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FINAL
REMEDIAL INVESTIGATION

RAYMARK -OU4- BALLFIELD SITE
STRATFORD, CONNECTICUT

RESPONSE ACTION CONTRACT (RAC), REGION I

For
U.S. Environmental Protection Agency

By
Tetra Tech NUS, Inc.

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Heather M. Ford
Project Manager

George D. Gardner, P.E.
Program Manager

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ACRONYMS AND ABBREVIATIONS USED IN THE REMEDIAL INVESTIGATION REORT

ARARs	Applicable or Relevant and Appropriate Requirements
AWQC	Ambient Water Quality Criteria
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
B&RE	Brown & Root Environmental
BSL	Below Screening Level
BTU	British Thermal Unit
°C	degree Celsius
CAA	Clean Air Act
CERCLA	The Comprehensive Environmental Response, Compensation, and Liability Act of 1980. Amended by SARA in 1986. Also called the Superfund Law.
cf	cubic foot
CFR	Code of Federal Regulations
CLP	(EPA) Contract Laboratory Program
cm	centimeter
COC	Contaminant of Concern
COPC	Contaminant of Potential Concern
CSF	Cancer Slope Factor
CT DEC	Connecticut Direct Exposure Criteria
CT DEP	Connecticut Department of Environmental Protection
CT PMC	Connecticut Pollutant Mobility Criteria
CTE	Central Tendency Exposure
CWA	Clean Water Act
CY	cubic yard
DABS	Dermal Absorption Factors
DAS	Delivery of Analytical Services
DDT	Dichloro diphenyl trichloroethane
dia	diameter
DNAPL	dense non-aqueous phase liquid
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
°F	degree Fahrenheit
FEMA	Federal Emergency Management Agency
FS	Feasibility Study
ft	foot
ft^2/day	square foot per day
ft^3/day	cubic foot per day
g	gram
GA/GAA	State of Connecticut Classification for drinking water sources
GB	State of Connecticut classification for non-drinking water sources
gpd	gallon per day
gpm	gallon per minute

GPR	Ground Penetrating Radar
GPS	Global Positioning System
GRA	General Response Actions
HBC	Housatonic Boat Club
HHRA	Human Health Risk Assessment
HI	Hazard Index
HNUS	Halliburton NUS Corporation
hr	hour
HQ	Hazard Quotient
IDW	Investigation-Derived Waste
IEUBK	EPA's Integrated Exposure Uptake and Biokinetic Model for lead exposure
ILCR	Incremental Lifetime Cancer Risk
in.	inch
K	Hydraulic conductivity
Kd	Adsorption coefficient
kg	kilogram
l	liter
lb	pound
LDR	land disposal restriction
m	meter
µ	micro (prefix)
µg/dL	micrograms per deciliter
µg/kg	microgram per kilogram
µg/l or µg/L	microgram per liter
MCL	Federal Safe Drinking Water Act maximum contaminant level. The primary MCL is health-based; the secondary is aesthetic-based.
MCLG	Federal Safe Drinking Water Act maximum contaminant level goal.
mg	milligram
mg/kg	milligram per kilogram
mg/l or mg/L	milligram per liter
mi	mile
ml	milliliter
MOA	Memorandum of Agreement
mph	miles per hour
MSL	mean sea level
NCP	National Oil and Hazardous Substances Contingency Plan
NESHAP	National Emission Standards for Hazardous Air Pollutants
NOAA	National Oceanic Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPW	Net Present Worth
O&M	Operations and Maintenance
OSHA	Occupational Safety and Health Administration
OSWER	(EPA's) Office of Solid Waste and Emergency Response
OU2	Operable Unit No. 2
OU3	Operable Unit No. 3

PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
POTW	Publicly-Owned Treatment Works
ppb	part per billion
PPE	personal protective equipment
ppm	part per million
PRG	Preliminary Remediation Goal
PRP	Potentially Responsible Party
psi	pound per square inch
PVC	polyvinyl chloride
QA/QC	Quality Control/Quality Assurance
RAC	Response Action Contract
RAO	Remedial Action Objective
Raymark Facility	Raymark Industries, Inc. Facility
RCRA	Resource Conservation and Recovery Act
Removal Action	Action taken by EPA to address immediate danger to public health and the environment
RfC	Reference Concentration
RfD	Reference Dose
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
ROD	(EPA's) Record of Decision. Documents the selection of a cost-effective Superfund remedy.
RSRs	State of Connecticut Remediation Standard Regulations
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act of 1986. Amended CERCLA. Also known as the Superfund law.
SB/SC	State of Connecticut Classification for Coastal and Marine Surface Water
SDWA	State Drinking Water Act
SPLP	Synthetic Precipitation Leaching Procedure
sf	square foot
SSL	Soil Screening Level
SVOC	Semivolatile Organic Compound
TAL	Target Analyte List
TBC	To Be Considered
TCDD	2,3,7,8 – tetrachlorodibenzo-p-dioxin
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TEF	Toxicity Equivalence Factor
TEQ	Toxicity Equivalency
TPH	Total Petroleum Hydrocarbons
TSDF	(RCRA) Treatment, Storage, and Disposal Facility
TtNUS	Tetra Tech NUS, Inc.
UCL	Upper Confidence Limit
USACE	U.S. Army Corps of Engineers

USCS	Unified Soils Classification System
USDOI	U.S. Department of the Interior
USGS	U.S. Geological Survey
VOC	Volatile Organic Compound
Weston	Roy F. Weston, Inc.

1.0 INTRODUCTION

This Remedial Investigation (RI) Report defines the nature and extent of contamination at the Raymark Ballfield site (the Study Area) resulting from past disposal practices at the Raymark Industries, Inc. Facility (Raymark Facility), located in Stratford, Fairfield County, Connecticut (Figure 1-1). This report was prepared by Tetra Tech NUS, Inc. (TtNUS) for the U.S. Environmental Protection Agency (EPA) under RAC Work Assignment No. 030-RICO-01H3, Contract No. 68-W6-0045, to partially fulfill the requirements for Operable Unit No. 4 (OU4), Raymark - Ballfield.

As requested by EPA, this report incorporates information collected by another EPA contractor in 1992 and 1993 with data collected under this work assignment. Information collected by the Connecticut Department of Environmental Protection (CT DEP) will be used qualitatively only. This RI Report was developed based on the approved Draft Final Work Plan dated February 1999. Additional efforts to evaluate groundwater contamination beneath and downgradient of the ballfield property are currently being conducted by TtNUS under Raymark-Operable Unit No. 2 (OU2 groundwater), RAC Work Assignment No. 029-RICO-01H3.

This RI Report was prepared in accordance with the *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, 1988). It is consistent with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986; and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This RI maintains consistency with the State of Connecticut's applicable and relevant environmental laws and regulations.

1.1 Purpose of Report

This RI Report documents the nature and extent of contamination, and associated public health and environmental risks within the ballfield property (see Figure 1-2 for identification of the Study Area). The overall objectives of the RI are to:

- Compile and evaluate all available data needed to characterize the Study Area conditions and to determine the nature and extent of contamination in the soil impacted by waste from the Raymark Facility.

- Assess the risks to human health and the environment within the soil of the Study Area.

- Serve as the data resource for developing, screening, and evaluating a range of potential alternative remedial actions that address the contamination within the Study Area. The RI supports the remedial alternatives screening and the Feasibility Study (FS).

1.2 Report Organization

This RI Report is comprised of one volume that presents the text and discussion of investigation activities, results, interpretations, and references. The tables, figures (including oversize figures), and the appendices are presented as separate tab sections at the end of the document. Appendix A inc'udes t'e resu'ts of the geophysica' survey; Appendix B contains the boring, test pit, and well construction logs; Appendix C contains the analytical data used to produce this RI report; Appendix D contains the backup tables and calculations for the Human Health Risk Assessment; Appendix E contains a series of historical aerial photographs.

This RI Report is organized as follows:

- Section 1.0, Introduction, discusses the purpose and scope of the RI, summarizes the background and history, and describes the Study Area.

- Section 2.0, Study Area Investigations, presents a summary of the previous field investigation activities conducted in the Study Area.

- Section 3.0, Physical Characteristics of the Study Area, presents descriptions of surface features and land uses, geology, hydrogeology, surface water hydrology, and meteorology.

- Section 4.0, Nature and Extent of Contamination, discusses the potential sources, contaminant presence, and contaminant distribution in soils in the Study Area.

- Section 5.0, Contaminant Fate and Transport, presents an interpretation of potential contaminant migration pathways and transport mechanisms.

- Section 6.0, Baseline Human Health Risk Assessment, includes identification of human receptors and exposure pathways, selection of contaminants of concern (COCs), discussion of the human health effects associated with the COCs, and results of the human health risk evaluation.

- Section 7.0, Ecological Evaluation, presents a summary of the environmental setting and identifies areas of potential ecological concern.

- Section 8.0, Summary and Conclusions, details the summary of Section 4.0, 5.0, 6.0, and 7.0 and the conclusions reached about the contaminated areas.

1.3 Raymark Facility Background

This section summarizes the history of the Raymark Facility, summarizes the past operations at the Raymark Facility, summarizes the Raymark Facility environmental permits, describes the Study Area, and identifies other ongoing activities associated with the Raymark Facility and its environs.

1.3.1 History of Raymark Facility and Environs

The Raymark Facility, formerly named Raybestos - Manhattan Company, was located at 75 East Main Street in Stratford, Fairfield County, Connecticut at latitude 41°12'02.5"N and longitude 73°07'14.0"W (see Figure 1-2). The Raymark Facility operated from 1919 until 1989, when the plant was shut down and permanently closed. The Raymark Facility produced and manufactured parts mainly for the automotive industry. The manufacturing of these products generated waste. The facility was demolished and a cap was placed over the contaminated areas on the property in 1996 and 1997. The facility occupied 33.4 acres (based on Stratford tax map information), and manufactured friction materials containing asbestos and non-asbestos components, metals, phenol-formaldehyde resins, and various adhesives. Primary products were gasket material; sheet packing; and friction materials including clutch facings, transmission plates, and brake linings. As a result of these activities, soils at the facility became contaminated primarily with asbestos, lead, and polychlorinated biphenyl compounds (PCBs).

Between 1919 and 1984, low-lying portions of the Raymark Facility were filled with manufacturing waste materials from various plant operations. The filling of those areas occurred over the life of the facility operations, and progressed essentially from north to south, across the Raymark Facility. New buildings and parking areas were constructed over these filled areas as the manufacturing facility expanded.

The Raymark Facility was underlain by an extensive drainage system network. This network collected water and wastes from the manufacturing operations and diverted it into

the facility drainage system. The system also collected stormwater runoff. These liquids were transported through the drainage system network, mixed with lagoon wastewaters, and discharged to Ferry Creek.

During peak operations at the Raymark Facility, approximately two million gallons of water were used for plant processes each day. Municipal water was used for both contact and non-contact cooling water. To supplement this source, Raymark installed an additional on-site supply well. The well, located in the northern corner of the facility, was used for non-contact cooling water. Facility water was recirculated, with some percentage reinjected into the on-site well; the remaining water and municipal water were discharged through the facility drainage system. Wastewater from facility operations was collected and discharged to a series of four settling lagoons located in the southwestern corner of the facility, and along the southern property boundary near Longbrook Avenue and the Barnum Avenue Cutoff. The wastewater consisted of wastewater from the acid treatment plant, wet dust collection, and paper making processes; non-contact cooling water; and solvent recovery plant operations. The lagoons also received stormwater drainage and surface water runoff.

Solids were allowed to settle in Lagoon Nos. 1, 2, and 3 prior to discharge of clarified wastewater and unsettled solids to Lagoon No. 4, that in turn discharged directly into Ferry Creek. Discharge of wastewater to Lagoon Nos. 1, 2, and 3 ceased in 1984. These lagoons were closed in December 1992 and January 1993. During the fall of 1994, stormwater drainage that exited the Raymark Facility through Lagoon No. 4 was diverted around this lagoon and connected directly to the storm drain, which ultimately discharges to Ferry Creek. Lagoon No. 4 was closed in early 1995.

During the operation of the lagoons, the settled material in the lagoons was periodically removed by dredging. During the facility's 70 years of operation, it was common practice to dispose of both this dredged lagoon waste and other manufacturing waste as "fill" material (referred to as "Raymark-type waste" in this RI) both at the Raymark Facility and

at various locations in Stratford. The ballfield Study Area is one of the locations that received Raymark-type waste.

A number of these off-the-facility "locations," with levels of asbestos, lead, and PCBs that posed a potential threat to public health, were remediated under EPA CERCLA time-critical removal actions during 1993 to 1996. The remediated locations are residential properties that were designated a health threat and excavated under EPA direction to abate the public health threat that may have existed. The excavated material from these residential locations was stored and ultimately placed under the cap at the Raymark Facility. Waste from one municipal property, Wooster Middle School, was also excavated, stored and ultimately placed under the cap at the Raymark Facility.

1.3.2 Raymark Facility Operating History

The following narrative presents a summary of plant operations and waste handling practices for Raymark's manufacturing operations; see OU1 RI (HNUS, 1995) for further details.

1.3.2.1 Phenolic Resin Manufacturing

Solid and liquid phenolic resin was manufactured at the Raymark Facility. The resin was produced in five or six pressure vessels; companion tanks held the raw product. After production, the liquid resins were transferred to the plant floor to be used to manufacture plant goods or to set in order to be used in solid form. Prior to use, the solid resins were pulverized on site to meet product specifications, and then transferred to the plant floor for use.

1.3.2.2 Brake Lining Production

Brake lining production began by adding dry asbestos materials, liquid phenolic resins, and solvents (to thin the resins) to the mixers located on the plant floor. The mixers operated

for approximately one hour until the liquid resin had penetrated and coated all the dry materials. This mixture, resembling a soft heavy mud, was formed into brake lining parts that were then baked in ovens for 6 hours. The end product was a hard material that was machined to specification. As necessary, materials that were trimmed and ground during the machining operations and not used in the finished product were disposed of on or off site as fill/soil-waste material; after 1984, these process wastes were shipped off site in containers.

During the machining operations, waste particulates were collected in a wet-type dust collection system. Particulates collected from the system were mixed with process water and pumped to the on-site lagoons as a 90/10 water/dust slurry mixture. The slurry mixture settled out in the lagoons and eventually filled them. When a lagoon was filled, the slurry mixture would be diverted to another lagoon, to allow time (several months) to dewater. The dewatered material in the lagoon was excavated and disposed of either on site or off site. After 1984, the waste particulates were collected in dry dust collectors and disposed of off site in 1-cubic yard bags.

1.3.2.3 Standard Transmission Clutch Plates

The process of producing clutch plates began by creating a mixture of asbestos, other components, and water and forming a paper-like sheet of material. This sheet was rolled onto a machine roller, saturated with phenolic resin, and then oven dried and cured. The clutch plates were machined to specifications from these sheets and the finished clutch plate was bonded to a steel core. As in the brake lining production, the manufacturing process produced machining particulates that were collected in the dust collection system, mixed into a wet slurry, and pumped to the lagoons to settle. This system was replaced in 1984 by the dry dust collectors.

In the early 1980s, the process was modified to allow water to be reused and captured into the manufacturing process, resulting in no discharge of water. In addition, the dry

asbestos used in the original manufacturing of the paper-like material was replaced with a cotton-type material, so the product became asbestos-free.

The Raymark Facility molded (raw) steel into a steel core onto which the clutch plate was mounted. After molding, the steel core was degreased, etched to specification, coated with a phenolic resin, and allowed to dry. The clutch plate was then mounted to the steel core.

A specialty heavy-duty clutch was also manufactured on the Raymark Facility. The process of mixing the asbestos, resins, and water to produce heavy-duty clutches was similar to that used to produce the standard transmission clutch plates.

1.3.2.4 Gasket Material Manufacturing

Gasket material was produced in large rubber sheets. The rubber was composed of naphtha, toluene, asbestos, phenolic resins, and various fillers. The process began by mixing asbestos, latex, rubber cement, and rubber together until the mix was homogeneous. The mix was then loaded onto a roller machine, where it was flattened into a sheet. The sheet was removed and laid out on a large table for cutting. The gaskets were then cut to specification.

The trim from cutting was pulverized and re-used in the process. Vapors were collected and passed through the activated carbon solvent recovery plant. Prior to the mid-1980s, no vapor collection/treatment occurred.

1.3.2.5 Disc Brake Pad Manufacturing Operations

Asbestos, glass, and semi-metallic disc brakes were manufactured at the Raymark Facility. Asbestos disc brakes were composed of asbestos, phenolic resin, and fillers; glass disc brakes, of fiberglass, phenolic resin, and fillers; and semi-metallic disc brakes, of steel wool, phenolic resin, and fillers. The operations to process these disc brake pads involved

mixing components in plant mixers until a homogenous mixture was coated completely with phenolic saturate, pouring the mixture into electronically heated molds to form a hard part, and machining this part into the specified product size.

Waste generated from the machining process was collected in the dust collector system, and transported as described above, as a water/waste slurry mixture, to the on-site lagoons. After 1984, dry dust collectors collected the particulate matter and the material was disposed of off site in 1-cubic yard bags. The trim and off-specification material, if not pulverized for reuse, was disposed of as fill.

1.3.2.6 Miscellaneous Activities

The following activities also occurred on the Raymark Facility:

- Coal-fired Steam Generation - The Raymark Facility generated steam from August 1919 until the early 1940s. Steam was generated from coal-fired steam boilers. The coal was delivered by rail directly onto the facility by a railroad spur that has since been removed. The coal was stored in the area surrounding the boiler house and heavy equipment moved it around the plant. No figures are available on the quantities of coal used.

- Steam boilers - The steam boilers were converted to oil in the early 1940s. Number 6 fuel oil was stored in two 50,000 gallon tanks. No figures are available on quantities of oil used.

- Material storage - Numerous tanks, located throughout the plant, stored raw product, manufactured goods not yet turned into a product, and waste products remaining from the various manufacturing processes.

- Dry trim reclamation - The materials that were trimmed from the baked products (dry trim) were stored outside under a roof on the asphalt pavement. The trim

re-use process consisted of using hammer mills to pulverize the waste trim. As dry trim re-use occurred more frequently during later years of facility operations, particulates from this process were collected in a separate dry dust collector system and bagged for disposal.

- Finished products - These materials were stored on site pending off-site shipment to customers.

1.3.3 Environmental Permits

The Raymark Facility was subject to the requirements of both state and federal permits.

1.3.3.1 RCRA Activities

Raymark filed a Notification of Hazardous Waste Activity form on August 15, 1980, under the name of Raybestos Friction Materials Company. The activities delineated on this form indicated that the company generated, treated, stored, and disposed of hazardous wastes such as chlorinated solvents, acetone, formaldehyde, toluene, sludge from lime treatment generated from steel finishing operations, asbestos, acids, phenols, methyl ethyl ketone, and ignitable, corrosive, and toxic wastes.

On November 12, 1980, the notification was expanded to include the activities and quantities listed below for each waste activity. However, the quantities listed below were the total permitted quantities and not the actual quantities or units reportedly used at Raymark.

- The Raymark Facility was permitted to process more than 2.5 billion gallons of lead-contaminated waste liquid each year in the on-site lagoons. It is estimated that 6 million gallons of the 2.5 billion gallons were treated each year.

- The Raymark Facility container storage area was permitted to handle approximately 23 million gallons of toxic, ignitable, corrosive, and acidic wastes each year.

- The Raymark Facility tank storage area was permitted to handle approximately 10 million gallons of waste yearly.

- The Raymark Facility incinerator was permitted to process approximately 240,000 gallons per year of toxic and ignitable wastes.

In 1986, Raymark filed a permit application for the various Raymark Facility activities under the name of Raymark Industries, Inc. At that time, the original RCRA Part A notification was re-filed and the on-site activities and waste generated were significantly reduced. The activities described in that submittal included 7,040 gallons of liquid container waste, 150 cubic yards of solid container waste stored on the property, and an approximately 7-acre landfill on the property. The "landfill" was comprised of the lagoons previously located along the southern boundary of the Raymark Facility. Each of these activities appeared to include the handling of ignitable, toxic, corrosive, and toluene-contaminated wastes.

The facility closed in September 1989. In 1990, pursuant to a RCRA 3007 information request, Raymark indicated it still had significant quantities of waste and unused products remaining on site. Some of these waste products were 400,000 gallons of an asbestos slurry in tanks and 1,700 cubic yards of unfinished asbestos product. These wastes were removed from the Raymark Facility between 1990 - 1994.

In 1992, EPA issued Raymark a CERCLA 106 Removal Order and work plan designed to abate the danger or threat to public health and welfare, and the environment posed by four open lagoons containing asbestos, metals, solvents, and PCBs; a hazardous waste pile; buildings and land containing hazardous substances; and large tanks of questionable integrity containing asbestos and hazardous substances; and to eliminate the potential for hazardous substances to migrate off site.

Three of the open lagoons were temporarily closed in December 1992 and January 1993 under the EPA order. The fourth lagoon was temporarily closed in 1994. In 1993, on-site storm water was rerouted around Lagoon No. 4 so the storm water no longer discharged into Lagoon No. 4. The facility cleanup/remediation was conducted under the CERCLA program, and the on-site sources (lagoons, tanks, incinerator) have been removed and/or remediated as part of the long-term solution.

1.3.3.2 Wastewater Activities

The Raymark Facility had a 2.5 million gallon per day water and wastewater discharge flow from the plant operations into the lagoons for discharge into Ferry Creek. This discharge was permitted under the State of Connecticut National Pollution Discharge Elimination System (NPDES) program from the early 1970s until the early 1990s, with volumes decreasing as plant activities were reduced. The activities permitted included: acid treatment plant wastewater, dust collection system wastewater, noncontact cooling water, and solvent recovery plant wastewater. A separate permit was issued for an extraction well, which was installed on site to remove groundwater contaminated with toluene from the aquifer and discharge it to the sanitary sewer. The toluene contamination was the result of a spill that occurred on site in 1984.

1.4 Study Area Description and Setting

The Study Area, which is located north of the former Raymark Facility, encompasses a total area of 13.5 acres and includes the 3-acre Raybestos Memorial Ballfield, an 8.5-acre vacant field, and a 2-acre densely wooded area. Residential properties border the north/northwest side of the Study Area along Clinton Avenue. Town, commercial, and industrial properties are located along Frog Pond Lane to the Northeast. Railroad tracks and the former Raymark Facility border the Study Area to the east/southeast. An inactive industrial property abuts the Study Area to the south/southwest.

The Study Area boundary line seen on each figure defines the horizontal limits of the data points used for this RI. The boundary line mimics the security fence line surrounding the OU4 property that was installed as part of an interim remedial effort performed by the EPA in 1992. There are two areas where the Study Area boundary line extends beyond the perimeter fencing and covers portions of the abutting property. One of these locations is situated along the southern border abutting the Contract Plating Property, indicated on Figure 1-2, where two test pits were extended into the neighboring property to attempt to locate the horizontal extent of fill. The second area where the Study Area boundary line exceeds the perimeter fencing is along the eastern border parallel to the railroad tracks where Roy F. Weston collected surficial soils samples for the EPA in 1992 and 1993.

The information in this section is based on data from previous site investigations, removal action reports, and aerial photographs taken in 1940, 1949, 1960, 1971, and 1990. The aerial photographs from 1940, 1949, 1960, 1971, and the most recent 1999 photograph is included in Appendix E.

Aerial photographs indicate that the Raybestos Memorial Field was built between 1940 and 1949. The ballfield area was used as a softball field for the Raybestos women's softball team from the 1940s until the 1980s. The Study Area still contains the bleachers, fencing, lighting, parking area, and playing field outline that was used during team play.

The vacant area outside the ballfield was used as a source of sand and gravel in the 1940s. A large pond (Frog Pond) is visible in the 1940 photograph and is located in the southern portion of the field. Apparent pond filling occurred in the years that followed, since the pond appears to significantly diminish in size through the 1949 and 1960 aerial photographs. Frog Pond appears to have been almost completely filled by the 1971 photograph and does not appear to be present in the 1990 aerial photograph.

Evaluation of test borings and analytical data indicates that the pond was filled with Raymark-type waste materials. It is unclear whether Frog Pond was formed as a result of excavation activities associated with the sand and gravel operations mentioned above. A

peat layer approximately 2.5 feet thick was encountered in the area of the pond during test borings. This peat could be indicative of the pond's existence prior to excavation activities. The pond was likely formed in association with regional deglaciation. It appears the historical pond (1940s) outlet drained south toward the railroad tracks and eventually discharged to Long Brook or Ferry Creek.

