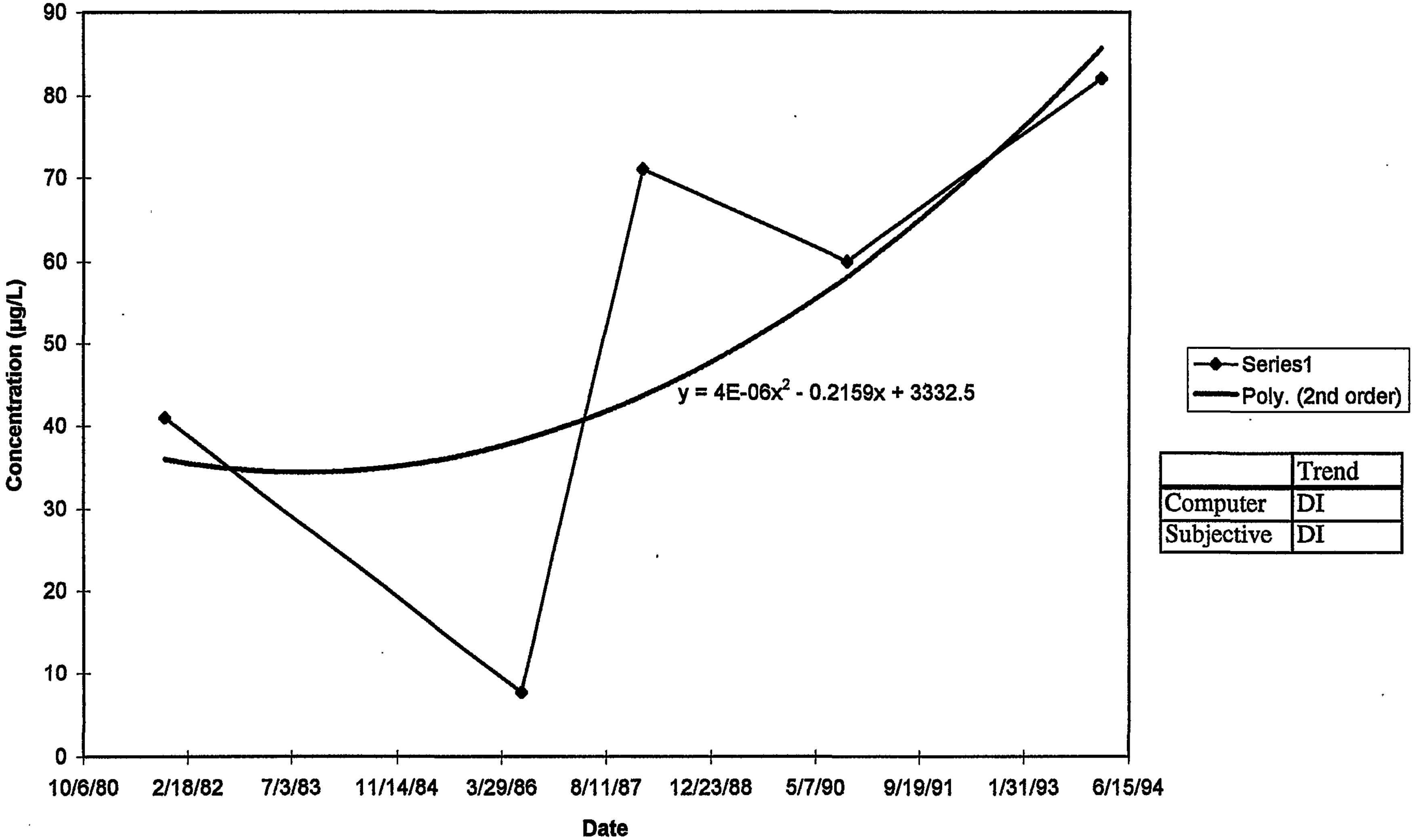
	Trend
Computer	D
Subjective	D

Statistical Trend Analysis: 2,4,6-TNT - Well G0068



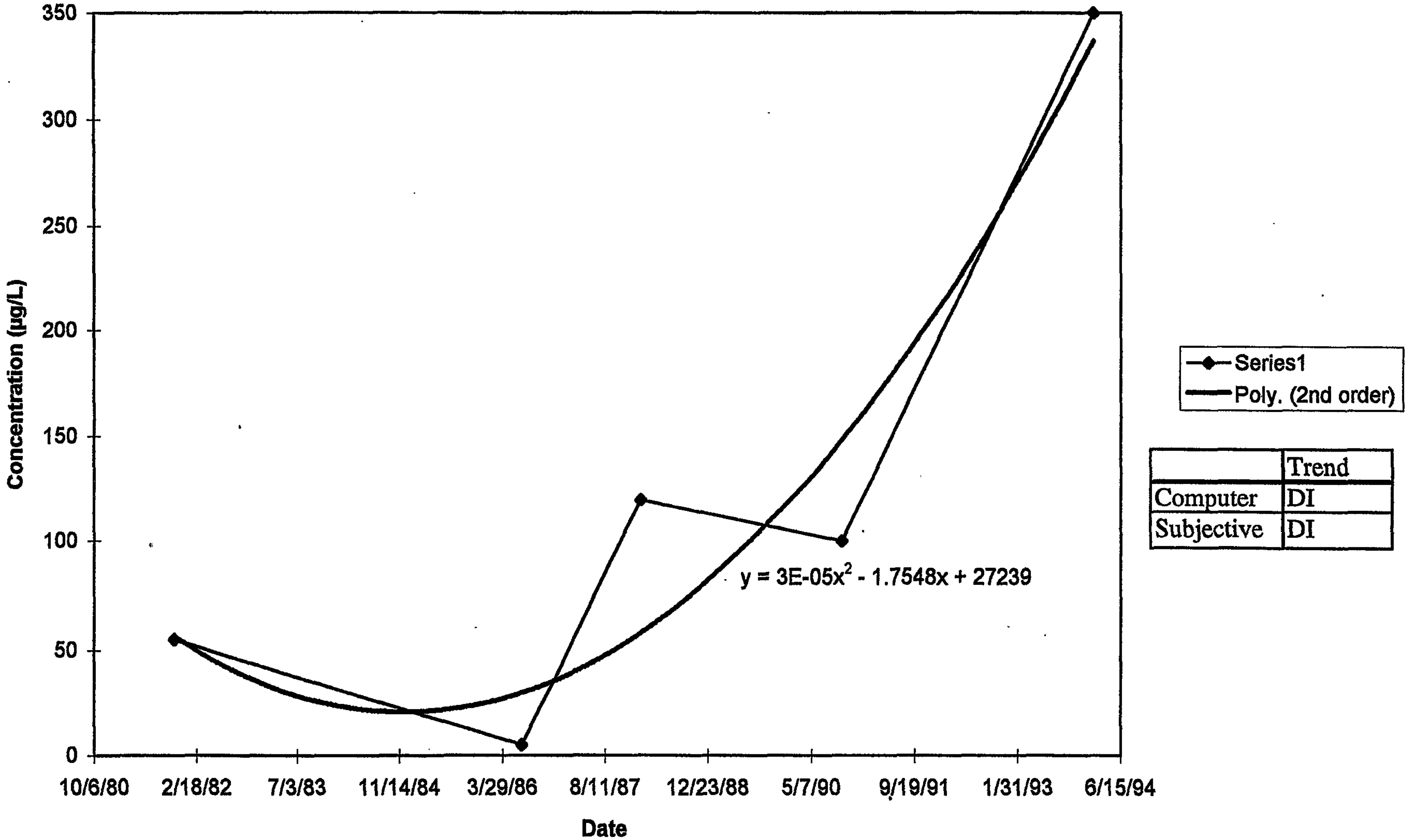
	Trend
Computer	ID
Subjective	ID

Statistical Trend Analysis: 1,3-DNB - Well G0068



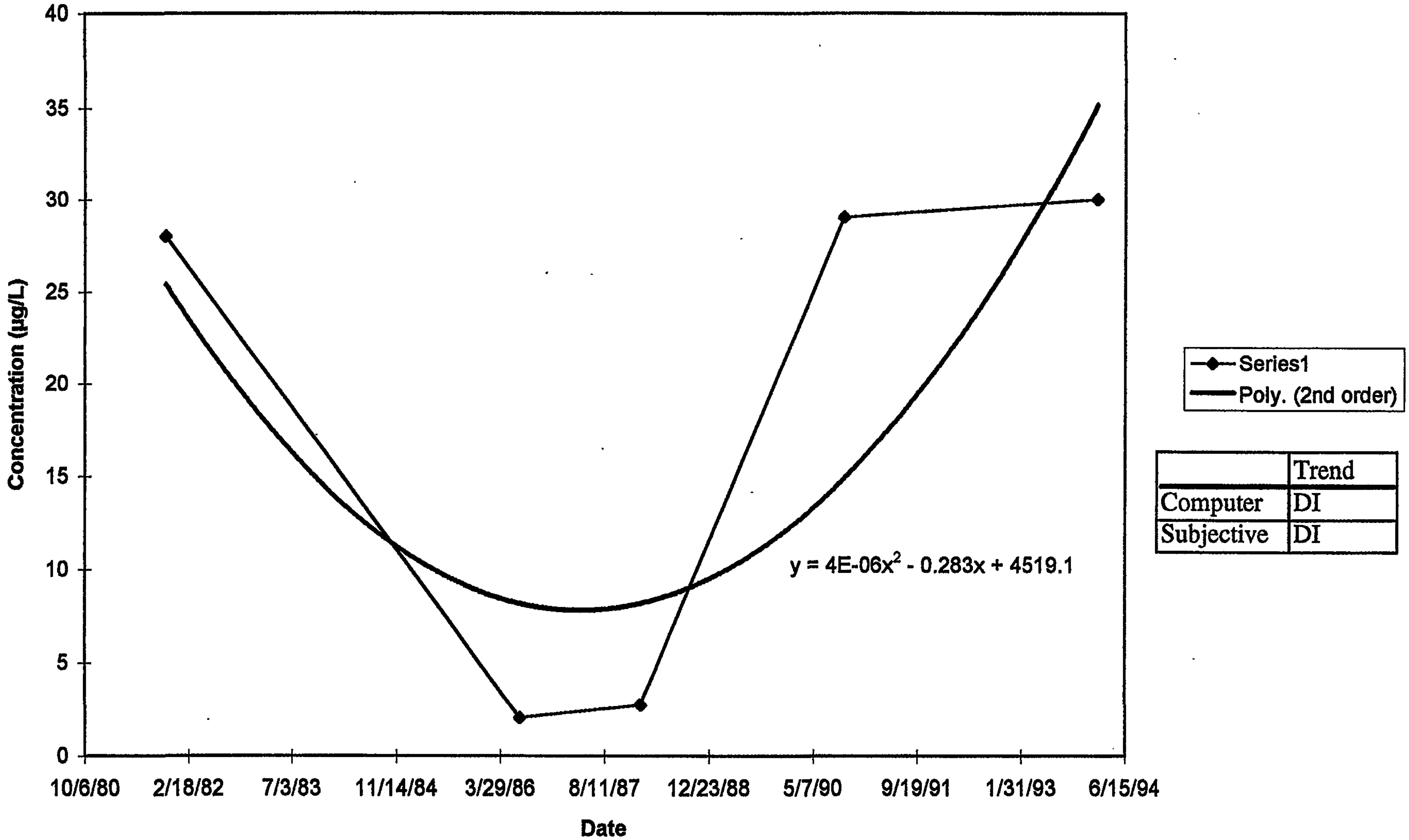
	Trend
Computer	DI
Subjective	DI

Statistical Trend Analysis: 2,4-DNT - Well G0068



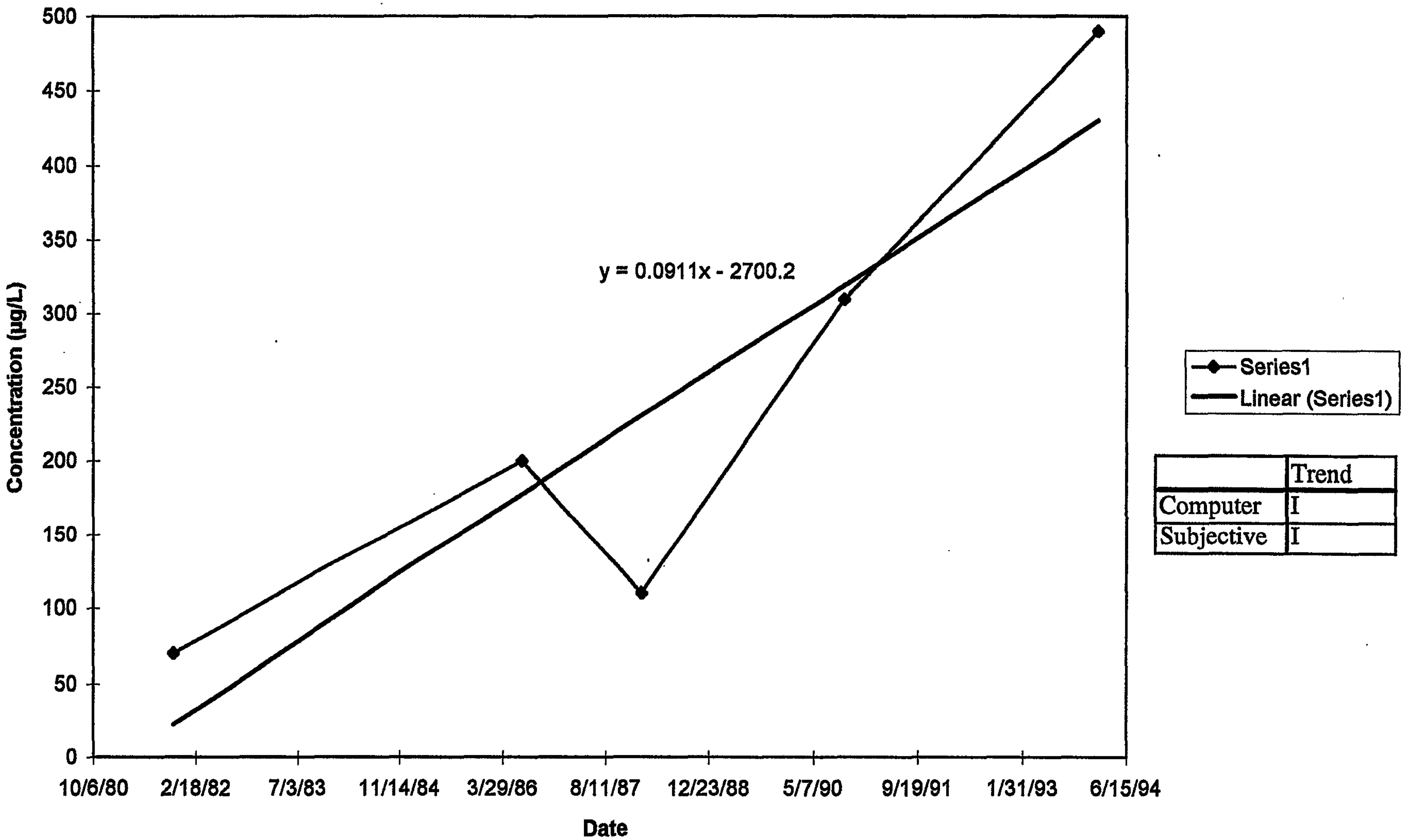
	Trend
Computer	DI
Subjective	DI

Statistical Trend Analysis: 2,6-DNT - Well G0068



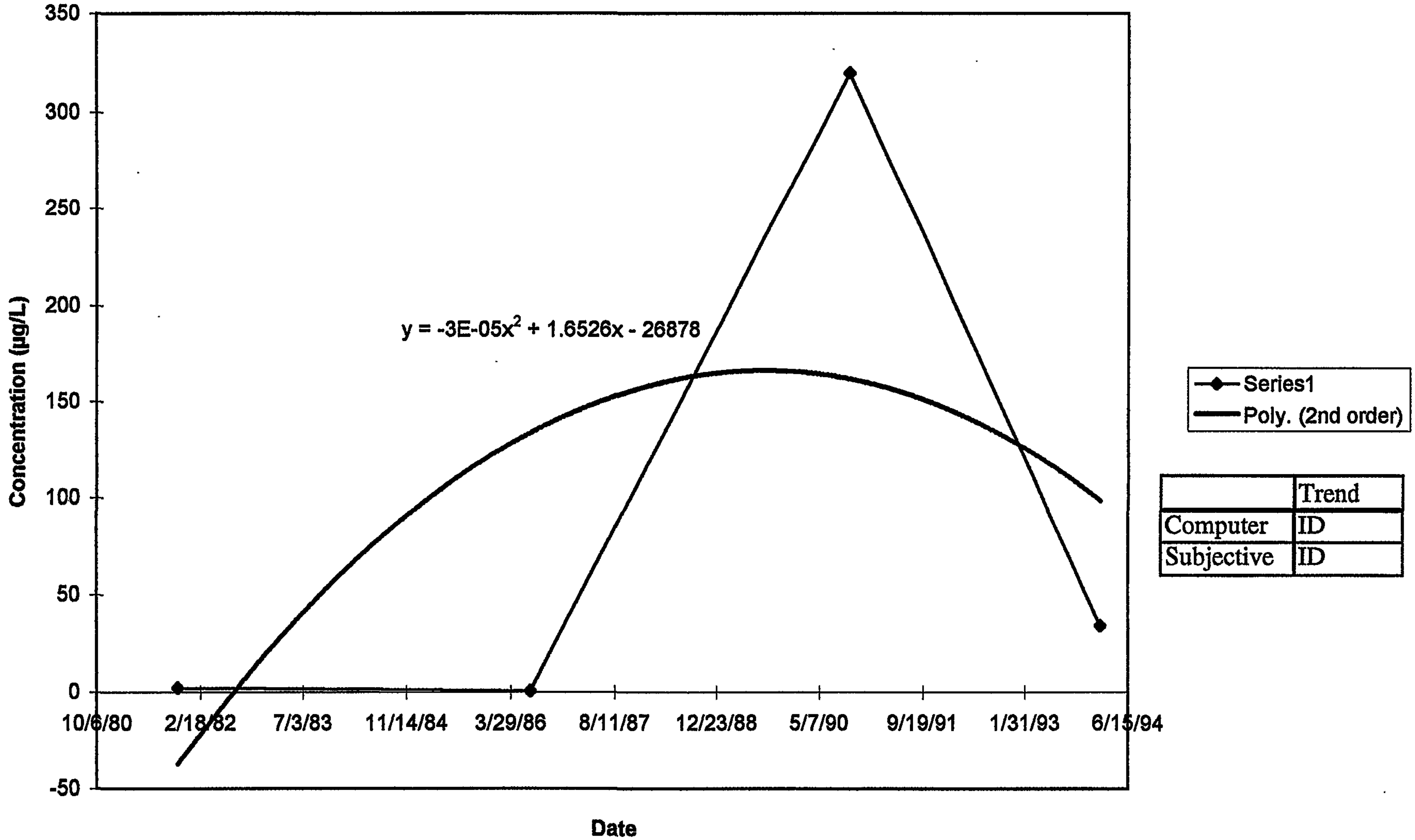
	Trend
Computer	DI
Subjective	DI

Statistical Trend Analysis: 1,3,5-TNB - Well G0068

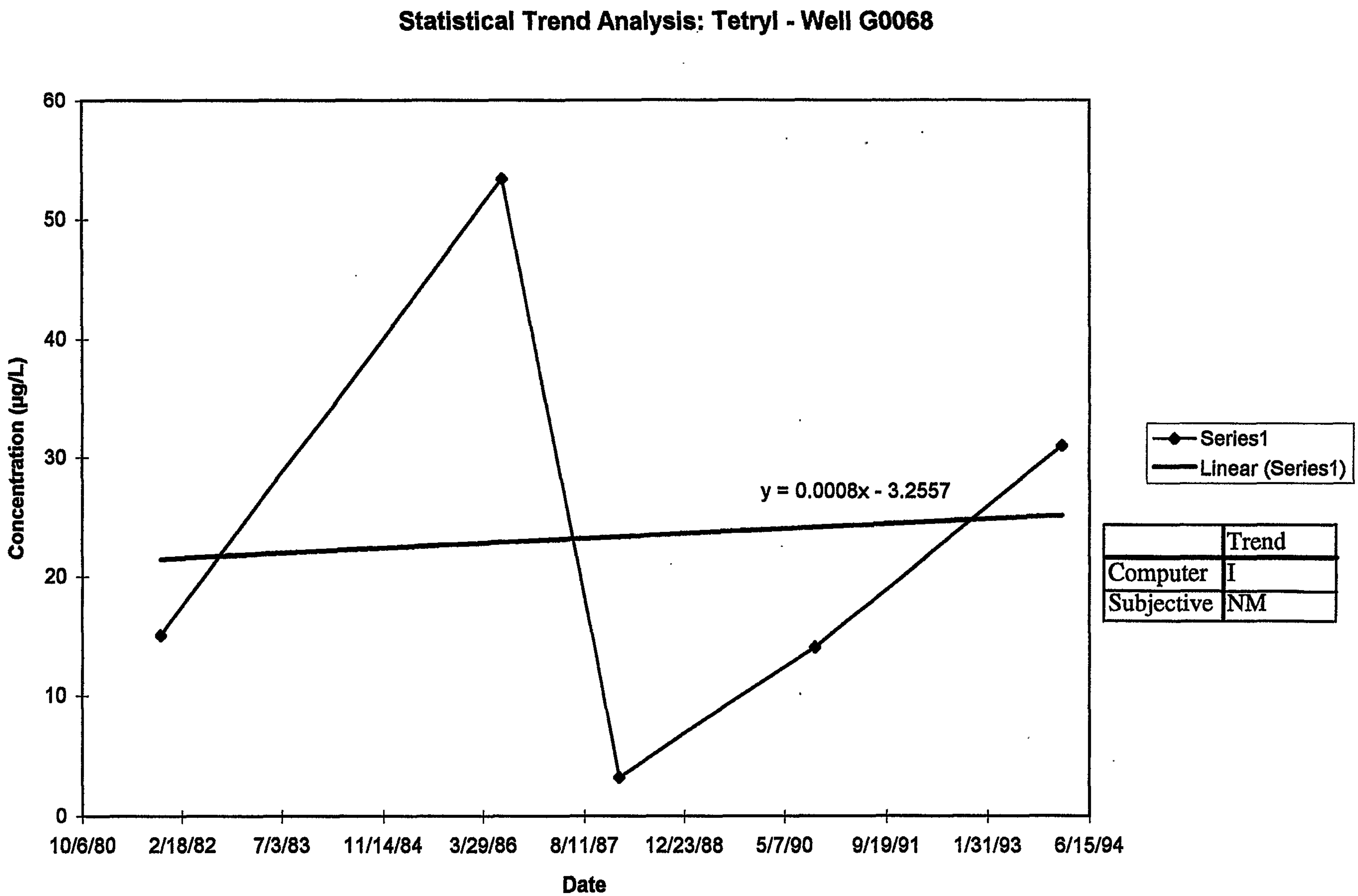


	Trend
Computer	I
Subjective	I

Statistical Trend Analysis: NB - Well G0068

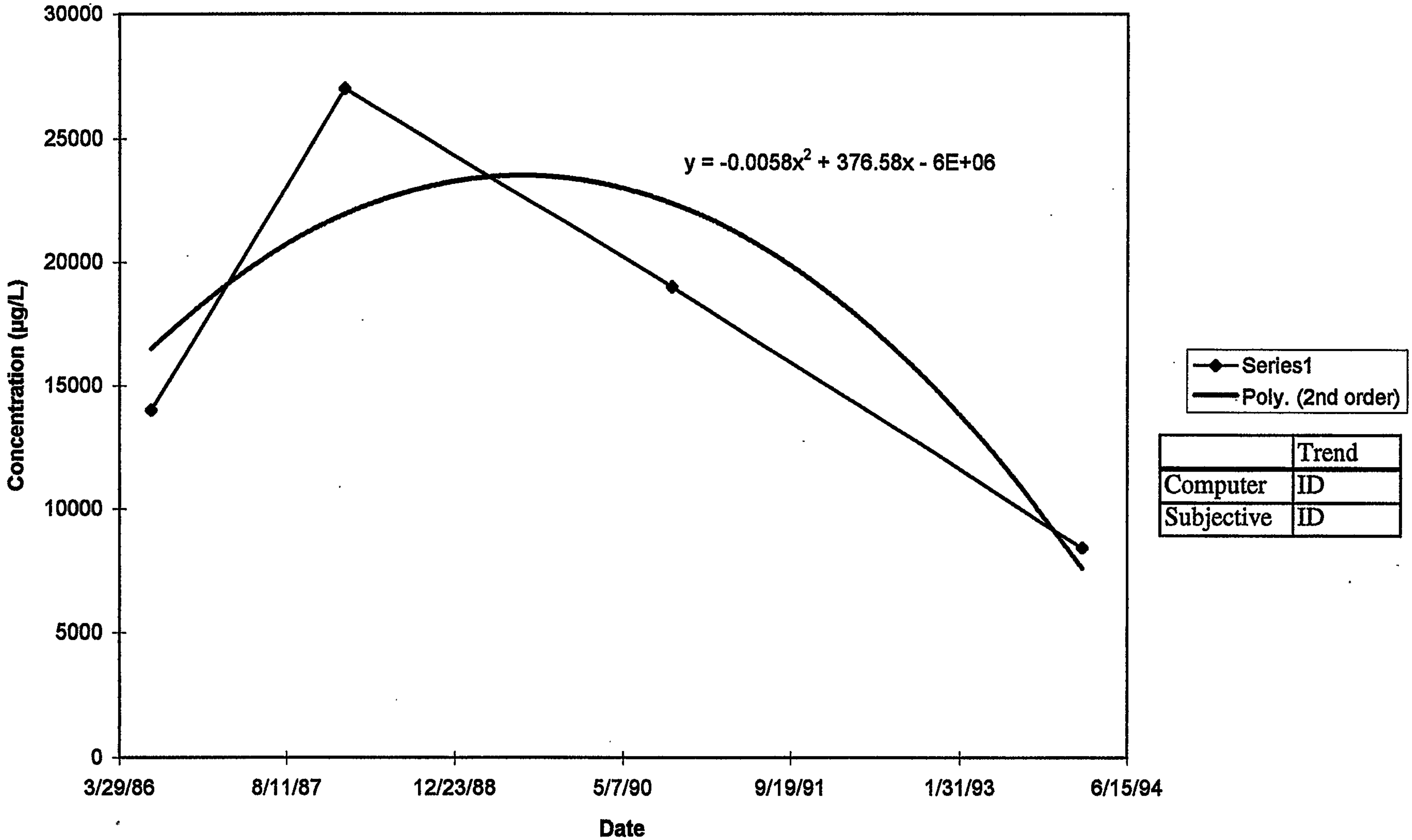


	Trend
Computer	ID
Subjective	ID



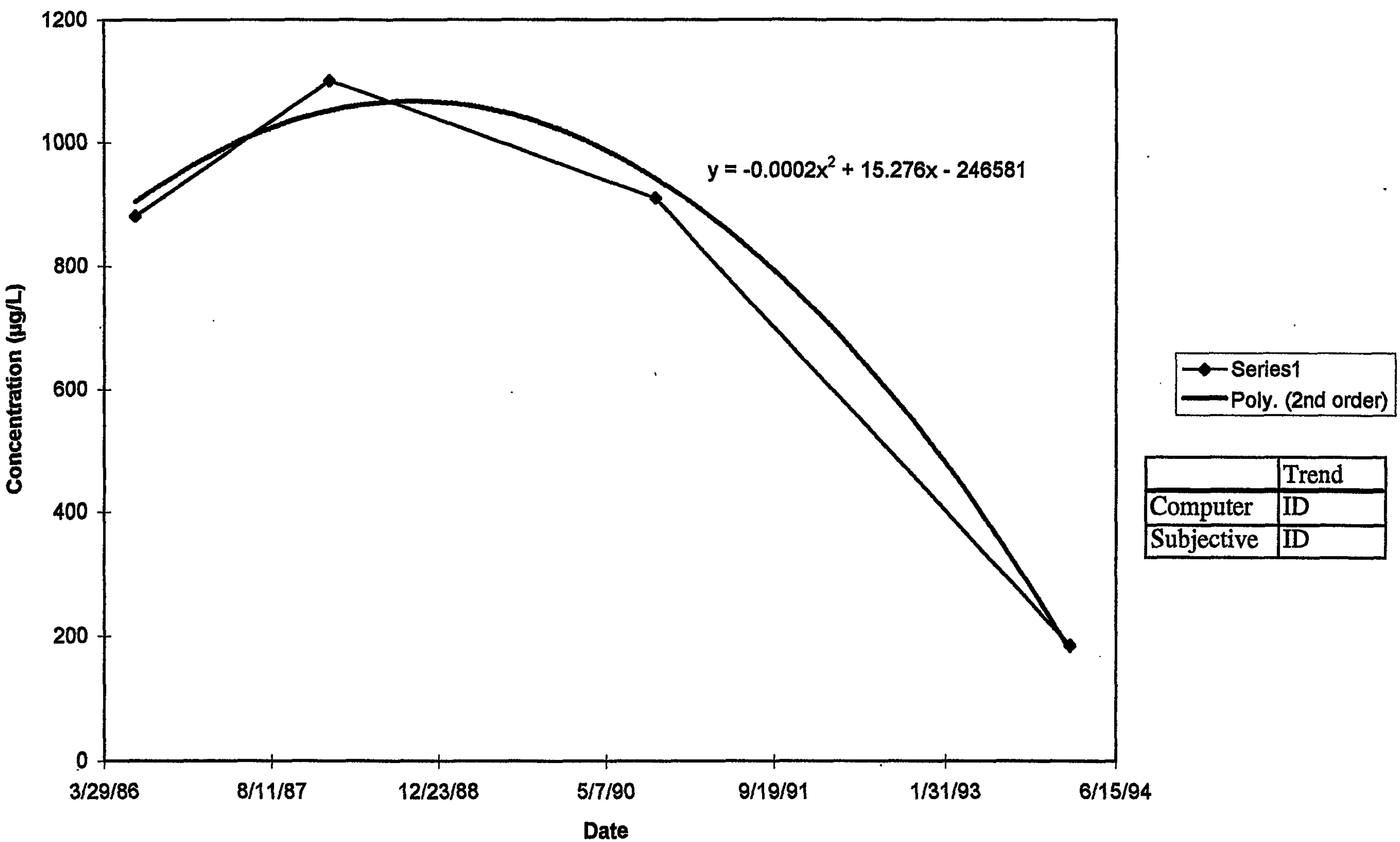
	Trend
Computer	I
Subjective	NM

Statistical Trend Analysis: RDX - Well G0104

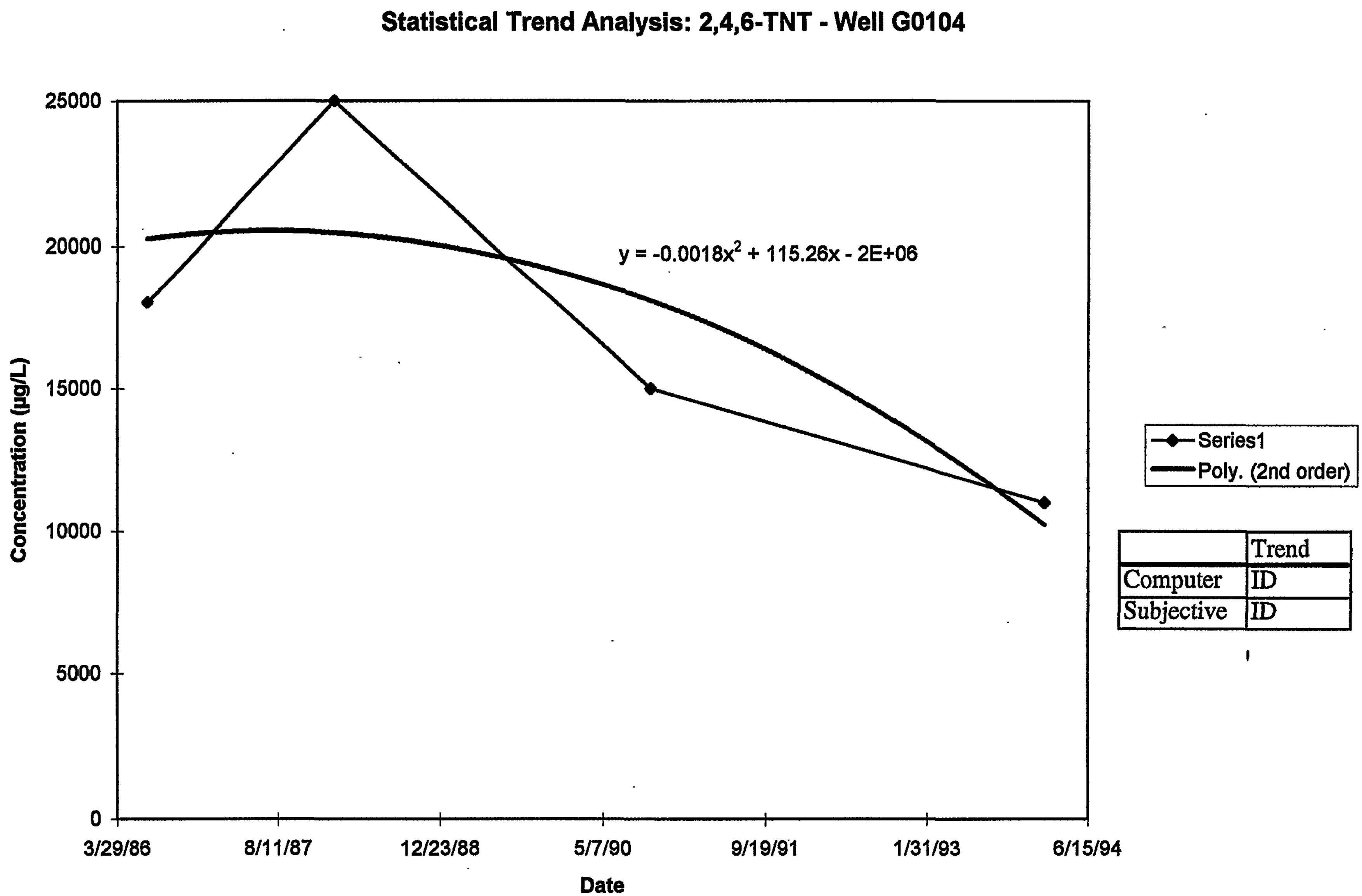


	Trend
Computer	ID
Subjective	ID

Statistical Trend Analysis: HMX - Well G0104

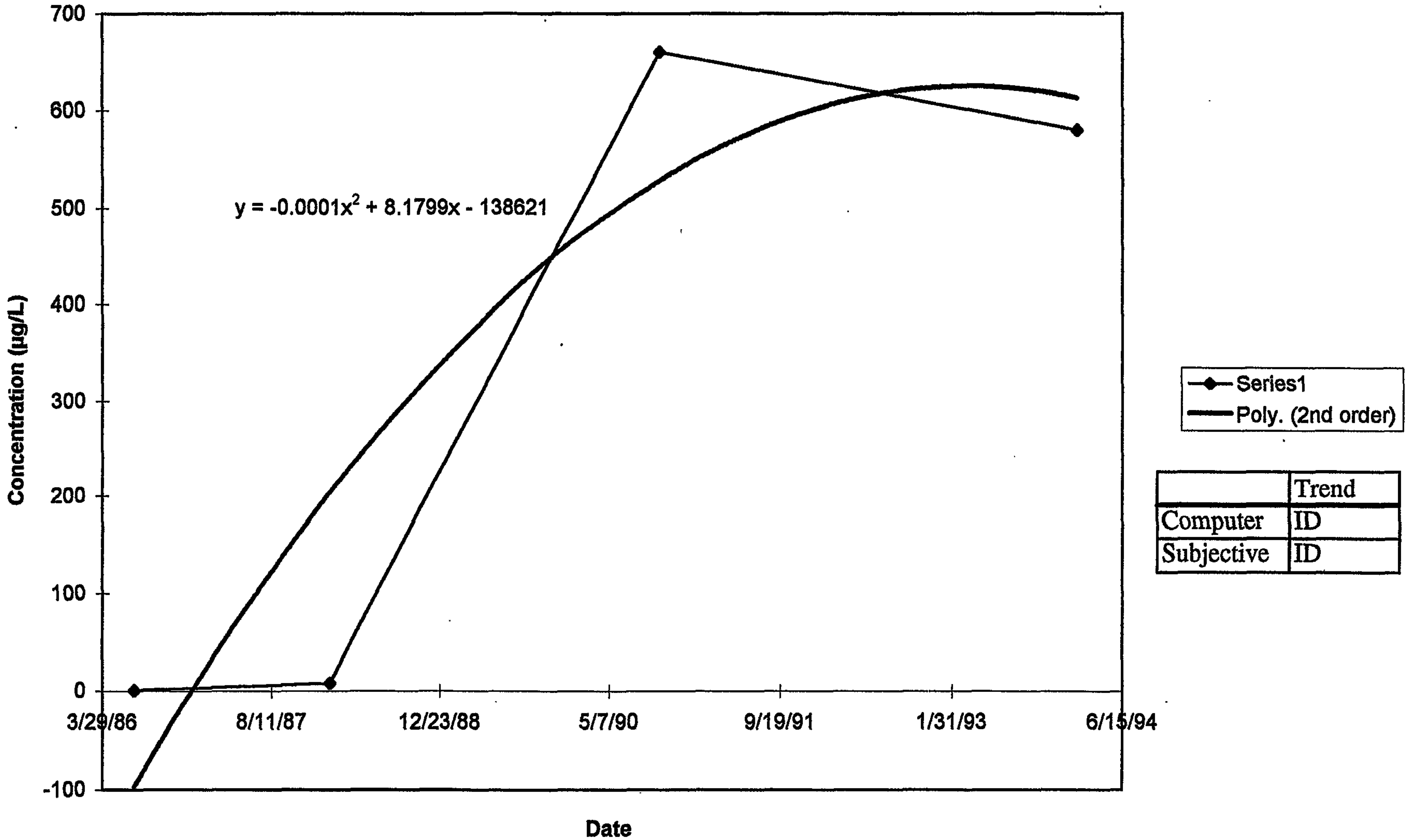


	Trend
Computer	ID
Subjective	ID



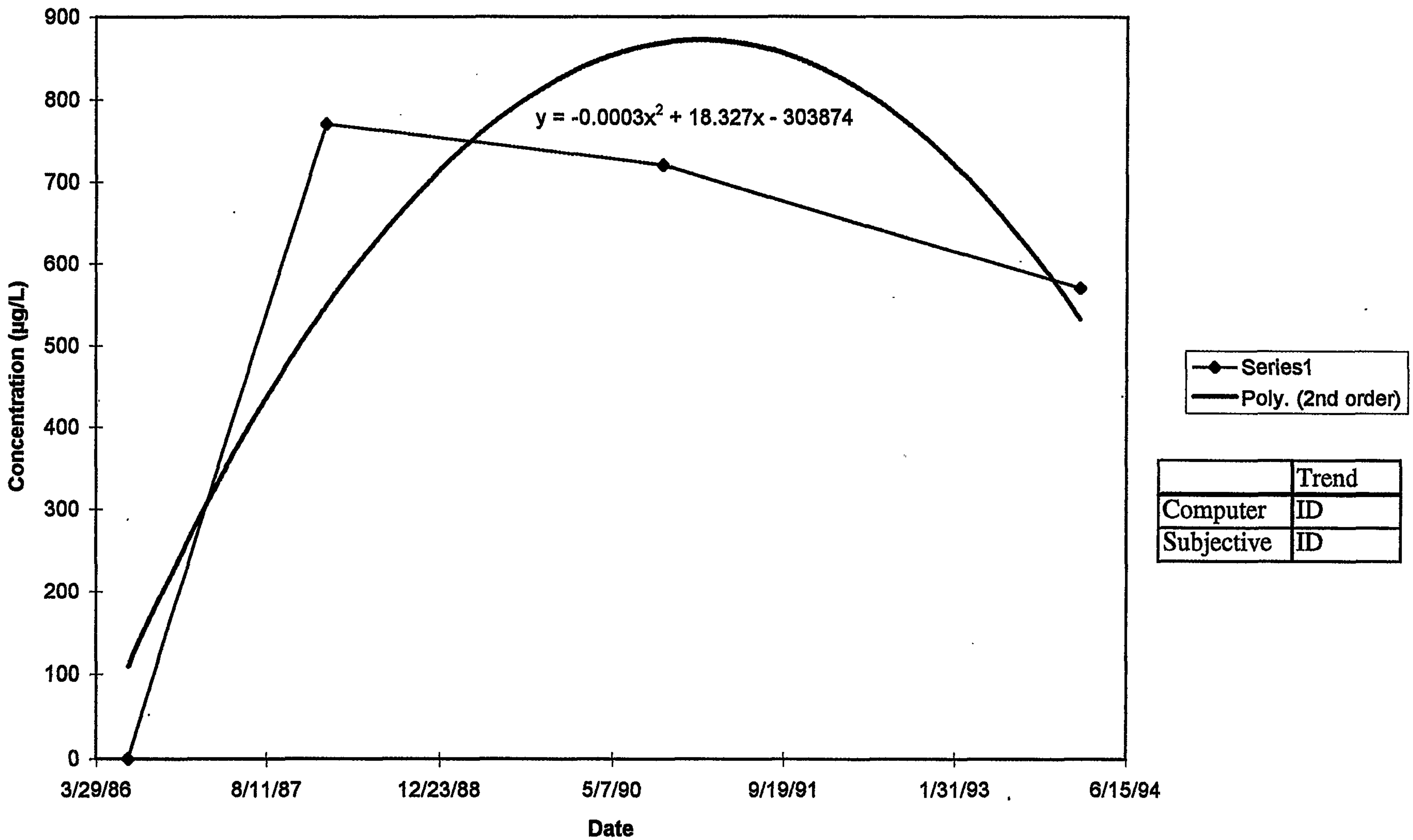
	Trend
Computer	ID
Subjective	ID

Statistical Trend Analysis: 1,3-DNB - Well G0104



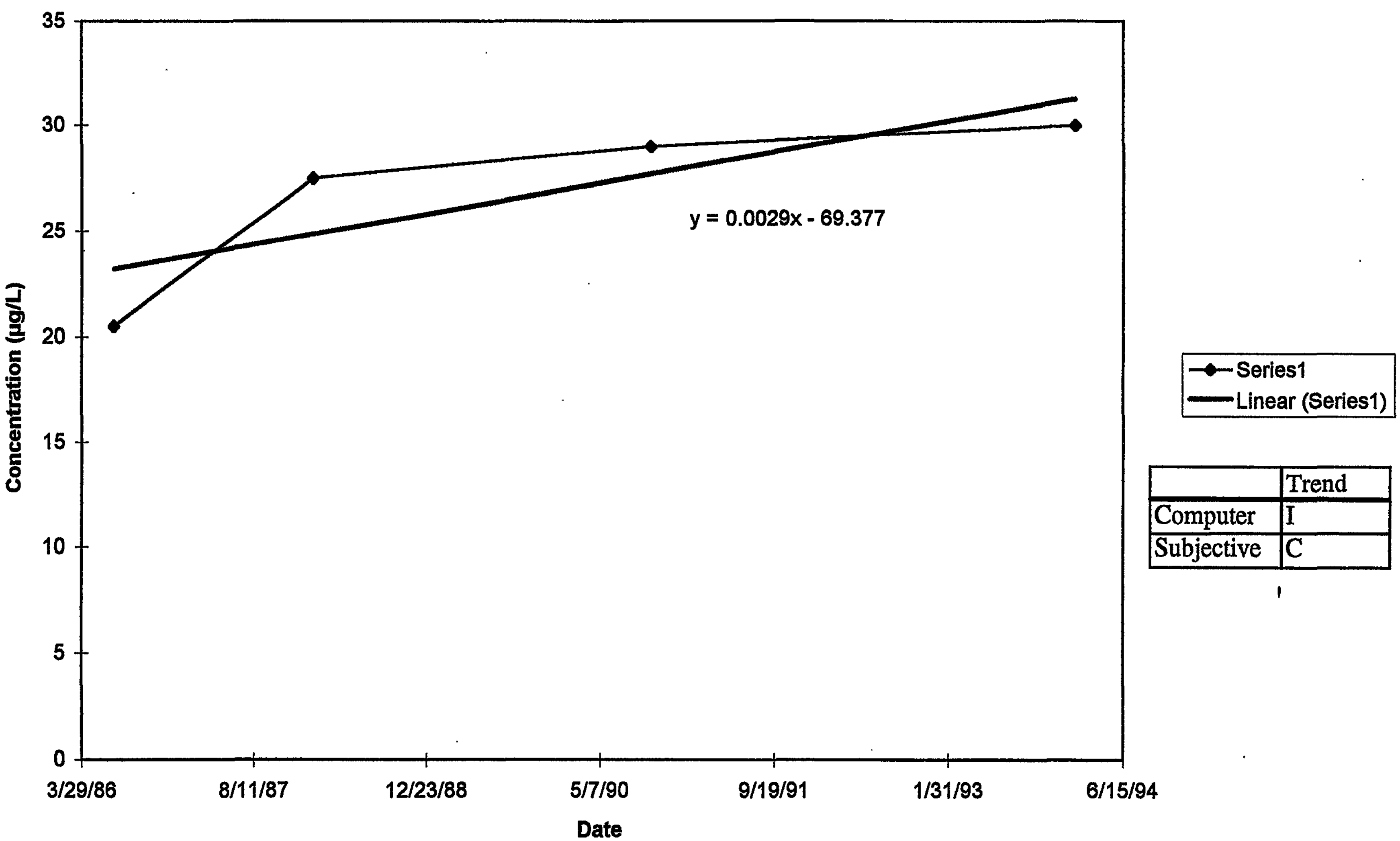
	Trend
Computer	ID
Subjective	ID

Statistical Trend Analysis: 2,4-DNT - Well G0104



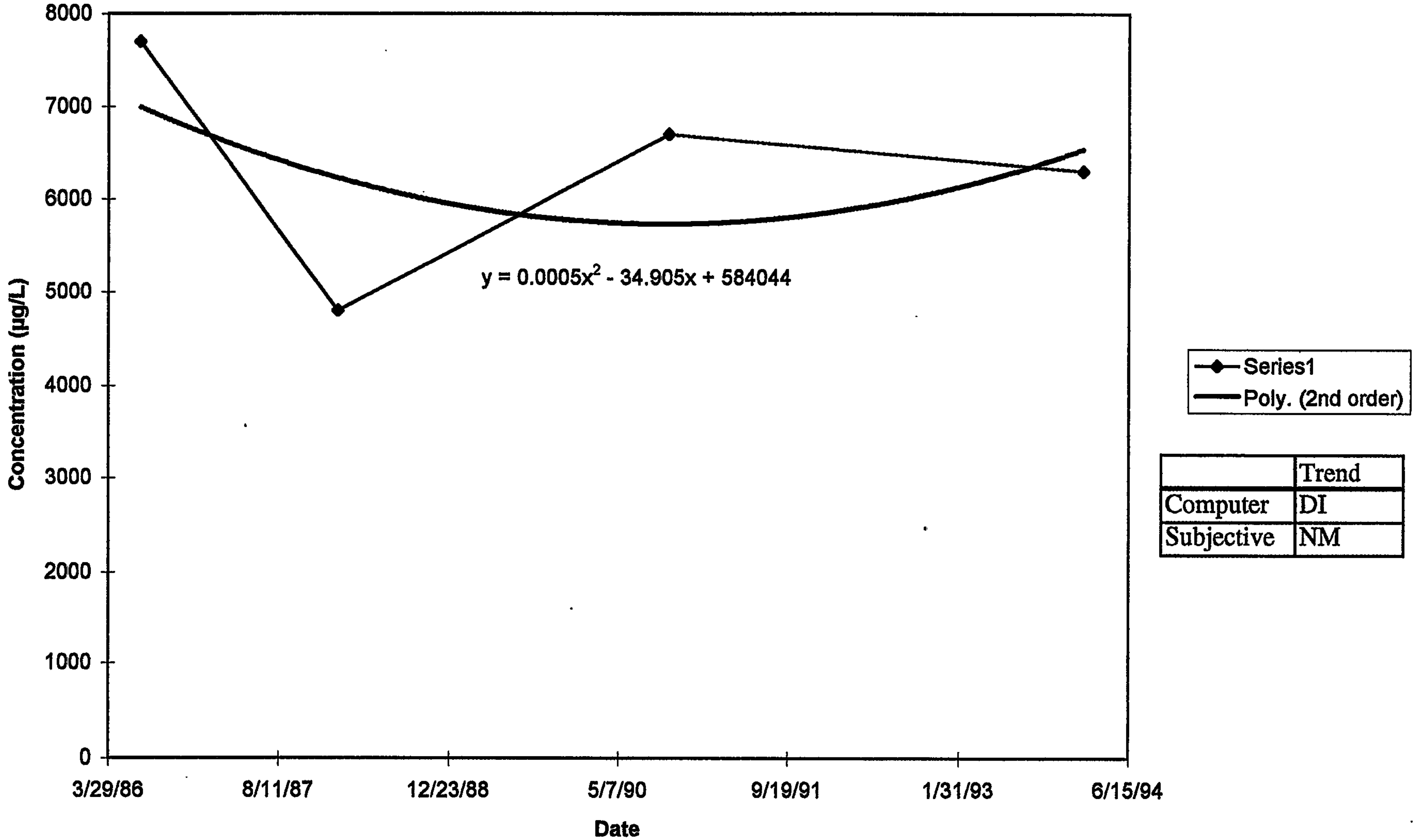
	Trend
Computer	ID
Subjective	ID

Statistical Trend Analysis: 2,6-DNT - Well G0104