A review of previous consultants' evaluations of the ballfield area indicates that prior to development as a ballfield, the site was used as a gravel pit operation for an unknown period of time and was then used to dispose of brake linings and associated industrial waste. The former Raymark Industries Inc. company disposed of an unknown quantity of wastes containing asbestos and non-asbestos material, metals, pheno-formaldehyde resins, and various adhesives on this Study Area. Between 1940 and 1949, the site was graded and the northern corner of the property was developed as a softball field (ES&E, Inc., July 1991).

The southern and western portions of the Study Area were used by the Town of Stratford as a dumping and temporary storage area for asphalt, road salt, brush and leaves, dirt, and trash. Because of the easy access to the site, the public also used this area as a dump. Jugs of dumped waste oil were noted near the piles of brush and leaves. Additionally, Metro North Railroad tracks located near the dumping area are noted as a potential source of creosote. Creosote and similar substances may have been used as a preservative for the railroad ties (EAI, Inc., July 1990).

In the 1970s, Raymark Industries, Inc. performed two cleanup activities to place a 2-foot soil cover over identified areas of surficial asbestos contamination. The Study Area was purchased by the Daley Development Corporation (Daley) of Stratford, Connecticut, in 1986.

In 1989, EPA conducted a preliminary assessment of the Study Area. In 1990, EPA issued an Administrative Order for Removal Action to the Daley Development Corporation. In 1992, as a result of Daley's failure to implement the removal action, EPA assumed

responsibility for site actions. The removal action implemented by EPA included installing a site security fence, clearing vegetation that would interfere with cap/cover placement, grading and capping areas of the site with clean soil (6 inch minimum cover), and sampling and removing on-site drums. Soil sampling profiles collected after completion of the cover indicate the soil cover ranges in thickness from approximately 6 to 11 inches (EPA, 1992). Other site investigations were performed during the period from 1988 through 1992 (soil borings, soil sampling, test pits); however, these activities appear to have had little impact on site habitat or topographic features.

1.5 Community Description

The principal industries within the Stratford community include manufacturing of aircraft, air conditioning, chemicals, plastic, paper, rubber goods, electrical and machine parts, and toys. The Stratford Town Clerk reported the latest (1997) estimate for the population of the Town of Stratford as 47,230 people within the 19.9 square miles (12,736 acres) of the town. This is a decrease from the last census in 1990 when the population was listed as 49,389.

1.6 Other Activities Associated with Raymark

Activities undertaken in the vicinity of the Study Area that are related to the investigations conducted to support this RI include:

- Raymark Facility Closure - The property has been capped by EPA under the U.S. Army Corps of Engineers Total Environmental Restoration Contract (TERC). A soil vapor extraction system is in place to capture the bulk of the toluene remaining under the cap, and a dense non-aqueous phase liquid (DNAPL) extraction system is removing separate phase NAPL (predominantly 1,1,1-trichloroethane [1,1,1-TCA]), which is collected in the sump portion of the wells. Operation and maintenance activities are being conducted by the CT DEP. The effects of the pump and treat system on groundwater quality are unknown at this time.

- Groundwater Remedial Investigation Activities - TtNUS is undertaking an RI for Raymark – OU2 to evaluate groundwater contamination under and downgradient of the former Raymark Facility. The OU2 RI is being conducted concurrently with this OU4 RI work assignment. A Technical Memorandum for OU2 presenting preliminary results of the 1997 field efforts was submitted to EPA in May 1998.

A substantial number of field investigations relating to soil, sediment, surface water, and groundwater have been conducted at the Raymark Facility and its environs. A list of the major activities conducted to date was provided on Table 1-1 in the Ferry Creek – OU3, Area I RI (TtNUS, 1999).

2.0 STUDY AREA INVESTIGATIONS

This section describes investigations performed to characterize the impacts on the Study Area resulting from past disposal of waste materials. A figure showing current Study Area conditions is presented as Figure 1-2.

Investigations performed at the Raymark Facility are summarized in the Final Remedial Investigation Report, (HNUS, 1995). Evaluation of groundwater contamination beneath and migrating downgradient of the Study Area, the Raymark Facility and surrounding properties is currently being summarized in a Remedial Investigation/Feasibility Study Report under Raymark – Operable Unit No. 2 groundwater, RAC W. A. No. 029-RICO-01H3. Investigation of properties potentially impacted by Raymark Facility wastes have been conducted since 1992. This information is detailed in chronological order in the Draft Ferry Creek – OU3, Area I Remedial Investigation (TtNUS, 1999). Development of RI Reports for commercial and industrial properties located around the Raymark Facility are being conducted under separate work assignments (W.A. 35 and W.A. 42). These RIs and the groundwater RI are planned to be available for public review during 1999.

2.1 Previous Investigations

The EPA, CT DEP, and the current property owner, Daley Development, have conducted investigations at the Study Area. The EPA Emergency Planning and Response Branch conducted the first investigation in 1989. In 1990, Environmental Assurance, Inc. conducted a follow-up investigation on behalf of the property owner, Daley Development. In 1991, the EPA and CT DEP conducted an additional investigation documented in a report titled, Supplementary Site Assessment at Raybestos Memorial Field, (Environmental Science and Engineering, Inc., 1991). The analytical results from these studies are not included in this RI Report because sample locations could not be verified and data were not validated. On behalf of EPA, Weston prepared a report titled, After Action Report for the Raybestos Memorial Field Site Stratford, Connecticut, dated 1992. It documents actions taken by the EPA, Emergency Planning and Response Branch to mitigate the threat to public health resulting from actual or potential exposure to nearby human populations.

The actions taken at the site included installing a fence and placing a minimum 6-inch vegetative cover. In 1993, EPA conducted soil sampling at many areas in Stratford including the Raybestos Memorial Ball Field (Weston, 1994). These data were used to supplement the data gathered during this RI Investigation. See Figure 2-1 for the location of all samples used in this RI. Since completion of the older investigations, the site has been graded and covered with a temporary soil cap to limit potential exposure to the site contaminants.

2.2 Study Area Investigation Activities and Methods

This section describes the most recent activities conducted by TtNUS for this Remedial Investigation. The investigation activities performed at the Study Area include a geophysical survey, geologic investigation, hydrogeologic investigation, monitoring well installation, groundwater level monitoring, groundwater sampling, and topographic survey. A brief discussion of the objective and rationale for each activity is presented. See Figure 2-1 for these field investigation locations.

2.2.1 Geophysical Survey

A geophysical survey using electromagnetic (EM) and ground penetrating radar (GPR) was performed by Hager Richter Geoscience as a subcontractor to TtNUS. The purpose of the survey was to determine the presence, location, and character of wastes disposed as fill, including the location of potential buried vessels and subsurface utilities. This information was used to select soil boring locations and to develop estimates of the fill thickness in the Study Area. Thickness of fill in the Study Area is discussed in Section 3.2.

The geophysical surveys were conducted in a phased approach. The first phase was a 1-day field test to determine whether the EM and GPR were able to meet the investigation objective of identifying the thickness of the waste. This first phase was also used to evaluate optimum transmitter frequency and evaluate line spacing and other survey parameters. The second phase consisted of the full survey of the Study Area using the EM and GPR techniques.

A review of previous investigations and aerial photographs was conducted to select a location for the 1-day field test. This review involved estimating the location of the historic Frog Pond and the areas of thicker fill. Results of the geophysical survey are provided in Appendix A.

2.2.2 Geologic Investigation

The geologic investigation consisted of advancing soil borings and excavating test pits throughout the Study Area. Soil and bedrock samples from these explorations were used to provide data on the type, thickness, and lateral extent of the fill and geologic materials at the property.

The geologic investigation activities included advancing 14 soil borings, (SB-421 – SB-430, and MW-401S, MW-401B, MW-402S, and MW402B), installing two monitoring well clusters (MW-401 and 402) consisting of both an overburden and bedrock well, and excavating 22 test pits. The boring procedures are fully described in the Technical Specification Drilling Services presented in the Sampling and Analysis Plan (TtNUS, 1998). Locations are indicated on Figure 2-1. The 14 soil borings were used to supplement data concerning the nature and extent of the fill materials gathered from the test pit excavations. The borings also add vertical definition of the overall geologic conditions found at the Study Area. Ten of the 14 borings (SB-401B, SB-402B, SB-421 through SB-427, and SB-429) were advanced to the top of the bedrock surface and cored into the bedrock to confirm bedrock presence and provide data on the nature and depth to bedrock. The locations of SB-424, 425, 426, and 427 were selected based on the geophysical surveys, which identified areas of potentially thicker waste/fill. SB-428 and SB-430 were only advanced to 16 feet below ground surface (bgs) to fill gaps in test pit data concerning the extent of fill. These two locations were not used to define bedrock topography. The locations of SB-429 and SB-422 were selected to confirm the nature and depth of bedrock in the vicinity of Test Pits 20 and 22 where bedrock was encountered at a shallow depth.

Continuous soil samples were collected through the waste material using 3-inch outside diameter, 2-foot long split-barrel samplers. Soil samples were collected by driving the split-barrel sampler into the subsurface ahead of the drilling casing, using a procedure similar to that described in ASTM D-1586-84, Split-Barrel Sampling, except for use of a 3-inch outside diameter split-barrel and a 300-pound hammer with an 18-inch fall.

Beneath the waste materials, soil samples were collected at 5-foot intervals using a 2-inch outside diameter split-barrel sampler. The soil sampler was advanced as described in ASTM D-1586-84, Split-Barrel Sampling. Completed borings logs are presented in Appendix B.

Soil samples collected for laboratory analysis are biased toward higher concentrations because their selection was based on the highest photoionization detector (PID) and flame ionization detector (FID) readings detected in each borehole. Samples were collected from both waste and natural materials. Details of the soil sampling procedure are presented in the SAP.

Eighty-one soil samples were collected from the ballfield borings for off-site analysis for the presence of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls (PCBs), and metals. The VOC samples were preserved immediately after collection and were analyzed using the low concentration procedure. Details of the soil VOC sampling and preservation methods are presented in the SAP. Sixty-four samples were analyzed for asbestos at an off-site laboratory.

Six soil samples (including one duplicate) were collected for grain size analysis. The samples collected were selected to complement other grain size soil sampling tasks that were being performed under the OU2 groundwater investigation. The samples were selected to provide grain size data for both coarse and fine-grained soils that were encountered in both the OU4 and OU2 Study Areas.

Five soil samples (including one duplicate) were collected for analysis of total organic carbon (TOC). The samples were selected to complement both the OU4 and OU2 groundwater Study Area investigations.

Bedrock borings were advanced through the overburden material as described above. Bedrock was cored at each soil boring and monitoring well cluster location.

The depth of bedrock coring was determined after a review of the recovered bedrock core and the objectives of the boring. One of the objectives of the soil borings was to confirm the top of bedrock. Typically coring was completed to a depth of 5-feet below the top of the bedrock at soil boring locations. The actual depth of bedrock coring was determined in the field by the project geologist after a review of the recovered rock core.

The objective of installing the bedrock monitoring wells was to provide a location capable of responding to seasonal changes in groundwater elevation and to sample groundwater from the bedrock aquifer. The actual depth of bedrock coring was determined in the field by the project geologist after a review of the recovered rock core and observations of water loss during the drilling process. If the packer tests results indicated that the bedrock would not produce water at an acceptable rate, the bedrock boring was advanced deeper.

Twenty-two test pits were excavated at the Study Area. These test pits were located along the perimeter of the Study Area, along the outfield fence, and in the outfield area to provide data to estimate the extent of the fill and waste materials. In addition, these test pits provided information on the thickness and type of waste materials at the property.

2.2.3 Hydrogeologic Investigation

A complete hydrogeologic investigation of the Study Area is not part of the scope of this RI. However, a limited discussion of the groundwater conditions observed during the OU4 RI investigation is presented. This discussion is intended to provide a more complete picture of Study Area conditions. The extent of the hydrogeologic discussion will include

a water table map and an estimate of the volume of waste materials that are located below the water table (see Section 3.3).

2.2.4 Monitoring Well Installation

Monitoring well clusters were installed at two locations on the Study Area. Each cluster consists of one water-table overburden well and one bedrock well. All wells were constructed using schedule 40 PVC and were completed with a locking protective steel casing. Details of the well installations were recorded on monitoring well installation forms and are presented in Appendix B. The monitoring wells were constructed to supply data on groundwater elevations, hydraulic conductivity, vertical gradients, and groundwater quality that could be used for both the OU4 and OU2 RIs. These data will be used to determine if this area represents a groundwater recharge area and determine the groundwater quality. Data from these wells and other wells installed as part of the OU2 groundwater investigation and the OU1 Post Closure monitoring will be used to construct a water table map for the Ballfield Site. The water table elevation data from these wells supports an evaluation of remedial options.

The monitoring wells were developed after installation to remove fine particles and sediments from around the well screens, and to remove drill cuttings and residual drilling fluids from the monitored interval. The field geologist/engineer recorded observations such as turbidity and specific conductivity on a well development log. The well development logs are presented in Appendix B.

The hydraulic conductivity of both the overburden and bedrock aquifers was measured during this site investigation. The field methods used included a constant head discharge test method and packer testing for the overburden and bedrock, respectively.

2.2.5 Groundwater Level Monitoring

A round of groundwater levels was conducted throughout the entire OU2 Study Area including the ballfield during an approximate 4-hour period on March 24, 1999. The

depths to groundwater and other pertinent observations were recorded on groundwater monitoring log sheets. These data were used to construct the water table contour figure (see Section 3.3).

2.2.6 Groundwater Sampling

The monitoring wells were purged and sampled using the low stress (Low Flow) methodology. Groundwater samples were labeled and packed as described in the SAP and shipped for off-site laboratory for analysis. Detailed field sampling procedures are presented in Section 2.0 of the Sampling and Analysis Plan, TtNUS, 1999.

Groundwater samples were collected and sent to an off-site laboratory for analysis of Target Compound List (TCL) VOCs, SVOCs, pesticides/PCBs (including Aroclors 1262 and 1268), Target Analyte List (TAL) metals, sulfate, chloride, total alkalinity, and nitrate/nitrite. In addition, samples from all wells were analyzed for natural attenuation parameters including carbon dioxide, ferrous iron, nitrite, sulfide, methane, ethane, and ethene.

2.2.7 Topographic Survey

A Connecticut-licensed surveyor was contracted to determine the coordinates and elevation of each monitoring well, soil boring, geophysical survey point, and test pit. In addition, a topographic survey of the Study Area was conducted. The topographic survey included locating physical features such as buildings, bleachers, fences, and other pertinent features. The elevation datum of the survey is the U.S. Geological Survey (NGVD 1929).

3.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA

This section summarizes regional and Study Area physical characteristics. The Study Area features and land uses are described in Section 3.1. Discussions of related geology, hydrogeology, surface water hydrology, and meteorology are presented in Sections 3.2 through 3.5, respectively.

3.1 Study Area Features and Setting

The Study Area is part of the Housatonic River Basin, a tidally influenced system. The Study Area is bordered by private residences, commercial/industrial properties, roadways, and active railroad tracks (Figure 1-2). The Housatonic River is located approximately 2,000 feet to the east. A complete description of the Study Area and history is included in Section 1.4.

The majority of the Study Area is relatively level, with a steep topographic rise along the western extreme, and to a lesser degree to the north and south. The overall impression of the Study Area topography is an irregular shallow depression with a wide flat bottom. Bedrock outcrops are exposed at numerous locations along the steep rise at the western property boundary.

In addition to the monitoring wells, soil borings, and test pits located within the Study Area, five monitoring well locations were selected outside of the Study Area boundary. These locations were selected to better define the on-site bedrock topography and the water table (see Figure 2-1). Data from two monitoring well clusters (MW-308B&DB and MW-216B&BD) were used as upgradient/background locations for the OU4 Study Area. Data from three monitoring well clusters (MW-309S, D, and B; PC-06S, M, D, and B; and PC-10S, M, D and B) were selected for use as downgradient locations for the OU4 Study Area.

The Study Area is located outside of the 100-year floodplain, as observed from Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps for Stratford, Connecticut (FEMA, 1992). The 100-year frequency base flood elevation is 10.1 feet National Geodetic Vertical Datum (NGVD); the 10-year frequency flood elevation is 8.5 feet NGVD (USACE, 1998). The majority of the Study Area lies at topographic elevations of approximately 14 to 16 feet NGVD 1929, but rises to a maximum elevation of 48 feet along the western edge of the Study Area.

As discussed in greater detail Section 7.0, no state or federally listed threatened or endangered flora or fauna were identified in the Study Area.

The Study Area encompasses a total area of approximately 13.5 acres, and includes the 3-acre Raybestos Memorial Ball Field, an 8.5-acre vacant field, and a 2-acre densely wooded area. A chain-link security fence that surrounds the property restricts Study Area access. There are two vacant buildings, concrete and steel bleacher seats, and two dugouts in the vicinity of the baseball diamond, along the northern edge of the Study Area. A double row of chain-link fence defines the outfield limits of the ballfield. Numerous flagpoles and utility/light poles are located between these two sets of fencing, with additional utility/light poles scattered throughout the Study Area. Many of these utility poles still have remnant wiring and lighting fixtures attached, although the wiring has been cut in place. The overall condition of the Study Area facilities is poor, due to a lack of maintenance. Asbestos warning signs are posted along the security fencing.

The Study Area is inactive except for a small paved area located in the eastern corner of the Study Area that is used by a construction company. This area is used to store construction and landscaping supplies, tractor-trailer bodies, and miscellaneous recreational items such as campers and boats. Numerous small piles of woody debris and general refuse are also present.

Residential properties border the north/northwest side of the Study Area on Patterson and Clinton Avenues. Town, commercial, and industrial properties including the Stratford

Department of Public Works office and garage are located on Frog Pond Lane to the northeast. State of Connecticut, Department of Transportation railroad tracks and the former Raymark Facility border the Study Area to the east/southeast. An inactive industrial property abuts the Study Area to the south/southwest.

Subsurface Study Area features include a 48-inch reinforced concrete sewer line entering the Study Area near the access gate off of Frog Pond Lane. The sewer line had a grade of 0.05 percent at a depth of approximately 5 feet below grade at the time of construction. The sewer line extends through the southeastern portion of the Study Area, parallel to the fence line, approximately 600 feet from Frog Pond Lane and then crosses beneath the adjacent rail lines. The current depth of the sewer line is unknown due to the history of dumping at the site and the subsequent re-grading and capping activities. Potential buried utilities were also identified during the geophysical survey of the Study Area. The results of the geophysical survey are discussed in Section 3.2.2 and are included in Appendix A. Other subsurface features located during test pit activities include an 8-inch diameter corrugated steel drainpipe surrounded with ¾-inch crushed stone, as encountered at test pit 3 near the outfield fence. A buried electrical line was also exposed during the excavation of test pit 21 in the ballfield outfield. All soil boring, test pit, and monitoring well locations are shown on Figure 2-1. Additional detail concerning these features can be found on the test pit logs in Appendix B.

3.2 Geology

This section provides a brief overview of the geology of the region, as well as that of the OU4 Study Area. A more detailed evaluation of the surrounding area, including additional geologic/hydrogeologic data, and additional geologic cross-sections, groundwater contour maps, and bedrock surface contour maps will be presented in the OU2 groundwater RI (W.A. No. 029). The description of the Study Area geology is a general discussion of soils (natural deposits and artificial fill deposits) and bedrock as encountered in Study Area borings and test pits, with an emphasis on surficial soils. For the purposes of this report, fill is included within the category of soil.

3.2.1 Regional Geology

The discussion of the regional geology is based on published reports and is a summary of the regional geology discussion from the *Final Remedial Investigation Report, Raymark Industries, Inc. Facility* (HNUS, 1995). Discussion of the regional geology is divided into two subsections: overburden and bedrock. The overburden is defined as the unconsolidated deposits of sand, silt, gravel, clay, and peat. The overburden is underlain by bedrock consisting of the metamorphic rock types schist and gneiss.

3.2.1.1 Regional Overburden Geology

Connecticut has been covered by glacial ice at least twice in geologic time. During the last glacial retreat, glaciers deposited a thin, discontinuous mantle of till overlying bedrock. Glacio-fluvial outwash deposits formed thicker, highly stratified sequences of silty sand to gravelly sand, overlying till, and filling bedrock valleys. Windblown sand and silt were also deposited on valley floors, however, these deposits are indistinguishable from present day organic topsoil deposits.

The Study Area is generally located in the Stratford outwash plain, on the western Housatonic River valley floor. Natural overburden deposits in the vicinity of Stratford consist of glacial deposits (outwash sediments, ice-contact stratified drift, and till) and recent swamp and marsh deposits.

Glacial till, deposited by glacial ice, is variable in thickness, forming a discontinuous mantle over bedrock. The till consists of a non-stratified, poorly sorted mixture of coarse (gravel/cobbles/boulders) and fine (sand/silt/clay) fractions, with the coarse fraction generally not exceeding 20 percent.

Ice-contact stratified drift includes mixtures of sand, gravel, silt, and clay, which is frequently poorly sorted with abrupt changes in grain size. These deposits were formed

during glaciation in streams and local ephemeral lakes in close relation to melting glacier ice, and often grade into outwash sediments.

Glacial outwash deposits are predominant in the stream valleys, and consist of highly stratified sand, silty sand, and gravelly sand. Beds are not persistent, and individual lenses attain thicknesses of tens of feet, and thin out or are truncated over short distances. Outwash units in the vicinity of the Study Area generally consist primarily of sands with up to 50 percent gravel, grading up-valley (northward).

Swamp and marsh deposits are present in lowlands, depressions, and in proximity to the Housatonic River. Tidal marshes are also present in this area. Swamp and marsh deposits consist of silt, sand, and clay-sized particles interbedded with organic fragments and peat deposits. The oldest marshes in the western coastal area of Connecticut (2,000 to 4,000 years old) have peat deposits of approximately 10 feet.

3.2.1.2 Regional Bedrock Geology

According to the "Bedrock Geological Map of Connecticut" (CT GNHS, 1985) the Study Area is located in the Connecticut Valley Synclinorium of Connecticut's Western Uplands. The regional bedrock setting consists of a series of meta-sedimentary and meta-volcanic rocks of the Early and Middle Paleozoic Age, generally foliated, with foliation trending northeast-southwest, in a large syncline. These rocks are mainly schists and gneisses. The sequence was tightly folded and subjected to progressive regional metamorphism, ranging from chlorite to kyanite grade. A high angle fault is mapped approximately 1 mile to the southeast of the Study Area, across the Housatonic River, generally trending southwest to northeast. The implication of this fault and any related splay faulting to local geology and contaminant transport was not evaluated.

Outcrops of bedrock occur within the Study Area along the western edge of the property. Bedrock outcrops were also observed and surveyed at numerous locations outside of, but surrounding the Study Area. A bedrock ridge appears to control local topography, and a

portion of the ridge forms the rise along the western edge of the Study Area. This ridge measures approximately ½ mile in length, trends northeast to southwest, with multiple outcrops.

3.2.2 Study Area Geology

The geology of the Study Area is divided into two subsections: overburden (surficial) and bedrock. The discussion of the Study Area geology is based on overburden and bedrock data collected during soil boring and test pit activities conducted during field investigations, as summarized in Section 2.0.

3.2.2.1 Study Area Overburden Geology and Fill Thickness

The overburden deposits that occur within the shallow subsurface of the Study Area are mapped as Stratford outwash sediments and fill deposits (Flint, 1968). Based on borings advanced and test pits excavated in the Study Area by TtNUS, the surficial sediment deposits are characterized primarily by a variety of locally derived glacial outwash deposits, ice contact deposits, alluvial deposits, swamp and marsh deposits, and fill materials. The deposited sediments consist of silt, sand, and gravel, and range from silt with trace clay, to sands and coarse gravels. Swamp and/or marsh deposits in the form of peat/organic silt deposits were identified only at one location, SB-425, underlying fill materials. At boring SB-422, cobbles and boulders were encountered, in addition to sand and gravel, but these coarse materials may be related to the past sand and gravel removal activities. Based on existing data, glacial till has not been identified in the Study Area.

The Study Area overburden geology discussed below is based on boring and test pit data from investigations conducted by TtNUS, as summarized in Section 2.0. For discussion purposes only, a series of geologic profiles (cross-sections) were constructed using the available data collected from the borings and test pits advanced within the Study Area. Figure 3-1 indicates the locations of the four cross-sections and the individual data points included in each. The four cross-sections are shown on Figure 3-2. The purpose of these

profiles is to present the vertical distribution of fill at the Study Area and to indicate the geologic setting of the Study Area. These cross-sections were located within the Study Area at locations where data indicated the thickest fill material. The thickness of fill and the contacts between geologic materials between borings is an interpretation. The actual contacts may vary from those presented. The cross-section contacts were generated using a compilation of the boring and test pit logs, as well as the contour lines created from these same logs for bedrock topography, fill thickness, and water table elevations. The surface elevation data are based on the survey conducted as part of the RI field investigation.