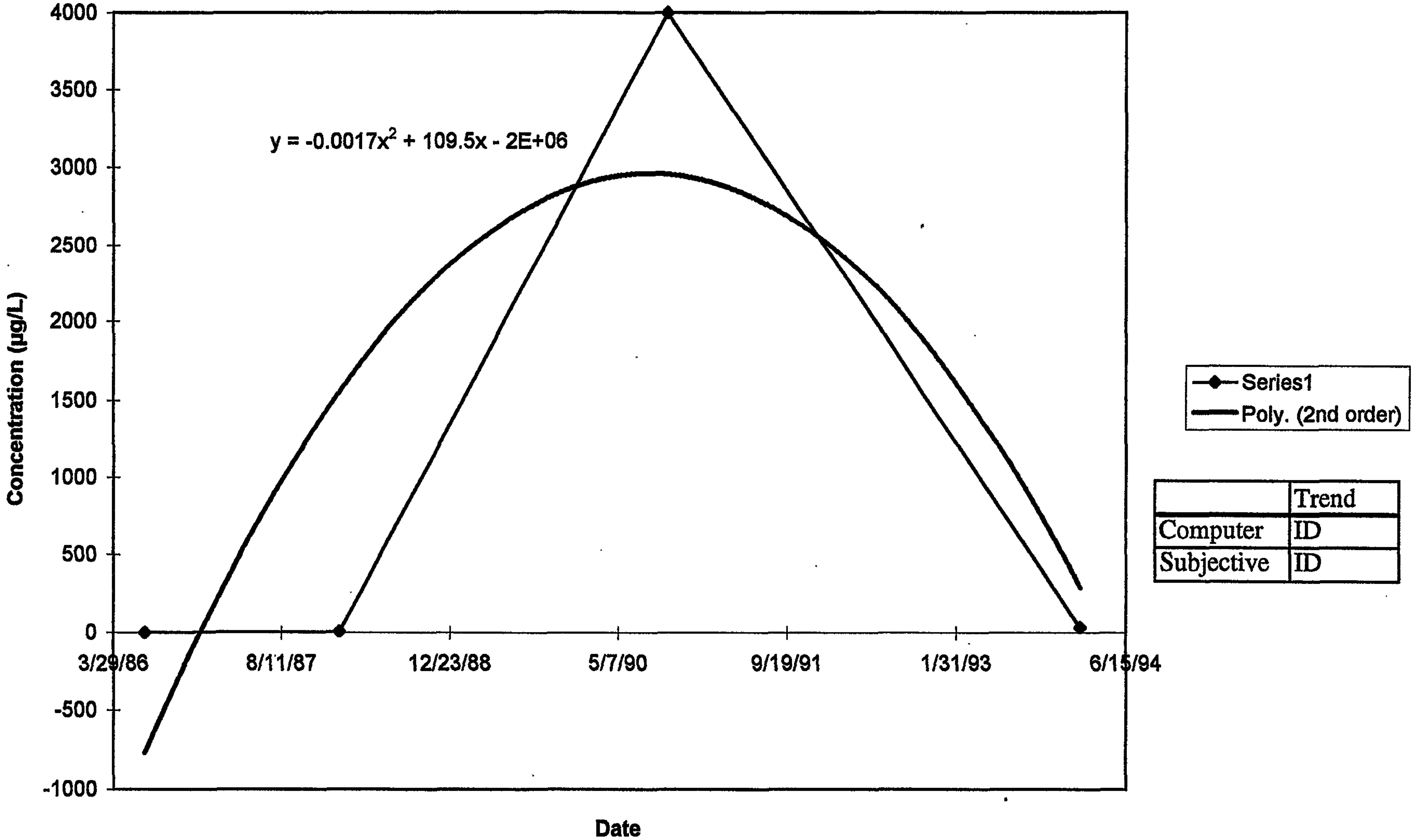
	Trend
Computer	I
Subjective	C

Statistical Trend Analysis: 1,3,5-TNB - Well G0104



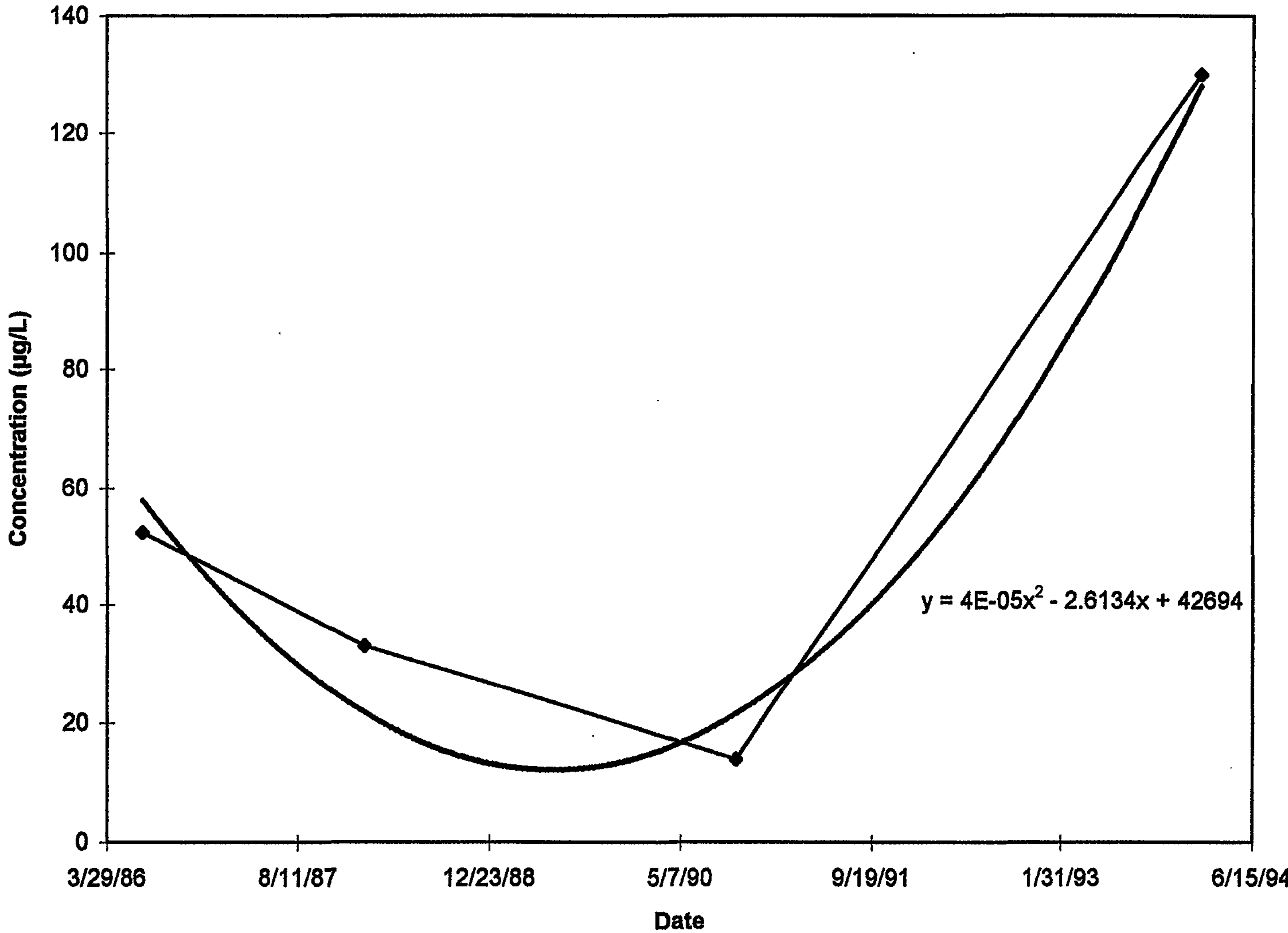
	Trend
Computer	DI
Subjective	NM

Statistical Trend Analysis: NB - Well G0104



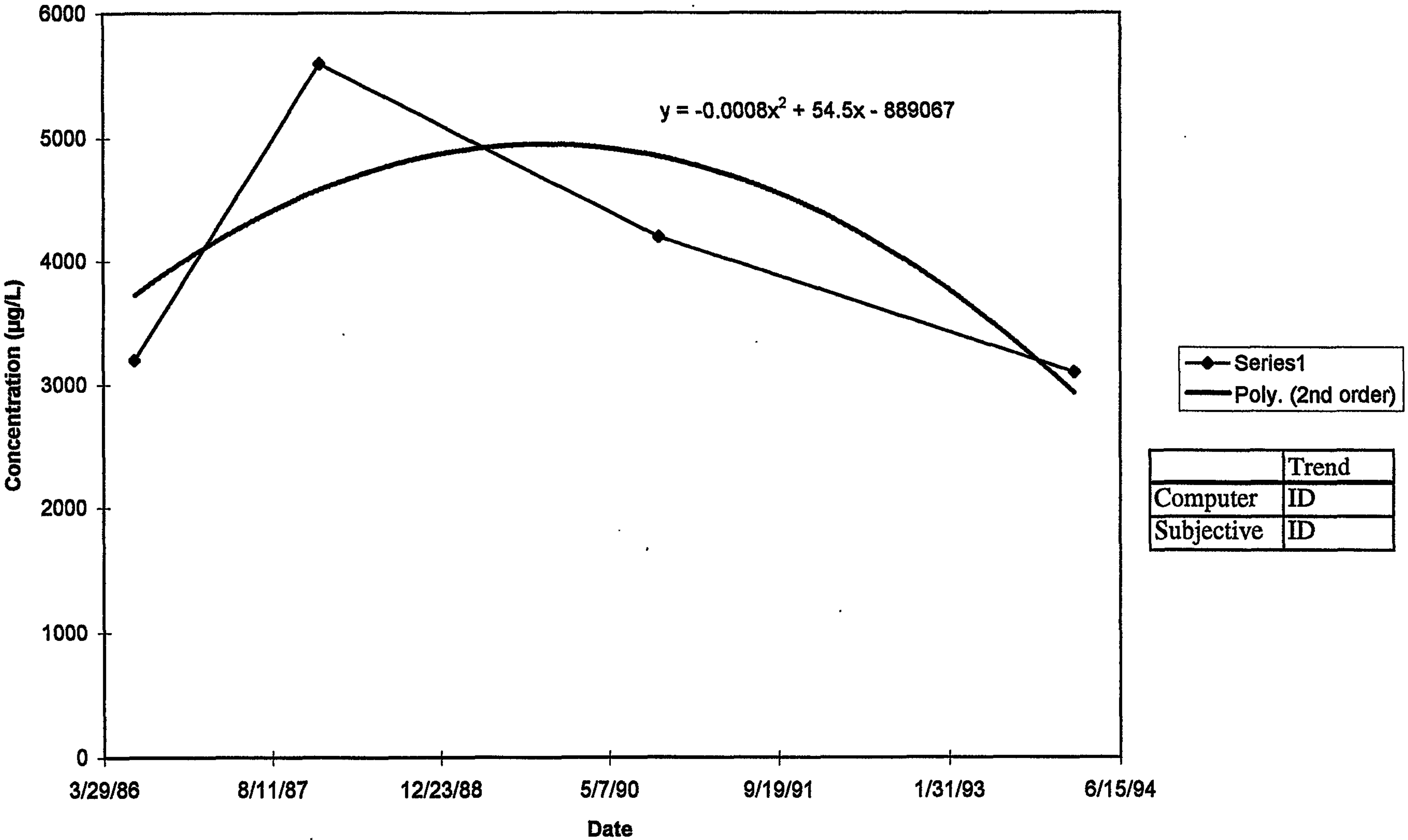
	Trend
Computer	ID
Subjective	ID

Statistical Trend Analysis: Tetryl - Well G0104



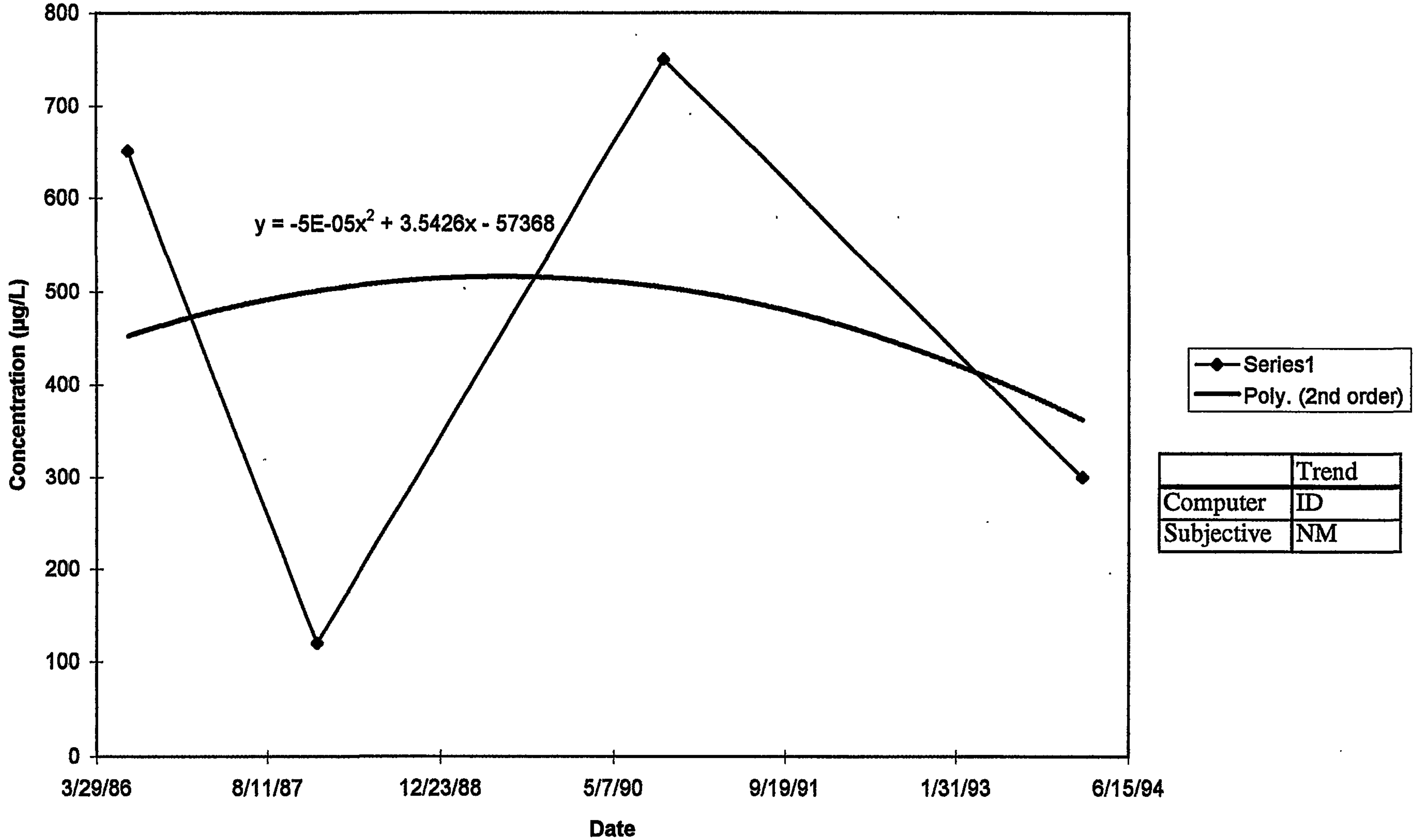
	Trend
Computer	DI
Subjective	DI

Statistical Trend Analysis: RDX - Well G0109



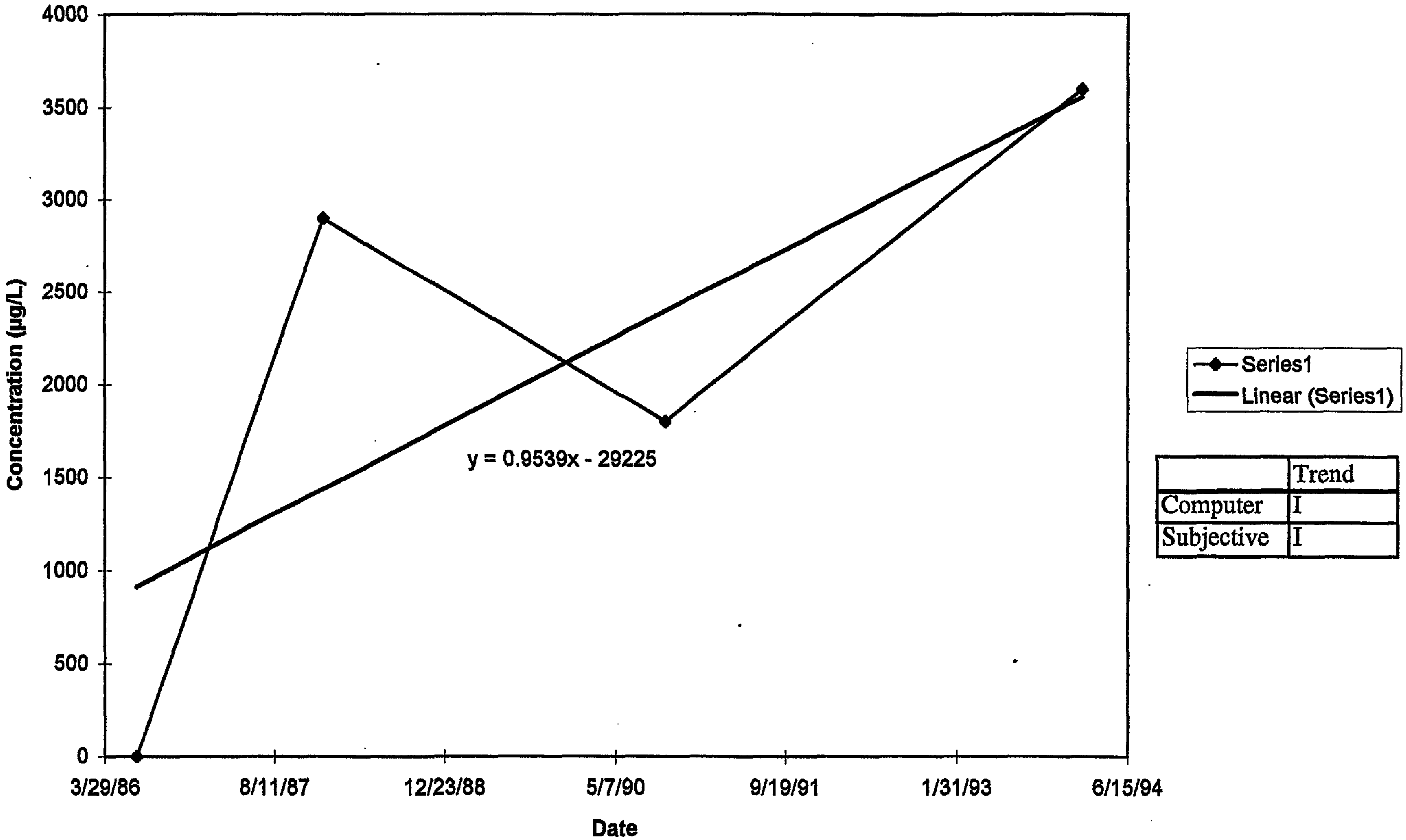
	Trend
Computer	ID
Subjective	ID

Statistical Trend Analysis: HMX - Well G0109



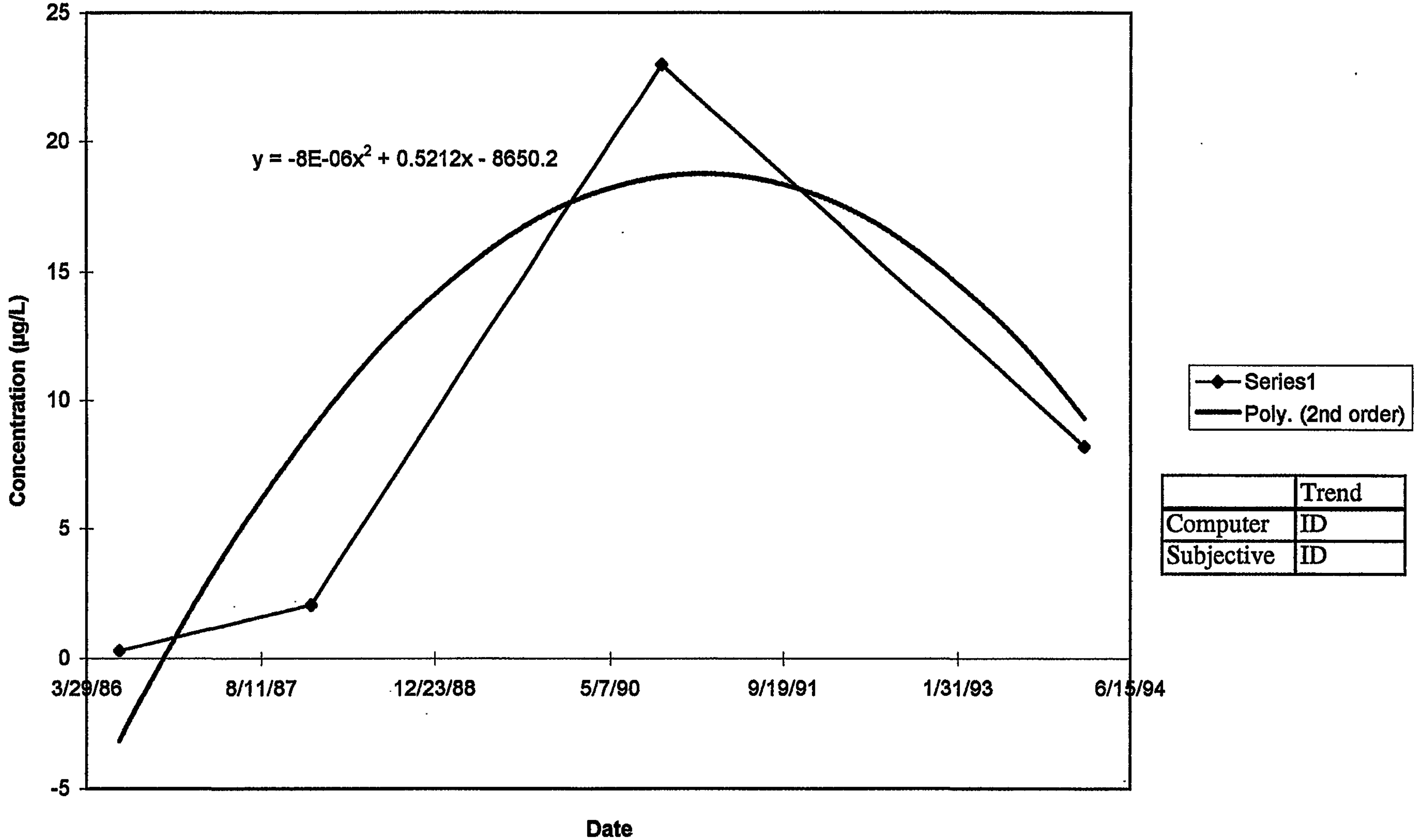
	Trend
Computer	ID
Subjective	NM

Statistical Trend Analysis: 2,4,6-TNT - Well G0109

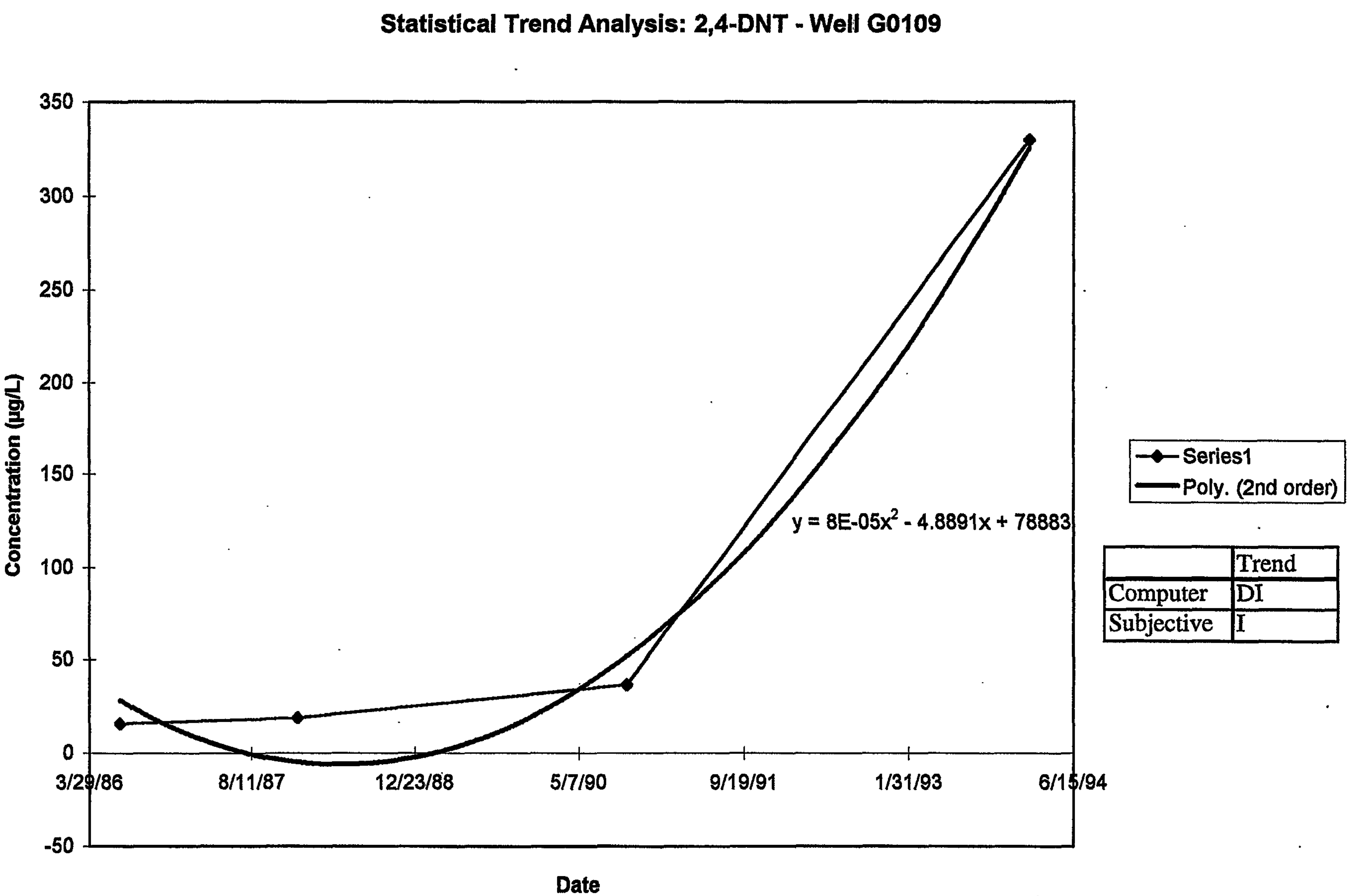


	Trend
Computer	I
Subjective	I

Statistical Trend Analysis: 1,3-DNB - Well G0109

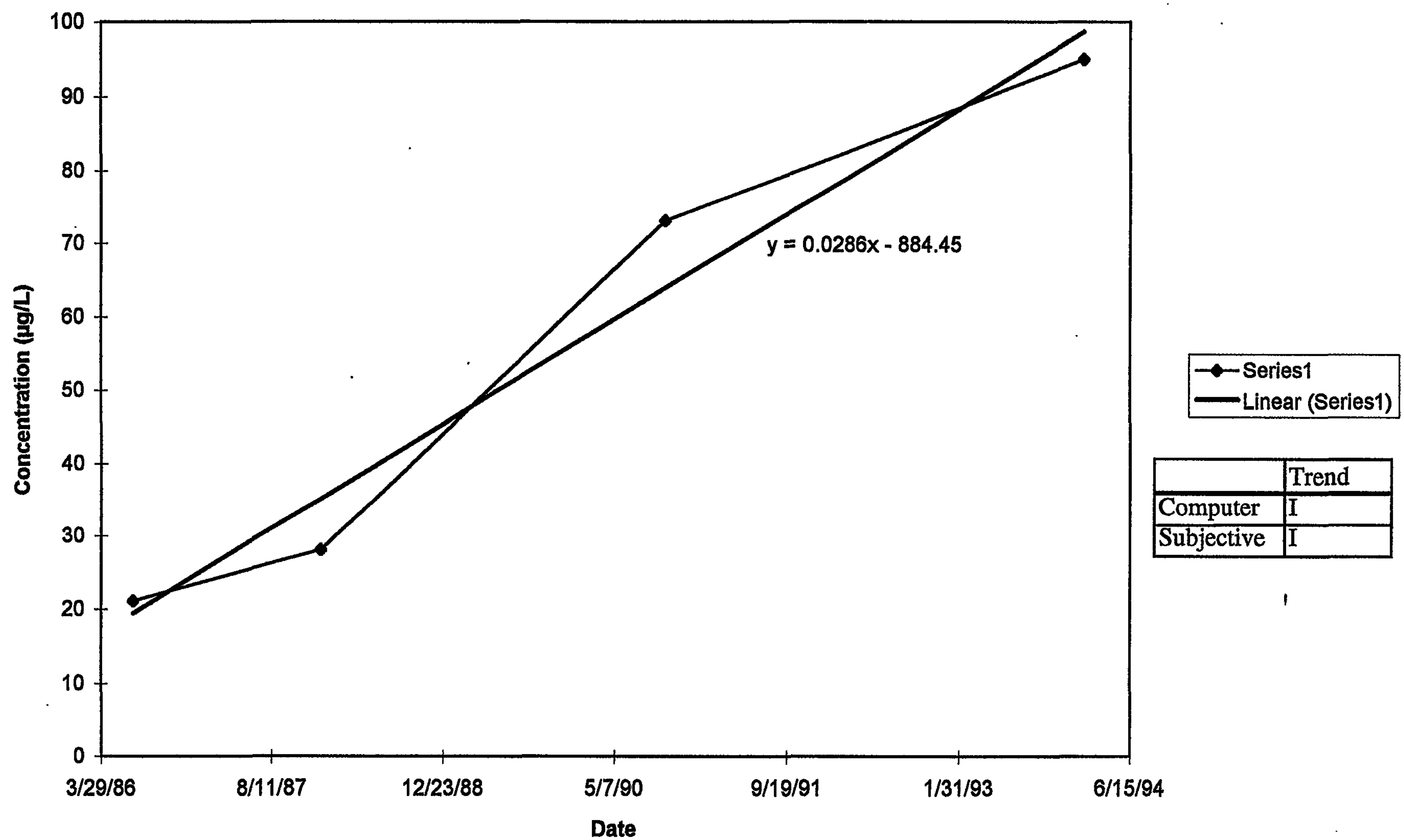


	Trend
Computer	ID
Subjective	ID



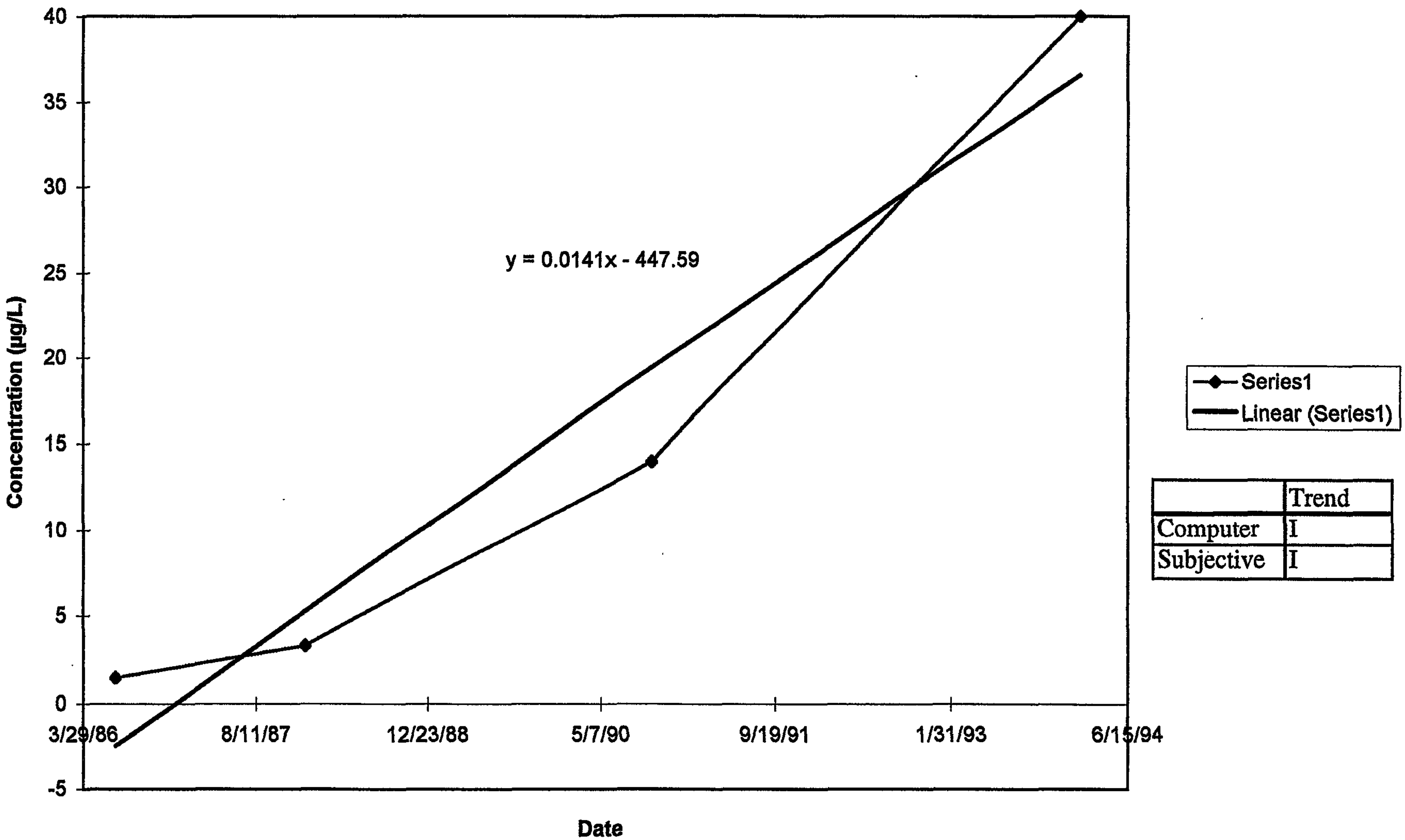
	Trend
Computer	DI
Subjective	I

Statistical Trend Analysis: 1,3,5-TNB - Well G0109



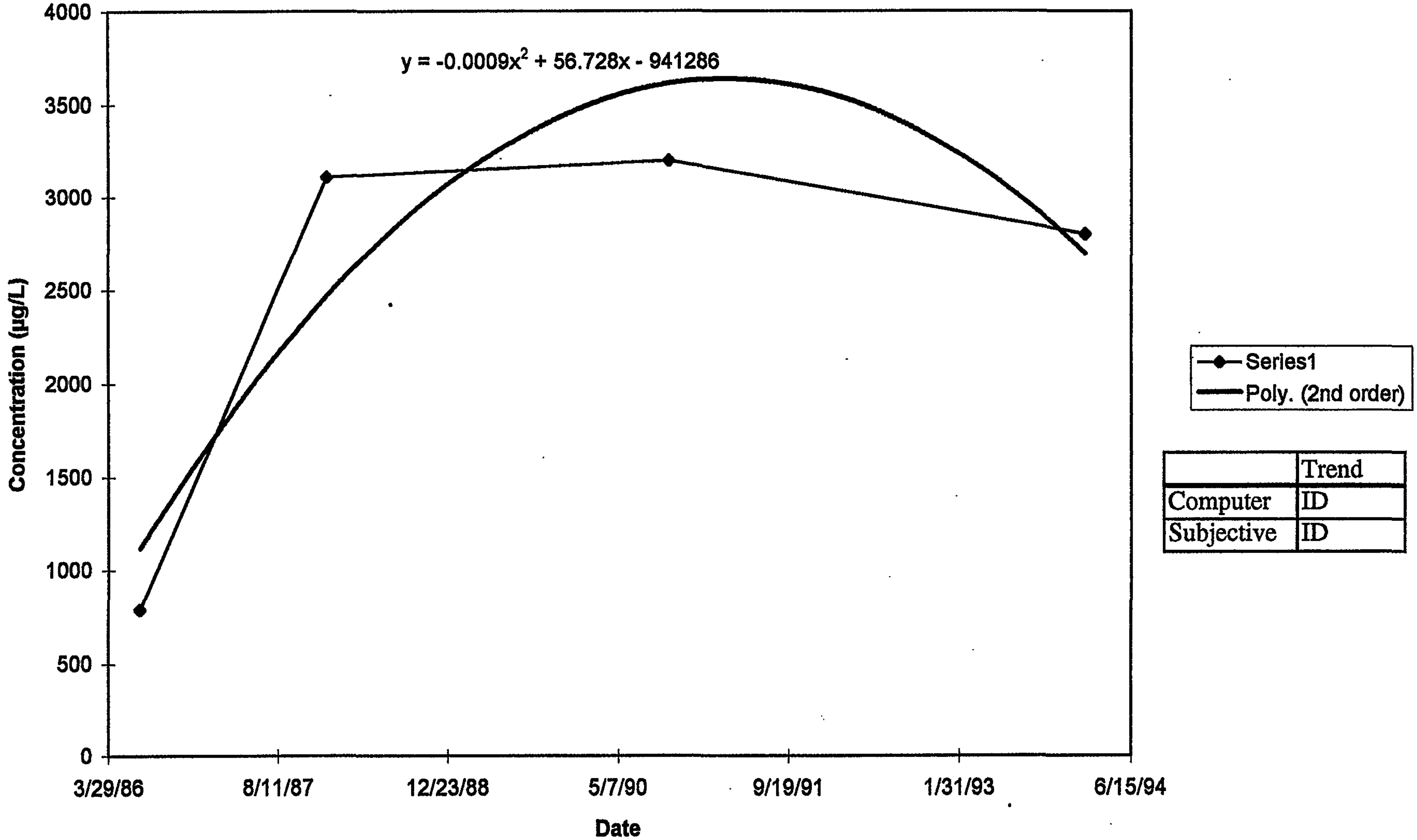
	Trend
Computer	I
Subjective	I

Statistical Trend Analysis: Tetryl - Well G0109



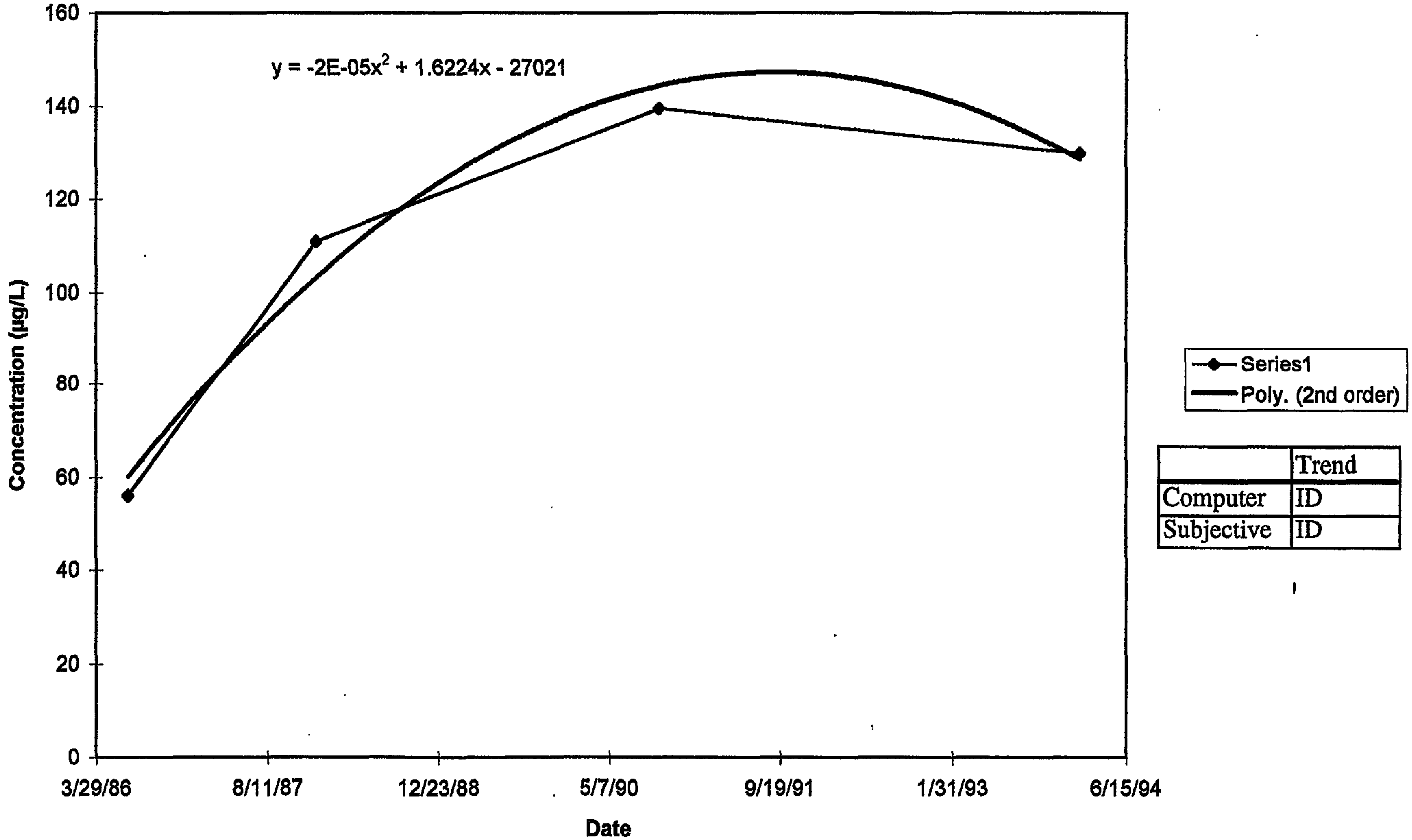
	Trend
Computer	I
Subjective	I

Statistical Trend Analysis: RDX - Well G0110



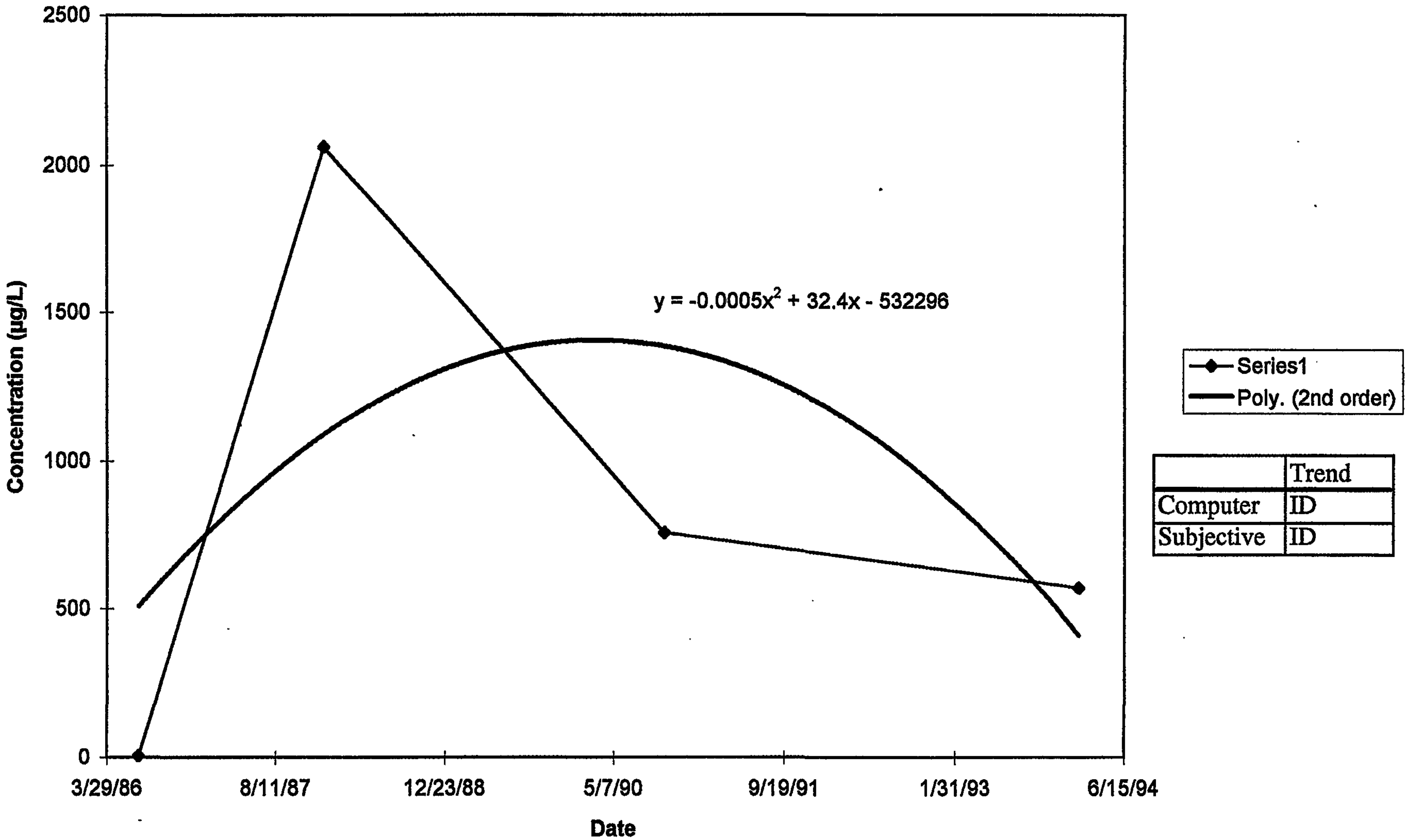
	Trend
Computer	ID
Subjective	ID

Statistical Trend Analysis: HMX - Well G0110



	Trend
Computer	ID
Subjective	ID

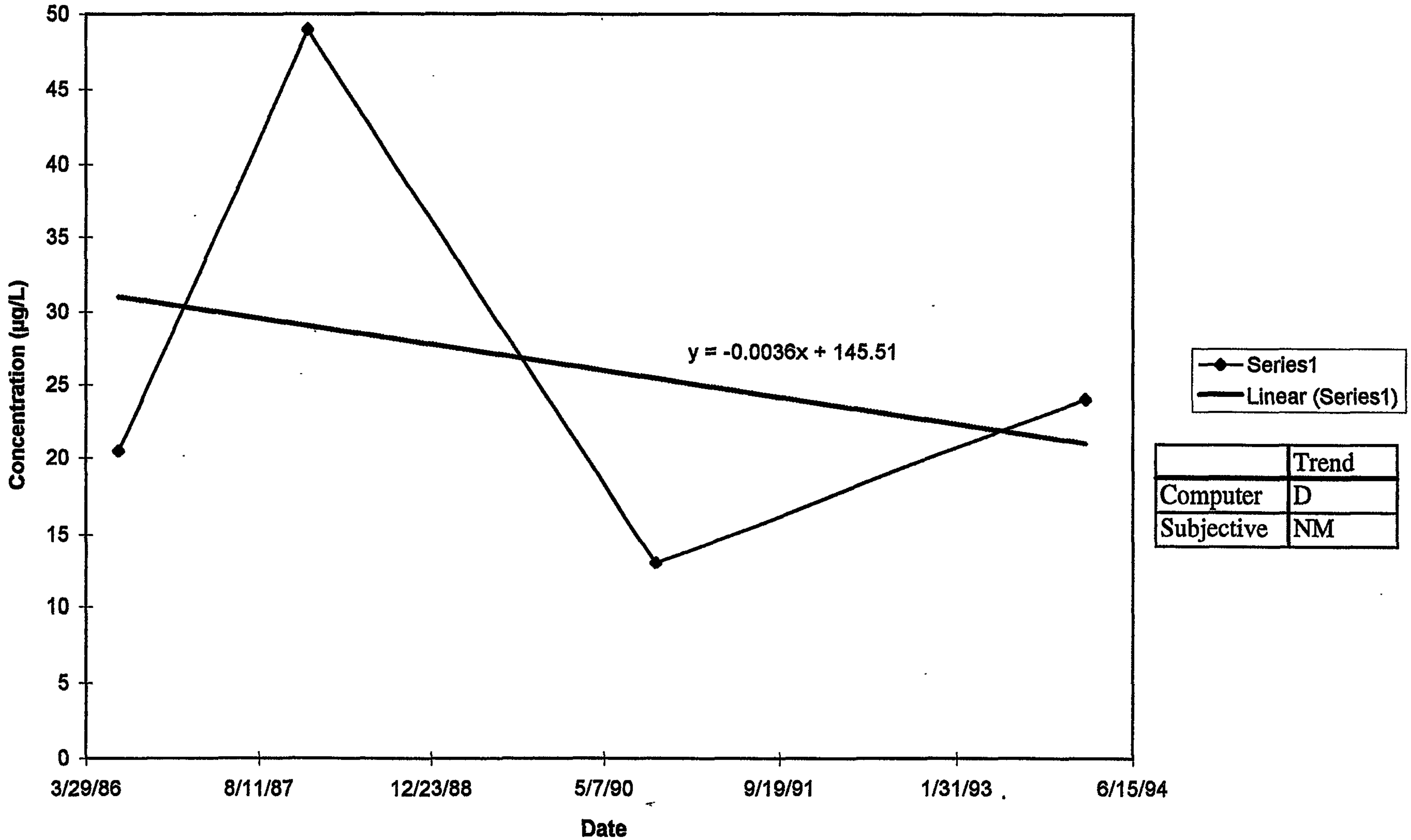
Statistical Trend Analysis: 2,4,6-TNT - Well G0110