The description of overburden geologic materials presented below is based on soil borings and test pits that were advanced in the Study Area by TtNUS in 1998 and 1999, as part of the RI (described in Section 2). These boring and test pit locations are presented on Figure 2-1 (field investigation locations) and the logs included are in Appendix B. In general, overburden thickness increases as the depth to bedrock increases, from west to east across the Study Area.

Overburden thickness varies from 0 feet where bedrock outcrops at the surface to a maximum depth of 62 feet below grade at SB-423.

The peat/silt horizon, identified at only one location (SB-425), was underlain by sands with varying amounts of silt, gravel, and clay-sized particles, as detailed in the boring logs.

Fill consists of both natural and artificial materials placed as a result of human activity. Fill materials frequently include manufacturing, household, and construction debris, usually mixed with natural materials such as silty sand and gravel. Fill was identified by visual descriptions of soil and sediment samples collected during the field investigations. An estimated thickness of fill map (Figure 3-3) was created based on these descriptions. The estimated thickness-of-fill map was prepared for the Study Area where sufficient data were collected to allow reasonable estimations of thickness of fill across the area

(Figure 3-3). It is assumed that fill thickness varies uniformly between data points, however, the actual thickness of fill between data points may be different than depicted.

Fill consists of a mixture of natural and man-made materials. Natural materials include various amounts of clay, silt, sand, and gravel. Man-made materials consist of asphalt, metal, brick, glass, plastic, and other miscellaneous man-made materials, including manufacturing debris. Other fill materials that do not contain visual evidence of man-made debris are present throughout the Study Area, generally consisting of sands with varying amounts of silt and gravel. This fill is frequently more difficult to distinguish from natural/native deposits, but it is included on the fill thickness map (Figure 3-3). Specific information on the presence or absence of artificial fill material and contaminated soil intervals was determined from the borings and test pit logs prepared during the OU4 field investigation (Appendix B). From the site history discussed in Section 1.3.4, it is known that the surface of portions of the Study Area was re-graded as part of the remedial action taken by the EPA. Approximately 6-11 inches of clean cover fill was placed over much of the Study Area following the grading operations. Because of this capping activity and the obvious construction and modifications that had to occur at the ballfield and paved lot portions of the Study Area, it was assumed that fill covered the surface of the Study Area, except possibly the western corner of the property.

Fill thickness identified in borings and test pits varied from depths of less than 1.0 foot (TP-15) to 17.5 feet below ground surface (SB-427), as indicated in Figure 3-3. Fill thickness in the Study Area generally increases toward the southern portion of the property in the approximate area of the former Frog Pond where the fill is in contact with peat and organic silts that likely formed the former pond bottom. The fill appears to be in direct contact with the bedrock surface at locations such as SB-421 and SB-427, while at many locations such as SB-424 and 426, the fill overlies outwash and ice-contact sands and silt.

Fill materials generally consist of varying amounts of sand, silt, and gravel, with artificial fill materials intermixed at many locations, including "sludge, brake pads, gasket materials,

and asbestos fibers" observed. Some larger man-made debris was noted in the test pits, such as a crushed drum and other smaller containers in TP-7, located near the perimeter fence abutting the Contract Plating property. At SB-421, a strong solvent odor was noted immediately after drilling through a piece of steel, which may have been another drum. The individual test pit and boring logs found in Appendix B provide additional details.

The integrated interpretation of the EM and GPR geophysical data collected at the Study Area (as discussed in Section 2.0) generally confirms the findings of the intrusive investigations. The geophysical report and figures summarizing the findings are supplied as Appendix A. While the purpose of the geophysical survey was to aid in selecting soil boring and monitoring well locations, these data are also useful for confirming areas of more conductive material interpreted as fill, areas of thickest fill (filled depressions), potential areas containing buried metal (possible drums), and buried utilities.

3.2.2.2 Study Area Bedrock Geology

This section provides a detailed evaluation of the Study Area bedrock geology that is based on the review of referenced geologic maps and logs for 12 borings advanced within the Study Area, 5 borings surrounding the Study Area, and 4 of the 22 test pits from the Study Area where bedrock was encountered.

Bedrock elevations from these locations were used to create a bedrock surface topography Figure (3-4). Bedrock outcrops added detail for the bedrock contours in the western portion of the property. Two boring locations (SB-428 and SB-430) did not come in contact with bedrock and were not used for this figure.

Bedrock outcrops are located within the Study Area along the western edge of the property. The elevation of the top of bedrock as observed at sample locations varies 91.4 feet at the Study Area. The highest elevation of the bedrock surface (as observed at sample locations) is approximately 42.3 feet NGVD (3.5 feet below grade) at TP-16, located along the western edge of the Study Area. The lowest elevation of the top of

bedrock, as observed at SB-423 is -49.1 feet NGVD (62 feet below grade), located in the northeast portion of Study Area. The bedrock surface elevation data from the bedrock borings indicates that the top of bedrock slopes from the western exposures downward to the east across the Study Area.

Bedrock underlying the Study Area is mapped as the Derby Hill Schist, a mainly medium- to fine-grained, thinly laminated, greenish-gray to medium dark-gray chloritic muscovite schist, which is Lower to Middle Ordovician in age. This formation may contain minor bands of quartz-rich paragneiss. This rock type is composed mainly of quartz, muscovite, chlorite, and sodium plagioclase, with accessory minerals (Fritts, 1965). As described in Fritts, the bedrock cores from within the Study Area were typically described as foliated, quartz-rich, chlorite-mica-schist with variable amounts of garnet and sulfide minerals such as pyrite. Typically, the bedrock is medium-grained, and usually dark green or dark gray. Veins composed of both quartz and calcite were frequently observed. In most (if not all) coring runs, high-angle schistosity and foliation were observed to be common; weathered fractures ranging from low-angle or horizontal up to high-angle and vertical were also noted. Many of the fractures noted were oriented parallel to foliation planes. Another rock type found underlying the Study Area at SB-422 was a fine- to medium-grained granofels, composed primarily of quartz and feldspar. This light- to medium-gray rock was in gradational contact with the underlying paragneiss or schist at this location. At SB-424, the gneiss showed abundant smokey-quartz veining with pyrite mineralization. In addition to the bedrock fractures, areas of secondary porosity were noted, i.e., vugs or pitting, especially in or along the calcite-rich areas and veins.

In summary, the subsurface materials found at the Study Area are divided into two units, the overburden and the bedrock. The bedrock was found to be highly variable both in topographic relief and composition. The bedrock topography controls the vertical extent of the overburden materials. As seen in the cross-sections (Figure 3-2) and bedrock surface topography (Figure 3-4), the bedrock is exposed at or near the ground surface along the western edge of the property and forms a topographic rise where there is limited overburden material. As bedrock slopes downward to the east, overburden thickness

increases to more than 60 feet below grade. The majority of the overburden materials within the Study Area are natural glacial outwash, ice contact deposits, and alluvial deposits composed mostly of sands and gravels. There is a minor peat and organic silt that may correlate with the former Frog Pond located in the southern portion of the property (see A-A' and C-C', Figure 3-2). The remainder of the overburden materials are considered fill, consisting of man-made material including manufacturing waste, metal, and concrete, as well as re-worked natural materials such as sand and gravel. The surficial material covering the majority of the Study Area consists of natural fill materials used to reduce exposure potential to the underlying fill.

3.3 Hydrogeology

This section provides a brief description of the regional and Study Area hydrogeology; a more detailed discussion of hydrogeology will be presented in the OU2 Groundwater RI, (W.A. No. 029-RICO-01H3), which focuses on groundwater under, and in the vicinity of, the former Raymark Facility.

3.3.1 Regional Hydrogeology

Regional hydrogeologic units consist of unconsolidated overburden deposits, including till, stratified outwash, swamp and marsh deposits, and an upper fractured bedrock unit. Regional groundwater flow direction is generally toward the Housatonic River (HNUS, 1995).

Groundwater in the vicinity of the Study Area is classified as GB (unsuitable for drinking without treatment) by the CT DEP. The Town of Stratford public drinking water is supplied primarily by the Bridgeport Hydraulic Company. The source of the public drinking water is Trapp Falls Reservoir in Shelton, Connecticut, located approximately 5 miles north of the Study Area. The remainder of the drinking water is supplied by private drinking water wells within Stratford, none of which are known to exist near the Study Area.

3.3.2 Study Area Hydrogeology

This section presents an overview of the Study Area hydrogeology. Groundwater is currently being investigated as part of the OU2 Groundwater RI. A more detailed presentation and evaluation of the hydrogeologic data will be presented in the OU2 Groundwater RI.

The hydrogeology of the Study Area is complex because of the presence of a wide variety of unconsolidated overburden materials and fractured bedrock. The water table, as seen in Figure 3-5, is located in the shallow bedrock along the western edge of the Study Area and crosses into the overburden materials toward the east. Another factor in the potential complexity of the Study Area hydrogeology is the presence of the former Frog Pond bottom sediments that may act as an impermeable or a semi-impermeable barrier where present.

As summarized in Section 3-2, the Study Area is located in the Stratford outwash plain, on the western Housatonic River valley floor. The surficial deposits immediately underlying the Study Area are mapped as Stratford outwash sediments and artificial fill (Flint, 1968). A review of boring logs indicates that the geology and description of unconsolidated deposits are consistent with those described for the region (Appendix B). One minor additional surficial deposit located within the Study Area, which is not indicated on the surficial geologic map, is a minor peat and organic-rich silt lens that was logged at SB-425 from 15.5 to 18.0 feet below grade. The thickness of the overburden materials ranges from zero along the bedrock exposures to the west of the Study Area, to 62 feet below grade in the northeastern portion of the Study Area (at SB-423).

On March 24, 1999, a water level round was conducted in 164 overburden and bedrock wells located within the OU2 Study Area, which includes the OU4 Study Area. The measurements from applicable shallow overburden wells were used to construct the water table elevation map for the Study Area (Figure 3-5).

Estimated groundwater flow directions for the Study Area are presented as arrows on the water table contour map (see Figures 3-5). In general, the shallow overburden groundwater flow direction within the Study Area is toward the east- southeast toward the former Raymark Facility. Further definition of the groundwater flow direction for the Study Area will be presented in the OU2 Groundwater RI Report.

The water table is located in bedrock at MW-308B, west of the Study Area and at MW-216B, north of the Study Area. The water table is located in overburden materials at the remainder of the well locations in and surrounding the Study Area. The depth to the water table varies across the Study Area but generally mimics the surface topography. Maximum depth to the water table is along the western edge of the property where it exceeds 20 feet. The minimum depth to the water table of approximately 5 feet occurs in the northern area of the ballfield at SB-429. Based on a comparison of the fill thickness and water table elevations from March 1999, it is estimated that approximately 70 percent of the fill is above the water table and 30 percent is saturated below the water table.

3.4 Surface Water Hydrology

The Study Area is located within the Housatonic Main Stem Regional Drainage Basin. Long Island Sound receives the area's entire surface drainage via the Housatonic River. The Housatonic River is tidally influenced 11 miles upstream of the mouth of Ferry Creek, as far up as the Derby Dam in Derby, Connecticut. The Housatonic River is listed as Class SC/SB water, Coastal Marine Surface Waters, with an average discharge of 3,400 cubic feet per second at its mouth, based on an average discharge (Weston, 1993).

Historic photographs of the property indicate the presence of two small water bodies. These were subsequently filled and today there are no longer any surface water bodies located within the Study Area.

Surface runoff of precipitation is controlled by the topography of the site, which is discussed in Section 3.1 and can be seen in Figure 1-2. In general, the precipitation that does not contribute to groundwater within the property runs off the site toward the east and Frog Pond Lane and East Main Street where the Town of Stratford drainage system controls the discharge into the Housatonic River.

The University of Connecticut has estimated peak storm event precipitation rates for the State of Connecticut (University of Connecticut, 1999). Peak precipitation accumulation rates are listed below for the Study Area.

- 2-year storm = approximately 1.28 inches/hour
- 25-year storm = approximately 2.0 inches/hour
- 100-year storm = approximately 2.5 inches/hour

Using the 100-year storm peak precipitation rate of 2.5 inches/hour, the runoff peak flow rate for the entire Study Area would be 30,063 ft^3/hour or 224,887 gallons/hour.

3.5 Meteorology

A National Oceanographic and Atmospheric Administration (NOAA) Climatological Station is located at the Bridgeport - Sikorsky Airport, approximately 2 miles from the Study Area. Data from this station have been used to describe the climate in the area, as provided below.

The Town of Stratford, Fairfield County, Connecticut, is located in a temperate-humid climate characterized by highly changeable weather, with daily and annual temperature variations strongly influenced by Long Island Sound and the Atlantic Ocean. The area is characterized by monthly, seasonal, and annual variations in temperature, wind speed, direction, and precipitation amounts, which is in the form of both rain and snow.

On average, July is the warmest month, with an average temperature of 73.7 degrees F. Average wind speed and direction for the warmest months is 10.2 miles per hour (mph) from the southwest. The coldest month is January, with an average temperature of 28.9 degrees F. Average wind speed and direction for the colder portion of the year is 13.3 mph from the northwest.

Normal annual precipitation for the area is 41.66 inches of rain, with a regular distribution throughout the year. Snow fall typically occurs between November and April, with a mean of 25 inches per year (NOAA, 1993).

4.0 NATURE AND EXTENT OF CONTAMINATION

This section summarizes analytical data from field investigations performed during the RI to characterize the nature and extent of chemical contamination in the Study Area. A discussion of the potential sources of contamination affecting the Study Area (see Figures 1-1 and Figure 1-2) is provided in Section 4.1. Section 4.2 presents an overview of the types of chemical compounds detected in the Study Area, and a brief discussion relating the presence of these chemicals to past operations at the former Raymark Facility. Section 4.3 discusses the background concentrations developed for comparison with the Study Area values. Comparisons of analytical results for Study Area environmental media to background results and available benchmark criteria are provided in Section 4.4. Analytical data used to evaluate the nature and extent of contamination are presented in Appendix C.

Although the evaluation of the nature and extent of contamination includes discussions of all the major classes of chemical contaminants analyzed, the RI focuses on chemical characterization of three of the major contaminants (lead, PCBs, and asbestos) associated with past activities at the former Raymark Facility. Figures depicting the presence and concentrations of these contaminants are included to support the analyses in Section 4.4.

4.1 Potential Sources of Contamination

The major source of contamination at the Study Area is the disposal of Raymark soil-waste materials. Waste materials were brought from the former Raymark Facility and used as fill to develop a ballfield. Additional sources of contamination that may have contributed to soil contamination in the Study Area include dumping of unknown wastes, and disposal of drums and debris from sources other than the Raymark Facility (Weston, 1993). Disposal of these materials has resulted in contaminant levels in Study Area soils that exceed those in background location samples.

4.2 Overview of Chemical Compounds Detected

Brief descriptions of the major classes of chemical contaminants detected in the soil in the Study Area, and the common industrial uses of these chemicals, are provided in Sections 4.2.1 through 4.2.7. Section 4.2.8 and Table 4-1 provide a summary of the specific chemicals known to have been stored, handled, or used at the Raymark Facility during its operation that may have contributed to contamination of the Study Area. A discussion of the terminology used for evaluating the analytical data collected in the Study Area is provided in Section 4.2.8.

4.2.1 Volatile Organic Compounds (VOCs)

The VOCs detected in environmental samples collected from the Study Area may be separated into three major groups: chlorinated hydrocarbons, aromatic hydrocarbons, and ketones. Many of these VOCs are organic solvents commonly used in industrial processes to degrease parts; to prepare metal surfaces prior to painting, coating, or bonding; as constituents of paint thinners and resins; and to extract organic compounds from materials. Additionally, some of the detected VOCs are common components of gasoline and petroleum fuels.

VOCs used at the Raymark Facility consisted mainly of chlorinated hydrocarbons, aromatic hydrocarbons, and ketones used as organic solvents. Organic solvents were also used in various capacities at the former Raymark Facility.

4.2.2 Semivolatile Organic Compounds (SVOCs)

The SVOCs detected in environmental samples collected from the Study Area may be separated into three major groups: phenolic compounds, polynuclear aromatic hydrocarbons (PAHs), and phthalates. Other SVOCs detected include only a few isolated compounds. SVOCs are common constituents of various industrial products. Phenolic compounds are typically associated with fuels, coal, and petroleum products, and are used

to manufacture friction materials. PAHs are common components of coal tar (bitumen and asphaltic tars), petroleum products (motor and fuel oil), and combustion by-products. Phthalates are typically used as plasticizers in the manufacture of synthetic materials.

SVOCs used at the Raymark Facility included phenolic compounds, naphthalene, and phthalates. Phenolic resins were used in manufacturing friction materials, and were mixed with asbestos to manufacture brake pads and linings at the former Raymark Facility.

4.2.3 Pesticides

Pesticides are typically used to control the presence or population of unwanted insects in both residential and commercial areas, as well as to prevent crop destruction in agricultural settings. Pesticide formulations may include chlorinated and organophosphorus varieties.

Pesticides may have been used at the Raymark Facility to control insect populations. However, no documentation of use has been identified.

4.2.4 Polychlorinated Biphenyls (PCBs)

The PCBs detected in the environmental samples collected from the Study Area consisted primarily of Aroclor 1262 and Aroclor 1268. PCBs are extremely stable chemicals with a wide range of physical properties. They have been historically used in plasticizers, adhesives, lubricants, heat transfer fluids, and as dielectric fluids in transformers and capacitors. Aroclor 1262 and Aroclor 1268, specifically, are commonly used as plasticizers in synthetic resins. Aroclor 1268 is also commonly used as a wax extender and plasticizer in rubbers.

No information has been provided directly by the Raymark Facility documenting the specific use of PCBs as part of their manufacturing process. However, EPA has reported that PCBs were used in manufacturing brake linings. The Raymark Facility was also known as having used and/or manufactured both rubber (gasket materials) and resins

(phenolic resins in brake linings). Aroclor 1262 and Aroclor 1268 may have been used as plasticizers in these materials. Aroclor 1262 and 1268 were both identified in soils and groundwater at the former Raymark Facility.

4.2.5 Metals

Numerous metals were detected in the environmental samples collected from the Study Area. Metals are naturally occurring components of soil and/or localized mineral deposits and occur as a result of decomposition of weathered bedrock. Metals may also be introduced into the environment through various industrial activities including disposal of waste materials or process sludges, and fugitive emissions from various thermal or combustion processes.

Barium, copper, lead, tin, and zinc were the primary metals used at the Raymark Facility to fabricate various brake and friction materials. Each was detected at elevated concentrations in the Study Area.

4.2.6 Asbestos

Asbestos was detected in sediment and soil samples collected from the Study Area. Asbestos is a group of magnesium silicate minerals that contains varying quantities of iron and calcium silicates. Because of its non-combustible and heat-resistant properties, asbestos was commonly used to manufacture brake linings, gaskets, fireproof fabrics, roofing materials, and electrical and heat insulation, and as a reinforcing agent in rubber and plastics.

Asbestos-containing materials were a primary component in the products manufactured at the Raymark Facility. Asbestos fibers were mixed with phenolic resins to manufacture brake pads and linings. Asbestos was also used to manufacture friction materials (clutches and transmission plates) and gaskets.

4.2.7 Chemical Compounds Used or Handled at the Raymark Facility

A number of chemical compounds and materials were handled, stored, and/or used in manufacturing processes at the Raymark Facility during its operation. A list of these chemicals, presented in Table 4-1, was developed from information provided in the *RCRA Facility Investigation Report* (ELI, 1995) and the RCRA Part A application (August 15, 1980). A Part B application was drafted but never filed for the Raymark Facility.

4.2.8 Terminology for Evaluating Analytical Data

In order to evaluate the nature and extent of contamination in the Study Area, and determine its relationship to past disposal and operational practices at the Raymark Facility, data generated from analysis of field samples are typically compared to background concentrations and reviewed in relation to the data collected throughout an entire area of concern. Definitions of the terms used to describe and compare the contaminant concentrations in the following sections are as follows:

- elevated - detected at a concentration either greater than its corresponding average background concentration, or greater than a specified concentration if no average background concentration was determined

- high, higher, or highest - detected in one location at one or more orders of magnitude greater than at another location

- comparable - detected in one location at the same order of magnitude as another location

- low or lower - detected in one location at one or more orders of magnitude less than another location

Discussion about the development of background concentrations is provided in Section 4.3.

Definitions of terms related to sampling depths and media are as follows:

- surface samples – Samples collected at depths of up to 2.0 feet below bgs
- subsurface samples – Samples collected at depths of greater than 2.0 feet bgs

4.3 Background Concentrations

To assess whether chemicals (organic compounds and metals) detected in Study Area environmental media are related to or are the result of past disposal activities or releases, it is necessary to compare the analytical results for on-site samples with those obtained from locations that are unlikely to have been affected by past site activities. In this way, on-site chemical presence may be attributed to naturally occurring sources (such as metals in soils), contamination that is pervasive in an area, i.e., pesticides in agricultural communities, lead in urbanized areas, etc., or to site-related occurrences.

For purposes of evaluating the nature and extent of contamination, the average background concentrations serve as a basis to identify elevated contaminant concentrations in samples collected within the Study Area (see Section 4.4). If contaminant concentrations exceeded the average background concentrations, a contaminant source was suspected and the contaminant concentrations were considered "e'evated." Because of the industria' nature of the Stratford area, contaminant concentrations below the average background levels are not considered representative of an affected area and, therefore, did not warrant further discussion in the evaluation of nature and extent. However, it is important to note for the human health risk assessment

that background concentrations were not used to eliminate chemicals of potential concern (COPCs) except in the case of non-carcinogenic metals.

Contaminants not analyzed in the background samples were compared to other screening values such as the Connecticut Pollutant Mobility Criteria (CT PMC) for GB Aquifers or the Connecticut Direct Exposure Criteria (CT DEC) for Residential Soil.

Background soil samples were collected from various locations around the Town of Stratford from schools, day care centers, and recreational areas. The samples were analyzed for pesticides/PCBs and metals. Metals results from 34 of 39 sample locations and pesticides/PCBs results from 27 of 37 sample locations were determined to be representative of background conditions. Because of variability in the analytical data and/or heterogeneity of the samples, average background concentrations were developed by averaging the numerical data from samples deemed representative of background conditions. (The numerical averages were calculated as the arithmetic average of the detected concentrations and half the detection limits for those compounds/analytes reported as undetected.) The summary statistics for background concentrations for pesticides, PCBs, and metals are presented in Table 4-2. Background soil samples were not analyzed for VOCs or SVOCs.

4.4 Nature and Extent of Contamination in Soil

To evaluate the soil analytical results, the data were compared with average background concentrations for pesticides, PCBs, and metals. The CT DEC and the CT PMC were also used as screening values in the RI to help identify potential chemicals of concern that would be addressed in the baseline human health risk evaluation, or to identify chemicals that may pose potential threats to groundwater quality. If both criteria exist for a particular contaminant, the CT PMC is used because it is typically more conservative. In the case of metals and PCBs, the CT DEC is used because the CT PMC requires Synthetic Precipitation Leaching Procedure (SPLP) or Toxicity Characteristic Leaching Procedure (TCLP) results. None is available for the Study Area.

In addition, the EPA has adopted the following criteria specifically for sites where Raymark wastes are known to have been deposited:

Lead – 400 mg/kg
Asbestos – 1 percent
Total PCBs – 1 ppm or 1,000 ug/kg

These are the primary contaminants associated with Raymark-type waste and when two or three of the three contaminants are present, a property was selected for cleanup to levels below these criteria. Analytical results for lead, asbestos, and PCBs at the ballfield was compared to the EPA criteria as well as background, CT PMC and CT DEC, if available.

Summary statistics and a comparison to available benchmarks described above are presented in Table 4-3 for surface soils and Table 4-4 for subsurface soils. The presence in surface soils of total PAHs, PCBs, lead, arsenic, barium, zinc, and asbestos are depicted on Figures 4-1a, 4-2a, 4-3a, 4-4a, 4-5a, 4-6a, and 4-7a, respectively. The presence of those same contaminants in subsurface soils is depicted on Figures 4-1b through 4-7b. These compounds have been selected as chemicals of potential concern regarding risk to human health. Copper and chromium (Figures 4-8a and b and 4-9a and b) were also evaluated in detail as chemicals that may pose potential threats to groundwater.