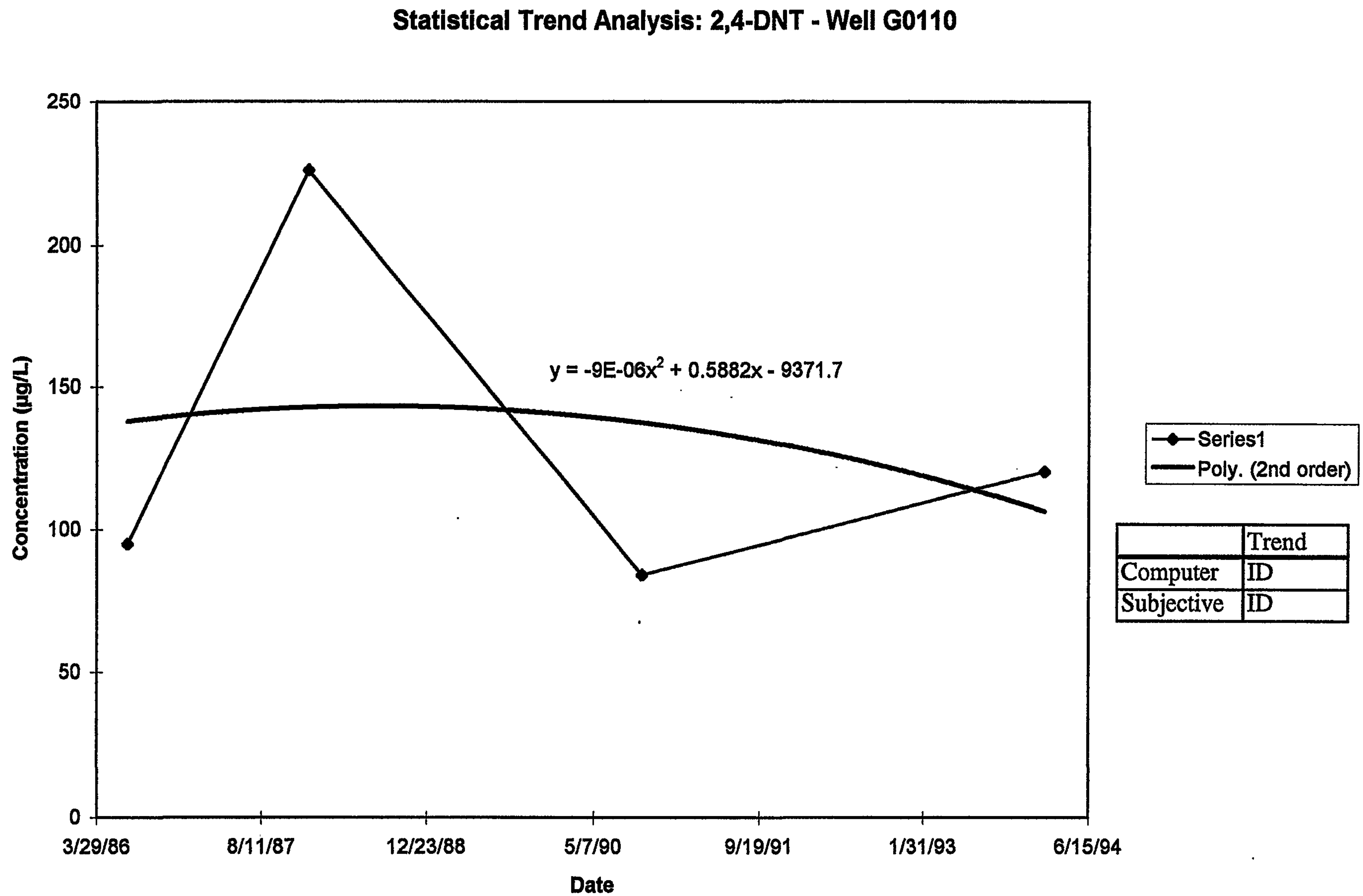
	Trend
Computer	ID
Subjective	ID

D-50

Statistical Trend Analysis: 1,3-DNB - Well G0110

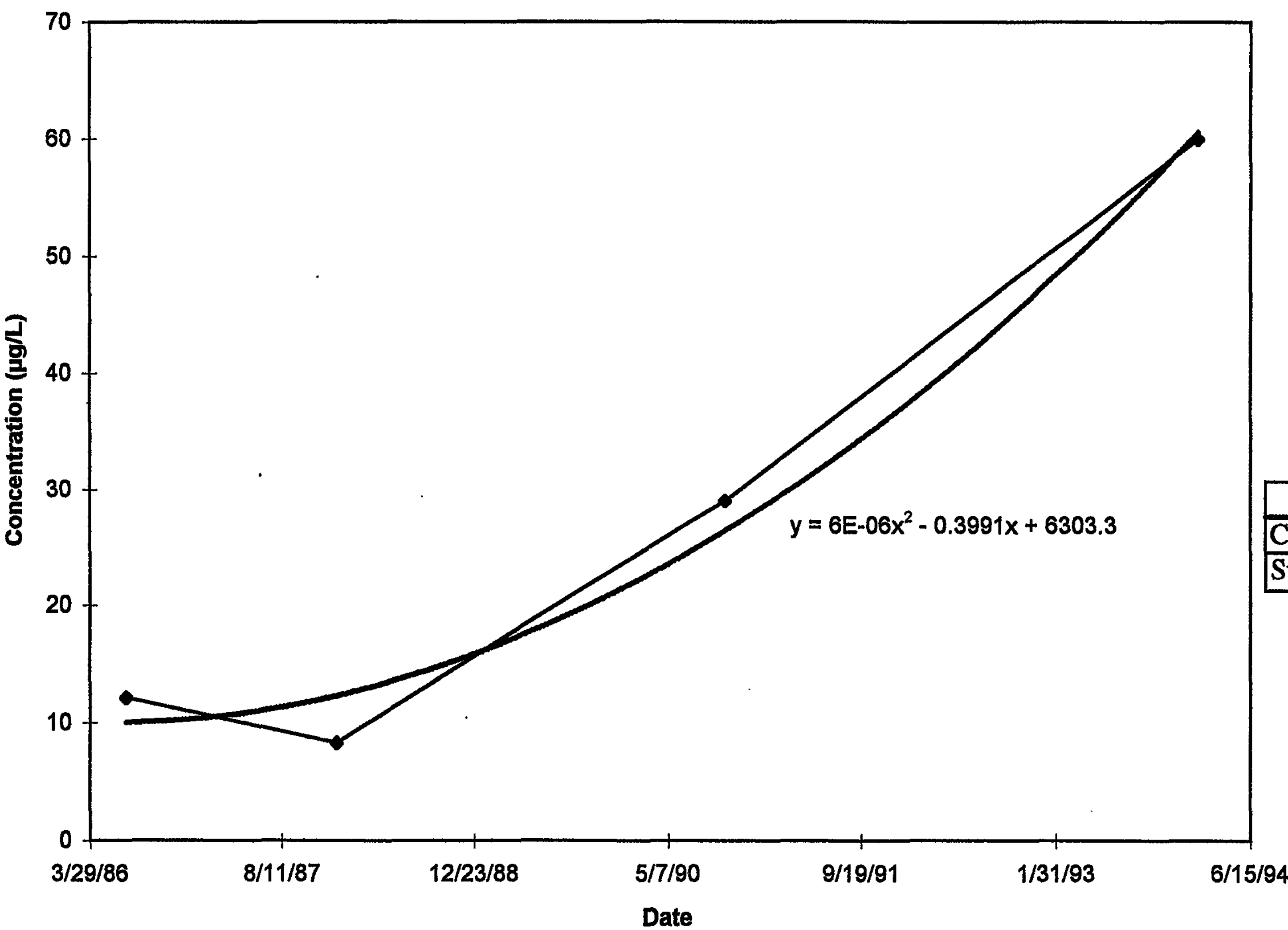


	Trend
Computer	D
Subjective	NM



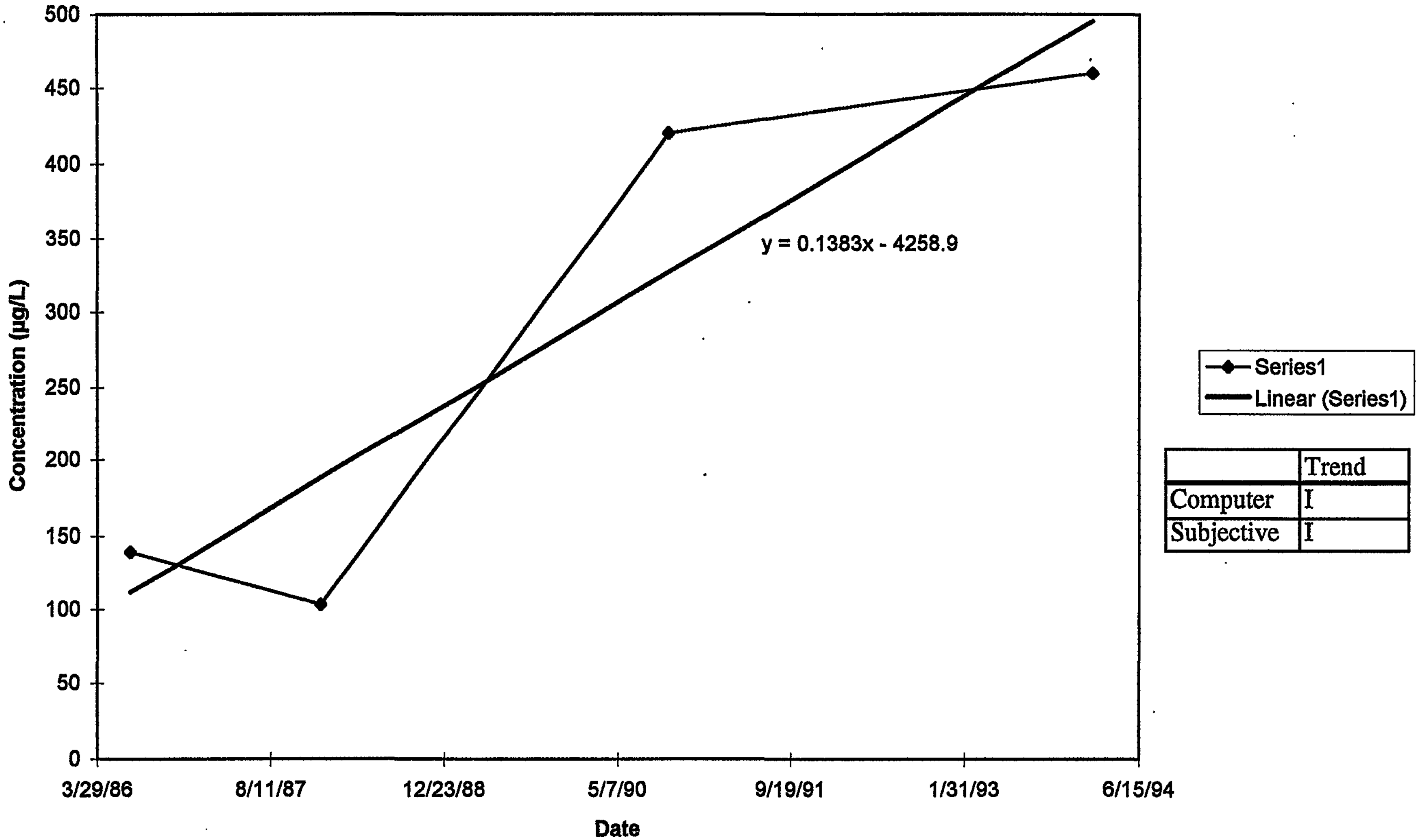
	Trend
Computer	ID
Subjective	ID

Statistical Trend Analysis: 2,6-DNT - Well G0110



	Trend
Computer	DI
Subjective	DI

Statistical Trend Analysis: 1,3,5-TNB - Well G0110



	Trend
Computer	I
Subjective	I

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APPENDIX E

TREND ANALYSIS SUPPORTING DATA

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APPENDIX E

TREND ANALYSIS SUPPORTING DATA

This appendix contains supporting data for the trend index (TI) values presented in the report and other related tables. The following tables are provided in this appendix:

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08-Aug-94

TABLE E-1. TREND INDEX CALCULATIONS BY WELL
FIVE YEAR REVIEW REPORT
LOUISIANA ARMY AMMUNITION PLANT

Well No.	NIMP		NSTA		NDET		UNI		TI=NIMP+NSTA-NDET		VALID DATA SETS	
	w/o HAL	All	w/o HAL	All	w/o HAL	All	w/o HAL	All	w/o HAL	All	w/o HAL	All
Upper Terrace												
GO-009	1	3	0	0	2	4	2	2	-1	-1	3	7
GO-012*	6	6	0	0	2	2	1	1	4	4	8	8
GO-014*	3	5	0	0	0	1	3	3	3	4	3	6
GO-068	3	4	0	0	3	5	0	0	0	-1	6	9
GO-083	--	--	--	--	--	--	--	9	--	0	--	0
GO-084	--	--	--	--	--	--	--	9	--	0	--	0
GO-085	--	--	--	--	--	--	--	9	--	0	--	0
GO-104*	5	6	0	0	2	3	0	0	3	3	7	9
GO-109	2	3	0	0	2	4	2	2	0	-1	4	7
TOTAL	20	27	0	0	11	19	8	35	9	8	31	46
Lower Terrace/Sparta Sand												
GO-105*	--	--	--	--	--	--	--	9	--	0	--	0
GO-106*	--	--	--	--	--	--	--	9	--	0	--	0
GO-110	4	5	0	0	1	2	2	2	3	3	5	7
TOTAL	4	5	0	0	1	2	2	20	3	3	5	7

NOTE: Asterisk (*) denotes wells located outside the cap.
HAL -- Drinking Water Health Advisory Level

TABLE E–2. TREND INDEX CALCULATIONS BY WELL (WITHIN CAP)

07–Jul–94

FIVE YEAR REVIEW REPORT
LOUISIANA ARMY AMMUNITION PLANT

Well No.	NIMP		NSTA		NDET		UNI		TI=NIMP+NSTA–NDET		VALID DATA SETS	
	w/o HAL	All	w/o HAL	All	w/o HAL	All	w/o HAL	All	w/o HAL	All	w/o HAL	All
Upper Terrace												
GO–009	1	3	0	0	2	4	2	2	–1	–1	3	7
GO–068	3	4	0	0	3	5	0	0	0	–1	6	9
GO–083	––	––	––	––	––	––	––	9	––	0	––	0
GO–084	––	––	––	––	––	––	––	9	––	0	––	0
GO–085	––	––	––	––	––	––	––	9	––	0	––	0
GO–109	2	3	0	0	2	4	2	2	0	–1	4	7
TOTAL	6	10	0	0	7	13	4	31	–1	–3	13	23
Lower Terrace/Sparta Sand												
GO–110	4	5	0	0	1	2	2	2	3	3	5	7
TOTAL	4	5	0	0	1	2	2	2	3	3	5	7

Note: HAL – Drinking Water Health Advisory Level

TABLE E-3. TREND INDEX CALCULATIONS BY WELL (OUTSIDE CAP)
FIVE YEAR REVIEW REPORT
LOUISIANA ARMY AMMUNITION PLANT

08-Aug-94

Well No.	NIMP		NSTA		NDET		UNI		TI=NIMP+NSTA-NDET		VALID DATA SETS	
	w/o HAL	All	w/o HAL	All	w/o HAL	All	w/o HAL	All	w/o HAL	All	w/o HAL	All
Upper Terrace												
GO-012	6	6	0	0	2	2	1	1	4	4	8	8
GO-014	3	5	0	0	0	1	3	3	3	4	3	6
GO-104	5	6	0	0	2	3	0	0	3	3	7	9
TOTAL	14	17	0	0	4	6	4	4	10	11	18	23
Lower Terrace/Sparta Sand												
GO-105	--	--	--	--	--	--	--	9	--	0	--	0
GO-106	--	--	--	--	--	--	--	9	--	0	--	0
TOTAL	0	0	0	0	0	0	0	18	0	0	0	0

Note: HAL - Drinking Water Health Advisory Level

TABLE E-4. TREND INDEX CALCULATIONS BY CONTAMINANTS

07-Jul-94

FIVE YEAR REVIEW REPORT
LOUISIANA ARMY AMMUNITION PLANT

Well No.	NIMP		NSTA		NDET		UNI		TI=NIMP+NSTA-NDET		VALID DATA SETS	
	w/o HAL	All	w/o HAL	All	w/o HAL	All	w/o HAL	All	w/o HAL	All	w/o HAL	All
DNB	4	5	0	0	1	1	6	6	3	4	5	6
2,4-DNT	3	4	0	0	1	3	5	5	2	1	4	7
2,6-DNT	1	2	0	0	0	3	7	7	1	-1	1	5
HMX	1	4	0	0	1	3	5	5	0	1	2	7
NB	1	2	0	0	0	0	10	10	1	2	1	2
RDX	6	6	0	0	1	1	5	5	5	5	7	7
TETRYL	1	2	0	0	1	3	7	7	0	-1	2	5
TNB	1	1	0	0	6	6	5	5	-5	-5	7	7
TNT	6	6	0	0	1	1	5	5	5	5	7	7
TOTAL	24	32	0	0	12	21	55	55	12	11	36	53

Note: HAL - Drinking Water Health Advisory Level

Table E-5. Subjective Trends in Groundwater Quality

Aquifer	Upper Terrace Aquifer									Lower Terrace/Sparta Sand Aquifer		
Contaminant/Well	009	012*	014*	068	083	084	085	104*	109	105*	106*	110
1,3-DNB	Z	D	ID	DI	Z	Z	Z	ID	ID	Z	Z	NM
2,4-DNT	DI	ID	ID	DI	Z	Z	Z	ID	I	Z	Z	ID
2,6-DNT	ID	ID	ND	DI	Z	Z	Z	C	ND	Z	Z	DI
HMX	ID	ID	ID	D	Z	Z	Z	ID	NM	Z	Z	ID
Nitrobenzene	ND	ND	ND	ID	Z	Z	Z	ID	ND	Z	Z	Z
RDX	ID	ID	ID	D	Z	Z	Z	ID	ID	Z	Z	ID
Tetryl	ID	ID	ND	NM	Z	Z	Z	DI	I	Z	Z	Z
1,3,5-TNB	DI	DI	ID	I	Z	Z	Z	NM	I	Z	Z	I
2,4,6-TNT	ID	NM	ID	ID	Z	Z	Z	ID	I	Z	Z	ID
Trend Index (TI) W/O HAL	+1/3	+5/8	+3/3	0/6	0/0	0/0	0/0	+4/7	0/4	0/0	0/0	+2/5
Trend Index (TI) ALL DATA	+3/7	+5/8	+6/6	0/9	0/0	0/0	0/0	+6/9	-2/7	0/0	0/0	+2/7

OTI for Upper Terrace Aquifer
w/o HAL +13/30
All data +18/46

OTI for Lower Terrace
w/o HAL +2/5
All data +2/7

Table E-5. Subjective trends in groundwater quality (continued)

Note: Shaded areas indicate concentration levels for the contaminant in that monitoring well were below the Health Advisory Level established for that contaminant at LAAP. Trends in bold indicate discrepancy with the computer-determined trend. An asterisk (*) denotes wells located outside the capped area. Trend index (TI) is presented for all data, and for data excluding the data sets with concentrations below HALs (w/o HAL).

OTI - Overall Trend Index
HAL - Health Advisory Level

Trend Index, TI = NIMP + NSTA - NDET

where,

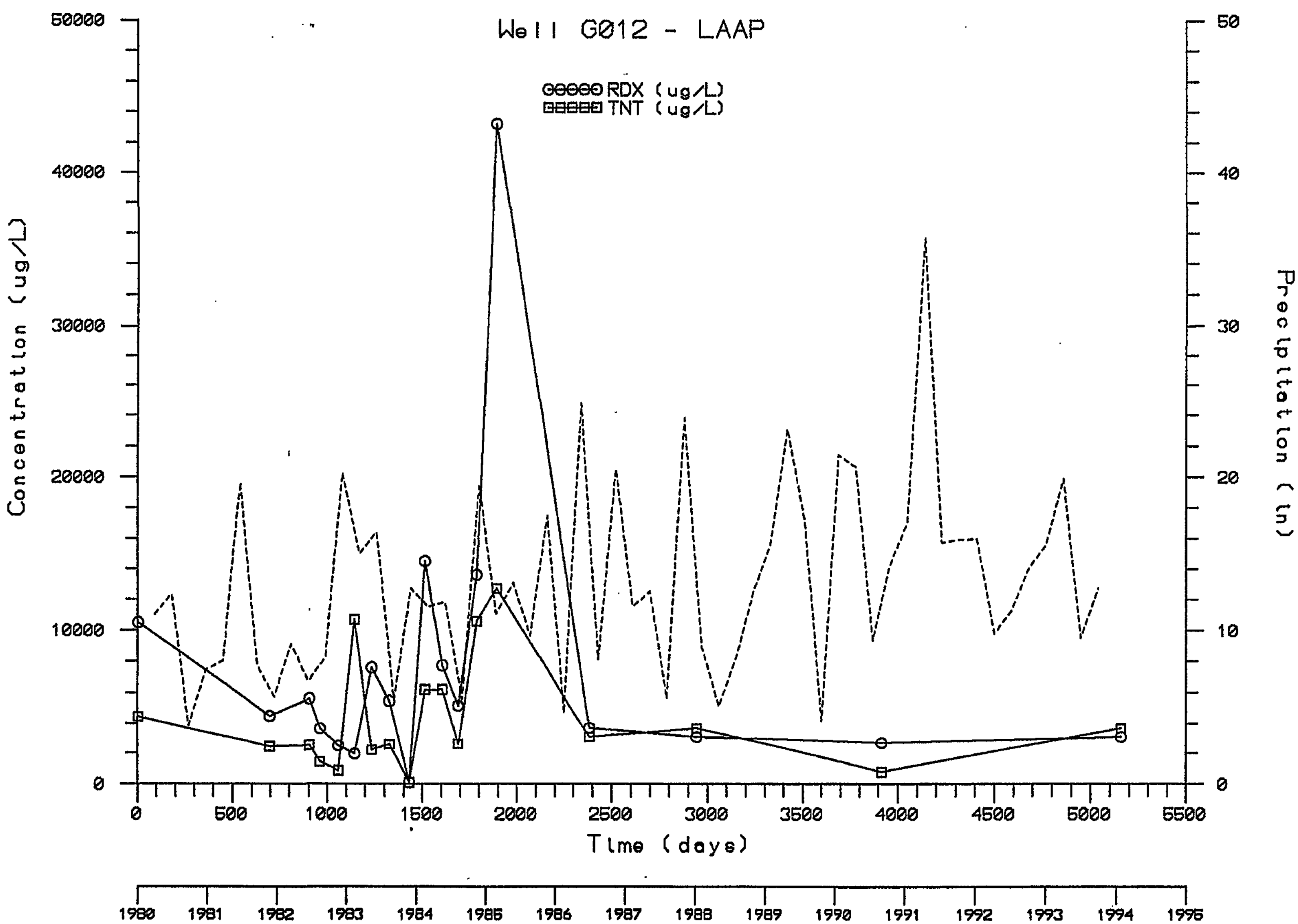
NIMP is number of improving conditions (ID and D)
NSTA is number of static conditions (C)
NDET is number of deteriorating conditions (DI and I).

Table E-6. Estimated dates of minimum concentration with DI trends

Well No.	Contaminant	Estimated Minimum Concentration Date
GO009	RDX HMX 2,4-DNT 1,3,5-TNB	April 1991 ***May 1990*** ***July 1989*** August 1989
GO012*	HMX 1,3,5-TNB	August 1989 November 1985
GO014*	HMX	***December 1990***
GO068	DNB 2,4-DNT 2,6-DNT	August 1983 November 1984 ***April 1987***
GO083	None	None
GO084	None	None
GO085	None	None
GO104*	Tetryl 1,3,5-TNB	June 1989 October 1990
GO109	2,4-DNT	***May 1988***
GO105*	None	None
GO106*	None	None
GO110	2,6-DNT	***April 1986***

Notes: (*) denote monitoring wells located outside the Area P cap.

Italicized minima are for the contaminant levels below the Health Advisory Levels (HALs)


Well G012 - LAAP
RDX (ug/L)
TNT (ug/L)
Concentration (ug/L)
Precipitation (in)
Time (days)
0
10000
20000
30000
40000
50000
10
20
30
40
50
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995

APPENDIX F

DATA QUALITY ASSESSMENT

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APPENDIX F. DATA QUALITY ASSESSMENT

F.1 INTRODUCTION

A comprehensive quality assurance/quality control (QA/QC) program was followed during the Five-Year Review of Interim Remedial Action conducted at the Louisiana Army Ammunition Plant (LAAP) Former Area P Lagoons, located in Shreveport, Louisiana, to ensure that the analytical results and the decisions based on these results are representative of the environmental conditions at the site. The objectives of the Five-Year Review of the Area P Lagoons was to evaluate the effectiveness of the interim remedial measures. The following documents were used during evaluation of the quality control (QC) data: the *U.S. Army Toxic and Hazardous Material Agency (USATHAMA) Quality Assurance Program, PAM 11-41* (January 1990) for groundwater samples; QC requirements detailed in guidelines and specifications described in the Quality Assurance Project Plans (QAPPs) submitted as part of the project work plans prepared by Science Applications International Corporation (SAIC); the *Installation Restoration Data Management Information System (IRDMIS), Volume II Data Dictionary*, Potomac Research Institute (PRI) (1994); and the U.S. Environmental Protection Agency's (EPA's) *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analysis* (1988). The numbers of groundwater samples collected, in addition to the numbers of field QC samples collected and selected laboratory QC (i.e., matrix spikes and matrix spike duplicates) samples analyzed, are presented in Table F-1. The data review and validation worksheets are referenced within the subsection describing the applicable analysis. The QC checks and results are summarized below.

F.1.1 Data Quality Objectives

A comparison of the analytical results to the project data quality objectives (DQOs) as defined in the QAPP formed the basis for evaluating the quality of the analytical data. As described in the QAPP, analytical data must be of a known and acceptable quality in order to be used to evaluate site contamination at LAAP. DQOs are set to define and establish the criteria against which the fitness of the data will be judged. DQOs are quantitative and qualitative indicators of data quality. The DQO process is designed to ensure that the type,

Table F-1. Analytical Methods and Total Number of Groundwater Samples Collected Louisiana Army Ammunition Plant

PARAMETER	ANALYTICAL DETECTION		WATER SAMPLES	REPLICATES	EQUIPMENT BLANKS	MS/MSD	TOTAL NUMBER OF ANALYSES
	METHOD	LIMIT					
EXPLOSIVES							
1,3,5 - Trinitrobenzene	UW25	(a)	12	2	6	1/1	22
1,3 - Dinitrobenzene	UW25	(a)	12	2	6	1/1	22
2,4,6 - Trinitrotoluene	UW25	(a)	12	2	6	1/1	22
2,4 - Dinitrotoluene	UW25	(a)	12	2	6	1/1	22
2,6 - Dinitrotoluene	UW25	(a)	12	2	6	1/1	22
Cyclotetramethylenetetranitramine	UW25	(a)	12	2	6	1/1	22
Nitrobenzene	UW25	(a)	12	2	6	1/1	22
Hexahydro-1,3,5-trinitro-1,3,5-triazine	UW25	(a)	12	2	6	1/1	22
N-methyl-N,2,4,6-tetranitroanailine	UW25	(a)	12	2	6	1/1	22

(a) - Detection limits are matrix and sample specific. All certified reporting limits are listed on the comprehensive tables located in Section 3.

quantity, and quality of environmental data used in decisionmaking are appropriate for the intended application. Determination of data quality is based on evaluation of the precision, accuracy, representativeness, comparability, and completeness (PARCC) characteristics of the data.

F.1.1.1 Precision

Precision is defined as the reproducibility, or degree of agreement, among replicate measurements of the same quantity. Specifically, it is a quantitative measure of the variability of a group of measurements compared to their average value. The overall precision of measurement data is a mixture of sampling and analytical factors. Precision is stated in terms of standard deviation, coefficient of variation, range, and relative range. The closer the numerical values of the measurements are to each other, the more precise the measurement is. Analytical precision can be measured through the analysis of U.S. Army Environmental Center (USAEC) Class 1 laboratory QC duplicate sample spike recoveries, and sampling precision and spatial variability of contamination can be assessed through the analysis of field replicates. Precision was expressed as the percentage of the difference between results of duplicate samples for a given compound or element. Relative percent difference (RPD) was calculated using the following equation:

$$\frac{|V_1 - V_2|}{\left(\frac{V_1 + V_2}{2}\right)} x\ 100$$

where:

V_1 = Concentration of the compound or element in the sample

V_2 = Concentration of the compound or element in the duplicate/replicate.

Precision was evaluated based on the analysis of three different types of QC samples: USAEC Class 1 laboratory QC duplicate sample spike recoveries (LCS), matrix spike and matrix spike duplicate (MS/MSD) samples, and replicate field sample analyses. The first type of QC sample, USAEC Class 1 laboratory QC duplicate sample spike recoveries, is required as part of the USAEC analytical program for all methods and provides ongoing information on the performance of each lot for each analytical method in a standard matrix. For each analytical lot, the results of these sample spike recoveries were compiled on single-day and three-day control charts (i.e., X-bar and range) and submitted to the USAEC Chemistry Branch for approval. Upon final approval by the USAEC Chemistry Branch, the data within each lot will be revised at phase 3 in the Installation Restoration Data Management Information System (IRDMIS).

Same single-day (high spike concentration) control charts were outside QC criteria for: hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), 1,3,5-trinitrobenzene (135TNB), 2,4,6-trinitrotoluene (246TNT), 2,4-dinitrotoluene (24DNT), and nitrobenzene (NB) for lots AIUD and AIWV; and RDX, 135TNB, NB, and 246TNT for lots AIYH and AJDT. Out-of-control situations in these lots are expected to have a negligible impact on data quality, and are discussed in Section F.3.1 of this appendix.

One sample per 20 samples collected was randomly selected to be spiked as an MS/MSD sample. MS/MSD analyses help to detect any systematic problems in the analysis and also help determine how well the target analytes can be recovered from environmental matrices, identifying a matrix effect. Three aliquots were collected for the sample designated to be analyzed for MS/MSD. MS/MSD samples were prepared by routinely analyzing the first aliquot for the parameters of interest, while the remaining two aliquots were spiked with known quantities of the parameters of interest before analysis. The relative percent difference (RPD) between the two spike results (MS/MSD) was not calculated because background concentration was greater than the spike level.

Replicate field samples are the third type of QC sample. Sample collection reproducibility and media variability were measured by the analysis of field replicates. Field replicates were collected using the same techniques as those used to collect the environmental samples. One sample in 10 for each similar matrices was collected. Sample collection reproducibility and media variability were evaluated based on the RPD values between the two replicate samples. The RPD between field replicates indicates that environmental conditions at the site are spatially and temporally variable. The data should be utilized with this consideration. No sample was qualified based on the results of these replicate samples, since EPA has no guidelines for this QC parameter. However, the amount of heterogeneity of the matrices is shown by the number of times the replicate samples collected and calculated exceeded the selected control limits, based on EPA acceptance criteria.

Immediately after purging, groundwater samples were collected from existing monitoring wells at LAAP using Teflon® bailers. The samples were shipped to DataChem Laboratories (DCL) for explosives-related compounds analysis. Field replicate RPD values were calculated only for compounds detected in concentrations greater than the certified reporting limits (CRLs) in both replicate pair samples. The explosive water field replicate did not exceed the control limit of 30 percent for RPD acceptance criteria. In general, the RPD between field replicates was low. Based on these RPD results and the acceptable laboratory QC results, the sample collection DQO for reproducibility is considered to have been met. A comprehensive discussion of all replicate sample results is presented in Section F.2.3.

F.1.1.2 Accuracy

Accuracy, or the bias in a measurement system, is a measure of the closeness of a reported concentration to the true value. The closer the numerical value of the measurement approaches the true value, or actual concentration, the more accurate the measurement is. Analytical accuracy is expressed as the percent recovery of a compound or element that has been added to the environmental sample at a known concentration before analysis. The percent recovery values were calculated using the following equation:

$$\frac{S_s - S_o}{S_a} \times 100$$

where:

S_s = Total compound or element concentration detected in the spiked sample

S_o = Concentration of the compound or element detected in the unspiked sample

S_a = Concentration of the compound or element added to the sample.

One field sample was randomly selected to be analyzed as an MS/MSD sample. The information gathered was not used to assess the effect of matrix on sample recovery. Recoveries were not calculated because background concentration was greater than the spiking level. The laboratory accuracy for this project was qualitatively assessed by evaluating the following laboratory QC information: method blank, initial calibration verification (ICV), continuing calibration verification (CCV), and USAEC Class 1 laboratory QC sample spike results calculated from all analyses conducted on environmental samples. Each type of spiked sample provided different information on the accuracy of the measurement system.

USAEC QC samples were used as the primary control of accuracy in the laboratory system. The laboratory plotted the mean percent recovery and range of percent recovery on control charts prepared for each control compound. The laboratory utilized the percent recovery of each compound in spiked QC samples, the average percent recovery, and the difference between the percent recovery of two high spiked samples in a continuous assessment of method accuracy. Thirty-two percent recovery values (of 135 values) were out-of-control. The flag code (i.e., "7") was applied to three RDX and five 246TNT concentrations to indicate that the QC samples' low spike recovery was outside of QC criteria. The flag code (i.e., "L") was applied to six NB concentrations to indicate that NB data were rejected due to low recovery for the low spike. Despite these values, no systematic laboratory error was detected, and the results are considered to have little impact on the overall environmental data quality.

In addition, an analysis accuracy was calculated for method UW25 based on found versus recovered compounds. Analysis accuracies are reported with each applicable lot of data to USAEC. Concentrations reported in IRDMIS reflect the accuracy of the analytical method.

All supporting explosives QC information (i.e, method blanks, ICVs, and CCVs) was qualitatively evaluated with respect to the analytical accuracy DQO. The method blank results for groundwater were generally below the CRLs with one exception. Lot AIWV had a method blank with the concentration of 135TNB above the CRL. As a result, 135TNB concentrations in three field samples was flagged (i.e., "B") to indicate that this explosives-related compound was found in the associated method blank. Percent recovery results from the ICVs and CCVs were within the limits specified in DCL performance demonstrated method UW25. The overall laboratory accuracy is acceptable, and as such, the analytical DQO for accuracy was met.

Sampling accuracy was maximized by the adherence to the strict quality assurance (QA) program presented in the Five-Year Review of the Area P Lagoons QAPP. All procedures (i.e., groundwater sample collection, equipment decontamination, and health monitoring equipment calibration and operation) used were documented as standard operating procedures (SOPs). Monitoring of field activities that affected accuracy was performed by assessing the results of the equipment rinsate analyses. Equipment rinsate blanks were prepared to ensure that all samples represent the particular site from which they were collected, assess any cross-contamination that may have occurred, and flag the associated analytical data accordingly.

The flag code (i.e., "G") was applied to the 135TNB and RDX in SAIC01 Site ID G0009, SAIC04 Site ID G0083, and SAIC02 and SAIC03 Site ID G0084 to indicate that these compounds were detected in the associated equipment rinsate blank.

Based on an evaluation of the explosives-related compounds detected in the equipment rinsate blanks, the overall field accuracy is acceptable. As a result, the field DQO for accuracy is considered to have been met. A comprehensive discussion of the field QC results is presented in Section F.2.

F.1.1.3 Representativeness

Representativeness was defined as the degree to which the data accurately and precisely represent a characteristic of a population, parameter variations at a sampling location, a process condition, or an environmental condition. Sample representativeness was ensured by collecting sufficient samples of a population medium, properly distributed with respect to location and time. Representativeness was assess by reviewing sample collection methods, equipment, and sample containers, in addition to evaluating the RPD values from the field replicate samples and the concentrations of explosives-related compounds detected in the equipment rinsate blanks and method blanks. The reproducibility of a representative set of samples reflects the degree of heterogeneity of the sampled medium, as well as the effectiveness of the sample collection techniques.

Based on the evaluation of the factors described above and summarized in Section F.3, the samples collected are considered to be representative of the environmental conditions at LAAP.

F.1.1.4 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another and is limited to the other PARCC parameters, because only when precision and accuracy are known can one data set be compared to another. The characteristic of comparability reflects the consistency of sample collection and handling procedures, analytical techniques, and expression of results in units consistent with other organizations reporting similar data. To optimize comparability, only the specific methods and protocols that were specified in the Five-Year Review of the Area P Lagoons QAPP, as required by the *USATHAMA Quality Assurance Program, PAM 11-41* (January 1990), were used to collect and analyze samples. By using consistent sampling and analysis procedures, all data sets were comparable within the sites at LAAP and between sites at the installation to ensure that decisions and priorities were based on a consistent data base. No changes to planned procedures were implemented that would affect data comparability. Comparability also was ensured by the analysis of USAEC reference materials, establishing that the analytical procedures used were generating valid data.

All groundwater samples collected for explosives analyses were analyzed using DCL performance demonstrated method UW25. Based on the precision and accuracy assessment presented above, the data collected are considered to be comparable with the data collected during previous investigations.

F.1.1.5 Completeness

Completeness was defined as the percentage of valid data obtained from the sampling and analysis process. For data to be considered valid, they must have met all acceptance criteria, including accuracy and precision, as well as any other criteria specified by the analytical methods used.

Project completeness was calculated using the following equation:

$$\frac{DP_v}{DP_p} x\ 100$$

where:

DP_v = Valid data points
DP_p = Planned data points.

For analytical data to be usable, each data point must be satisfactorily validated. The completeness objectives established for this project were 90 percent. Based on the evaluation of the field and laboratory QC results presented in Sections F.2 and F.3, 96.7 percent of the sample data collected for explosives analyses were used as the basis for all recommendations presented in this report. All explosives analyses for the groundwater and field QC samples were performed within the holding times.

Completeness of the data also was evaluated by comparing work plan sampling requirements to the completed chain-of-custody forms to establish that all samples required by the work plan were in fact collected. Upon completion of this process, analytical results in the IRDMIS data base and laboratory data packages were compared to those required by the chain-of-custody to establish that the results for all samples taken were indeed in the data base.

F.2 FIELD QUALITY CONTROL ASSESSMENT

Six equipment rinsate blanks, two source water samples, and two field replicates were collected and analyzed for explosives-related compounds using the same laboratory techniques as those used for the environmental samples. The analytical results obtained from the field QC samples are used to assess the efficiency and effectiveness of the sample collection, handling, and equipment decontamination procedures used in the field. Table F-2 contains a cross-reference of environmental samples to the associated equipment rinsate blank samples.

F.2.1 Duplicate Source Water Samples and Equipment Rinsate Blanks

Duplicate source water samples and equipment rinsate blanks were collected to assess the impact of decontamination procedures on analytical results.

Duplicate source water results provided information on the water used to decontaminate the sample collection devices. The source water samples were found to be free of any explosives-related compounds. Thus, any compound detected in the equipment rinsates would be due to decontamination procedures and not from the water used to perform the decontamination. Table F-3a summarizes the concentrations of the explosives-related compounds in the duplicate water source water sample.

Equipment rinsate blanks provided a measure of the cumulative contamination derived from the field sampling equipment, sample transit, storage, and analysis. Equipment rinsate blanks were prepared for manual and small automated sampling equipment used to collect environmental samples. One equipment rinsate blank was collected daily by pouring analyte-free water through a recently decontaminated sample collection device into a prepared sample container appropriate for the required analysis. Equipment rinsate blanks were shipped to the laboratory to be analyzed using the methods required for the environmental samples collected on the same day. Table F-3b summarizes the concentrations of the compounds detected in the equipment rinsate blanks collected during the Five-Year Review of the Area P Lagoons.

Explosives Analysis—Duplicate source water samples (i.e., SAIC01 and SAIC02), used to determine that the water used for equipment decontamination was free of explosives, were collected on October 12, 1993. Duplicate source water samples were analyzed for explosives-related compounds. These analyses were performed before the field work began and the results were submitted to the USAEC Chemistry Branch for approval. No explosives-related compounds were detected.

Table F - 2. Equipment Rinsate Cross Reference - Groundwater - Area P Lagoons, Louisiana Army Ammunition Plant

Site ID	Field Sample Number	Lab Sample Number	Collection Date	Associated Equipment Rinsate	Requested Analysis: Explosives
G0012	SAIC01	UB01144	2/24/94	G0012	X
G0014	SAIC01	UB01145	2/24/94	G0012	X
G0009	SAIC01	UB01176	2/25/94	G0009	X
G0083	SAIC01	UB01179	2/25/94	G0009	X
G0083	SAIC02	UB01179M	2/25/94	G0009	X
G0083	SAIC03	UB01179M	2/25/94	G0009	X
G0084	SAIC01	UB01177	2/25/94	G0009	X
G0084	SAIC02	UB01178	2/25/94	G0009	X
G0105	SAIC01	UB01192	2/28/94	G0110	X
G0109	SAIC01	UB01193	2/28/94	G0110	X
G0110	SAIC01	UB01191	2/28/94	G0110	X
G0106	SAIC01	UB01225	3/1/94	GO-146	X
G0068	SAIC01	UB01226	3/1/94	GO-146	X
G0104	SAIC01	UB01242	3/2/94	GO-145	X
G0104	SAIC02	UB01243	3/2/94	GO-145	X
G0085	SAIC01	UB01270	3/3/94	GO-150	X

Table F-3a. Data Summary Table: Groundwater - Area P Lagoons, Source Water Results, Louisiana Army Ammunition Plant

Site ID	#6	#6	#6	#6
Field Sample Number	SAIC01	SAIC01	SAIC02	SAIC02
Site Type	RNSW	TAPW	RNSW	TAPW
Collection Date	10/13/94	10/12/94	10/13/94	10/12/94
Depth (ft)	0	0	0	0
Associated Field QC Sample - Site ID	N/A	N/A	N/A	N/A
Associated Field QC Sample - Field Sample No.	N/A	N/A	N/A	N/A

Explosives (UW25)

Laboratory ID Number			UA03234				UA03229				UA03235				UA03228			
Parameter	Units	CRL			FC	DQ			FC	DQ			FC	DQ			FC	DQ
1,3,5-Trinitrobenzene	µg/L	0.21	LT	0.21			LT	0.21	H	I	LT	0.21	D		LT	0.21	DH	I
1,3-Dinitrobenzene	µg/L	0.458	LT	0.458			LT	0.458			LT	0.458	D		LT	0.458	D	
2,4,6-Trinitrotoluene	µg/L	0.426	LT	0.426			LT	0.426			LT	0.426	D		LT	0.426	D	
2,4-Dinitrotoluene	µg/L	0.397	LT	0.397			LT	0.397			LT	0.397	D		LT	0.397	D	
2,6-Dinitrotoluene	µg/L	0.6	LT	0.6			LT	0.6			LT	0.6	D		LT	0.6	D	
Cyclotetramethylenetetranitramine	µg/L	0.533	LT	0.533			LT	0.533			LT	0.533	D		LT	0.533	D	
Nitrobenzene	µg/L	0.682	LT	0.682			LT	0.682			LT	0.682	D		LT	0.682	D	
Hexahydro-1,3,5-trinitro-1,3,5-triazine	µg/L	0.416	LT	0.416			LT	0.416			LT	0.416	D		LT	0.416	D	
N-methyl-N,2,4,6,-tetranitroanaline	µg/L	0.631	LT	0.631			LT	0.631			LT	0.631	D		LT	0.631	D	

N/A - Not applicable
ID - Identification
QC - Quality Control
CRL - Certified reporting limit
LT - Less than
FC - Flagging Codes:
  D - Duplicate analysis
  H - Out of control but data accepted due to high recoveries
DQ - Data Qualifiers:
  I - The low-spike recovery is high.

Table F-3b. Data Summary Table: Groundwater - Area P Lagoons, Quality Control, Equipment Rinsates, Louisiana Army Ammunition Plant

Site ID	G0009	G0012	G0110	GO-145	GO-146
Field Sample Number	SAICRB02	SAICRB01	SAICRB03	SAICRB05	SAICRB04
Site Type	RNSW	RNSW	RNSW	RNSW	RNSW
Collection Date	2/25/94	2/24/94	2/28/94	3/2/94	3/1/94
Depth (ft)	0	0	0	0	0
Associated Field QC Sample - Site ID	N/A	N/A	N/A	N/A	N/A
Associated Field QC Sample - Field Sample No.	N/A	N/A	N/A	N/A	N/A

Explosives (UW25)

Laboratory ID Number			UB01175				UB01143				UB01190				UB01240				UB01223			
Parameter	Units	CRL			FC	DQ			FC	DQ			FC	DQ			FC	DQ			FC	DQ
1,3,5-Trinitrobenzene	µg/L	0.21		0.42	CB	I	LT	0.21			LT	0.21			LT	0.21			LT	0.21		
1,3-Dinitrobenzene	µg/L	0.458	LT	0.458			LT	0.458			LT	0.458			LT	0.458			LT	0.458		
2,4,6-Trinitrotoluene	µg/L	0.426	LT	0.426	7	JN	LT	0.426			LT	0.426			LT	0.426		J	LT	0.426		J
2,4-Dinitrotoluene	µg/L	0.397	LT	0.397		N	LT	0.397			LT	0.397			LT	0.397		J	LT	0.397		J
2,6-Dinitrotoluene	µg/L	0.6	LT	0.6			LT	0.6			LT	0.6			LT	0.6			LT	0.6		
Cyclotetramethylenetetranitramine	µg/L	0.533	LT	0.533			LT	0.533			LT	0.533			LT	0.533				5.03	C	
Nitrobenzene	µg/L	0.682		2.66	U		LT	1.84	K			2.95	UQ		LT	0.682	L	J	LT	0.682	L	J
Hexahydro-1,3,5-trinitro-1,3,5-triazine	µg/L	0.416		0.746	U		LT	0.416	K7	J	LT	0.416			LT	0.416			LT	0.416		
N-methyl-N,2,4,6,-tetranitroanaline	µg/L	0.631	LT	0.631			LT	0.631			LT	0.631			LT	0.631			LT	0.631		

Table F-3b. Data Summary Table: Groundwater - Area P Lagoons, Quality Control, Equipment Rinsates, Louisiana Army Ammunition Plant (Continued)

Site ID	GO-150
Field Sample Number	SAICRB06
Site Type	RNSW
Collection Date	3/3/94
Depth (ft)	0
Associated Field QC Sample - Site ID	N/A
Associated Field QC Sample - Field Sample No.	N/A

Explosives (UW25)

Laboratory ID Number				UB01267		
Parameter	Units	CRL			FC	DQ
1,3,5-Trinitrobenzene	µg/L	0.21	LT	0.21		
1,3-Dinitrobenzene	µg/L	0.458	LT	0.458		
2,4,6-Trinitrotoluene	µg/L	0.426	LT	0.426		
2,4-Dinitrotoluene	µg/L	0.397	LT	0.397		J
2,6-Dinitrotoluene	µg/L	0.6	LT	0.6		
Cyclotetramethylenetetranitramine	µg/L	0.533	LT	0.533		
Nitrobenzene	µg/L	0.682	LT	0.682		
Hexahydro-1,3,5-trinitro-1,3,5-triazine	µg/L	0.416	LT	0.416		
N-methyl-N,2,4,6,-tetranitroanaline	µg/L	0.631	LT	0.631		

N/A - Not applicable
ID - Identification
QC - Quality Control
CRL - Certified reporting limit
LT - Less than
FC - Flagging Codes:
- B - Analyte was found in the method blank or QC blank as well as the sample.
- C - Analysis confirmed
- K - Reported results affected by interferences or high background
- L - Out of control, data rejected due to low recoveries.
- Q - Sample interference obscured peak of interest
- U - Analysis is unconfirmed
- 7 - Low spike recovery is not within control limits

DQ - Data Qualifiers:
- I - The low-spike recovery is high.
- J - The low-spike recovery is low.
- N - The high-spike recovery is low.

Six equipment blanks (i.e., SAICRB01, SAICRB02, SAICRB03, SAICRB04, SAICRB05, and SAICRB06) were collected and analyzed by DCL for explosives-related compounds using DCL performance demonstrated method UW25. 135TNT, NB, and RDX were detected in SAICRB02 at concentrations of 0.42 μg/L, 2.7 μg/L, and 0.75 μg/L, respectively. 135TNT and RDX concentrations detected in field sample SAIC01 Site ID G0009, SAIC04 and SAIC05 Site ID G0083, SAIC02 and SAIC03 Site ID G0084, and NB concentrations detected in SAIC05 and SAIC06 Site ID G0083 were flagged (i.e., "G") to indicate that the compound concentration was found in the associated equipment rinsate blank.

Nitrobenzene was detected in SAICRB03 (2.9 μg/L) and hexahydro-1,3,5-trinitro-1,3,5-triazine (HMX) in SAICRB04 (5 μg/L); however, since these compounds were not detected in the associated environmental samples, no flag codes were applied.

F.2.3 Field Replicates

One replicate environmental sample was collected for every 10 environmental samples, as required by the project-specific QAPP and the *USATHAMA Quality Assurance Program, PAM 11-41* (January 1990). The RPD value of each detected compound was reviewed to assess the sample collection reproducibility and matrix variability. A total of 16 groundwater and 2 replicate samples were collected. One field replicate groundwater sample was collected after each 10 environmental samples, as indicated on the chain-of-custody forms.

As required by the Five-Year Review of the Area P Lagoons QAPP, the first bailer volume was used to fill the sample bottles. The next bailer volume was used to fill the replicate sample bottles. No specific control limits for field replicates were established in part because the natural heterogeneity of the environmental media proved to have a much greater influence than that imparted by field activities.

Replicate results were evaluated using 30 RPD EPA acceptance criteria for water samples. Table F-4 summarizes the concentrations of the explosives-related compounds detected in the groundwater replicate pairs.

Table F-4. Data Summary Table: Groundwater - Area P Lagoons, Results of Replicated Groundwater Sampling Analysis, Louisiana Army Ammunition Plant

Site ID	G0084	G0084	G0104	G0104
Field Sample Number	SAIC02	SAIC03	SAIC01	SAIC01
Site Type	WELL	WELL	WELL	WELL
Collection Date	2/25/94	2/25/94	3/2/94	3/2/94
Depth (ft)	21.6	21.6	18	18
Associated Field QC Sample - Site ID	G0009	G0009	GO-145	GO-145
Associated Field QC Sample - Field Sample No.	SAICRB02	SAICRB02	SAICRB05	SAICRB05

Explosives (UW25)

Laboratory ID Number				UB01177				UB01178				UB01242				UB01243		
Parameter	Units	CRL			FC	DQ			FC	DQ			FC	DQ			FC	DQ
1,3,5-Trinitrobenzene	µg/L	0.21		320	UGB	I		310	DUG	I		6000	C			6300	DC	
1,3-Dinitrobenzene	µg/L	0.458	LT	0.458			LT	0.458	D			560	C			580	DC	
2,4,6-Trinitrotoluene	µg/L	0.426		250	C7	JN		240	DC7	JN		11000	C	J		11000	DC	J
2,4-Dinitrotoluene	µg/L	0.397		12.1	UQ	N		11.2	DUQ	N		550	C	J		570	DC	J
2,6-Dinitrotoluene	µg/L	0.6	LT	0.6			LT	12	D		LT	60	JI		LT	60	DJI	
Cyclotetramethylenetetranitramine	µg/L	0.533		13.3	U			14	DUQ		LT	370	K		LT	310	DK	
Nitrobenzene	µg/L	0.682	LT	0.682			LT	0.682	D		LT	68	LJI	J	LT	68	DLJI	J
Hexahydro-1,3,5-trinitro-1,3,5-triazine	µg/L	0.416		110	CG			120	DCG			7100	C			8400	DC	
N-methyl-N,2,4,6,-tetranitroanaline	µg/L	0.631		5.66	U			5.03	DU			120	C			130	DC	

N/A - Not applicable
ID - Identification
QC - Quality Control
CRL - Certified reporting limit
LT - Less than
FC - Flagging codes:
- B - Analyte found in the method blank or QC blank as well as the sample.
- C - Analysis confirmed
- D - Duplicate analysis
- G - Analyte found in rinse blank as well as field sample.
- I - Interferences in sample caused the quantitation and /or identification to be suspect
- J - Value is estimated
- K - Reported results affected by interferences or high background
- L - Out of control, data rejected due to low recoveries.
- Q - Sample interference obscured peak of interest
- U - Analysis is unconfirmed
- 7 - Low spike recovery is not within control limits

DQ - Data Qualifiers:
- I - The low-spike recovery is high.
- J - The low-spike recovery is low.
- N - The high-spike recovery is low.

Explosives Analysis—Sixteen groundwater samples were collected and analyzed for explosives-related compounds using DCL performance demonstrated method UW25. Two groundwater samples (i.e., SAIC01 site ID G0083 and SAIC01 site ID GO104) were collected in duplicate. RPD values were not calculated for compounds less than the CRL in both the sample and replicate sample. The explosives field replicate RPDs did not exceed the control limit of 30 percent.

F.3 LABORATORY QUALITY CONTROL ASSESSMENT

All groundwater samples and equipment rinsate blanks collected were analyzed using the DCL performance demonstrated method, from the following reference:

- *The Determination of Explosives in Water by High Performance Liquid Chromatography*, Method Number: UW25.

Data verification and validation of the resulting analytical data packages ensured that the DCL produced an acceptable quality level for results. All data were flagged using the guidelines and specifications described in the following documents:

- *User's Guide, The Installation Restoration Data Management Information System (IRDMIS), Volume II Data Dictionary*, Potomac Research Institute (PRI), 1994.
- *Laboratory Data Validation Functional Guidelines For Evaluating Organics Analyses*, EPA Contract Laboratory Program, February 1988
- *U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) Quality Assurance Program, PAM 11-41*. (January 1990).

If necessary, flagging codes are assigned to data points by the laboratory and SAIC. Each data point was assessed to determine whether the value was considered usable (i.e., no qualifier), usable but flagged (i.e., "G," "U," and "Q"), or not usable (i.e., "L"). All flag codes used were applied to all data (i.e., detected and less than the CRL values), as necessary, on the IRDMIS data presentation tables in Appendix A, and to the appropriate detected values summarized in the data tables presented in Section F.3.1. All flag codes are defined at the bottom of each table presenting analytical data.

F.3.1 Explosives Compound Analysis (DCL Performance Demonstrated Method UW25)

Fourteen groundwater samples and 6 equipment blanks were collected and analyzed by DCL for explosives using DCL performance demonstrated method UW25. Data quality was evaluated using the guidelines and control limits specified for holding times, initial and continuing calibration verification, method blank and USAEC QC spike samples, and MS/MSD results. The explosives data review and validation worksheets are presented in Tables F-5a and F-5b.

Holding Times—Holding times were defined as the maximum amount of time allowed to elapse between the date and time of sample collection and the date and time the sample was extracted. Holding times were further defined as the maximum amount of time allowed to elapse between the date and time of extraction and sample analysis. DCL was required to meet holding times of 7 days for samples collected for explosives analysis. All analyses were required within 40 days after extraction.

Analysis of samples that have exceeded the method-recommended holding times may result in the following: 1) concentrations of compounds that would have been detected ordinarily are undetected due to chemical transformation, compound volatilization, or biodegradation; 2) reported concentrations lower than those originally present, due to the factors previously stated; 3) or reported concentrations greater than those originally present in the sample due to external contamination of water samples. Based on an evaluation of all field samples and equipment rinsate blanks analyzed for explosives-related compounds using DCL method UW25, all holding time criteria were met.