4.4.1 VOCs in Soils

The extent of VOC contamination in surface and subsurface soils is discussed below.

Surface Soils

VOCs were analyzed for at eight sample locations concentrated in the southern portion of the Study Area. Only four VOCs were detected (2-butanone, acetone, carbon disulfide, and

chlorobenzene). All concentrations were low; none exceeded the CT PMC for soils, which are listed in Table 4-3.

Subsurface Soils

The VOCs detected in surface soils were also detected in subsurface soils. Concentrations of 2-butanone and acetone were comparable in surface and subsurface soils, but concentrations of carbon disulfide and chlorobenzene were slightly higher in subsurface soils. The aromatic hydrocarbons chlorobenzene, benzene, and total xylenes were detected at concentrations exceeding the CT PMC at SB-425 and SB-427, which are located in the southwestern portion of the Study Area. The highest concentrations of benzene (7,700 μg/kg) and total xylenes (43,000 μg/kg) were detected at 16 feet bgs to 18 feet bgs at SB-425. At SB-427, high benzene and chlorobenzene concentrations (1,100 μg/kg and 47,000 μg/kg, respectively) were detected from 10 feet to 12 feet bgs. The CT PMC for chlorobenzene, benzene and total xylenes are 2,000 μg/kg, 200 μg/kg, and 19,500 μg/kg, respectively. The southwest portion of the Study Area was reportedly used as a dumping area for brush, leaves, and street sweepings by the Stratford Department of Public Works (DPW). Drums and jugs of waste oil have also been found in this portion of the property (EAI, July 26, 1990; Weston, January 1993). This may constitute the source of some VOC contamination, particularly compounds found in petroleum products like benzene. No other VOCs were detected at concentrations exceeding CT PMC, and none of the contaminants described above was detected in groundwater at the Study Area, indicating that soils at the Study Area are not likely contributing to VOC contamination in groundwater at this time.

4.4.2 SVOCs in Soils

The extent of SVOC contamination in surface and subsurface soils is described below.

Surface Soils

Semi-volatile organic compounds (SVOCs) are distributed throughout the southern portion of the Study Area at low concentrations. In general, SVOCs are not abundant at the Study Area, as evidenced by the low frequencies of detection presented in Table 4-3. The SVOCs detected consist of a number of PAHs, phthalates, and a few other compounds. Almost all soil SVOCs were detected at concentrations below the CT PMC. Dibenzo(a,h)anthracene (CT PMC = 0.96 μg/kg), indeno(1,2,3-cd)pyrene (CT PMC = 9.6 μg/kg), and N-nitroso-di-n-propylamine (CT PMC = 1.0 μg/kg) exceeded CT PMC in every sample where the analyte was detected. Figure 4-1a shows the total PAH concentrations in surface soils. Total PAHs were highest at SB-425 and ranged from 579 ug/kg to 3,842 ug/kgs with an average concentration of 1,800 ug/kg. Similar concentrations were widely distributed throughout the limited number of samples collected throughout the Study Area.

Subsurface Soils

Similar to the distribution in surface soils, SVOCs are widely distributed throughout subsurface soils in the southern portion of the Study Area (Figure 4-1b). PAHs are the primary SVOCs detected. Total PAH concentrations range from 22 μg/kg at MW-401 to 68,820 μg/kg at SB-421 from 4 feet to 6 feet bgs. Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene are the primary contributors to the high total PAH concentrations. Each compound was detected above CT PMC, which are listed in Table 4-4. High concentrations of SVOCs were found as deep as 18 feet bgs at SB-427.

This comparison with the screening levels indicates that elevated SVOCs presence is very limited in Study Area surface soils, but higher SVOC concentrations exist in subsurface

soils in the Study Area from 2 feet to 18 feet bgs. The higher concentrations of total PAHs were not detected in any one portion of the Study Area in surface soils. In subsurface soils, the higher concentrations appear to be focused in the southern and western portions of the Study Area. No SVOCs were detected in groundwater samples collected from the Study Area, suggesting that Study Area soils are not currently contributing to SVOCs presence in groundwater. Potential threats to human health risks due to SVOCs, particularly PAHs, are evaluated in the risk assessment.

4.4.3 Pesticides in Soils

The extent of pesticide contamination in surface and subsurface soils is described below.

Surface Soils

Pesticides have been detected in Study Area soils at low concentrations and their presence is sparse, as indicated by the low frequencies of detection depicted in Table 4-3. Few pesticides (heptaclor epoxide, alpha chlordane, gamma chlordane, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT) were detected at concentrations greater than average background. All locations where 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT exceeded average background are located in the ballfield playing area (except SB-24 along the railroad track). Concentrations of 4,4',-DDE and 4,4'-DDT exceeded CT PMC (21 μg/kg for both compounds) in half of the samples analyzed. 4-4'-DDD, endrin, and endrin ketone concentrations also exceeded CT PMC, 21 μg/kg, 0.0 μg/kg and 0.0 μg/kg, respectively. It is likely that pesticides were applied to the ballfield area for insect control during the years when the ballfield was in full use. The pesticides detected in surface soils were each detected at low concentrations in groundwater from one overburden on-site well (MW-402S), but none exceeded MCLs (where numbers are available). It is not likely that pesticides in Study Area soils are acting as a major contributor to pesticide contamination of groundwater. Pesticides were also detected in groundwater samples from wells located upgradient of the Study Area.

Subsurface Soils

The pesticides detected in surface soils were also detected in subsurface soils. Concentrations of 4,4'-DDE and gamma chlordane were slightly higher in subsurface soils. In addition to the pesticides detected in surface soils, aldrin, alpha-BHC, beta-BHC, delta-BHC, dieldrin, encosulfan I and II, and endrin aldehyde, were detected at concentrations greater than average background. Gamma chlordane was detected above average background most frequently. Detected concentrations ranged from 0.039 μg/kg at SB-401 from 14 feet to 16 feet bgs, to 220 μg/kg at SB-425 from 2 feet to 4 feet bgs. Concentrations of other pesticides exceeding average background concentrations were detected throughout the Study Area and at all subsurface depths. Fifteen of the twenty pesticides detected in subsurface soils were measured at concentrations exceeding CT PMC, which are listed in Table 4-4.

4.4.4 PCBs in Soils

The extent of PCB contamination in surface and subsurface soils is described below. A comparison to the CT DEC is used for screening purposes. No SPLP or TCLP results are currently available for the Study Area, so a comparison to CT PMC is not provided.

Surface Soils

One hundred eleven surface soil samples were analyzed for PCBs (Figure 4-2a). The range of detected concentrations of total Aroclors was 182.1 μg/kg – 35,149 μg/kg; the highest concentration was found at BF021 behind the first base bleachers. Elevated PCB concentrations (greater than the EPA criterion for Raymark-type waste of 1,000 μg/kg) were sporadic except along the western Study Area boundary (at BF005, BF006, BF008, and BF020). Elevated concentrations were also detected in three samples from the playing field (RMF C+50, RMF C+200, and RMF C+300) and at SB402B in the southeast corner of the property. No Aroclor concentrations greater than 1,000 μg/kg were detected in the southwest portion of the Study Area. Aroclor 1262 and Aroclor 1268 were detected most frequently, while Aroclors 1016, 1242, and 1248 were each detected once. Concentrations of Aroclor

1016 and 1248 were less than the EPA criterion for Raymark-type waste and the CT DEC of 1,000 μg/kg. Aroclor 1242 was detected at BF020 at 3,000 μg/kg, which is above the CT DEC. No Aroclors were detected in background samples.

Subsurface Soils

No subsurface samples were collected where surface soil sample results showed highest Aroclor concentrations. Similar to the surface soils, Aroclor 1262 and Aroclor 1268 were detected most frequently, and had the highest concentrations. Refer to Figure 4-2b for the distribution of total Aroclors In subsurface soils in the Study Area. Aroclor 1262 was detected in 46 of 59 samples and detected concentrations ranged from 7.2 μg/kg (SB-422 from 2 feet to 4 feet bgs) to 110,000 μg/kg (SB-426 from 6 feet to 8 feet bgs). Aroclor 1268 was detected in 49 of 59 samples and detected concentrations ranged from 10 μg/kg (SB-423 from 6 feet to 8 feet bgs) to 230,000 μg/kg (SB-426 from 6 feet to 8 feet bgs). The maximum concentration of each Aroclor was detected at SB-426 from 6 feet to 8 feet bgs. Aroclors 1232 and 1242 were detected at relatively low concentrations (110 μg/kg to 210 μg/kg) in samples from borings SB-421 and SB-424 at depths ranging from 4 feet to 14 feet bgs. Aroclors were not detected in background samples. Subsurface soil samples were not collected from the areas with the highest surface soil PCB contamination (behind the first base bleachers and along the western Study Area boundary or in the ballfield), so the vertical extent of PCB contamination in those areas is undefined.

However, based on high concentrations in surface soils in these areas, it is likely that the subsurface soils also have elevated concentrations of PCBs. The depth to bedrock in these areas is relatively shallow. The highest subsurface soil concentrations of total Aroclors are found throughout the Study Area. In eight of 15 borings, subsurface soil concentrations exceeded 25,000 μg/kg (25 ppm).

Aroclors 1262 and 1268 are the two Aroclors detected in samples collected from the soils at the former Raymark facility, and it is likely that their presence at the Study Area is due to the presence of Raymark-type soil-waste/fill materials.

4.4.5 Metals in Soils

A variety of metals have been detected in soil samples collected from the Study Area. Tables 4-3 and 4-4 summarize the analytical results for soil samples collected from the Study Area. Toxic metals detected in Study Area soils include: antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, and zinc. Some metals are components of essential nutrients, or occur naturally, or are present at such low concentrations that they are considered to be of low concern. These metals include aluminum, calcium, iron, magnesium, potassium, and sodium. To assess whether the presence of metals is attributable to past activities or releases at the Study Area, the analytical results were compared with background metals data. A comparison to the CT DEC is used for screening purposes. No SPLP or TCLP results are currently available for the Study Area, so a comparison to CT PMC is not provided. Potential threats to human health due to metals are evaluated in Section 6.0, the Baseline Human Health Risk Assessment.

4.4.5.1 Lead

The extent of lead contamination in surface and subsurface soils is described below.

Surface Soil

One hundred eleven surface soil samples were analyzed for lead (Figure 4-3a). Concentrations ranged from 19.2 mg/kg to 8,270 mg/kg (at BF006 from 0-0.5 ft bgs), with an average detected concentration of 563 mg/kg. Highest concentrations were generally found near the first base bleachers (3,490 mg/kg at BF021 from 0-0.5 ft bgs; 6,200 mg/kg at BF021 from 0.5 -1 ft bgs; 6,610 mg/kg at BF022 from 0-0.5 ft bgs.

Lead was not detected above the EPA's criterion for Raymark-type waste of 400 mg/kg (or the CT DEC of 500 mg/kg) in the playing field or from the area south of the playing field. One

sample (009) from the southwest corner of the Study Area contained lead at 950 mg/kg. All other sample results from that area were less than 400 mg/kg. Lead's presence in much of the Study Area is elevated in comparison with the average background levels and these analytical results indicate that the lead in on-site soils is likely associated with past activities or releases in the Study Area.

Subsurface Soil

Lead was detected in 51 of 59 subsurface soil samples (Figure 4-3b). Concentrations ranged from 3.3 mg/kg (SB-423 from 14 feet to 16 feet bgs) to 172,000 mg/kg (SB-421 from 8 feet to 10 feet bgs). Thirty-five samples from throughout the Study Area (excluding the playing field and southwest corner of the Study Area) had concentrations exceeding the average background concentrations. Similarly, 30 of those samples had concentrations exceeding the CT DEC of 500 mg/kg. In general, lead concentrations in subsurface soils were elevated compared to surface soils. Concentrations exceeding screening criteria were detected at all subsurface depths and did not appear to be concentrated in any particular portion of the Study Area. Subsurface soil samples were not collected from the areas where surface soils had the highest concentrations (behind the first base bleachers and along the western Study Area boundary), so the vertical extent of lead contamination in those areas is undefined. However, based on high concentrations in surface soils in these areas, it is likely the subsurface soils also contain elevated concentrations of lead.

4.4.5.2 Arsenic

The extent of arsenic contamination in surface and subsurface soils is described below.

Surface Soil

Surface soils analyzed for arsenic were collected along the western Study Area boundary, in the playing field, in the southwest portion of the Study Area, and south of the playing field. Arsenic was detected in 16 of 35 surface soil samples (Figure 4-4a). Concentrations ranged

from 1.6 mg/kg at SB-421 to 27 mg/kg at BF006, with an average detected concentration of 7.6 mg/kg. Background concentrations were exceeded in 11 of those samples. The highest concentrations were detected in samples from the playing field area and along the western boundary of the Study Area. The sample from SB-402 in the eastern corner of the Study Area also had high concentrations of arsenic. The CT DEC of 10 mg/kg was exceeded in two locations along the western boundary of the Study Area.

Subsurface Soil

Subsurface soil samples analyzed for arsenic were collected primarily from the southern portion of the Study Area (Figure 4-4b). One subsurface sample was collected from the playing field. Arsenic was detected in 54 of 58 samples. Concentrations ranged from 0.65 mg/kg at SB-401 (6 feet to 8 feet bgs) to 45.5 mg/kg at SB-427 (4 feet to 6 feet bgs), with an average detected concentration of 8.3 mg/kg. Concentrations exceeding background and the CT DEC were pervasive throughout subsurface soils. Most surface soil locations with high arsenic concentrations did not have corresponding subsurface samples collected, and therefore the vertical extent of arsenic is not defined along the western Study Area boundary or in the playing field. However, based on high concentrations in surface soils in these areas, it is likely the subsurface soils also have elevated concentrations of arsenic. The depth to bedrock in these areas is relatively shallow. Average concentrations of arsenic were higher in subsurface soils than surface soils, but the frequencies of detection were comparable.

4.4.5.3 Barium

The extent of barium contamination in surface and subsurface soils is described below.

Surface Soil

Surface soils analyzed for barium were collected along the western Study Area boundary, in the playing field, in the southwest portion of the Study Area, and south of the playing field (Figure 4-5a). Barium was detected in 18 of 35 surface soil samples. Concentrations ranged

from 30.5 mg/kg at SB-423 to 2750 mg/kg at BF021, with an average detected concentration of 375 mg/kg. Background concentrations (57.47 mg/kg) were exceeded in 14 of those samples. The highest concentrations (one order of magnitude higher than background concentrations) were detected in samples along the western Study Area boundary and behind the first base bleachers (BF006 and BF021). These were the only two locations where the CT DEC (4,700 mg/kg) was exceeded.

Subsurface Soil

Subsurface soil samples analyzed for barium were collected primarily from the southern portion of the Study Area (Figure 4-5b). One subsurface sample was collected from the playing field. Barium was detected in all 59 samples. Concentrations ranged from 15.1 mg/kg at SB-422 (14 feet to 16 feet bgs) to 18,800 mg/kg at test pit 15 (1 feet to 3 feet bgs), with an average detected concentration of 3,530 mg/kg. Concentrations exceeding background (57.47 mg/kg) and the CT DEC (4,700 mg/kg) were pervasive throughout subsurface soils. Most surface soil locations with high barium concentrations did not have corresponding subsurface samples co"ected, and therefore the vertica' extent of barium is not definec a'ong the western Study Area boundary or in the playing field. However, based on high concentrations in surface soils in these areas, it is likely the subsurface soils also have elevated concentrations of barium. The depth to bedrock in these areas is relatively shallow. Average concentrations and frequency of detection of barium were higher in subsurface soils than surface soils. Potential threats to human health risks due to barium are evaluated in the risk assessment.

4.4.5.4 Zinc

The extent of zinc contamination in surface and subsurface soils is described below.

Surface Soil

Surface soils analyzed for zinc were collected along the western Study Area boundary, in the playing field, in the southwest portion of the Study Area, and south of the playing field

(Figure 4-6a). Zinc was detected in 18 of 35 surface soil samples. Concentrations ranged from 28.8 mg/kg at SB-423 to 3410 mg/kg at BF006, with an average detected concentration of 270 mg/kg. Background concentrations (112.32 mg/kg) were exceeded in three of those samples. The highest concentration, which was one order of magnitude higher than background concentrations but still below the CT DEC (20,000 mg/kg), was detected in a sample along the western Study Area boundary (BF006).

Subsurface Soil

Subsurface soil samples analyzed for zinc were collected primarily from the southern portion of the Study Area (Figure 4-6b). One subsurface sample was collected from the playing field. Zinc was detected 53 of 59 samples. Concentrations ranged from 20.7 mg/kg at SB-42 (6 feet to 8 feet bgs) to 23,500 mg/kg at SB-426 (6 feet to 8 feet bgs), with an average detected concentration of 3,410 mg/kg. Concentrations exceeding background (112.32 mg/kg) were pervasive throughout subsurface soils, while only three samples (from two soil borings) exceeded the CT DEC (20,000 mg/kg). Most surface soil locations with high zinc concentrations did not have corresponding subsurface samples collected, and therefore the vertical extent of zinc is not defined along the western Study Area boundary or in the playing field. However, based on high concentrations in surface soils in these areas, it is likely the subsurface soils also have elevated concentrations of zinc. The depth to bedrock in these areas is relatively shallow. Average concentrations and frequency of detection of zinc were higher in subsurface soils than surface soils.

4.4.5.5 Copper

The extent of copper contamination in surface and subsurface soils is described below.

Surface Soil

Surface soils analyzed for copper were collected along the western Study Area boundary, in the playing field, in the southwest portion of the Study Area, and south of the playing field

(Figure 4-7a). Copper was detected in 17 of 35 surface soil samples. Concentrations ranged from 9 mg/kg at BF024A to 4900 mg/kg at BF006, with an average detected concentration of 586 mg/kg. Background concentrations (28.79 mg/kg) were exceeded in 13 of those samples, and the CT DEC (2,500 mg/kg) was exceeded twice. The highest concentration, which was two orders of magnitude higher than background concentration, was detected in a sample along the western Study Area boundary (BF006).

Subsurface Soil

Subsurface soil samples analyzed for copper were collected primarily from the southern portion of the Study Area (Figure 4-7b). One subsurface sample was collected from the playing field. Copper was detected in 58 of 59 samples. Concentrations ranged from 10 mg/kg at SB-422 (14 feet to 16 feet bgs) to 193,000 mg/kg at SB-426 (6 feet to 8 feet bgs), with an average detected concentration of 25,700 mg/kg. Concentrations exceeding background (28.79 mg/kg) and the CT DEC (2,500 mg/kg) were pervasive throughout subsurface soils. Most surface soil locations with high copper concentrations did not have corresponding subsurface samples collected, and therefore the vertical extent of copper is not defined along the western Study Area boundary or in the playing field. However, based on high concentrations in surface soils in these areas, it is likely the subsurface soils also have elevated concentrations of copper. The depth to bedrock in these areas is relatively shallow. Average concentrations and frequency of detection of copper were higher in subsurface soils than surface soils.

4.4.5.6 Chromium

The extent of chromium contamination in surface and subsurface soils is described below.

Surface Soil

Surface soils analyzed for chromium were collected along the western Study Area boundary, in the playing field, in the southwest portion of the Study Area, and south of the playing field

(Figure 4-8a). Chromium was detected in 18 of 35 surface soil samples. Concentrations ranged from 11 mg/kg at SB-423 to 119 mg/kg at BF006, with an average detected concentration of 24.9 mg/kg. Background concentrations (16.97 mg/kg) were exceeded in 13 of those samples, and the CT DEC (100 mg/kg) was exceeded once. The highest concentration, which was one order of magnitude higher than background concentration, was detected in a sample along the western Study Area boundary (BF006).

Subsurface Soil

Subsurface soil samples analyzed for chromium were collected primarily from the southern portion of the Study Area (Figure 4-8b). One subsurface sample was collected from the playing field. Chromium was detected in 59 of 59 samples. Concentrations ranged from 4 mg/kg at SB-422 (14 feet to 16 feet bgs) to 234 mg/kg at test pit 15 (1 foot to 3 feet bgs), with an average detected concentration of 59.5 mg/kg. Concentrations exceeding background (16.97 mg/kg) were pervasive throughout subsurface soils. Most surface soil locations with high chromium concentrations did not have corresponding subsurface samples collected, and therefore the vertical extent of chromium is not defined along the western Study Area boundary or in the playing field. However, based on high concentrations in surface soils in these areas, it is likely the subsurface soils also have elevated concentrations of chromium. The depth to bedrock in these areas is relatively shallow. Average concentrations of chromium were comparable in surface and subsurface soil, but the frequency of detection of chromium was higher in subsurface soils than surface soils.

4.4.6 Asbestos in Soils

The extent of asbestos contamination in surface and subsurface soils is described below.

Surface Soil

One hundred forty-nine surface soil samples were analyzed for asbestos (Figure 4-9a). Seventy-nine of those samples had observable amounts of asbestos ranging from trace to 45

percent. Nineteen samples contained asbestos greater than EPA's criterion of 1 percent for Raymark-type waste. The highest observable amount of asbestos was found at A001, located behind the first base bleachers. High amounts of asbestos were also found in other samples in the same area (A002 and BF028). Elevated asbestos (greater than 1 percent) results were found in samples between the western Study Area boundary and the playing field, and under the left field bleachers of the playing field. No asbestos greater than 1 percent was detected along the railroad track, in the area south of the playing field, or in the southwestern corner of the Study Area.

Subsurface Soil

Forty-six subsurface soil samples were analyzed for asbestos (Figure 4-9b). Observable asbestos ranged from trace to 60 percent at test pit 17. Thirty-five samples contained asbestos greater than the EPA's recommended criterion of 1 percent. The highest asbestos concentrations were detected in samples collected from test pits where soil samples were selected based on visual observation of potential waste of fill materials. Samples from test pits 9, 14, 15, and 17 contained 50 percent or more asbestos. Elevated asbestos results were detected at depths ranging from 1 foot to 3 feet bgs at test pit 17, where 50 percent asbestos was found, to 18 feet to 20 feet bgs at SB-425, where 2 percent asbestos was found. Average asbestos concentrations were higher in subsurface soils than in surface soils.

No subsurface samples were collected from areas where surficial soils had high concentrations of asbestos (behind the first base bleachers and the western boundary), so the vertical extent of asbestos contamination in those areas is undefined. However, based on high concentrations in surface soils in these areas, it is likely the subsurface soils also have elevated concentrations of asbestos. The depth to bedrock in these areas is relatively shallow.

5.0 CONTAMINANT FATE AND TRANSPORT

Complex factors govern the fate and transport of contaminants within the Study Area. The past operations and disposal history associated with the Raymark Facility, the varying geologic and hydrogeologic conditions of the Study Area and environs, and the transfer and cross-migration of contaminants between environmental media all influence the migration of contaminants in the soil and groundwater. This section presents a summary of the fate and transport for contaminants within Study Area soils.

Fate and transport issues related to groundwater are not fully addressed in this RI because groundwater is currently under investigation and evaluation as part of OU2.

Section 5.0 summarizes the fate and transport of contamination including:

- Section 5.1 - Contaminant Sources and Releases
- Section 5.2 - Contaminant Fate and Transport in the Study Area

The location of the Study Area is shown on Figure 1-1 and defined in Section 1.0.

5.1 Contaminant Sources and Releases

Contaminants were released into the environment in the Study Area by various historical disposal and operational practices associated with the former Raymark Facility, and potentially from other disposal practices within the Study Area. A summary of past sources and releases of contamination is presented below. A detailed description of former Raymark Facility operations and manufacturing processes is presented in Section 1.0.

A series of four unlined lagoons at the Raymark Facility were used by Raymark to retain and settle particulate matter from process waters generated as a by-product of the manufacturing activities. Sludges excavated or dredged from the lagoons, "off-specification" materials that were discarded, and other waste products were disposed of

as fill in low topographic areas of the Study Area. The nature and concentrations of various contaminants in the fill materials changed over the 70-year operational lifetime of the Raymark Facility due to alterations in manufacturing processes and product lines.

Additionally, a portion of the Study Area was used by the Stratford DPW as a dumping/storage area for brush, leaves, and street sweepings. Jugs of waste oil as well as numerous 55-gallon drums have also been found on site. Spillage, leakage, and other releases of contaminants from other on-site dumping/storage may also be contributors to soil contamination in the Study Area.

5.2 Mechanisms and Factors Governing Fate and Transport

The fate and transport of contaminants in environmental media are determined by a variety of factors. The physical and chemical properties of contaminants and the environmental media, i.e., soil, groundwater, surface water, air, in which the contaminants are released are all factors that determine the eventual fate of these chemicals. For Raymark OU4 Ballfield Site, the combination of site-related contaminants, geologic and hydrogeologic conditions, and surface features influence how contaminants released to site soils have migrated into the underlying groundwater. Once these contaminants have entered groundwater, other fate and transport mechanisms occur that may cause further chemical migration or transformations. Fate and transport of contaminants in groundwater will be addressed under OU2 in the RI report.

5.3 General Fate and Transport Processes of Soil Contaminants

A variety of processes occur that may cause organic and inorganic chemicals present in on-site soils to become immobilized, degraded, or to be mobilized to another environmental medium. Some of these processes include:

Volatilization – Chemicals having high Henry's Law coefficients or vapor pressures will readily enter (volatilize) the ambient air rather than remain adsorbed to the soil particles. Once in the atmosphere, the chemicals may undergo further transport through additional

processes such as advection, diffusion, or dispersion. The chemicals may also be transformed through chemical processes such as hydrolysis or photolysis.

Leaching – Chemicals may be transported downward through the soil strata by water from precipitation or by liquids that infiltrate through the soils. The leaching of chemicals from soils and the subsequent mobilization are controlled by soil properties, i.e., adsorptive capacity, organic carbon content, clay content, or specific surface area, and by chemical properties such as solubility, and ability to partition to other phases.

Runoff/Erosion – In situations where the chemicals remain adsorbed (bound) to soil particles because of the soil or chemical characteristics, chemicals may still be mobilized from contaminated areas to other uncontaminated environmental media. Contaminants can be conveyed over land by runoff that occurs during precipitation events (solubilized in rainwater or adsorbed to suspended particles), or through the erosion of contaminated soils that are present on unstable slopes or topographic features.

These processes are directly influenced by the chemical properties and physical states of the contaminant, as summarized below.

5.3.1 Chemical Properties that Influence Contaminant Fate and Transport

Several chemical properties strongly influence the fate and transport of contaminants in the environment. Each property, along with its relationship to the various fate and transport properties, is defined below.

5.3.1.1 Water Solubility

Water solubility is one of the primary chemical characteristics used to assess chemical fate and transport in the environment. The water solubility of a chemical contaminant provides considerable insight into its mobility, stability, tendency to adsorb to soil or sediment, and propensity to accumulate in the environment or bioaccumulate in the food chain.

Chemicals with high water solubilities, greater than 1000 mg/l or 0.1 percent (Ney, 1990), will have a tendency to remain dissolved in the water column and will not likely partition to soil particles or accumulate in the environment or bioaccumulate in aquatic organisms in the food chain. Highly soluble chemicals are less likely to volatilize from water and are generally more prone to biodegrade and metabolize. As these characteristics indicate, chemicals with higher water solubilities are more likely to be mobile, and therefore less likely to persist in the environment.

Conversely, chemicals with low water solubilities, less than 10 mg/l or 0.001 percent (Ney, 1990), are generally less mobile and are more likely to adsorb to soil particles, accumulate and/or bioaccumulate, and persist in the environment. Low solubility chemicals tend to biodegrade or be metabolized less readily in plants and animals.

Many of the VOCs identified during the RI including ketones, chlorinated compounds, and aromatic compounds have moderate to high water solubilities. SVOCs, pesticides, PCBs, metals, and asbestos detected in the Study Area, which all have relatively low solubilities, are more likely to stay adsorbed to soil and sediment particles and be less mobile.

5.3.1.2 Octanol-Water Partition Coefficient (K_{ow})

The octanol-water partition coefficient (K_{ow}) is a measure of the tendency of an organic compound to partition between organic (in this case, octanol) and aqueous phases. The chemical-specific K_{ow} is an indicator of its water solubility, mobility, sorption, and bioaccumulation. It has also been shown to correlate well with bioconcentration factors in aquatic organisms and the adsorption to soil and sediment (Howard, 1990).

The higher the K_{ow} value of a specific chemical, the greater is the chemical's potential for sorption to soil particles, the lower its mobility, and the more likely it is to accumulate in the environment and bioaccumulate in the food chain. A high K_{ow}, greater than 1000 (Ney, 1990), is indicative of low water solubility and greater persistence in the environment.

Conversely, the lower the K_{ow} value, the greater is the chemical's potential to biodegrade and be metabolized by plants and animals. A low K_{ow}, less than 500 (Ney, 1990), is indicative of high water solubility, high mobility, and little or no accumulation or bioaccumulation.

The VOCs identified in the Study Area have widely varied K_{ow} values. VOCs, as a group, have a stronger tendency to enter into an aqueous solution and migrate in groundwater and surface water than the other organic compounds. Most other organic compounds detected in the Study Area have high K_{ow} values, indicating a stronger preference to adsorb to soil particles and be less mobile.

5.3.1.3 Adsorption Partition Coefficient (K_d & K_{oc})

The adsorption partition coefficients (K_d and K_{oc}) are measures of the tendency of an organic contaminant to bind to soil or sediment particles. Adsorption coefficients are useful in evaluating the mobility of contaminants in the subsurface media. K_d is an experimentally derived coefficient that measures the tendency of a chemical to sorb to a particular soil/ sediment medium. The K_d is both a chemical- and a sorption media-specific coefficient related to the organic carbon content of the medium. K_{oc}, the organic carbon partition coefficient, is a chemical-specific value derived by dividing K_d by the organic carbon content of the sorption medium in order to normalize the value to the organic carbon content of the medium. K_{oc} is defined as the ratio of the amount of chemical absorbed per unit weight of organic carbon in the medium to the concentration of the chemical in solution at equilibrium. Chemicals with high adsorption coefficients have a tendency to bind to soil particles containing organic carbon and are, therefore, relatively immobile in groundwater.

Most of the VOCs identified in the Study Area have low to moderate K_{oc} values. These include: the ketones with the lowest K_{oc} values, and the chlorinated and aromatic compounds with low to moderate K_{oc} values. The VOCs, as a group, have a low tendency to adsorb to soil particles and are, therefore, more mobile in the environment than the

other organic compounds. Most other organic compounds detected in the Study Area have high K_{oc} values, indicating a tendency to sorb to soil particles and be more persistent in the Study Area.

5.3.1.4 Vapor Pressure

Vapor pressure is a measure of the ability of a compound volatilizing from the pure liquid phase into the vapor phase. It provides an indication of the rate at which a chemical will volatilize from soil, sediment, or water. This property is of primary significance at environmental interfaces, such as surficial soil/air, surficial sediment/air, and surface water/air.

Chemicals with higher vapor pressures are expected to enter into the vapor phase more readily than those with lower vapor pressures. If chemicals with low vapor pressures (less than 10^{-6} mm Hg) are present in the atmosphere, they are most likely adhered to suspended particulate matter.

VOCs all have relatively high vapor pressures and will, therefore, tend to enter the vapor phase. Vapor pressures for the major groups of VOCs identified in the Study Area (ketones, chlorinated hydrocarbons, and aromatic hydrocarbons) are generally many orders of magnitude higher than vapor pressures for SVOCs, pesticides, and PCBs. The VOCs identified in the RI are more likely to volatilize from the soil into the soil pore space in the vadose zone. Metals and asbestos, having very low or immeasurable vapor pressures, do not readily volatilize.

5.3.2 Physical State of Contaminants in Environmental Media

The physical state in which contaminants exist in various environmental media dictate the manner in which they may migrate or be transported. The phases in which organic and inorganic contaminants may be present in the soil within the Study Area, as well as the potential to migrate, are discussed below. Issues related to groundwater contaminants are

addressed in a qualitative fashion as they relate to the migration of contaminants to or from soil. Fate and transport of contaminants in groundwater will be addressed as part of the OU2 RI report.

Organic and inorganic contaminants introduced at the ground surface through spills, discharges, or disposal may contaminate the underlying soil, and migrate to downgradient groundwater sources, and/or be discharged into the atmosphere. These contaminants may be present in soils in three principal physical phases: solid, liquid, or vapor.

Solid Phase - Inorganic contaminants (metals and asbestos) are often present in the solid phase, as bulk solids or as suspended particulates in aqueous discharge, when disposed on the surface or into the subsurface. In the solid phase, inorganics are relatively immobile in a soil or sediment matrix unless the particle sizes are sufficiently small that migration may occur as a suspended particle or colloid. Solid phase metal contaminants may also be broken down and/or leached by precipitation or subsequent liquid spills that solubilize the inorganic constituents, and may thereby become mobile.

Organic contaminants are rarely present in the environment in the solid phase.

Liquid Phase - Most of the organic contaminants related to industrial sites are present in the liquid phase (as a separate product or a mixture of liquid chemicals) or in the aqueous phase (dissolved in a water-based solution). Once these liquids enter unsaturated soil or sediment, several processes may occur. The organic contaminants may: (1) become adsorbed to the soil matrix because of low water solubilities, high soil organic carbon partition coefficients, and/or high soil organic content; (2) remain in a liquid phase in the soil pore water spaces as a result of pore size and interfacial tension; or (3) volatilize into soil pore spaces if the contaminants have high vapor pressures or high air-liquid partition coefficients. If present in sufficient quantity, a liquid contaminant (either dissolved or separate phase) may migrate downward under the influence of gravity and enter underlying groundwater.

Metals may also be present in the liquid phase, as dissolved ions. In low pH conditions, more metals are apt to be present as dissolved ions and are, therefore, more readily available to mobilize. For instance, aqueous acid solutions used for cleaning metal surfaces contain numerous dissolved metals. If the solution is discharged into soil, some of the metals may remain in the aqueous phase and/or additional metals present in the soil may dissolve if the pH is sufficiently low. In addition, some metals may precipitate from solution in the presence of minerals in the soil matrix and become adsorbed onto soil particles.

Asbestos is not present in the environment in the liquid phase.

Vapor Phase - Organic contaminants, principally VOCs, present in an unsaturated soil or sediment matrix may volatilize into the pore spaces and migrate through the soil if the vapor pressure is sufficiently high. Once in the vapor phase, VOCs can migrate readily if no barriers impede their movement.

Other organic contaminants (with lower vapor pressures), as well as inorganic contaminants, are not typically present in the environment in the vapor phase.

5.4 Contaminant Fate and Transport in Soils at the Ballfield Study Area

The following section describes the distribution and releases of contaminants at the Study Area, summarizes the physical states of contaminants in the environmental media (soil), and discusses the primary pathways for contaminants in the Study Area to migrate into other environmental media in and around the Study Area.

The fate and transport discussions are focused on the major contaminants of concern (COCs) identified from the human health risk assessment. These COCs include: PAHS, PCBs, and metals (primarily lead), and asbestos. A discussion of VOCs was also included to supplement the evaluation of VOCs in groundwater to be provided in the RI report for OU2.

Contaminants are present in soil samples collected throughout the Study Area; groundwater samples were collected but will be evaluated under the OU2 RI. A summary of the activities resulting in contaminant release to the area, the physical state of the contaminants present in Study Area soil, and the associated fate and transport mechanisms are presented below. Tables 4-3 and 4-4 summarize the analytical results and provide comparisons to relevant criteria.

Based on a prevalence of Raymark-type COCs, the deposition of Raymark fill in the Study Area is a major source of contamination to Study Area soils and to a lesser extent, groundwater. Soluble contamination leaching from waste/fill materials contaminates underlying soils and groundwater. Erosion and surface runoff of dissolved contaminants from waste/fill materials and adsorbed contaminants and asbestos may lead to contamination of soils downwind and downstream of the Study Area. Contact and mixing of waste/fill materials with proximate soils may also lead to the transport of contamination throughout the Study Area and also to off-site locations.

The fate and transport of contamination therefore, depends on the transport mechanisms and the type of chemical contaminant present. A discussion of the fate and transport of the various categories of chemical contaminants in soil throughout the Study Area is presented below.

5.4.1 VOCs in Soils

Due to their high water solubilities, low soil partition coefficients, and low octanol-water partition coefficients, VOCs are readily leached from soil and transported into an aqueous medium. Furthermore, VOCs present in surface soil have more of a tendency to volatilize into the atmosphere. VOCs adsorbed to soil particles or present in soil pore spaces are more apt than other organic compounds to volatilize into unsaturated soil pore spaces or voids, and may potentially migrate to the surface or follow some other preferential flow paths (subsurface drains, utility conduits, etc.) due to their high vapor pressures.

These chemical properties support the infrequent detection of elevated levels of VOCs in surface soil and the somewhat higher frequency in subsurface soil throughout the Study Area. The higher concentrations of VOCs, primarily aromatic hydrocarbons (benzene, toluene, ethylbenzene, and/or xylenes (total), were detected in subsurface soils located in the southern portion of the Study Area. The presence of these contaminants may have been the result of localized releases. This portion of the Study Area was historically used as a dumping/storage area.

5.4.2 SVOCs in Soils

Due to their low water solubilities, high soil partition coefficients, and high octanol-water partition coefficients, SVOCs (primarily PAHs) are more readily adsorbed to soil particles than are VOC contaminants. Furthermore, SVOCs present in surface soil have a tendency to volatilize into the atmosphere. SVOCs adsorbed to soil particles or present in soil pore spaces have a tendency to volatilize into unsaturated soil pore spaces or voids and may potentially migrate to the surface or follow some other preferential flow paths. Their ability to volatilize, however, is less than that of VOCs (with higher vapor pressures) but greater than that of PCBs (with much lower vapor pressures).

These chemical properties support the frequent detection of elevated levels of SVOCs, primarily PAHs, in subsurface soil and the somewhat lower frequency in surface soil throughout the Study Area. The high frequency of detections suggests that the PAHs were sorbed onto soil particles placed in the area as fill material. The somewhat higher frequency of detections in the surface samples suggests a more recent source of contamination, such as residual from street sweepings once dumped at the Study Area.

5.4.3 PCBs in Soils

Due to their low water solubilities, high soil partition coefficients, and high octanol-water partition coefficients, PCBs are more readily adsorbed to soil particles than are either VOC or SVOC contaminants. Furthermore, PCBs present in surface soil have less of a tendency

to volatilize into the atmosphere. PCBs adsorbed to soil particles or present in soil pore spaces have less of a tendency to volatilize into unsaturated soil pore spaces or voids and to potentially migrate to the surface or follow some other preferential flow paths due to their low vapor pressures, compared to the highly volatile VOCs and somewhat volatile SVOCs.

These chemical properties support the frequent detection of elevated levels of PCBs, particularly Aroclor 1262 and Aroclor 1268 (with less frequent detections of Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, and Aroclor 1248), in both surface and subsurface soil throughout the Study Area. The high frequency of PCB detections in both surface and subsurface soils suggests that the PCBs were sorbed onto soil particles placed in the area as fill material from the Raymark Facility. Due to the lack of mobility of PCBs in the environment, the PCBs are likely to have remained where they were deposited.

The levels of PCBs were relatively consistent in soil samples throughout the Study Area. The highest levels were detected in subsurface samples. Surface soils may not have been impacted by Raymark soil-waste/fill to the same extent as subsurface soils. A layer of clean soil put in place to mitigate immediate risks to human health in 1992 may explain lesser concentrations of PCBs in surface soils.

5.4.4 Metals in Soils

Metals tend to be less mobile in the environment than organic contaminants. Under natural conditions, dissolution of metals may occur in the presence of water (due to rainwater runoff or groundwater infiltration) and some metal ions may migrate. However, these dissolved metals can readily precipitate out of solution and adsorb to soil particles. Metals will be more soluble and remain in an aqueous state if the pH is sufficiently low.

These properties support the frequent detection of elevated levels of lead in both surface and subsurface soil throughout the Study Area. The higher concentrations in the subsurface soils may be due to the low likelihood of metals mobility in the environment,

and the likelihood that they have remained where deposited in the soil/waste fill material from the former Raymark Facility.

The leaching of metals to groundwater may not be of concern unless the groundwater quality is degraded to the extent that it poses potential threats to human health or to the environment. MCLs were used to qualitatively identify metals in groundwater that may be of concern. For site groundwater, no metals exceed the MCLs. Most metals that were detected in on-site wells were comparable to concentrations in upgradient wells. Iron and manganese were detected in on-site wells at concentrations greater than at upgradient wells. The presence of iron and manganese in the groundwater samples may reflect the presence of suspended solid/colloids in the wells water column, rather than a dissolved metals presence. In general, the groundwater analytical results indicate that metals in site soils are not being mobilized to groundwater; on-site groundwater metals concentrations are generally comparable to upgradient aquifer locations. Groundwater will be addressed in detail as part of the OU2 RI report.

5.4.5 Asbestos in Soils

Asbestos is relatively immobile in the environment, except through bulk advective movement or dispersion in aqueous or airborne environments.

Elevated levels of asbestos were detected in both surface and subsurface soil through the Study Area, in mostly the same regions where elevated levels of copper and lead were found. Due to the low likelihood of asbestos mobility in the environment, the contaminant is likely to have remained where deposited in the fill material from the Raymark Facility.

6.0 BASELINE HUMAN HEALTH RISK EVALUATION

Section 6.0 presents the methodology for and the results of a baseline human health risk assessment conducted for the Raybestos Memorial Field Study Area described in Sections 1.0 through 5.0. The objective of the assessment is to estimate potential current or future risks to the public from the organic and inorganic chemicals detected in the soil samples collected in the Study Area. Section 6.1 provides an overview of the risk assessment process. Sections 6.2 through 6.5 outline the methodology and results of the baseline human health risk assessment. Appendix D-1, Table 1 presents an overview of the various media, exposure points, potential receptors, and exposure pathways evaluated in this risk assessment. A detailed discussion of the potential receptors, exposure locations, and exposure pathways listed in Appendix D-1, Table 1 is presented in Section 6.3. An analysis of the uncertainties is presented in Section 6.6. The risk assessment conducted for this report follows the most recent guidance from the EPA (EPA, 1989b and 1991a), including regional EPA guidance (EPA, 1989a, 1994c, 1995, and 1996c). Tables were prepared following the standard format in accordance with Risk Assessment Guidance for Superfund Part D (EPA, 1997c). These tables are presented in Appendix D-1.

6.1 Introduction - Overview of Risk Assessment Process

A risk assessment provides the framework for developing information necessary to determine the need for remediating and developing potential remedial alternatives for a site. A baseline human health risk assessment consists of five major components:

- Data evaluation and identification of chemicals of potential concern (COPCs)
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Uncertainty characterization in the risk estimates

To assess potential public health risks, four major aspects of chemical contamination and exposure must be considered: contaminants with toxic characteristics must be found in

environmental media; contaminants must be released by either natural processes or by human action; potential exposure points must exist; and human receptors must be present at the point of exposure. Risk is a function of both toxicity and exposure. If any one of the requirements listed above is absent for a specific site, the exposure route is regarded as incomplete and no potential risks will be considered for human receptors.

The risk assessment for the Raybestos ballfield Study Area estimates the potential for human health risk from exposures to soils in the Study Area.

The Data Evaluation Section is primarily concerned with selecting COPCs that are representative of the type and magnitude of potential human health effects. Both current and historical data are considered in developing a list of COPCs for each medium. In turn, these COPCs are used to evaluate potential risks. A discussion of the process and site-specific issues is contained in Section 6.2.

The Exposure Assessment section (Section 6.3) identifies potential human exposure pathways at the Study Area under consideration. Exposure routes are identified based on information on Study Area chemical concentrations, chemical release mechanisms, human activity patterns, and other pertinent information to develop a conceptual site model. Section 6.3.4 presents the potential human receptors and the relevant exposure assumptions. Section 6.3.6 presents the equations for estimating chemical intake.

The Toxicity Assessment presents the available human health criteria for all the selected COPCs. This assessment is contained in Section 6.4. Quantitative toxicity indices are presented where they are available. A discussion of health effects and dose-response parameters such as Reference Doses (RfDs) and Cancer Slope Factors (CSFs) are presented for each COPC.

The Risk Characterization section (Section 6.5) describes how the estimated intakes are combined with the toxicity information to estimate risks. Uncertainties associated with the risk assessment process are discussed qualitatively in Section 6.6.

6.2 Data Evaluation

Data evaluation is a Study Area-specific task that uses a variety of information to determine which of the detected chemicals at a Study Area are most likely to present a risk to potential receptors. The end result of this qualitative selection process is a list of COPCs and representative exposure point concentrations for each medium. The methodology used to identify COPCs for the OU4 RI Report is provided in Section 6.2.1. The rationale for the selection and/or exclusion of each detected chemical for the OU4 ballfield area is presented in Section 6.2.2. The methodologies used to determine exposure point concentrations for the selected COPCs are presented in Section 6.2.3.

6.2.1 Selection of Chemicals of Potential Concern

COPCs for the baseline human health risk assessments are limited to those chemicals that exceed a selection criterion. For this risk assessment, federal risk-based criteria were used to reduce the number of chemicals and exposure routes considered in a risk assessment. The premise of this screening step is that risk is typically dominated by a few chemicals and that, although dozens may actually be detected, many chemicals may contribute minimally to the total risk.

Maximum detected concentrations (in a single sample) in the soils of the ballfield area were compared to the risk-based screening criteria. If the maximum concentration exceeded the federal screening criteria, that chemical was retained as a COPC for all exposure routes involving soils. For example, if barium was retained for soil, this chemical was evaluated as a COPC for both ingestion and dermal exposure routes.

In general, all available validated data and unvalidated field screening data for metals and PCBs from all EPA historical investigations and the recent (1998 and 1999) TtNUS sampling effort were used to identify COPCs for the Study Area. The COPC selection tables for the OU4 ballfield Study Area soils are discussed in Section 6.2.2. Analytical results qualified as rejected, "R", during the data validation process, were not considered because of their potential unreliability. Soil data collected from depths greater than 15 feet

(the maximum assumed depth for potential human exposure during excavation/construction) and composite soil samples were not used in the COPC selection process.

Essentially, two types of COPCs are identified in the baseline human health risk assessment: direct exposure COPCs and groundwater protection benchmarks based on potential contaminant migration tendencies. Direct exposure COPCs are those chemicals detected at maximum concentrations in excess of criteria developed for the protection of direct human contact with a medium, e.g., risk-based EPA Region IX COPC screening levels for soil contact. Connecticut Remediation Standard Regulations (RSRs) for pollutant mobility are used to identify groundwater protection benchmarks based on likely contaminant migration pathways in the OU4 Study Area. Only chemicals selected as COPCs based on comparisons to direct contact criteria were evaluated quantitatively in the baseline risk assessment. The criteria used to identify COPCs are presented in Appendix D-1, Tables 2.1 and 2.2. The Connecticut RSRs are also presented in Appendix D-1, Tables 2.1 and 2.2. As discussed previously, the groundwater resource at the OU4 ballfield area is not evaluated in this baseline risk assessment. A discussion of the contaminants that exceed the Connecticut RSRs is included in Section 2.2.2.

A discussion of the criteria used for COPC selection is provided in the remainder of this section.

6.2.1.1 Criteria for the Selection of COPCs in Soil

COPCs for soils were selected for the ballfield area. The COPCs selected for shallow soils from depths of 0 to 2 feet bgs are presented separate from COPCs selected for "all soil". The "all soil" category refers to soil samples collected from depths of 0 to15 feet bgs and is based on Connecticut DEP's definition of accessible soils. This category is used to account for soil to which future residents or future commercial workers may be potentially exposed. If a chemical is identified as a COPC for shallow soils, it is automatically retained as a COPC for "all soil." If a compound is found in the "all soil" category only, at

a concentration of concern (in excess of screening criteria), it is retained as a COPC for the "all soil" category only.

The following screening criteria were used to identify COPCs for direct contact exposure to soils:

- **EPA Region IX Preliminary Remedial Goals (PRGs) for Residential Soil Ingestion.** Because land use surrounding the site is residential, it is assumed that future use of the site will be residential. PRG concentrations for soil contact for residential land use were used conservatively as COPC selection criteria. These values were developed using the current EPA Region IX Preliminary Remedial Goals Table (EPA, 1998a), which identifies concentrations of potential concern for nearly 600 chemicals in various media (air, drinking water, and soil) using certain reasonably maximum exposure default assumptions. The EPA Region IX residential soil exposure values were calculated based on the methodology presented in RAGS HHEM, Part B (USEPA 1991b) and consider the ingestion, dermal, and inhalation exposure pathways. For carcinogenic chemicals, the values used for COPC screening are based on a 1E-6 target incremental lifetime cancer risk and incorporate age-adjusted factors (for small children and adults). The criteria for noncarcinogenic chemicals are based on a target hazard quotient (HQ) of 1.0. These EPA Region IX residential soil exposure values for noncarcinogenic chemicals were adjusted to COPC screening levels based on a target hazard quotient (HQ) of 0.5, which is one-half of the suggested cumulative target noncarcinogenic risk for a potential receptor, and exposure defaults for small children. The estimation of cumulative target noncarcinogenic risks is described in greater detail in Section 6.5.