Initial Calibration Results—The sensitivity limit of the detectors and the linear range of the analytical systems for each compound were established by injecting a calibration standard. Calibration of the high-performance liquid chromatography (HPLC) used to analyze the samples collected during the Five-Year Review of the Area P Lagoons was established and validated by injecting a blank and eight standards into the liquid chromatograph system. Calibration standards were analyzed and linear calibration curves were generated from the data. Before analysis, the operating parameters were adjusted to optimize instrument response. Retention

Table F-5a: Explosive Analysis, Louisiana Army Ammunition Plant, Five-Year Review of Area P Lagoons Data Review and Validation

Site ID	Field Sample Number	Site Type	Laboratory Sample Name	Sampling Date	Extraction Date	Analysis Date	Initial Calibration (ICV) and Daily Calibration (CCV)	Method Blank Results
Lot AIUD								
G0012	SAICRB01	RNSW	UB01143	2/24/94	2/28/94	3/3/94	All ICV and CCV percent recoveries within control limits (75-125)	No compounds detected at concentration greater than the CRL
G0012	SAIC01	Well	UB01144	2/24/94	2/28/94	3/3/94		
G0014	SAIC01	Well	UB01145	2/24/94	2/28/94	3/3/94		
Lot AIWV								
G0009	SAICRB02	RNSW	UB01175	2/25/94	3/02/94	3/22/94	All ICV and CCV percent recoveries within control limits (75-125)	Compounds detected at concentration greater than the CRL *135TNB=0.304 µg/L
G0009	SAIC01	Well	UB01176	2/25/94	3/02/94	3/22/94		
G0084	SAIC01	Well	UB01177	2/25/94	3/02/94	3/22/94		
G0084	SAIC01	Well	UB01178	2/25/94	3/02/94	3/22/94		
G0083	SAIC01	Well	UB01179	2/25/94	3/02/94	3/22/94		
G0083	SAIC01MS	Well	UB01179M	2/25/94	3/02/94	3/22/94		
G0083	SAIC01MSD	Well	UB01179M	2/25/94	3/02/94	3/22/94		
Lot AIYH								
GO-146	SAICRB04	RNSW	UB01223	3/01/94	3/03/94	3/29/94	All ICV and CCV percent recoveries within control limits (75-125)	No compounds detected at concentration greater than the CRL
G0106	SAIC01	Well	UB01225	3/01/94	3/03/94	3/29/94		
G0068	SAIC01	Well	UB01226	3/01/94	3/03/94	3/29/94		

Table F-5a. Explosive Analysis, Louisiana Army Ammunition Plant, Five-Year Review of Area P Lagoons Data Review and Validation (Continued)

Site ID	Field Sample Number	Site Type	Laboratory Sample Name	QC Sample Matrix Spike Low (2xCRL)	QC Sample Matrix Spike High (10xCRL)	Duplicate Spiked QC Results (10xCRL)	Matrix Spike Results	Matrix Spike Duplicate Results
Lot AIUD								
G0012	SAICRB01	RNSW	UB01143	All recoveries met QC criteria, except: RDX=71.6%	All recoveries met QC criteria, except: RDX=94..7%; 135TNB=86.9%; NB=78.8%; 246TNT=82.8%.	All recoveries met QC criteria, except: RDX=97.8%; 135TNB=90.6%; NB=85.3%; 246TNT=87.2%.	No MS analyzed for lot AIUD.	No MSD analyzed for lot AIUD.
G0012	SAIC01	Well	UB01144					
G0014	SAIC01	Well	UB01145					
Lot AIWV								
G0009	SAICRB02	RNSW	UB01175	All recoveries met QC criteria, except: 135TNB=145% 246TNT=57.5%.	All recoveries met QC criteria, except: RDX=92.8%; 135TNB=104%; NB=75.3%; 246TNT=75.9%; 24DNT=71.3%.	All recoveries met QC criteria, except: RDX=93.8%; NB=77.5%; 246TNT=79.1% 24DNT=68.8%.	No percent recoveries were calculated due to background concentration greater than the spike level.	No RPD values were calculated due to background concentration greater than the spike level.
G0009	SAIC01	Well	UB01176					
G0084	SAIC01	Well	UB01177					
G0084	SAIC01	Well	UB01178					
G0083	SAIC01	Well	UB01179					
G0083	SAIC01MS	Well	UB01179M					
G0083	SAIC01MSD	Well	UB01179M					
Lot AIYH								
GO-146	SAICRB04	RNSW	UB01223	All recoveries met QC criteria, except: NB=51.1% 246TNT=60.1% ; 24DNT=55.9%.	All recoveries met QC criteria.	All recoveries met QC criteria, except: RDX=105%; 135TNB=103%; NB=72.2%; 246TNT=85%.	No MS analyzed for lot AIYH	No MSD analyzed for lot AIYH
G0106	SAIC01	Well	UB01225					
G0068	SAIC01	Well	UB01226					

Table F-5a. Explosive Analysis, Louisiana Army Ammunition Plant, Five Year Review of Area P Lagoons
Data Review and Validation (Continued)

Site ID	Field Sample Number	Site Type	Laboratory Sample Name	Equipment Blank Results	Flagged Results
Lot AIUD					
G0012	SAICRB01	RNSW	UB01143	No compounds detected at concentration greater the CRL in SAICRB01	NB LT 1.840K /RDX LT 0.416K7 µg/L
G0012	SAIC01	Well	UB01144		135TNB=950C/13DNB=35C/246TNT=3700C/24DNT=120C/26DNT LT 32.3K/HMX=110C/ NB LT 12.3K/RDX LT 3100K7/TERYL LT 6.3JI µg/L
G0014	SAIC01	Well	UB01145		135TNB LT 0.429K/ HMX=2.92C/RDX=14.4C7 µg/L
Lot AIWV					
G0009	SAICRB02	RNSW	UB01175	Compounds detected at concentration greater the CRL in SAICRB02 *135TNB=0.42/ NB=2.7/RDX=0.75 µg/L	135TNB=0.42CB/246TNT LT 0.43 "7"/NB=2.7U/RDX=0.75U µg/L
G0009	SAIC01	Well	UB01176		135TNB=29UGB/246TNT=28C7/24DNT=37UQ/HMX=26C/RDX=430C µg/L
G0084	SAIC01	Well	UB01177		135TNB=320UGB/246TNT=250C7/24DNT=112UQ/HMX=13U/RDX=110CG/TERYL=5.7U µg/L
G0084	SAIC01	Well	UB01178		135TNB=310DUGB/13DNB LT 0.46D/246TNT=240DC7/24DNT=11DUQ/26DNT LT 12D/ HMX=14DUQ/NB LT 068D/RDX=120DUQ/TERYL=5DU µg/L
G0083	SAIC01	Well	UB01179		135TNB=800UGB/13DNB =5.6C/246TNT=3100C7/24DNT=95UQ/HMX=99C/NB LT 14JI/ /RDX=1200CG/TERYL=95U µg/L
G0083	SAIC01MS	Well	UB01179M		135TNT=830GB/246TNT=3200 "7"/26DNB LT 12JI/NB=24G/RDX=1900G µg/L
G0083	SAIC01MSD	Well	UB01179M		135TNB=780DGB/13DNB=5.1D/246TNT=3000D7/24DNT=130D/26DNT LT 12DJI/HMX=130D/ NB=25DG/RDX=1600DG/TERYL=88D µg/L
Lot AIYH					
GO-146	SAICRB04	RNSW	UB01223	Compound detected at concentration greater the CRL in SAICRB04 *HMX=5 µg/L	HMX=5C/NB LT 0.68L µg/L
G0106	SAIC01	Well	UB01225		135TNB=970C/13DNB=330C/246TNT=8800C/24DNT=640C/26DNT LT 60JI/HMX LT 53JI/ /NB LT 68JL/RDX 4100C/TERYL LT 63JI µg/L
G0068	SAIC01	Well	UB01226		135TNB=490C/13DNB=82C/246TNT=3600C/24DNT=350UQ/26DNT LT 60JI/HMX LT 350K/ NB LT 68JL/RDX=2500C/TERYL=31U µg/L

LT =Less than (Boolean)

Flag Codes:

B=Analyte found in the method blank as well as the sample

C=Analysis was confirmed

D=Duplicate analysis.

G=Analyte found in rinse blank as well as field sample

K=Reported results are affeted by interferences or high background

I=Interferences in the sample make quantitation and /or indentification to be suspect

J=Value is estimated

L=Out of control, data rejected due to low recoveries.

Q=Sample interference obscured peak of interest

U=Analysis was unconfirmed

7=Low spike recovery is not within control limits.

Table F-5b. Explosive Analysis, Louisiana Army Ammunition Plant, Five Year Review of Area P Lagoons
Data Review and Validation

Site ID	Field Sample Number	Site Type	Laboratory Sample Name	Sampling Date	Extraction Date	Analysis Date	Initial Calibration (ICV) and Daily Calibration (CCV)	Blank Results QC Sample
Lot AIYH								
GO-145	SAICRB05	RNSW	UB01240	3/02/94	3/03/94	3/29/94	All ICV and CCV percent recoveries within control limits (75-125)	No compounds detected at concentration greater than the CRL
G0104	SAIC01	Well	UB01242	3/02/94	3/03/94	3/29/94		
G0104	SAIC01	Well	UB01243	3/02/94	3/03/94	3/29/94		
Lot AIWA								
G0110	SAICRB03	RNSW	UB01190	2/28/94	3/01/94	3/29/94	All ICV and CCV percent recoveries within control limits (75-125)	No compounds detected at concentration greater than the CRL
G0110	SAIC01	Well	UB01191	2/28/94	3/01/94	3/29/94		
G0105	SAIC01	Well	UB01192	2/28/94	3/01/94	3/29/94		
G0109	SAIC01	Well	UB01193	2/28/94	3/01/94	3/29/94		
Lot AJDT								
GO-150	SAICRB06	RNSW	UB01267	3/03/94	3/10/94	4/08/94	All ICV and CCV percent recoveries within control limits (75-125)	No compounds detected at concentration greater than the CRL
G0085	SAIC01	Well	UB01270	3/03/94	3/10/94	4/08/94		

Table F-5b. Explosive Analysis, Louisiana Army Ammunition Plant, Five Year Review of Area P Lagoons Data Review and Validation (Continued)

Site ID	Field Sample Number	Site Type	Laboratory Sample Name	QC Sample Matrix Spike		Duplicate Spiked QC Results (10xCRL)	Matrix Spike Results	Matrix Spike Duplicate Results
				Low (2xCRL)	High (10xCRL)			
Lot AIYH								
GO-145	SAICRB05	RNSW	UB01240	All recoveries met QC criteria, except: NB=51.1% 246TNT=60.1%.	All recoveries met QC criteria, except: RDX=93.1%; 135TNB=87.5%; NB=81.6%; 246TNT=82.2%.	All recoveries met QC criteria, except: RDX=105%; 135TNB=103%; NB=72.2%; 246TNT=85%.	No MS analyzed for lot AIYH.	No MS/MSD analyzed for lot AIYH.
G0104	SAIC01	Well	UB01242					
G0104	SAIC01	Well	UB01243					
Lot AIWA								
G0110	SAICRB03	RNSW	UB01190	All recoveries met QC criteria, except: NB=51.1% 246TNT=60.1%.	All recoveries met QC criteria, except: RDX=93.1%; 135TNB=87.5%; NB=81.6%; 246TNT=82.2%.	All recoveries met QC criteria, except: RDX=105%; 135TNB=103%; NB=72.2%; 246TNT=85%.	No MS analyzed for lot AIYH.	No MS/MSD analyzed for lot AIWA.
G0110	SAIC01	Well	UB01191					
G0105	SAIC01	Well	UB01192					
G0109	SAIC01	Well	UB01193					
Lot AJDT								
GO-150	SAICRB06	RNSW	UB01267	All recoveries met QC criteria, except: NB=71.2% 246TNT=61.1%.	All recoveries met QC criteria, except: RDX=90.6%; 135TNB=93.1%; NB=85.6%; 246TNT=86.9%.	All recoveries met QC criteria, except:246TNT=90.3%	No MS analyzed for lot AJDT.	No MS/MSD analyzed for lot AJDT.
G0085	SAIC01	Well	UB01270					

Table F-5b. Explosive Analysis, Louisiana Army Ammunition Plant, Five Year Review of Area P Lagoons Data Review and Validation (Continued)

Site ID	Field Sample Number	Site Type	Laboratory Sample Name	Equipment Blank Results	Flagged Results
Lot AIYH					
GO-145	SAICRB05	RNSW	UB01240	No compounds detected at concentration greater the CRL in SAICRB05	NB LT 0.68L µg/L
G0104	SAIC01	Well	UB01242		135TNB=6000C/13DNB=560C/246TNT=1100C/24DNT=550C/ 26DNT LT 60JI/HMX LT 370K/NB LT 68JIL/RDX=7100C/TERYL=120C µg/L
G0104	SAIC01	Well	UB01243		135TNB=6300DC/13DNB=580DC/246TNT=1100DC/24DNT=570DC/ 26DNT LT 60DJI/HMX LT 310DK/NB LT 68DJIL/RDX=8400DC/TERYL=130DCµg/L
Lot AIWA					
G0110	SAICRB03	RNSW	UB01190	Compound detected at concentration greater the CRL in SAICRB03 *NB=2.9 µg/L	NB=29UQ µg/L
G0110	SAIC01	Well	UB01191		135TNB=460C/13DNB=24UQ/246TNT=570C/24DNT=120C/ 26DNT LT 60JI/HMX=130C/NB LT 6.8JI/RDX=2800C µg/L
G0105	SAIC01	Well	UB01192		135TNB=3900C/13DNB=320UQ/246TNT=17C/24DNT=54C/ 26DNT LT 60JI/HMX=360C/NB LT 6.8JI/RDX=330C/TERYL=3.7U µg/L
G0109	SAIC01	Well	UB01193		135TNB=95C/13DNB=8.2UQ/246TNT=3600C/24DNT=330C/ 26DNT LT 60JI/HMX=300C/NB LT 6.8JI/RDX=3100C/TERYL=40U µg/L
Lot AJDT					
GO-150	SAICRB06	RNSW	UB01267	No compound detected at concentration greater the CRL in SAICRB06.	None Applied
G0085	SAIC01	Well	UB01270		135TNB=1.52C/246TNT=2.93C/RDX=5.04C/TERYL=1.12C µg/L

LT =Less than (Boolean)
Flag Codes:
B=Analyte found in the method blank as well as the sample
C=Analysis was confirmed
D=Duplicate analysis.
G=Analyte found in rinse blank as well as field sample
K=Reported results are affeted by interferences or high background
I=Interferences in the sample make quantitation and /or indentification to be suspect
J=Value is estimated
L=Out of control, data rejected due to low recoveries.
Q=Sample interference obscured peak of interest
U=Analysis was unconfirmed
7=Low spike recovery is not within control limits.

APPENDIX G

ASTM METHOD D5093-90

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Designation: D 5093 – 90

Standard Test Method for Field Measurement of Infiltration Rate Using a Double-Ring Infiltrometer with a Sealed-Inner Ring[1]

This standard is issued under the fixed designation D 5093; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method describes a procedure for measuring the infiltration rate of water through in-place soils using a double-ring infiltrometer with a sealed inner ring.

1.2 This test method is useful for soils with infiltration rates in the range of 1×10^{-7} m/s to 1×10^{-10} m/s. When infiltration rates $\geq 1 \times 10^{-7}$ m/s are to be measured Test Method D 3385 shall be used.

1.3 This test method provides a direct measurement of infiltration rate, not hydraulic conductivity. Although the units of infiltration rate and hydraulic conductivity are similar, there is a distinct difference between these two quantities. They cannot be directly related unless the hydraulic boundary conditions, such as hydraulic gradient and the extent of lateral flow of water are known or can be reliably estimated.

1.4 This test method can be used for natural soil deposits, recompacted soil layers, and amended soils such as soil bentonite and soil lime mixtures.

1.5 The values stated in SI units are to be regarded as standard. The values in parentheses are for information only.

1.6 *This standard does not purport to address the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 653 Terminology Relating to Soil, Rock, and Contained Fluids[2]

D 3385 Test Method for Infiltration Rate of Soils in Field Using Double Ring Infiltrometers[2]

3. Terminology

3.1 *Definitions:*

3.1.1 *infiltration*—downward entry of liquid into a porous body.

3.1.2 *infiltration rate, I*—quantity of liquid entering a porous material (m^3) per unit area (m^2) per unit time (s), expressed in units of m/s.

3.1.3 *infiltrometer*—a device used to pond liquid on a porous body and to allow for the measurement of the rate at which liquid enters the porous body.

3.1.4 For definitions of other terms used in this test method, see Terminology D 653.

4. Summary of Test Method

4.1 The infiltration rate of water through soil is measured using a double-ring infiltrometer with a sealed or covered inner ring (Fig. 1). The infiltrometer consists of an open outer and a sealed inner ring. The rings are embedded and sealed in trenches excavated in the soil. Both rings are filled with water such that the inner ring is submerged.

4.2 The rate of flow is measured by connecting a flexible bag filled with a known weight of water to a port on the inner ring. As water infiltrates into the ground from the inner ring, an equal amount of water flows into the inner ring from the flexible bag. After a known interval of time, the flexible bag is removed and weighed. The weight loss, converted to a volume, is equal to the amount of water that has infiltrated into the ground. An infiltration rate is then determined from this volume of water, the area of the inner ring, and the interval of time. This process is repeated and a plot of infiltration rate versus time is constructed. The test is continued until the infiltration rate becomes steady or until it becomes equal to or less than a specified value.

5. Significance and Use

5.1 This test method provides a means to measure low infiltration rates associated with fine-grained, clayey soils, and are in the range of 1×10^{-7} m/s to 1×10^{-9} m/s.

5.2 This test method is particularly useful for measuring liquid flow through soil moisture barriers such as compacted clay liner or covers used at waste disposal facilities, for canal and reservoir liners, for seepage blankets, and for amended soil liners such as those used for retention ponds or storage tanks.

5.3 The purpose of the sealed inner ring is to: (*1*) provide

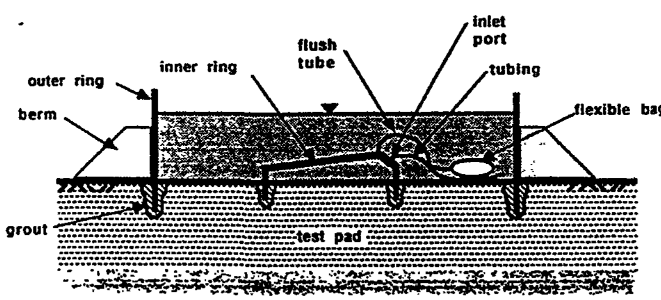


FIG. 1 Schematic Of A Double-Ring Infiltrometer With A Sealed Inner Ring

[1] This test method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.04 on Hydrologic Properties of Soil and Rocks.

Current edition approved June 29, 1990. Published August 1990.

[2] *Annual Book of ASTM Standards*, Vol 04.08.

a means to measure the actual amount of flow rather than a drop in water elevation which is the flow measurement procedure used in Test Method D 3385 and (*2*) to eliminate evaporation losses.

5.4 The purpose of the outer ring is to promote one-dimensional, vertical flow beneath the inner ring. The use of large diameter rings and large depths of embedments helps to ensure that flow is essentially one-dimensional.

5.5 This test method provides a means to measure infiltration rate over a relatively large area of soil. Tests on large volumes of soil can be more representative than tests on small volumes of soil.

5.6 The data obtained from this test method are most useful when the soil layer being tested has a uniform distribution of pore space, and when the density and degree of saturation and the hydraulic conductivity of the material underlying the soil layer are known.

5.7 Changes in water temperature can introduce significant error in the volume change measurements. Temperature changes will cause water to flow in or out of the inner ring due to expansion or contraction of the inner ring and the water contained within the inner ring.

5.8 The problem of temperature changes can be minimized by insulating the rings, by allowing enough flow to occur so that the amount of flow resulting from a temperature change is not significant compared to that due to infiltration, or by connecting and disconnecting the bag from the inner ring when the water in the inner ring is at the same temperature.

5.9 If the soil being tested will later be subjected to increased overburden stress, then the infiltration rate can be expected to decrease as the overburden stress increases. Laboratory hydraulic conductivity tests are recommended for studies of the influence of level of stress on the hydraulic properties of the soil.

6. Apparatus

6.1 *Infiltrometer Rings*—The rings shall be constructed of a stiff, corrosion-resistant material such as metal, plastic, or fiberglass. The shape of the rings can be circular or square. However, square rings are recommended because it is easier to excavate straight trenches in the soil. The rings can be of any size provided: (*1*) the minimum width or diameter of the inner ring is 610 mm (24 in.); and (*2*) a minimum distance of 610 mm is maintained between the inner and outer ring. The following is a description of a set of rings that can be constructed from commonly available materials, incorporates the requirements described above, and has worked well in the field.

6.1.1 *Outer Ring*—A square ring (Fig. 2) comprised of four sheets of aluminum approximately 3.6 m by 910 mm by 2 mm (12 ft by 36 in. by 0.080 in.) The top edge of the aluminum sheet is bent 90° in order to provide rigidity. A hole is provided in the center of the top edge. One edge of each sheet is bent 90°. Holes are drilled along each side edge so that the sheets can be bolted at the corners. A flat rubber gasket provides a seal at each corner. A wire cable approximately 15 m long with a clamp may be needed to tie the top edges together.

6.1.2 *Inner Ring*—A square ring (Fig. 3), 1.52 m (5 ft) on a side, made of fiberglass provided with two ports. The top is shaped in such a way as to vent air from the ring as it is filled. A port is provided at the highest point so that any air that accumulates in the ring during the test can be flushed out. One port must be located at the top of the ring. The other port must be located beneath the top port. A 150 mm (6 in.) skirt, that is embedded into the soil, is provided along the edge of the ring. Barbed fittings that accept flexible tubing are attached to the ports. Handles are provided at each corner of the inner ring.

6.2 *Flexible Bag*—Two clear flexible bags with a capacity of 1000 to 3000 mL. Intravenous bags available from medical supply stores work well. A means for attaching a

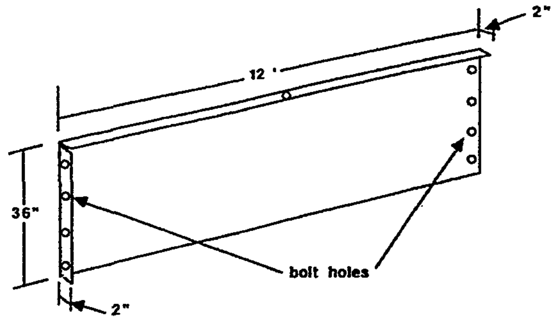


FIG. 2 Panel For Outer Ring

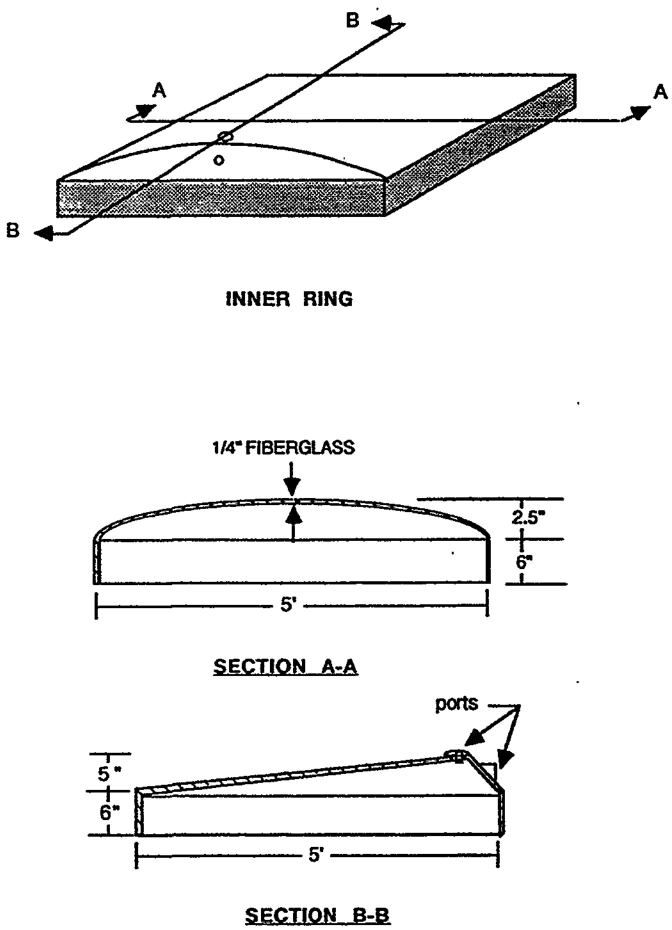


FIG. 3 Inner Ring

shut-off valve to the bag shall be provided. The shut-off valve shall be provided with a barbed fitting that will connect to the inlet tube on the inner ring.

6.3 *Tubing*—Clear, flexible tubing approximately 4.5 m (15 ft) long with a minimum ID of 6 mm (¼ in.)

6.4 *Scissors or Knife.*

6.5 *Excavation Tools.*

6.5.1 *Mason's Hammer*—Hammer with a blade approximately 120 mm long and 40 mm wide.

6.5.2 *Trenching Machine*—Capable of excavating a trench with a maximum width of 150 mm (6 in.) and a depth of 460 mm (18 in.)

6.5.3 *Chain Saw*—(Optional—see Note 1) Equipped with a carbide-tipped chain and bar.

6.5.4 *Hand Shovel*, garden type.

6.6 *Levels*—A surveyor's level and rod and a carpenter's level.

6.7 *Buckets*—Five buckets with a capacity of approximately 20 L (5 gal.)

6.8 *Blocks*—Cinder blocks to serve as a platform for the flexible bag.

6.9 *Cover*—An opaque cover to place on top of the outer ring. The cover can be a tarp or plywood supported by wooden beams.

6.10 *Grout*—A bentonite grout for filling the trenches and sealing the rings in place.

6.11 *Mixing Equipment*—A large (four bag) grout mixer for mixing the bentonite grout.

6.12 *Trowel.*

6.13 *Thermometer*—Readable to 0.5°C with a range of 0 to 50°C.

6.14 *Scale*—Capacity of 4000 g and an accuracy of 1 g.

6.15 *Watch*—Readable to 1 s.

6.16 *Water Supply*—Preferably water of the same quality as that involved in the problem being examined. Approximately 5600 L (1400 gal) are needed for this test.

6.17 *Splash Guard*—Plywood, rubber sheet, or burlap 600 by 600 mm (2 by 2 ft).