- **EPA Soil Lead Guidance.** EPA Region IX has developed PRG concentrations for lead, based on the EPA's Office of Solid Waste and Emergency Response (OSWER) soil screening level of 400 mg/kg for residential land use (EPA, 1994b). The EPA's Integrated Exposure Uptake and Biokinetic (IEUBK) model, which estimates the risk to a child resident is the basis for this soil screening level. Because land use surrounding the site is residential, it is assumed that future use of the site will be residential. The lead screening level based on residential land use was used as a conservative approach.

- **National Emission Standards for Hazardous Air Pollutants Benchmark for Asbestos.** EPA Region IX has not developed risk-based concentrations for asbestos. Asbestos was a primary component of friction materials, e.g., gaskets material, sheet packing and friction materials, including clutch facing, transmission plates, and brake linings, manufactured at the former Raymark Facility. Quantitative risk estimates (inhalation risk estimates) cannot be developed for this parameter, however asbestos is considered a potential inhalation hazard. The National Emission Standards for Hazardous Air Pollutants - EPA Regulation 40 CFR Subpart M, Appendix A, Part 61 (NESHAPs) defines asbestos as material containing more than 1 percent asbestos. Since asbestos was detected at the site, TtNUS has adopted the NESHAPs benchmark of 1 percent for an asbestos screening value.

Background concentrations for chemicals in soil are presented in Appendix D-2. Concentrations in the background soil samples were not used to select COPCs. A discussion of site data in comparison to the established inorganic and organic background levels is provided in the uncertainty section. It should be noted that background concentrations were considered when developing recommendations and conclusions for the site, i.e., identifying whether additional sampling or remediation is warranted.

Frequency of detection was not used as a COPC selection criterion.

6.2.1.2 Criteria for Identification of Groundwater Protection Benchmarks

In order to identify the potential for contaminant migration to groundwater, state criteria were used to evaluate shallow soil and "all soil" (soil collected from depths of 0 to 15 feet bgs), but, these criteria were not used to select COPCs for quantitative risk assessment.

The state has developed pollutant mobility RSRs for GA/GAA (drinking water source) and GB (non-drinking water source) classified areas. Since the ballfield area is classified by the state as a GB area, Connecticut RSRs for GB pollutant mobility were used to identify groundwater protection benchmarks. For most organic chemicals, RSRs for pollutant

mobility are calculated using methodologies similar to those used to develop the EPA generic SSLs for contaminant migration to groundwater. However, the actual models and reasonable maximum exposure default assumptions employed by the state are different from those advocated by EPA. The standards for carcinogenic chemicals are based on a 1E-6 target incremental lifetime cancer risk. The standards for noncarcinogenic chemicals are based on a target HQ of 1. The comparison of site data to these standards is discussed in Section 6.2.2.2. As mentioned previously, the State of Connecticut has not developed RSRs for all chemicals positively detected at OU4. Therefore, TtNUS has calculated RSRs using state guidance (CT DEP, 1996) for use in the risk assessment (Appendix D-3).

6.2.2 Identification of COPCs

Appendix D-1, Tables 2.1 and 2.2 present a summary of the COPCs for quantitative risk assessment for the ballfield surface soils and "all soils" to a depth of 15 bgs, respectively. COPCs were identified based on a comparison of site data to the COPC screening levels defined in Section 6.2.1. All validated CLP data and field screening data for metals and PCBs collected during recent and historical investigations, except soil data collected from depths greater than 15 feet, were used to identify COPCs. Data for soils at depths greater than 15 feet were not used because human exposure to soils deeper than 15 feet below ground surface is considered unlikely.

An evaluation of groundwater is not part of the scope of work for this human health risk assessment, but will be addressed as part of an area-wide groundwater assessment to be provided in the RI report being prepared for OU2 groundwater. However, a preliminary qualitative assessment of the potential for chemical migration from soils to groundwater was conducted based on a comparison of maximum chemical concentrations detected in soil to the state pollutant mobility GB criteria. These criteria are intended to prevent further degradation by preventing any additional discharges which would cause irreversible contamination. Appendix D-1, Tables 2.1 and 2.2 present the Connecticut RSRs for pollutant mobility GB criteria. Chemicals with maximum concentrations greater than the Connecticut RSRs for pollutant mobility GB criteria are discussed in Section 6.2.2.2. The

comparison allows a preliminary evaluation of the chemicals' potential to migrate to groundwater and potentially impact the quality of groundwater. Chemicals in excess of Connecticut RSRs, but not in excess of direct exposures criteria, are not carried through the quantitative risk assessment (numerical risk estimates are not developed) because they are not considered to be significant contributors to the direct exposure pathways identified for potential human receptors.

A discussion of COPCs is presented in the following paragraphs.

6.2.2.1 Direct Contact COPCs for Soil

The results of the COPC selection process for soils are summarized in Appendix D-1, Tables 2.1 and 2.2. The following chemicals were identified as direct exposure COPCs based on a comparison of maximum site concentrations to Region IX PRG COPC screening levels for residential land use.

- VOCs (benzene, chlorobenzene)
- PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno[1,2,3-cd]pyrene)
- Total Aroclors (1016, 1232, 1242, 1262, and 1268)
- Metals (arsenic, barium, cadmium, chromium, lead, thallium, and zinc)
- Asbestos
- Pesticides (dieldrin, heptachlor)

Total Aroclors, benzo(a)pyrene, dibenzo(a,h)anthracene, arsenic, barium, chromium, lead, and asbestos were retained as COPCs for both surface soils and the 0 to 15 feet bgs category since they were present at concentrations exceeding Region IX PRG levels in 0 to 2 feet of soils. Benzo(a)anthracene, benzo(b)fluoranthene, indeno[1,2,3-cd]pyrene, benzene, chlorobenzene, dieldrin, heptachlor, cadmium, thallium, and zinc were selected as COPCs for the 0 to 15 feet bgs category only. The maximum concentrations of these chemicals in the surface soil samples (from depths of 0 to 2 feet bgs) were less than the direct exposure COPC screening levels.

6.2.2.2 Groundwater Protection Benchmarks

Maximum detections in soil were also compared to Connecticut RSRs for pollutant mobility in a GB-classified area. GB classified waters are defined as non-drinking water sources and such a classification stipulates elimination or reduction in the groundwater of pollutants which pose a threat to public safety, or an unacceptable risk to public health; meeting surface water protection and volatilization criteria; maintenance of quality consistent with designated use; and regulation of discharges to groundwater to prevent further degradation. Maximum concentrations of the following chemicals exceeded the Connecticut soil pollutant mobility criteria, indicating a potential for these chemicals to migrate to groundwater and potentially impact the quality of groundwater:

- VOCs (benzene)
- SVOCs (carbazole, 2,4-dimethylphenol, 4-methylphenol, 3,3'-dichlorobenzidine, and N-nitrosodiphenylamine)
- PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno[1,2,3-cd]pyrene)
- Pesticides (dieldrin, alpha-chlordane, gamma-chlordane, 4,4'-DDE, 4,4'-DDD, 4,4'-DDT, aldrin, alpha-BHC, beta-BHC, heptachlor, heptachlor epoxide, endrin, and endrin ketone)

Maximum detections of N-nitrosodiphenylamine, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, 4,4'-DDE, 4,4'-DDD, 4,4'-DDT, endrin, and endrin ketone exceeded the groundwater protection benchmarks in both surface soils and the 0 to 15 feet bgs soil category. Maximum detections in soil of benzene, carbazole, 2,4-dimethylphenol, 4-methylphenol, 3,3'-dichlorobenzidine, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dieldrin, alpha-chlordane, gamma-chlordane, aldrin, alpha-BHC, beta-BHC, heptachlor, and heptachlor epoxide exceeded the groundwater protection benchmarks for the 0 to 15 feet bgs category only. The maximum concentrations of these chemicals in the surface soil samples (from depths of 0 to 2 feet

bgs) were either less than the Connecticut RSRs for pollutant mobility in a GB-classified area or the chemicals were not detected in the surface soil samples.

6.2.4 Exposure Point Concentrations

According to the regional guidance, risk assessments are conducted using an exposure point concentration for each COPC. The exposure point concentration is defined as the 95 percent upper confidence limit (UCL) and is calculated using the latest risk assessment guidance from EPA (EPA, 1992b, 1992c, and 1994c). A value of one-half the detection limit is substituted for nondetected values in the calculation. Because of potential problems with sample heterogeneity, the maximum detected concentration reported for field duplicate pair samples was used to calculate the soil matrix, at the direction of EPA.

The UCL does not provide a good estimation of the upper bound of the mean concentration for the small data sets (EPA, 1992c). For sample sets consisting of less than 20 samples, the maximum concentration was used as the exposure point concentration for the reasonable maximum exposure (RME). For these small data sets, the lesser of the maximum and arithmetic average concentration was used as the exposure point concentrations for central tendency exposure (CTE). For larger sample sets, the methodology used depends on the distribution of the sample set. For this risk assessment, the distribution was determined using the Shapiro-Wilk W-Test (Gilbert, 1987). When the results of the test were inconclusive and the distribution was regarded as undefined, the distribution was assumed to be log normal and the 95 percent UCL for log-normally distributed data sets was selected as the exposure point concentration for both the RME and CTE cases.

For normally distributed data, the calculation of the UCL is a two-step process. First the standard deviation of the sample set must be determined, as follows:

$$S = \left[\frac{\Sigma(X_i - \overline{X})^2}{(n-1)} \right]^{1/2}$$

where:	S	=	standard deviation
	X_i	=	individual sample value
	n	=	number of samples
	$\bar{x}$	=	mean sample value

The one-sided UCL on the mean is then calculated as follows:

$$UCL = \bar{X} + t\left(\frac{S}{n^{1/2}}\right)$$

where:	UCL	=	95 percent Upper confidence limit of the mean
	$\bar{X}$	=	Arithmetic average
	t	=	One-sided t distribution factor ($t_{0.95,\ n-1}$)
	S	=	standard deviation
	n	=	number of samples

For log-normally distributed data sets, the UCL is calculated using the following equation:

$$UCL = \exp\left(\bar{X} + 0.5s^2 + \frac{Hs}{(n-1)^{1/2}}\right)$$

where:	UCL	=	95 percent UCL of the mean
	exp	=	Constant (base of the natural log, e)
	$\bar{X}$	=	Mean of the transformed data
	s	=	Standard deviation of the transformed data
	H	=	H-statistic (from Gilbert, 1987; $H_{0.95}$)
	n	=	Number of samples

This equation uses individual sample results that have been transformed by taking the natural logarithm of the results.

Sample calculations for determining the distribution of a data set, UCL, and average and maximum concentrations are provided in Appendix D-4. After the UCL was calculated, it

was compared to the maximum detected concentration within the data set. In data sets in which the calculated 95 percent UCL exceeded the maximum detected concentration, the maximum detected concentration was used as the RME exposure point concentration; the lesser of the mean or maximum concentration detected was used for the CTE exposure point concentrations. Support documentation for the calculation of 95 percent UCLs is presented in Appendix D-4. Exposure point concentrations used in the risk assessment are presented in Appendix D-1, Tables 3.1 and 3.2.

6.3 Exposure Assessment

The exposure assessment defines and evaluates the exposures experienced by a receptor population. To have an exposure, several factors must be present: there must be a source of contamination, there must be a mechanism through which a receptor can come into contact with the contaminants in that medium, and there must actually (or potentially) be a receptor present at the point of contact.

The exposure assessment presented consists of several sections that characterize the physical site setting and the receptors of concern, identifies the potential contaminant migration and exposure pathways, defines the contaminant concentrations at the point of exposure, and presents the equations used to quantify exposure in terms of contaminant intake (dose). Appendix D-5 of this report contains sample calculations for the exposure assessment. Exposure Assumptions are presented in Appendix D-1, Tables 4.1 through 4.5. Intakes are presented in Appendix D-1, Tables 7.1 through 7.3 and 8.1 through 8.3.

6.3.1 Exposure Setting

This section contains information on the land use and receptor characteristics in the Raybestos ballfield Study Area. The potential for exposure at the Raybestos ballfield Study Area is based on several factors, including current and future land uses, activity patterns, site access controls, chemical behavior in the environment, and the presence of human receptors. Based on these variables, exposure scenarios were developed to characterize the potential for human exposure under both current and future site conditions. The future

scenario accounts for possible or anticipated changes in land use and site characteristics that may alter exposure and/or concentrations of COPCs in a given medium.

The exposure assessment is based on the assumptions that, in general, chemical compositions for environmental media are identical under current and future site conditions. Under current conditions, potential human receptors (the recreational user and commercial worker) are assumed to be exposed to exposed surface soil (0 to 2 feet bgs). Similar soil exposure is likely for potential recreational receptors under future conditions. In the future contaminated soils currently located at depth and/or beneath pavement to a maximum depth of 15 feet bgs may be brought to the surface during land development (excavation/construction). Under future conditions, commercial workers and residents are evaluated for exposure to soils collected from depths of 0 to 15 feet bgs.

A summary of the potentially significant exposures identified for quantitative evaluation is provided in Appendix D-1, Table 1.

Land Use. The Raybestos ballfield Study Area was described in detail in Section 1.3.4 and is shown in Figure 6.1. The Study Area, owned by the Daley Development Corporation, includes a former ballfield area and a vacant field. One corner of the site is used for commercial storage. Most of the property within the Raybestos ballfield Study Area is fenced and vacant. None of the property within the Raybestos ballfield Study Area has been developed for residential purposes. However, residential areas do border the Study Area.

The ballfield lies north-northwest of the former Raymark Facility. The site encompasses approximately 13 acres, 10 of which lie outside of the ballfield proper (identified as within the outfield fence).

The ballfield area was used as a softball field for the Raybestos women's softball team from the 1940s until the 1980s. The Study Area still contains the bleachers, fencing, lighting, parking area, and playing field outline that was used during team play.

The Raybestos Memorial Field was built between 1940 and 1949 and has functioned as a ballfield continuously since that time. The existing vacant field was used as a source of sand and gravel in the 1940s. A large pond (Frog Pond) is visible in a 1940 aerial photograph and is located in the southern portion of the field. The pond was apparently filled in the years that followed.

Eventually, on-site sand and gravel removal activities ceased and the excavated area was used for disposal purposes. The former Raymark Industries Inc. company disposed an unknown quantity of wastes at this site containing asbestos and non-asbestos material, metals, pheno-formaldehyde resins, and various adhesives. Reportedly, the Town of Stratford also used the site as a dumping ground for asphalt, road salt, dirt, and trash (EAI, 1990).

In the 1970s, Raymark Industries, Inc. placed a 2-foot soil cover over identified areas of surficial asbestos contamination. The site was purchased by the Daley Development Corporation of Stratford, Connecticut in 1986.

In 1989, the U.S Environmental Protection Agency (EPA) conducted a preliminary assessment of the site. In 1990, EPA issued an Administrative Order for Removal Action to the Daley Development Corporation. In 1992, as a result of Daley's failure to implement the removal action, EPA assumed responsibility for site actions and implemented the following actions: installed a site security fence, cleared vegetation that may interfere with cap/cover placement, graded and capped areas of the site with clean soil (6 inch minimum cover), and sampled and removed on-site drums. Soil sampling profiles collected after completion of the cover indicate the soil cover ranges in thickness from approximately 6 to 11 inches (EPA, 1992a). Other site investigations were performed during the period from 1988 through 1992 (soil borings, soil sampling, test pits); however, these activities appear to have had little impact on site habitat or topographic features.

Fences restricting access are located around most of the site; however, access may still be possible. In addition, fencing may not limit access under future land use conditions.

Exposed Populations. The Raybestos ballfield Study Area is located in Stratford, Fairfield County, Connecticut. The principal industries within the community of Stratford include manufacturing aircraft, air conditioners, brake linings, chemicals, plastic, paper, rubber goods, electrical and machine parts, and toys. There were 49,389 people reported on the 1990 census for the Town of Stratford. The Stratford Town Clerk reported this as a slight decrease from the last census in 1980. Potentially exposed populations within the Raybestos ballfield Study Area are discussed in Section 6.3.4.

Several potential receptor populations were initially considered for inclusion in the exposure assessment. However, the majority of these receptors were eliminated from further evaluation based on the current land use, site access, COPCs, and the likelihood of exposure. Of the receptors initially considered (residents, recreational users, commercial workers, construction workers, and trespassers), the receptors retained for quantitative evaluation are current recreational users, future residents, and future commercial workers.

The Raybestos ballfield Study Area was primarily used for recreational purposes, however, the area is now vacant except for one corner where commercial activities take place. All areas of the site are assumed to be accessible to all receptors.

Possible exposures of commercial workers to site-related contaminants would be through future commercial/industrial activities in the Raybestos ballfield Study Area. The area of the site currently used for commercial purposes is covered by pavement, eliminating current exposures for commercial workers.

Future on-site residents and commercial workers were included in the baseline risk assessment. No major construction projects are planned for the Raybestos ballfield Study Area or the surrounding areas. However, the baseline risk assessment was conducted assuming that the future commercial worker or resident may be exposed to soils as deep as 15 feet bgs in the future. Groundwater at the site is not used or expected to be used in the future as a potable water supply because of brackish conditions.

6.3.2 Conceptual Site Model

This section discusses the general conceptual site model for the Raybestos ballfield Study Area. A conceptual site model facilitates consistent and comprehensive evaluation of the risks to human and ecological health by creating a framework for identifying the paths by which human health may be impacted by contaminants predicted to exist at the source areas. A conceptual site model depicts the relationships between the elements necessary to construct a complete exposure pathway, as follows:

- Sources and potential COPCs
- Contaminant release mechanisms
- Contaminant transport pathways
- Exposure mechanisms and exposure routes
- Receptors

One simple conceptual site model was developed for the Study Area to provide the basis for identifying the potential risks to human health and the environment. The model considers the current and future conditions within the Study Area, and the actual or potential receptors that might come into contact with the COPCs.

The conceptual site model first considers the contaminant sources assumed to be available, either currently or in the future. For this model, the Raymark Facility soil-waste disposed of within the Study Area, is considered the source. Contaminants may be released from this sources by mechanisms such as wind or water erosion or leaching to the subsurface. Once released from the source, contaminants are transported in media such as air, surface water, or groundwater. Receptors may be exposed either directly or indirectly to contaminants in environmental media via a variety of mechanisms. The exposure mechanisms considered include recreating or working outdoors, etc. These exposure mechanisms generally act along one or more exposure routes such as ingestion, inhalation, or direct dermal contact.

The conceptual site model also indicates those exposure routes that are carried through the quantitative risk assessment for each receptor. An objective of developing the conceptual site model is to focus attention on those pathways that contribute the most to the potential impacts on human health and the environment, and to provide the rationale for screening out other exposure pathways that are minor components of the overall risk.

6.3.2.1 Sources of Contamination

The Raymark Industries, Inc. (Raymark) Facility, formerly named Raybestos - Manhattan Company, is located at 75 East Main Street in Stratford, Fairfield County, Connecticut. This facility occupied 33 acres and manufactured friction materials containing asbestos and non-asbestos materials, metals, phenol-formaldehyde resins, and various adhesives. Primary products were gasket material, sheet packing and friction materials including clutch facings, transmission plates, and brake linings. As a result of these activities, soils at the Raymark Facility have been contaminated primarily with asbestos, lead, and PCBs. A source control remedial action (Operable Unit No. 1) consistent with the Record of Decision (ROD) was completed at the Raymark Facility in 1997.

Raymark operated from 1919 until 1989, when the plant was shut down and permanently closed. During Raymark's 70 years of operation, it was common practice to dispose of manufacturing waste at locations in Stratford. The former Raymark Industries Inc. company disposed an unknown quantity of wastes containing asbestos and non-asbestos material, metals, pheno-formaldehyde resins, and various adhesives in the formerly excavated area of this site.

6.3.2.2 Contaminant Release and Migration Mechanisms

Chemicals may be released from the Study Area by a variety of mechanisms. These include stormwater runoff and subsequent surface soil erosion, soluble chemicals infiltration, and subsequent migration through the subsurface soil to the water table where the chemicals may migrate downgradient, and via wind erosion of surface soil from unpaved areas (Section 5.1).

Storms generate runoff, which is directed toward stormwater drainageways. Initially, this water may move across an area as sheet flow, which can entrain loose soil material. This soil is moved as a sediment and will be deposited where the flow velocity diminishes below that needed to carry a particular grain size. Typically, in undeveloped areas, this soil/sediment is deposited in small drainageways and migrates farther downstream with each new storm, which also adds new material.

Soluble chemicals released to the ground surface may also migrate downward through the soil column with infiltrating precipitation. The migration of these chemicals may be somewhat impeded by the chemical's tendency to bind to soil organic material. Eventually, these soluble chemicals may reach the water table. Once in the groundwater, chemicals may continue to migrate via dispersion and advection in the downgradient direction. Eventually, these chemicals may discharge with the groundwater to surface water bodies such as Ferry Creek.

Chemicals adsorbed to surface soil may also be released from a site via wind erosion of loose soil material. These particulates are carried downwind and potentially off site if the grain size is small enough and the wind velocity is great enough. Additionally, chemicals may also be released from soil via volatilization.

6.3.3 Potential Routes of Exposure

A receptor can come into contact with contaminants in a variety of ways, which are generally the result of interactions between a receptor's behavior or lifestyle and an exposure medium. This assessment defines an exposure route as a stylized description of the behavior that brings a receptor into contact with a contaminated medium.

6.3.3.1 Direct Contact with Soil

Receptors may come into direct contact with soil affected by the release of chemicals from the source areas. During the receptor's period of contact, the individual may be

exposed via inadvertent ingestion of a small amount of soil or via dermal absorption of certain contaminants from the soil.

Because of the limited guidance available to estimate exposure to soil via dermal contact, EPA Region I recommends performing a quantitative evaluation of dermal risks for arsenic; cadmium; chlordane; 2,4-dichlorophenoxyacetic acid (2,4-D); dichlorodiphenyltrichloroethane (DDT); dioxins; PAHs (benzo(a)pyrene); PCBs (Aroclor 1254 and 1242); and pentachlorophenol, only. Several of these chemicals were selected as COPCs for the Raybestos ballfield Study Area. Therefore, dermal risks associated with soil were quantitatively addressed in the risk assessment. Dermal contact with other chemicals detected in the site soils may or may not result in a significant exposure. It should be noted that organics such as PAHs, which were detected frequently in the soil samples and selected as COPCs, tend to strongly adhere to organic matter in soil. For these chemicals to be percutaneously absorbed, they must first desorb from soil and diffuse through the skin. Various factors affect the rate of dermal absorption, including the amount of soil on the skin surface, soil characteristics (moisture, pH, organic carbon content, etc.), skin characteristics (thickness, temperature, hydration, etc.), volatilization losses, and chemical-specific properties.

6.3.3.2 Air

This pathway is based on the scenario that a receptor is immersed in air that contains suspended particulates and volatile organic vapors originating from the source areas as part of daily living. Subsequent exposure of the receptor occurs upon inhalation of the ambient air.

Initially, a qualitative comparison of maximum detected soil concentrations and EPA Generic SSLs for inhalation, based on intermedia transfer (from soil to air), was performed to determine if additional quantitative analysis of this potential exposure pathway was warranted. The inhalation SSLs are based on residential land use and lifetime exposure scenarios and are therefore relatively conservative values for potential receptors under current land use conditions. Exposures to fugitive dust and VOCs released from soil

(surface soil and "all soil") were found to be insignificant in most cases based on the qualitative screening, which is summarized in Appendix D-6. Maximum chemical detections in soil were less than the SSLs for all COPCs identified in the Study Area, except for one sample each of benzene and heptachlor in the "all soil" category. Both the 95 percent UCLs and the average concentrations of these two chemicals were below their respective SSLs; therefore, the inhalation exposure pathway was not considered for further evaluation.

6.3.4 Potential Receptors

Several potential receptors have been identified under both current and future land use conditions. These receptors were identified by analyzing the interaction of current and anticipated future land use practices and the identified sources of contamination.

Several receptor groups have been defined for this risk assessment. These receptors are as follows:

- Frequent recreational users - Residents (adults and children) who reside at properties located in the vicinity of the Study Area and who may periodically visit (recreate) within the Study Area.

- Future Residents (adults and children) who reside at properties located within the Raybestos ballfield Study Area.

- Future Commercial Workers - Adults working 40 hours per week at a commercial facility within the Raybestos ballfield Study Area.

- Current Commercial Workers - Adults working 40 hours per week at a commercial facility within the Raybestos ballfield Study Area.

Except for current commercial workers, each receptor group is evaluated quantitatively. Table 1 of Appendix D-1 presents receptors and exposure pathways identified for the

Study Area and provides the rationale for the quantitative evaluation of selected exposure pathways.

Two bounding estimates of each exposure scenario are considered according to or consistent with EPA Region I guidance. The first is identified as a central tendency exposure (CTE) receptor, which was developed using both regional guidance (EPA, 1994c) and professional judgment regarding site-specific conditions. The second class of receptor is called the reasonable maximum exposure (RME) and was developed according to EPA guidance (EPA, 1989b and 1994c). The CTE scenario uses average values for exposure parameters concentrations and represents an "average case" exposure scenario. The RME scenario uses maximum values for exposure parameters and represents a "reasonable worst case" exposure scenario. The RME scenario is intended to provide an upper bound of the possible risk.

6.3.4.1 Recreational Users

Adult and child recreational users were evaluated for exposures to exposed surface soils. The frequent recreational user was evaluated because residential properties border the Study Area. Recreational users of the Study Area were assumed to be adults and young children.

Site-specific considerations were used to determine exposure frequencies for recreational users. Recreational users were assumed to be exposed 150 days/year, corresponding to 3 days/week year-round. Adult receptors are assumed to ingest an average of 50 mg of soil per day for 7 years for the CTE and 100 mg/day for 24 years for the RME. Child receptors are assumed to ingest an average of 100 mg/day for 2 years for the CTE and 200 mg/day for 6 years for the RME. The fraction of soil intake derived from the contaminated source is set at one. The proposed exposure duration values are based on EPA guidance for RME and CTE evaluation (EPA, 1997b). Values for small children for the RME reflect the entire age span for the receptor evaluated. The associated CTE values reflect a short period of time (basically one third of the RME value).

Hands, forearms, lower legs, feet, and head are expected to be available for dermal contact with soil for young children. Hands, forearms, lower legs, and head are expected to be available for dermal contact with soil for adults. The calculated available skin surface areas for dermal contact with soil for adults and small children (ages 0-6 years) were 5,700 cm^2 and 2,900 cm^2, respectively. No attempt was made to vary a receptor's surface area for the RME and CTE. Values of 0.07 mg/ cm^2 and 0.01 mg/cm^2 were used as soil-to-skin adherence factors for adult exposures for the RME and CTE, respectively. The adult recreational soil-to-skin adherence factor corresponds to 50th percentile weighted adherence values for reed gatherers. Values of 0.2 mg/ cm^2 and 0.06 mg/cm^2 were used as soil-to-skin adherence factors for child exposures for the RME and CTE, respectively. These values represent 95th percentile and 50th percentile values estimated for daycare activities. Daycare activities are considered a central tendency soil contact activity. The values have been recommended in working drafts of EPA Interim Guidance entitled: "Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance, Dermal Risk Interim Guidance" (EPA 1998b). The values were based on data presented in the 1997 version of the EPA Exposure Factor Handbook.

6.3.4.2 Future Potential Residents

Adult and child potential future residents were evaluated for exposures to soils to a depth of 15 feet bgs, regardless of pavement, for the future land use scenario. CT DEP defines accessible soils as those found at depths of 15 feet bgs or less. All residents are exposed to soils 350 days per year, which is consistent with EPA and DEP default values.

Adult residents are assumed to ingest an average of 50 mg/day of soil for 7 years for the CTE and 100 mg/day of soil for 24 years for the RME. Children are assumed to ingest an average of 100 mg/day of soil for 2 years for the CTE and 200 mg/day of soil for 6 years for the RME. Residents are assumed to ingest soil only from the contaminated source. The proposed exposure duration values are based on EPA guidance for RME and CTE evaluation. Values for small children for the RME reflect the entire age span for the receptor evaluated. The associated CTE values reflect a short period of time.

Hands, forearms, lower legs, feet, and head are expected to be available for dermal contact with soils for young children. Hands, forearms, lower legs, and head are expected to be available for dermal contact with soils for adults. The calculated available skin surface areas for adults and small children (0-6 years) were 5,700 cm^2 and 2,900 cm^2, respectively. No attempt was made to vary a receptor's surface area for the RME and CTE.

Values of 0.07 mg/ cm^2 and 0.01 mg/cm^2 were used as soil-to-skin adherence factors for adult residents for the RME case and CTE case, respectively. The RME value corresponds to 50th percentile weighted adherence values for gardeners. Gardening is considered a high-end soil contact activity. The CTE value corresponds to 50th percentile weighted adherence values for groundskeepers. Groundskeeping is intended to represent a central tendency soil contact activity. Values of 0.2 mg/ cm^2 and 0.06 mg/cm^2 were used as soil-to-skin adherence factors for child residents for the RME case and CTE case, respectively. These values represent 95th percentile and 50th percentile values estimated for daycare activities. Day-care activities are considered a central tendency soil contact activity. The values have been recommended in working drafts of EPA Interim Guidance entitled: "Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance, Dermal Risk Interim Guidance". The values were based on data presented in the 1997 version of the EPA Exposure Factor Handbook.

At the request of the state, risk estimates have been prepared for residential exposures to soils to a depth of 4 feet bgs using RME assumptions only. See Appendix D-10.

These risks are intended to address direct contact current or future risks for either residential or recreational exposures with institutional controls in place to prevent excavation of soils below four feet bgs.

6.3.4.3 Future Commercial Workers

The adult commercial worker was evaluated for exposures to soils to a depth of 15 feet bgs, regardless of pavement, for the future land use scenario. In the future, contaminated

soils currently located at depth and/or beneath pavement may be brought to the surface through excavation and land development. The area of the site currently used commercially is covered by pavement, therefore direct contact with surface soils is eliminated as a current exposure pathway.

Possible exposures of commercial workers to site-related contaminants would be through inadvertent contact. Commercial workers are assumed to be exposed to site media 250 days/year. These receptors are assumed to ingest an average of 50 mg/day for 7 years for the CTE and 100 mg/day for 25 years for the RME. Hands, forearms, lower legs, and head are expected to be available for dermal contact with soil. The calculated available skin surface area for dermal contact with soil for adults was 5,700 cm^2. No attempt was made to vary a receptor's surface area for the RME and CTE. A value of 0.07 mg/ cm^2 was used as the soil-to-skin adherence factor for adult commercial workers for both the RME case and CTE case. This value corresponds to 50th percentile weighted adherence values for gardeners. Gardening is considered a high-end soil contact activity (USEPA 1998b).

6.3.5 Exposure Pathways

An exposure pathway consists of four elements: a source and mechanism of release, a route of contaminant transport through an environmental medium, a contact point for a human receptor, and an exposure route at the point of contact. All four components must be present for the exposure pathway to be considered complete. This section summarizes the potentially complete exposure pathways that are quantitatively evaluated in the risk assessment and provides the rationale for those pathways that are not evaluated. Appendix D-1, Table 1 presents a summary of the potentially complete and incomplete exposure pathways and receptors.

The primary routes of exposure for potential human receptors at the Raybestos ballfield Study Area are incidental ingestion of and dermal contact with soil. Other potential exposure routes such as those associated with using groundwater or inhaling fugitive dust and volatile emissions, were not considered for the following reasons:

- The shallow aquifer at the Raybestos ballfield Study Area is not used as a potable water supply either at the Raybestos ballfield Study Area or in the surrounding areas. Shallow groundwater at the site discharges to Ferry Creek and its tributaries. Thus, domestic groundwater exposures by nearby residents are eliminated. In addition, as previously mentioned, groundwater at the site is not used or expected to be used in the future as a potable water supply because of brackish conditions and productivity constraints. It should be noted that groundwater quality at the Raybestos ballfield Study Area is being investigated as a separate operable unit.

- Potential exposure to volatile emissions and fugitive dust from soils at the Raybestos ballfield Study Area is considered to be minimal, thereby eliminating the need for quantitative evaluation of this exposure pathway. As shown in Appendix D-7, all reported surface and subsurface soil concentrations are less than the EPA Generic SSLs for transfers from soil to air (EPA, 1996a) with the exception of benzene and heptachlor.

6.3.6 Quantification of Exposure

Estimates of exposure are based on the contaminant concentrations at the exposure points and on scenario-specific assumptions and intake parameters. The models and equations used to quantify intakes are described in this section and have been obtained from a variety of EPA guidance documents that are cited in the specific intake estimation sections that follow.

Exposures depend on the predicted concentrations of chemicals in environmental media and local land use practices, and both are subject to change over time. This results in a large number of possible combinations of receptors, media, exposure pathways, and concentrations. As mentioned previously, Appendix D-1, Table 1 presents a summary of the exposure pathways evaluated in the quantitative risk assessment. Some of these

scenarios (such as occupational and recreational scenarios) may be applicable under both current and future land use conditions.

Exposure model parameters are presented in Appendix D-1, Tables 4.1 through 4.5. The values reflect current EPA guidance and comments received from EPA Region I. All parameters are referenced in footnotes on each table. These parameters are used in the equations presented in this section, along with the exposure point concentrations presented in Appendix D-1, Tables 3.1 and 3.2, to calculate intakes, which are used to determine risks. Individual chemical intakes for each receptor/exposure route combination are presented in Appendix D-1, Tables 7.1 through 7.3 and 8.1 through 8.3.

Incidental Ingestion of Soil. The estimation of intake of contaminants in soils is determined using the predicted concentration of a contaminant in the Study Area of interest. This pathway is evaluated for both child and adult receptors involved in recreational activities, potential future commercial workers, and potential future residents. In general, intakes associated with soil ingestion are calculated using the following equation:

$$Intake_{si} = \frac{(C_{si})(IR)(FI)(OABS)(EF)(ED)(CF)}{(BW)(AT)}$$

where: $Intake_{si}$ = intake of contaminant "i" from soil (mg/kg/day)

C_{si} = concentration of contaminant "i" in soil (mg/kg)

IR = ingestion rate (mg/day)

FI = fraction ingested from contaminated source (decimal fraction)

OABS = oral relative absorption factor (decimal fraction)

EF = exposure frequency (days/yr)

ED = exposure duration (yr)

CF = conversion factor (10^{-6} kg/mg)

BW = body weight (kg)

AT = averaging time (days);

for noncarcinogens, AT = ED*365 days/yr;

for carcinogens, AT = 70 yr*365 days/yr

Appendix D-1, Tables 4.1 through 4.5 contain summaries of the input parameters for incidental ingestion of soil.

Dermal Contact with Soil

Dermal contact exposures to soil may also occur during recreational, residential, and commercial/industrial scenarios. A quantitative evaluation of dermal exposure to soil was performed for arsenic, cadmium, PAHs (benzo(a)pyrene), and PCBs, only. Exposure to other chemicals detected at the Raybestos ballfield Study Area is addressed in a qualitative fashion.

The following equation was used to estimate the dermal exposure dose for soil:

$$Dose\ (mg/kg/day) = \frac{(C)(DABS)(AF)(SA)(EF)(ED)(CF)}{(BW)(AT)}$$

where:	C	=	exposure concentration for soil/sediment (mg/kg)
	DABS	=	dermal absorption factor (unitless)
	AF	=	soil-to skin adherence factor (mg/cm^2)
	SA	=	skin area available for contact (cm^2/day)
	EF	=	exposure frequency (days/year)
	ED	=	exposure duration (years)
	CF	=	conversion factor ($1E^{-6}$ kg/mg)
	BW	=	body weight (kg)
	AT	=	averaging time (70 years * 365 days/year for carcinogens; ED * 365 days/year for noncarcinogens)

Chemical-specific dermal absorption factors (DABS), presented in working drafts of EPA Interim Guidance entitled: "Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance, Dermal Risk Interim Guidance", were used to estimate exposure doses. Unfortunately, limited information regarding dermal absorption is available. The cited guidance presents sufficient data to evaluate arsenic, cadmium, chlordane, 2,4-D, DDT, dioxins, PAHs, PCBs, and pentachlorophenol, only. The DABS values provided for the COPCs among these chemicals are presented in Appendix D-1, Table 5.1. Because of the absence of dermal absorption data, TtNUS qualitatively evaluated dermal exposures to all other COPCs.

Input parameters for dermal contact with soil are summarized in Appendix D-1, Tables 4.1 through 4.5.

6.3.7 Exposure to Lead

Residential child exposure to lead was evaluated using the EPA Integrated Exposure Uptake Biokinetic (IEUBK) Model for lead, version 0.99D (EPA, 1994a). This model is designed to estimate blood levels of lead in children (under 7 years of age) based on either default or site-specific input values for air, drinking water, diet, dust, and soil exposure. Exposures to lead by nonresidential adults are evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, 1996c and 1996d). The approach focuses on estimating fetal blood-lead concentrations in women exposed to lead contaminated soil in non-residential scenarios. Since children are a more sensitive subpopulation than adults, exposure to lead by adults in a residential scenario is not generally evaluated. However, evaluation of risks from the ingestion of soil was performed based on a receptor exposure scenario for an adult commercial worker.

Blood lead concentration is the most widely used index of internal lead body burdens associated with potential adverse health effects. Studies indicate that infants and young children are extremely susceptible to adverse effects from exposure to lead. Considerable behavioral and developmental impairments have been noted in children with elevated blood-lead levels. The threshold for toxic effects to children from this chemical is believed

to be in the range of 10 μg/dL to 15 μg/dL. Blood lead levels greater than 10 μg/dL are considered to be a "concern."

In general, the IEUBK Model and Technical Review Work Group Model for lead were used to address exposures to lead when detected soil concentrations exceeded the OSWER soil screening level of 400 mg/kg for residential land use (EPA, 1994b). Exposure concentrations, as well as default parameters for some input parameters, were used in the evaluation. Because the output of these models is a range of predicted blood-lead concentrations, it is appropriate to input average soil lead concentrations rather than 95 percent UCL values. Entering a 95 percent UCL tends to bias the model outputs toward the high end, thus potentially overestimating risk. The exposure point concentrations selected for use in this evaluation are the arithmetic average soil lead concentrations for the exposure areas. The results of the lead exposure evaluation are discussed in Section 6.5.2. The input parameters used and the results of lead models, estimated blood-lead levels, and probability density histograms are presented in Appendix D-7.

6.4 Toxicity Assessment

The toxicity assessment for the COPCs examines information concerning the potential human health effects of exposure to COPCs. The goal of the toxicity assessment is to provide, for each COPC, a quantitative estimate of the relationship between the magnitude and type of exposure and the severity or probability of human health effects. The toxicity values presented in this section are integrated with the exposure assessment (Section 6.3) to characterize the potential for the occurrence of adverse health effects (Sections 6.5).

The toxicological evaluation involves a critical review and interpretation of toxicity data from epidemiological, clinical, animal, and in vitro studies. This review of the data ideally determines both the nature of the health effects associated with a particular chemical and the probability that a given quantity of a chemical could result in the referenced effect. This analysis defines the relationship between the dose received and the incidence of an adverse effect for the chemicals of potential concern.

The entire toxicological database is used to guide the derivation of cancer slope factors (CSFs) for carcinogenic effects and Reference Doses (RfDs) for noncarcinogenic effects. These data may include epidemiological studies, long-term animal bioassays, short-term tests, and evaluations of molecular structure. Data from these sources are reviewed to determine if a chemical is likely to be toxic to humans. Because of the lack of available human studies, however, the majority of toxicity data used to derive CSFs and RfDs comes from animal studies.

For noncarcinogenic effects, the most appropriate animal model (the species most biologically similar to the human) is identified. Pharmacokinetic data often enter into this determination. In the absence of sufficient data to identify the most appropriate animal model, the most sensitive species is chosen. The RfD is generally derived from the most comprehensive toxicology study that characterizes the dose-response relationship for the critical effect of the chemical. Preference is given to studies using the exposure route of concern; in the absence of such data, however, an RfD for one route of exposure may be extrapolated from data from a study that evaluated a different route of exposure. Such extrapolation must take into account pharmacokinetic and toxicological differences between the routes of exposure. Uncertainty factors are applied to the highest no-observed-adverse-effect-level (NOAEL) to adjust for inter- and intraspecies variation, deficiencies in the toxicological database, and use of subchronic rather than chronic animal studies. Additional uncertainty factors may be applied to estimate a NOAEL from a lowest-observed-adverse-effect-level (LOAEL) if the key study failed to determine a NOAEL. When chemical-specific data are not sufficient, an RfD may be derived from data for a chemical with structural and toxicologic similarity.

CSFs for weight-of-evidence Group A or B chemicals are generally derived from positive cancer studies that adequately identify the target organ in the test animal data and characterize the dose-response relationship. CSFs are derived for Group C compounds for which the data are sufficient but are not derived for Group D or E chemicals. (An explanation/definition of these weight-of-evidence classes is provided in Section 6.4.2). No consideration is given to similarity in the animal and human target organ(s), because a chemical capable of inducing cancer in any animal tissue is considered potentially

carcinogenic to humans. Preference is given to studies using the route of exposure of concern, in which normal physiologic function was not impaired, and in which exposure occurred during most of the animal's lifetime. Exposure and pharmacokinetic considerations are used to estimate equivalent human doses for computation of the CSF. When a number of studies of similar quality are available, the data may be combined in the derivation of the CSF.

Toxicological profiles for each of the major COPCs are presented in Appendix D-8. These profiles present a summary of the available literature on carcinogenic and noncarcinogenic effects associated with human exposure to the chemical. Brief summaries of the toxicity profiles for the major COPCs are presented in Section 6.4.3

6.4.1 Noncarcinogenic Effects

For noncarcinogens, it is assumed that there exists a dose below which no adverse health effects will be seen. Below this "threshold" dose, exposure to a chemical can be tolerated without adverse effects. For noncarcinogens, a range of exposure exists that can be tolerated. Toxic effects are manifested only when physiologic protective mechanisms are overcome by exposures to a chemical above its threshold level. Maternal and developmental endpoints are considered systemic toxicity.

The potential for noncarcinogenic health effects resulting from exposure to chemicals is assessed by comparing an exposure estimate (intake or dose) to an RfD. The RfD is expressed in units of mg/kg/day and represents a daily intake of contaminant per kilogram of body weight that is not sufficient to cause the threshold effect of concern. A RfD is specific to the chemical, the route of exposure, and the duration over which the exposure occurs.

To derive an RfD, EPA reviews all relevant human and animal studies for each compound and selects the study (studies) pertinent to the derivation of the specific RfD. Each study is evaluated to determine the NOAEL or, if the data are inadequate for such a determination, the LOAEL. The NOAEL corresponds to the dose (in mg/kg/day) that can

be administered over a lifetime without inducing observable adverse effects. The LOAEL corresponds to the lowest daily dose that induces an observable adverse effect. The toxic effect characterized by the LOAEL is referred to as the "critical effect." To derive an RfD, the NOAEL (or LOAEL) is divided by uncertainty factors to ensure that the RfD will be protective of human health. Uncertainty factors are applied to account for extrapolation of data from laboratory animals to humans (interspecies extrapolation), variation in human sensitivity to the toxic effects of a compound (intraspecies differences), derivation of a chronic RfD based on a subchronic rather than a chronic study, or derivation of a RfD from the LOAEL rather than the NOAEL. In addition to these uncertainty factors, modifying factors between 1 and 10 may be applied to reflect additional qualitative considerations in evaluating the data. For most compounds, the modifying factor is one.

A dermal RfD is developed by multiplying an oral RfD (based on an administered dose) by the gastrointestinal tract absorption factor. The resulting dermal RfD, based on an absorbed dose, is used to evaluate the dermal (absorbed) dose calculated by the dermal exposure algorithms.

The primary sources of information for Reference Dose values are the EPA Washington (EPA, 1997a, and 1999). EPA's database (IRIS - the Integrated Risk Information System) (EPA, 1999) was consulted as the primary source for RfD values, as well as for CSFs. EPA intends that IRIS supersede all other sources of toxicity information for risk assessment. If values are not available in IRIS, the annual Health Effects Assessment Summary Tables (HEAST) (EPA, 1997a) were consulted, as well as the current Region 9 EPA Preliminary Remediation Goals (PRGs) Table (EPA, 1998a). If no RfD is available from any of these sources, noncarcinogenic risks are not quantified and potential exposures are addressed in the uncertainty section, Section 6.6.

Reference Doses for the COPCs at the Raybestos ballfield Study Area are presented in Appendix D-1, Table 5.1. This table also includes the primary target organs affected by a particular chemical. This information may be used in the Risk Characterization section to segregate risks by target organ effects, unless the total Hazard Index is below unity.

PCB risk characterization is generally addressed by evaluating total Aroclor concentrations. For non-carcinogenic risk, however, two PCB congeners, Aroclor 1016 and Aroclor 1254, have oral RfDs available. A noncarcinogenic risk evaluation can be performed for individual Aroclors, substituting the RfD values for Aroclors 1016 and Aroclor 1254 for other similar Aroclors, based on the percent chlorine in each. The oral RfD for Aroclor 1016 is 7.00E-05 mg/kg/day and the oral RfD for Aroclor 1254 is 2.00E-05 mg/kg/day. Alternatively, PCB non-cancer risk can be evaluated using the total Aroclor concentration and the RfD for the more toxic Aroclor (Aroclor 1254). This approach is more conservative and tends to overestimate risks due to the lighter Aroclors. At this particular site, the heavier Aroclors, Aroclor 1262 and Aroclor 1268, comprise 97 percent of the total Aroclor concentration. Due to the high proportion of heavy Aroclors at this site, the use of total Aroclors, in combination with the RfD for Aroclor 1254, for evaluating non-cancer risks, does not significantly overestimate risks.

6.4.2 Carcinogenic Effects

The toxicity information considered in the assessment of potential carcinogenic risks includes a weight-of-evidence classification and a slope factor. The weight-of-evidence classification qualitatively describes the likelihood that a chemical is a human carcinogen and is based on an evaluation of the available data from human and animal studies. A chemical may be placed in one of three groups in EPA's classification system to denote its potential for carcinogenic effects:

- Group A - known human carcinogen
- Group B1 or B2 - probable human carcinogen
- Group C - possible human carcinogen

Chemicals that cannot be classified as a human carcinogen because of a lack of data are placed in Group D, and those for which there is evidence of noncarcinogenicity in humans are in Group E.

The CSF is the toxicity value used to quantitatively express the carcinogenic hazard of cancer-causing chemicals. It is defined as the upperbound estimate of the probability of cancer incidence per unit dose averaged over a lifetime. Slope factors are derived from studies of carcinogenicity in humans and/or laboratory animals and are typically calculated for compounds in Groups A, B1, and B2, although some Group C carcinogens also have slope factors and some B2 carcinogens, such as lead, have none. Slope factors are specific to a chemical and route of exposure and are expressed in units of $(mg/kg/day)^{-1}$ for oral routes. CSFs for COPCs at the Raybestos ballfield Study Area are presented in Appendix D-1, Table 6-1. The primary source of information for these values is the EPA IRIS database, followed by other EPA sources described for non-carcinogens.

CSFs exist for several (but not all) Class C compounds, which are identified as "possible" human carcinogens. These compounds typically exhibit inadequate evidence of carcinogenicity in humans and limited evidence in animals. In this human health risk assessment, Class C compounds are evaluated quantitatively as class A/B1/B2 compounds, but the risks associated with exposure to Class C compounds are also discussed separately if these chemicals are major risk drivers, underscoring the uncertainty associated with these estimations.

Dermal CSFs are derived from the corresponding oral values. To derive the dermal CSF, the oral CSF is divided by the gastrointestinal absorption efficiency to determine a CSF based on an absorbed dose rather than an administered dose. The oral CSF is divided by the absorption efficiency because CSFs are expressed as reciprocal doses. Dermal CSFs and the absorption efficiencies used in their determination are also included in Appendix D-1, Table 6-1. The absorption efficiencies were obtained from Table 4.1, "Summary of Gastrointestinal Absorption Efficiencies and Recommendations for Adjustment of Oral Slope Factors for Specific Compounds" of the working draft of EPA Interim Guidance entitled "Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance, Dermal Risk Interim Guidance" (EPA, 1998b).