7. Test Site

7.1 The test requires an area of approximately 7.3 by 7.3 m (24 by 24 ft).

7.2 The slope to the test area should be no greater than approximately 3 %.

7.3 The test may be set up in a pit if infiltration rates are desired at depth rather than at the surface.

7.4 The test area shall be covered with a sheet of plastic to keep the surface from drying.

7.5 Representative samples of the soil to be tested shall be taken before and after the test to determine its moisture content, density, and specific gravity. The thickness of the layer being tested shall be determined as well as the approximate hydraulic conductivity of the layer beneath it.

8. Procedure

8.1 *Assembly of Outer Ring*—Wipe off gaskets and side edges of the outer ring. Align gasket between the edges and bolt edges together.

8.2 *Excavation of Trenches:*

8.2.1 Place both rings on the area to be tested. Center the inner ring within the outer ring. Make sure that the outer ring is square by using the tape measure to check that the length of the diagonals are equal.

8.2.2 If plastic is covering the test area, cut out thin strips along the edge of each ring so that the trenches can be excavated. Leave as much of the plastic on as possible in order to keep the soil from drying.

8.2.3 Use the bottom edge of each ring to scribe a line on the ground to use as a guide for excavating the trenches.

8.2.4 Note the orientation of the rings and set them aside.

8.2.5 Use the surveyor's level and check the ground elevation where the corners of each ring will be. Note the high spots and excavate deeper in these areas so that the rings will be level.

8.2.6 Use the trenching machine and excavate a trench for the outer ring. The trench should be about 146 mm (18 in.) deep. Excavate deeper at high spots.

8.2.7 Use a small hand shovel to remove any loose material in the trenches.

8.2.8 Place the outer ring in the trench and use the carpenter's level to check that the top of the ring is reasonably level (±30 mm). Also check that the outer ring is square. Remove the ring and excavate any areas keeping the ring from being level and square.

8.2.9 Set the outer ring aside and cover the trenches to prevent the soil from drying.

8.2.10 Use the mason's hammer and excavate a trench 50 by 110 mm (2 by 4.5 in.) for the inner ring. Excavate deeper in high spots so that the inner ring will sit level in the trench. Excavate the trench carefully so that the surrounding soil is disturbed as little as possible. When using the mason's hammer, it is best to start by digging down several inches in one spot and then advancing the trench forward by chopping down on the soil. Do not pry the soil up as this tends to lift up large wedges of soil, opens cracks, and causes the trench to be oversized.

8.2.11 Place the inner ring in the trench to check the fit. Excavate any areas where the ring does not fit. Use a surveyor's level to check the elevation of the corners of the ring. The inner ring needs to be level or slightly tilted so that the back end is slightly lower than the front end.

8.2.12 Set the ring aside and cover the trenches.

NOTE 1—A chain saw that is equipped with a carbide-tipped chain and a bar may be used to excavate the trenches. Use of a chain saw will not only reduce the time needed to excavate the trench but will also greatly decrease the amount of grout needed to fill the trenches. If a chain saw is used, the trenches need only be 25 mm (1 in.) wide. A chain saw will not work well in some soils. A trial trench should be made to determine if it will work.

8.3 *Installation of Rings:*

8.3.1 Use the grout mixer to prepare enough grout to fill the trenches. The hydraulic conductivity of the grout should be less than approximately 1×10^{-8} m/s.

8.3.2 Fill the trenches to within 2.5 mm (1 in.) of the top of the trench. Rod or tamp the grout to remove any entrapped air.

8.3.3 Lift the inner ring and center it over the inner ring trench. Lower it into the trench and slowly push it down. Keep the ring level as it is pushed into place.

8.3.4 Use a surveyor's level to check that the ring is level.

8.3.5 Use a trowel to press the grout against the outside wall of the ring in order to ensure a good seal.

8.3.6 Cover the grout with plastic to prevent desiccation.

8.3.7 Lift the outer ring and center it over the outer ring trench.

8.3.8 Keep the ring level and push it into place.

8.3.9 Use the carpenter's level to make sure that the ring is level.

8.3.10 Use a trowel to push the grout against both the inside and the outside of the ring to ensure a good seal.

8.3.11 Cover the grout with plastic to prevent desiccation.

8.3.12 Place several cinder blocks between the inner and outer rings in the vicinity of the ports on the inner ring. These blocks will be used as a platform to stand on when connecting the fittings to the inner ring and also to support the flexible bags. The blocks should be no higher than 100 mm (4 in.)

8.3.13 Pile soil along the outside of the outer ring to a height of at least 30 cm (12 in.) This soil places an overburden pressure on the grout that will prevent it from being pushed out of the trench when the rings are filled with water.

8.4 *Filling the Rings:*

8.4.1 Fill two buckets with water and place one on each back corner of the inner ring. The buckets are placed on the inner ring to counteract the uplift force that acts on the ring as it is being filled. Make sure that the buckets are placed on the edge of the ring, not in the center as this may overstress the ring and cause it to crack. Do not to spill any water around the inner ring as this will make it difficult to check for leaks in the seal.

8.4.2 Place an empty bucket upside down on the ground near the top port on the inner ring. Place a second bucket on the first bucket. Fill the second bucket with water. Cut a length of the flexible tubing long enough to reach from the top bucket to the top port on the inner ring. Siphon the water from the bucket to the inner ring. Allow the siphoning to continue until the depth of the water in the inner ring is approximately 25 mm (1 in.). Avoid spilling any water around the inner ring during this filling process as this will make it difficult to check for leaks. Any other suitable method for adding the required volume of water to the inner ring may also be used.

8.4.3 Let the water stand in the inner ring for at least 30 min. Check for leaks in the inner ring seal and repair any that are found.

8.4.4 Start filling the outer ring slowly so as not to scour the soil and muddy the water. Direct the water so that it hits a splashboard first. Fill the outer ring until the water level is approximately 100 mm (4 in.) above the top of the inner ring. While the rings are being filled, use a board or shovel handle to gently tap the inner ring to dislodge air bubbles that are trapped inside. Continue tapping on the inner ring until bubbles cease to emerge from the top port.

8.4.6 Remove the buckets from the top of the inner ring.

8.5 *Installation of Fittings and Tubing:*

8.5.1 Wrap the threads of the two barbed fittings with TFE-fluorocarbon tape.

8.5.2 Saturate the fittings and connect them to the inner ring. Screw one of the barbed fittings into the top port and the other barbed fitting into one of the lower ports. Use caution when screwing the fittings into the ports as the threads in fiberglass inner rings can be easily damaged.

8.5.3 Cut two lengths of the clear flexible tubing, one 900-mm (3-ft) piece and one 1800-mm (6-ft) piece.

8.5.4 Saturate the tubing by placing it under water. Be sure to remove all air bubbles.

8.5.5 Connect one end of the 1.8-m (6-ft) piece to the fitting in the top port and seal the other end with a plug fitting. Do not let air into the tube during this process. This tube is the flush tube.

8.5.6 Connect the end of the 900-mm (3-ft) piece to the barbed fitting in the lower port. Prop the open end of this tube on the cinder block platform. Water is being drawn into this tube so be sure not to allow the open end of the tube to float to the surface and draw in air or sink to the bottom and draw in mud. This tube is the inlet tube.

8.6 *Covering the Rings:*

8.6.1 Cover the rings with either a tarp or plywood. The purpose of the cover is to minimize evaporation, minimize temperature changes, and inhibit the growth of algae.

8.6.2 Provide a means in the cover that makes it convenient to access the front of the inner ring to connect and disconnect the measurement bag.

8.7 *Maintaining the Water Level:*

8.7.1 Place a mark indicating the water elevation on the inside wall of the outer ring near the cinder blocks.

8.7.2 Observe the water level within the outer ring during the test and refill the ring to this mark before the water level drops more than 25 mm (1 in.) below the mark. Record the date, time, and the amount of water added.

8.8 *Purging the Inner Ring*—During the test, air may accumulate beneath the inner ring. This air may introduce error in flow measurements and consequently should be purged on a regular basis as follows.

8.8.1 Disconnect bag, if one is present, from end of inlet tube.

8.8.2 Lift the plugged end of the flush tube out of outer ring and below the water level in the outer ring so that water can be siphoned out of inner ring.

8.8.3 Remove plug from end of flush tube. Water and air if present will start to flow out of inner ring. If air completely fills the tube, the syphon will be lost. If this happens, saturate the tube and restart the siphon.

8.8.4 Allow water to flow from end of tube until air ceases to emerge from inner ring. Replace plug in end of flush tube and place tube back into outer ring. Note the approximate volume of purged air. Volume can be determined by multiplying the flow area of the flush tube by the height of the air bubbles which flow out of the tube.

8.8.5 Wait at least 30 min before taking any flow measurements.

8.8.6 Purge the inner ring on a weekly basis until no significant amount of air is found.

8.9 *Measurements:*

8.9.1 Attach the shut-off valve to the flexible bag and fill the bag with water. Remove all air bubbles from the bag. Use water that has been degassed or allow the bag to sit overnight so that the water can degas. If left to sit overnight, remove any air bubbles. Do not overfill the bag so that the water inside is under pressure.

8.9.2 Dry the outside of the bag and record its weight to the nearest gram.

8.9.3 With the shut-off valve closed, attach the bag to the open end of the inlet tube connected to the inner ring. Be sure not to trap any air bubbles in the inlet tubing or in the valve when attaching the bag. Lay the bag down on the cinder block platform.

8.9.4 Record the time, date, temperature of the water in the outer ring, and the depth of the water in the outer ring, and then carefully open the shut-off valve on the bag. Check that the inlet tube is not pinched and that the bag is arranged in such a manner that water can flow freely from it into the inner ring.

8.9.5 Sometime before the bag empties, close the shut-off valve, disconnect the bag from the inlet tube, and record the date, time, temperature of the water in the outer ring and the depth of the water in the outer ring. Be sure to prop the open end of the inlet hose as pointed out in 8.5.6. Do not leave the bag on long enough to empty as this will create a suction in the inner ring and cause leaks in the grout seal.

8.9.8 Dry the bag and record the weight of it to the nearest gram.

8.9.9 Refill the bag and repeat 8.9.2 through 8.9.8 until the infiltration rate (see Section 9) becomes steady or drops below a predetermined value.

NOTE 2—The reading times are governed primarily by the length of time the bag can remain connected to the inner ring without emptying. This length of time can only be determined through experience. Initially, flow rates will be high and the bag may need to be disconnected after several hours. As the test progresses, the flow rate will slow and the length of time it takes the bag to empty may increase to several days or weeks.

A second important factor that governs when readings should be made is the temperature of the water. In order to minimize the effects of temperature changes on the measured flow rate, the bag should be disconnected from the inner ring when the water is at the same temperature (within ±2°C) as when the bag was connected. More consistent readings are usually obtained if readings are made between 7 am and 9 am.

NOTE 3—It is not necessary to have the bag connected to the inner ring continuously. Flow only needs to be measured over timed intervals so that a plot of infiltration rate versus time can be constructed. The infiltration rate is not influenced by whether or not the bag is connected to the inlet tube. If the flow rate is high, it is more convenient to connect the bag to the inner ring for several hours a day and leave the inlet tube open in the outer ring for the remainder of the time.

NOTE 4—When connecting or disconnecting the bag from the inner ring, do not raise the bag above the level of the water in the outer ring with the shut-off valve open. This would cause an uplift force to act on the inner ring and could cause it to rise out of the trench.

8.10 *Ending Test:*

8.10.1 Remove the fittings and tubing from the inner ring.

8.10.2 Drain water from rings.

8.10.3 Excavate the grout from around the rings and pull the rings out of the ground.

8.10.4 Excavate a narrow trench in the area encompassed by the inner ring and take moisture content samples every 25 mm (1 in.) to a depth of 150 mm (6 in.) below the observed wetting front. An alternative to this is to push a thin-walled sampling tube into the soil, extrude the soil, and slice it every 25 mm (1 in.) for moisture content samples.

9. Calculation

9.1 Calculate the infiltration rate for each timed interval as follows:

$$I\,(\text{m/s}) = \frac{Q}{tA} \times 10^{-6}$$

where:

Q = volume of flow, mL,
 = $W_1 - W_2$
W_1 = initial weight of bag, g,
W_2 = final weight of bag, g,
t = time of flow, s = $t_2 - t_1$,
t_1 = time shut-off valve on bag was opened,
t_2 = time shut-off valve was closed, and
A = area of inner ring, m^2.

9.2 Calculate the amount of flow which resulted from any temperature fluctuations for each timed interval (see Note 5). If the flow due to temperature fluctuations is greater than 20 % of the total flow measured, then correct the flow used to calculate the infiltration rate by this amount.

NOTE 5—Expansion and contraction of the inner ring due to temperature changes will cause water to flow into or out of the measurement bag. The inner ring should be calibrated to determine if the flow resulting from temperature change is significant compared to flow due to infiltration. Calibration can be performed by sealing the inner ring to the bottom of a small plastic pool. Fill the pool and ring with water and allow the temperature to reach equilibrium. Connect a measurement bag to the inner ring and add ice to the pool water to lower the temperature several degrees. Allow the temperature to reach equilibrium and remove the bag. Determine the weight loss/gain and convert it to a volume of water. Divide this volume of water by the change in temperature to obtain a calibration factor for temperature changes.

9.3 Note the volume of air expelled from the weekly purging of the inner ring. Compare this volume of air with the volume of infiltration that occurred during the time the air collected in the inner ring. If this volume is significant, (that is, 20 % of that used to determine infiltration in 9.1,) then adjust the infiltration rates in 9.1 to account for it.

10. Report

10.1 Report the following information:

10.1.1 A data sheet such as the one shown in Fig. 4,

10.1.2 A semi-log plot of infiltration versus time such as that shown in Fig. 5,

10.2 Additional optional information that can be presented in the report includes the following,

10.2.1 Thickness of layer tested,

10.2.2 A description of material beneath the layer tested,

10.2.3 Total and dry density of the layer tested,

10.2.4 Initial moisture content of the layer tested,

10.2.5 Initial degree of saturation,

10.2.6 Moisture contents of samples taken after termination of test,

10.2.7 Estimate of the depth to the saturation front.

11. Precision and Bias

11.1 *Precision*—Due to the nature of the soil or rock materials tested by this test method, it is either not feasible or too costly at this time to produce multiple specimens which have uniform physical properties. Any variation observed in the data is just as likely to be due to specimen variation as to operator or laboratory testing variation. Subcommittee

Page __ of __

DATA FORM FOR SDRI TEST

Project: ______

Inner ring info: ______

Outer ring info: ______

Liner thickness (m): ______

$I = \frac{Q}{A\,t} \times 10^{-6}$

I = infiltration (m/sec)

Q = quantity of flow (mL)

t = interval of time (sec)

A = area of inner ring (m2) ______

Date (on / off)	Initial time (sec)	Final Time (sec)	t Interval of Time (sec)	Initial Wt. of Bag (grams)	Final Wt. of Bag (grams)	Q Quan. of Flow (mL)	I Infiltration (m/sec)	Temp (C) (on / off)	Water Depth (m) (on / off)

NOTES:

FIG. 4 Data Sheet For Infiltration Test Using A Double-Ring Infiltrometer With A Sealed Inner Ring

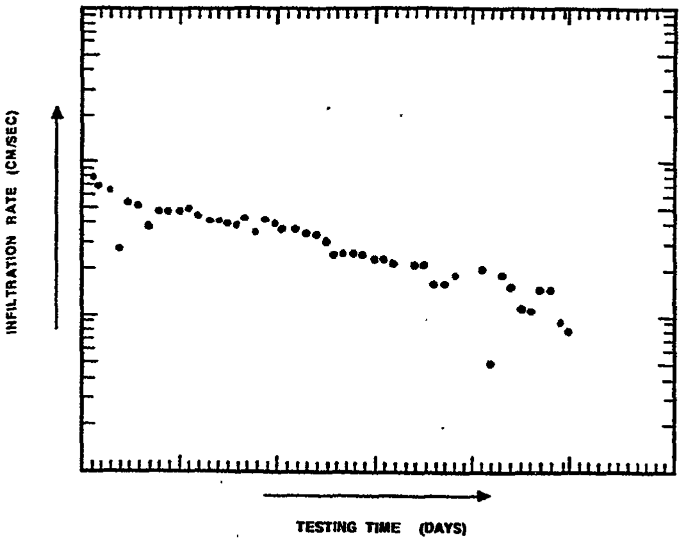


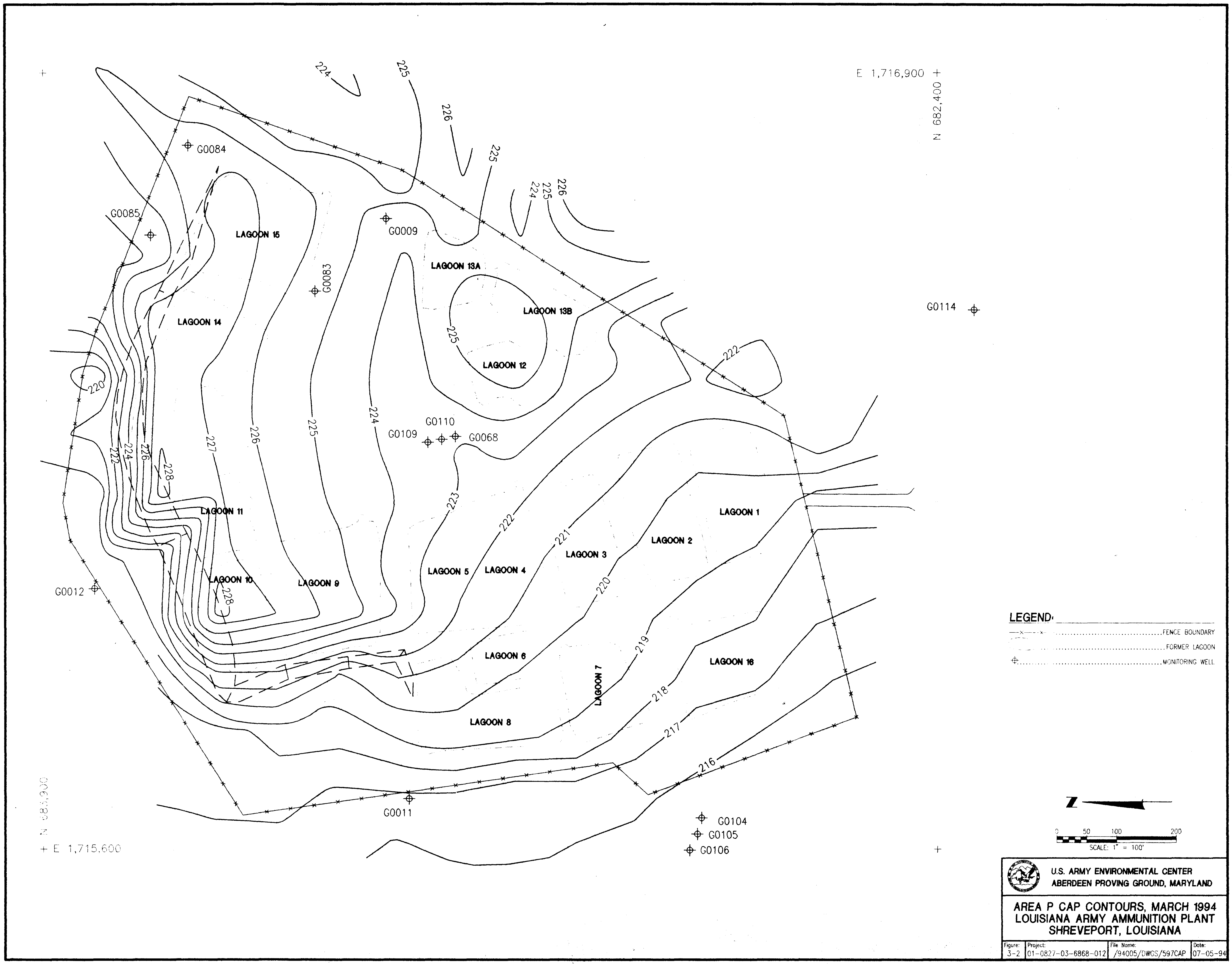
FIG. 5 Infiltration Rate Versus Time On A Semi-log Plot

D18.04 welcomes proposals that would allow for development of a valid precision statement.

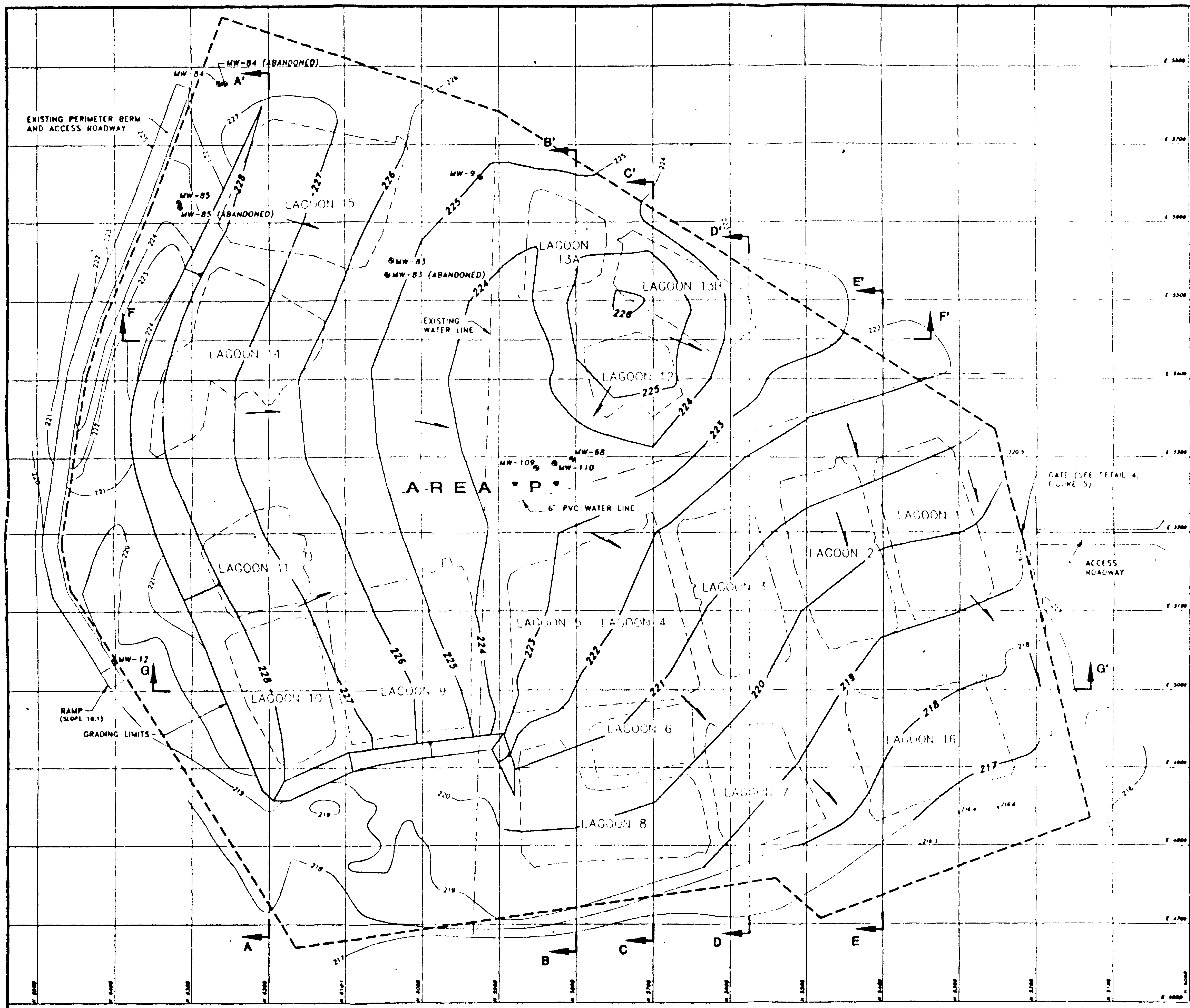
11.2 *Bias*—There is no accepted reference value for this test method, therefore, bias cannot be determined.

12. Keywords

12.1 double ring infiltration; in-place infiltration; soil moisture infiltrometer


E 1,716,900
N 682,400
LAGOON 15
LAGOON 14
LAGOON 13A
LAGOON 13B
LAGOON 12
LAGOON 11
LAGOON 10
LAGOON 9
LAGOON 5
LAGOON 4
LAGOON 3
LAGOON 2
LAGOON 1
LAGOON 6
LAGOON 7
LAGOON 8
LAGOON 16
G0084
G0085
G0009
G0083
G0114
G0109
G0110
G0068
G0012
G0011
G0104
G0105
G0106
N 683,900
E 1,715,600
LEGEND:
FENCE BOUNDARY
FORMER LAGOON
MONITORING WELL
SCALE: 1" = 100'
U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND
AREA P CAP CONTOURS, MARCH 1994
LOUISIANA ARMY AMMUNITION PLANT
SHREVEPORT, LOUISIANA
Figure: 3-2
Project: 01-0827-03-6868-012
File Name: /94005/DWGS/597CAP
Date: 07-05-94

166112



LEGEND

- COVER RUNOFF FLOW DIRECTION
- 220 — FINAL GRADING CONTOURS (TOP OF CAP) ELEVATION FEET ABOVE MEAN SEA LEVEL
- EXISTING MONITOR WELL LOCATION
- 220 — EXISTING CONTOUR
- APPROVED LAGOON EXCAVATION BOUNDARIES
- NEW FENCE BOUNDARY

NOTES

1. SEE FIGURE 2 FOR CROSS-SECTIONS A-A', B-B', C-C' AND D-D'.
2. SEE FIGURE 3 FOR CROSS-SECTIONS E-E', F-F' AND G-G'.

SCALE
0 60 120 FEET

NO	DATE	REVISIONS	BY	CHKD	DSGN ENGR	ENGR	PROJ ENGR	APPR

STARTING DATE 10-22-90 | INITIATOR / CHKD | DRAWN BST / CHKD | PROJECT ENGR

INTERNATIONAL TECHNOLOGY CORPORATION

LOUISIANA ARMY AMMUNITION PLANT

AS-BUILT CAP CONTOURS

FIG. NO.	JOB NO.	DRAWING NO.	REV.
1	306666	306666-E6	0

166113