Risk estimates for PAHs have, in the past, assumed that all carcinogenic PAHs have a potency equal to that for benzo(a)pyrene. While benzo(a)pyrene was well studied, other

Class B2 PAHs had insufficient data with which to calculate a CSF. EPA has published provisional guidance to assess PAHs (EPA, 1993). Estimated orders of potential potency (rather than a toxicity equivalence factor or TEF) were developed based on skin painting tests and are rounded to one significant figure (based on an order of magnitude). The values are based on a comparable endpoint (complete carcinogenesis after repeated exposure to mouse skin). The quality of the data does not support any greater precision. The orders of potential potency used in this health risk assessment are presented in Appendix D-9 and are those proposed for use by EPA Region I (EPA, 1994c). EPA has determined that the oral CSF for benzo(a)pyrene is 7.3 $(mg/kg/day)^{-1}$. Oral CSFs for other carcinogenic PAHs were determined by multiplying the oral CSF for benzo(a)pyrene by the estimated order of potential potency for the PAH. These oral CSFs for PAHs became the basis for deriving the dermal CSFs used to evaluate dermal risk from PAHs.

The toxicity and cancer risk characterization of PCBs was conducted according to guidance presented in the EPA technical guidance document entitled, "PCBs: Cancer Dose-Response Assessment and Application to Environmental Mixtures" (EPA, 1996b). The guidance document suggests a methodology for the risk evaluation of the total Aroclor concentration in an environmental medium.

6.4.3 Toxicity Summaries for Major Chemicals of Concern

This section contains brief summaries of the toxicological profiles for the major COPCs. The detailed profiles are contained in Appendix D-8.

6.4.3.1 Asbestos

Asbestos is poorly absorbed from the gastrointestinal tract and therefore displays low acute oral toxicity. However, respiratory exposure leads to pulmonary fibrosis called asbestosis, which symptoms include breathlessness, chest pain, cough, decreased lung function, and cyanosis. Occupational exposures to asbestos have resulted in higher incidences of lung cancer, especially in combination with cigarette smoking; the latent period is 15 to 30 years. An additional effect of asbestos exposure is the development of

pleural or peritoneal mesotheliomas; the latent period is 3.5 to 30.0 years. (Hodgson et al., 1988).

6.4.3.2 Polychlorinated Biphenyls (PCBs)

PCBs are a group of synthetic organic chemicals that contain 209 individual compounds (known as congeners). Mixtures of PCBs, or Aroclors, were manufactured for use in industry until 1977. EPA considers PCBs to be a probable human carcinogen based on evidence of the ability of PCBs to cause cancer in animal studies. Data on humans exposed to PCBs suggest an association between PCB exposure and human cancer, but lack of data on exposure dose, exposure length, PCB types and other chemicals people were exposed to precludes identifying a cause and effect relationship based only on human studies. Studies in animals have also demonstrated immunological, reproductive, and neurological effects from PCB exposure. Studies in mice, monkeys, guinea pigs, and rabbits have shown PCBs to be immunosuppressive. Some PCB congeners are considered dioxin-like.

6.4.3.3 Lead

Unborn children and young children are particularly sensitive to the adverse effects of exposure to lead. Exposure to a fetus through its mother may cause premature births, lower birth weight, and decreased mental ability of the infant. Lead exposure is dangerous for young children because they absorb lead at a greater rate than adults, retain more of the lead they ingest, and are more sensitive to its effects. Effects include decreased intelligence and decreased growth.

Lead is efficiently absorbed by children. The fate of lead in the body depends in part on the amount and rate of previous exposures, the age of the receptor, and the rate of exposure. The principal effects of acute oral exposure are colic, anemia, and, in severe cases, acute encephalopathy (particularly in children). Long-term exposure may result in neurological and hematological effects. Some of the effects on the blood and subtle neurobehavioral changes in children occur at levels so low as to be considered

nonthreshold effects. Rat and mouse studies have shown increases in renal tumors, but the human studies have yielded inconclusive results that failed to account for the presence of other potentially carcinogenic materials. EPA has classified lead as a B2 carcinogen based on the results of animal studies.

6.4.3.4 Arsenic

Arsenic is found in nature at low levels. Inorganic arsenic compounds are mainly used to preserve wood. They are also used to make insecticides and weed killers.

Inorganic arsenic is a human poison. Organic arsenic is less harmful. High levels of inorganic arsenic in food or water can be fatal. Arsenic damages many tissues including nerves, stomach and intestines, and skin. Breathing high levels can give you a sore throat and irritated lungs. Lower levels of exposure to inorganic arsenic may cause nausea, vomiting, diarrhea, decreased production of red and white blood cells, abnormal heart rhythm, blood vessel damage, and a "pins and needles" sensation in hands and feet.

Long term exposure to inorganic arsenic may lead to a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso. Direct skin contact may cause redness and swelling.

The federal Department of Health and Human Services (DHHS) has determined that arsenic is a known carcinogen. Breathing inorganic arsenic increases the risk of lung cancer. Ingesting inorganic arsenic increases the risk of skin cancer and tumors of the bladder, kidney, liver, and lung.

6.4.3.5 Barium

Increased blood pressure has been observed in experimental animals (rats) routinely exposed to barium in drinking water. Barium is also toxic to the nervous system, the muscular system, and gastrointestinal system when ingested at high concentrations. The soluble barium salts are more toxic than the insoluble barium salts (Clements Associates

Inc., 1985). This is probably due to the fact that the soluble barium salts are more likely to be absorbed than the insoluble barium salts.

6.4.3.6 Zinc

Zinc is a nutritionally required trace element. Distribution of absorbed zinc is primarily to the liver, with subsequent redistribution to bone, muscle, and kidney. Highest tissue concentrations are found in the prostate. The half-life of zinc absorbed from the gastro-intestinal (GI) tracts of humans in normal zinc homeostasis is approximately 162 to 500 days.

Orally, zinc exhibits a low order of acute toxicity. Animals dosed with 100 times dietary requirement showed no evidence of toxicity. In humans, acute poisoning from foods or beverages prepared in galvanized containers is characterized by GI upset. Chronic oral toxicity in animals is associated with poor growth, GI inflammation, arthritis, lameness, and anemia, possibly secondary to copper deficiency.

6.4.3.7 Polyaromatic Hydrocarbons (PAHs)

Benzo(a)pyrene is the most widely studied chemical in this class. It is used as the basis for defining the toxicity of other potentially carcinogenic PAHs. Benzo(a)pyrene is widely distributed in the tissues of treated rats and mice but is primarily found in high fat tissues. While the carcinogenicity of complex mixtures containing PAHs (such as coal tar, coke oven emissions, and cigarette smoke) is suggested, the carcinogenicity cannot be attributed solely to PAHs. The carcinogenicity of benzo(a)pyrene is based largely on the results of animal studies in which the animals were exposed to large doses of purified compound via atypical routes of exposure.

The noncarcinogenic PAHs appear to affect the liver, kidneys, and blood of exposed laboratory animals. Considered exposure routes include ingestion and inhalation, and exposure has resulted in anemia and mild liver lesions, and occasionally renal disease. The effects vary for the individual compounds.

6.5 Risk Characterization

This section provides a characterization of the potential human health risks associated with the potential exposure to COPCs in soils in the Raybestos ballfield Study Area. Section 6.5.1 outlines the methods used to estimate the type and magnitude of health risks, and Section 6.5.2 presents the results for the current and potential future land use conditions for the Raybestos ballfield Study Area.

6.5.1 Risk Characterization Methodology

Potential human health risks resulting from exposure to COPCs are estimated using algorithms established by EPA. The methods described by EPA are protective of human health and are likely to overestimate (rather than underestimate) risk. The methodology uses specific algorithms to calculate risk as a function of chemical concentration, human exposure parameters, and toxicity.

Risks from hazardous chemicals are calculated for either carcinogenic or noncarcinogenic effects. Some carcinogenic chemicals may also exhibit noncarcinogenic effects. Potential impacts are then characterized for both types of health effects.

Noncarcinogens. The hazards associated with the effects of noncarcinogenic chemicals are evaluated by comparing an exposure level or intake to an RfD. The ratio of the intake to the RfD is called the Hazard Quotient (HQ) and is defined as follows (EPA, 1989b):

$$HQ_i = \frac{Intake_i}{RfD_i}$$

where: HQ_i = Hazard Quotient for chemical "i" (unitless)

$Intake_i$ = Intake of chemical "i" (mg/kg/day), a function of exposure and chemical concentration

RfD_i = Reference Dose of chemical "i" (mg/kg/day)

If the ratio of the intake to the RfD exceeds unity, there exists a potential for noncarcinogenic (toxic) effects to occur. A Hazard Index (HI) is generated by summing the individual HQs for all COPCs. If the value of the HI exceeds unity, there is a potential for noncarcinogenic health effects associated with that particular chemical mixture, and therefore it is necessary to segregate the HQs by target organ effects. The HQ should not be construed as a probability, but rather as a numerical indicator of the extent to which a predicted intake exceeds or is less than an RfD.

Chemical Carcinogens. Risks attributable to exposure to chemical carcinogens are estimated as the probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. At low doses, the incremental lifetime cancer risk (ILCR) is determined as follows (EPA, 1989b):

$$ILCR_i = (Intake_i)(CSF_i)$$

where: $ILCR_i$ = Incremental Lifetime Cancer Risk for chemical "i", expressed as a unitless probability

$Intake_i$ = Intake of chemical "i" (mg/kg/day)

CSF_i = Cancer Slope Factor of chemical "i" $(mg/kg/day)^{-1}$

Risks below 1E-6 (or a risk less than 1 in 1 million) are generally considered to be acceptable by EPA, and risks greater than 1E-4 (1 in 10,000) are generally considered to be unacceptable.

Risks are estimated for all carcinogenic compounds regardless of the class designation (See Section 6.4.2).

6.5.2 Risk Characterization Results

A summary of the quantitative risk assessment for the Study Area is provided in this section. Sample calculations are provided in Appendix D-5. Appendix D-1, Tables 7.1

through 7.3 and Tables 8.1 through 8.3 present non-cancer and cancer risk estimates for each receptor and medium. Appendix D-1, Tables 9.1 through 9.3 present summaries of Cancer Risks and Health Hazard Indices from all applicable media and pathways for each exposure scenario. Appendix D-1, Tables 10.1 through 10.3 reduce the information developed in Appendix D-1, Tables 9.1 through 9.3 to the major risk drivers only for media and scenarios with cancer risks greater than 1E-04 or hazard indices greater than 1.0. Results of the evaluations of lead exposures are presented in Appendix D-7. Table 6-1 summarizes the results and provides primary contributors to unacceptable risks, lead screening results for all scenarios, and asbestos results.

6.5.2.1 Noncarcinogenic Risks

Hazard indices developed for current recreational users, future residents, and future commercial workers were as follows:

Summary of Hazard Indices

Exposure Scenario		RME Case	CTE Case
Recreational Users	(Surface Soils)		
	(Adult)	1.32E-01	5.15E-02
	(Child)	1.13E+00	5.09E-01
Future Commercial Workers	(All Soils)		
	(Adult)	4.89E+00	3.36E+00
Future Resident	(All Soils)		
	(Adult)	6.32E+00	2.35E+00
	(Child)	5.36E+01	2.35E+01

- HIs are less than unity for adult recreational exposures to soils, indicating that adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment for these receptors. HIs are greater than unity for child recreational exposures under RME conditions. Further examination of these results reveals that no organ-specific HI exceeds unity, indicating that adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment for these receptors. HIs are greater than unity for future

residential or commercial use of the site. Further examination of these results, reveals that individual hazard quotients for total Aroclors exceed unity under either scenario. These exposures may result in adverse noncarcinogenic health effects to the skin and eye. For child residential exposures under the RME scenario, individual hazard quotients for barium and zinc also exceed unity. These exposures may result in adverse noncarcinogenic health effects to the cardiovascular system, kidney, and blood.

6.5.2.2 Carcinogenic Risks

Incremental cancer risk estimates developed for current recreational users, future residents, and future commercial workers were as follows:

Summary of Cancer Risks

Exposure Scenario		RME Case	CTE Case
Recreational Users	(Surface Soils)		
	(Adult)	4.39E-06	4.88E-07
	(Child)	9.57E-06	1.36E-06
	(Lifetime)	1.40E-05	1.84E-06
Future Commercial Workers	(All Soils)		
	(Adult)	7.58E-05	1.47E-05
Future Resident	(All Soils)		
	(Adult)	9.38E-05	1.04E-05
	(Child)	1.99E-04	2.95E-05
	(Lifetime)	2.92E-04	3.99E-05

The risk estimates for recreational users and future commercial workers do not exceed the EPA target cancer risk range (1E-4 to 1E-6). The risk estimates for future adult residents do not exceed the EPA target cancer risk range (1E-4 to 1E-6). However, the risk estimates for future child and lifetime resident do exceed the EPA target cancer risk range (1E-4 to 1E-6), when the RME case is evaluated. Risk estimates for the CTE case are within the EPA target cancer risk range (1E-4 to 1E-6). The major contributors to risk at the site are PCBs, arsenic, and PAHs. Cancer risk estimates for each of these COPCs exceed 1E-6.

6.5.2.3 Exposure to Lead

Lead was identified as a COPC in both surface soil and "all soil" samples collected from the Study Area. Lead was detected at a maximum concentration of 8270 mg/kg in surface soil and 172,000 mg/kg in "all soils". Each of these maximum concentrations greatly exceeds the OSWER soil screening level of 400 mg/kg.

Exposure to lead in surface soils and "all soil" by the child resident was evaluated using the EPA IEUBK Model, as discussed in Section 6.3.7. The IEUBK model was developed to evaluate exposures to lead by children in a residential setting. The arithmetic average lead concentrations of 562 mg/kg for surface soil and 5800 mg/kg for "all soil", as well as several default parameters, were used to estimate blood-lead levels for children in a residential setting. IEUBK Model outputs are included in Appendix D-7. The IEUBK model estimates that 22.39 percent of children exposed to the surface concentrations of lead are expected to have blood-lead levels greater than 10 μg/dL; this exceeds the acceptable level of 5 percent. The IEUBK model estimates that 99.2 percent of children exposed to the "all soil" concentrations of lead are expected to have blood-lead levels greater than 10 μg/; this exceeds the acceptable level of 5 percent.

Exposure to lead in surface soils by the adult recreational users was evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, December 1996d). The exposure point concentration of 562 mg/kg for surface soil as well as several default parameters was used to estimate blood-lead levels for adults contacting site soils. Under the RME scenario, the model estimated that the 95th percentile blood-lead concentration among fetuses born to women having site exposures would be 10.09 µg/dL. Under the CTE scenario, the 95th percentile blood-lead concentration would be 5.34 µg/dL. The RME is at the level of concern. The CTE is less than the established level of concern of 10 μg/dL.

Exposure to lead in "all soil" by the adult commercial workers was evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA,

December 1996d). The exposure point concentration of 5800 mg/kg for "all soil" as well as several default parameters was used to estimate blood-lead levels for adults contacting site soils. Under the RME scenario, the model estimated that the 95th percentile blood-lead concentration among fetuses born to women having site exposures would be 64.87µg/dL. Under the CTE scenario, the 95th percentile blood-lead concentration would be 26.59 µg/dL. Both RME and CTE are more than the established level of concern of 10 µg/dL.

In conclusion, exposures to lead in soils exceed acceptable levels when either of the RME or CTE case is considered for either residential children or commercial workers exposed to soils from depths of 0 to 15 feet bgs.

6.5.2.4 Exposure to Asbestos

Asbestos was detected in 118 of 193 solid matrix samples collected in the 0 to 15-foot depth interval at a concentration range of 0.9 to 60 percent. The average concentration was 6 percent. Although quantitative risk estimates (inhalation risk estimates) cannot be developed for this parameter, it should be noted that asbestos-containing material is defined as material containing more than 1 percent asbestos (40 CFR Subpart M, Appendix A, Part 61). Asbestos is considered a potential inhalation hazard if it is "friable" (can be crumbled, pulverized, or reduced to powder) and, consequently, subject to entrainment/migration into the air.

6.6 Uncertainties Analysis

There are uncertainties associated with all baseline human health risk assessments, including the one presented in the preceding sections. This section summarizes these uncertainties, and discusses how they may affect the final risk numbers discussed in Section 6.5.

There is uncertainty associated with all steps of the risk assessment process. The selection of contaminants of concern is based on exposure assumptions and toxicity information, which in turn have associated uncertainties. Uncertainty in the selection of

COPCs is associated with the current status of the predictive databases and the procedures used to include or exclude constituents as chemicals of concern. Uncertainty associated with the exposure assessment includes the values used as input variables for a given intake route, the methods used and the assumptions made to determine exposure point concentrations, and the predictions regarding future land use and population characteristics. Uncertainty in the toxicity assessment includes the quality of the existing data to support dose-response relationships and the weight-of-evidence used for determining the carcinogenicity of chemicals of concern. Uncertainty in risk characterization includes that associated with exposure to multiple chemicals and the cumulative uncertainty from combining conservative assumptions made in earlier activities.

While there are various sources of uncertainty (as described above) throughout the risk assessment, assumptions were made so that the final calculated risks would be conservative estimates that are protective of public health. Thus, the resultant uncertainty in the numerical risk assessments is in how much lower the actual risks are.

Generally, risk assessments carry two types of uncertainty: measurement and informational uncertainty. Measurement uncertainty refers to the variance that can be attributed to sampling techniques and laboratory analysis of contaminants. For example, this type of uncertainty is associated with analytical data collected for each site. The risk assessment reflects the accumulated variances of the individual values used.

Informational uncertainty refers to estimates of toxicity and exposure. Often, this gap is significant, such as the absence of information on the effects of human exposure to low doses of a chemical, the biological mechanism of action of a chemical, or the behavior of a chemical in soil.

Once the risk assessment is complete, the results must be reviewed and evaluated to identify the type and magnitude of uncertainty involved. Reliance on results from a risk assessment without considering uncertainties, limitations, and assumptions inherent in the process can be misleading. For example, to account for uncertainties in the development of exposure assumptions, conservative estimates must be made to ensure that the

particular assumptions made are protective of sensitive subpopulations or the maximum exposed individuals. If a number of conservative assumptions are combined in an exposure model, the resulting calculations can propagate the uncertainties associated with those assumptions, thereby producing a much larger uncertainty for the final results. This uncertainty is biased toward overpredicting both carcinogenic and noncarcinogenic risks. Thus, both the results of the risk assessment and the uncertainties associated with those results must be considered when making risk management decisions.

This interpretation is especially relevant when the risks exceed the point-of-departure for defining "acceptable" risk. For example, when risks calculated using a high degree of uncertainty are below an "acceptable" risk level (1E-6), the interpretation of no significant risk is straightforward. However, when risks calculated using a high degree of uncertainty are above an "acceptable" risk level (1E-4), a conclusion can be difficult unless uncertainty is considered.

Recent EPA guidance on risk assessment (EPA, 1992b and 1994c) requires risk assessors to use exposure and toxicity assumptions from the "high end" and the "central tendency" of their distributions. These values correspond to the RME and CTE scenarios. The RME is conceptually the "high end" exposure above the 90th percentile of the population distribution but not higher than the individual in the population with the highest exposure. The CTE reflects the central (average) estimates of exposure.

6.6.1 Uncertainty in Selection of Chemicals of Concern

There is a minor amount of uncertainty associated with the selection of COPCs on the final risk values in the quantitative risk assessment. Conservative screening values were used to select COPCs; thus, it is unlikely that any contaminant that may pose a risk was eliminated from the risk assessment.

Background concentrations were not used to eliminate COPCs. Maximum detected concentrations were compared to average background concentrations. Among the selected COPCs, the only contaminant with a maximum detected concentration below the

average background concentration was Aroclor 1221. Since all Aroclors were retained in the estimate of total Aroclors, if any one exceeded the selection criteria, the use of background concentrations to eliminate COPCs would not have changed the selection of COPCs at this site.

Some of the data are the results of field screening rather than from a fixed-based analytical laboratory. The field screening data were obtained from the EPA database and therefore are assumed to have been validated and found to be acceptable. Typically, environmental samples analyzed in the field in "real time" may result in slight differences from those analyzed in a fixed-base laboratory. For example, volatile organic compound data collected in the field may be higher due to less loss of compound. Metals data collected in the field may result in higher exposure point concentrations because detection limits for metals in the field are higher. It is unlikely that use of the field screening data contributes significantly to the overall uncertainty of the risk assessment. At most, it may result in risks that are slightly higher than actual conditions.

COPCs were selected if the maximum detected concentration in soils exceeded its respective risk-based screening criterion. Even if the compound was detected at a very low frequency, i.e., less than 5 percent, if the maximum detected concentration exceeded the screening criterion, the compound would still be retained for evaluation in the risk assessment. Based on a review of the data, the absence of using frequency of detection as a COPC selection criterion did not result in a significant increase in the number of COPCs evaluated in this risk assessment. Therefore, this does not significantly contribute to the uncertainty of the risk assessment.

6.6.2 Uncertainty in the Exposure Assessment

Uncertainty in the exposure assessment arises from calculation of exposure point concentrations, determination of land use conditions, selection of receptors, and selection of exposure parameters. Each is discussed below.

Calculation of Exposure Point Concentrations. Semi-volatile organic compounds, pesticides, and some metals were evaluated in fewer than 20 surface soil samples. This makes the estimation of the upper 95 percent confidence limit on the mean highly uncertain and, therefore, the maximum detected chemical concentrations were used to assess RME risks and average concentrations were used to assess CTE risks. As a result, the estimations of risk where maximum concentrations were used as exposure concentrations are most likely to be overstated because it is unlikely that potential receptors would be exposed to the maximum concentration over the entire exposure period.

Exposure Routes and Receptor Identification. Exposure routes and receptor groups were based on discussions with the EPA and on site visits. This may either under- or over-estimates the risks, with the final result dependent on how well the receptors were defined.

One scenario that may overestimate risk is the evaluation of direct exposure to soils by future on-site residents. This risk assessment has served to quantify the amount of risk associated with a particular use and has found that the development of the property for residential use would result in unacceptable levels of risks to human health for all populations evaluated. The residential risk values used in this baseline risk assessment may, therefore, overestimate the risks associated with the site provided future use is not residential.

Selection of Exposure Parameters. Each exposure factor selected for use in this risk assessment has some associated uncertainty. Generally, exposure factors are based on surveys of physiological and lifestyle profiles across the United States. The attributes and activities studied in these surveys generally have a broad distribution. To avoid underestimation of exposure, EPA guidelines on the RME receptor were used that generally consist of the 95th percentile for most parameters. Therefore, the selected values for the RME receptor represent the upper bound of the observed or expected habits of the majority of the population.

Many of the exposure parameters were determined from statistical analyses on human population characteristics. Often the database used to summarize a particular exposure parameter (body weight) is quite large. Consequently, the values chosen for such variables in the RME scenario have low uncertainty. For many parameters for which limited information exists (dermal absorption of organic chemicals from soil), there is greater uncertainty.

Many of the quantities used to calculate exposures and risks in this report are selected from a distribution of possible values. For the RME scenario, the value representing the 95th percentile is generally selected for each parameter to ensure that the assessment bounds the actual risks from a postulated exposure. In order to estimate a central tendency estimate of exposure, EPA has suggested the use of the CTE receptor, whose intake variables are set at approximately the 50th percentile of the distribution. The risks for this receptor seek to incorporate the range of uncertainty associated with various intake assumptions. Many of the parameters were estimated using professional judgment, although EPA Region I provides some default parameters (EPA, 1994c).

6.6.3 Uncertainty in the Toxicological Evaluation

A toxicity evaluation is a chemical's hazard identification and dose-response assessment. The hazard identification deals with characterizing the nature and strength of the evidence of causation, or the likelihood that a chemical that induces adverse effects in animals will also induce adverse effects in humans. Hazard identification of carcinogenicity is an evaluation of the weight-of-evidence that a chemical causes cancer. Positive animal cancer test data suggest that humans contain tissue(s) that may also manifest a carcinogenic response; however, the animal data cannot necessarily be used to predict the target tissue in humans. In the hazard assessment of noncancer effects, however, positive animal data suggest the nature of the effects (the target tissues and type of effects) anticipated in humans.

Uncertainty in hazard assessment arises from the nature and quality of the animal and human data. Uncertainty is reduced when similar effects are observed across species,

strain, sex, and exposure route; when the magnitude of the response is clearly dose-related; when pharmacokinetic data indicate a similar fate in humans and animals; when postulated mechanisms of toxicity are similar for humans and animals; and when the chemical of concern is structurally similar to other chemicals for which the toxicity is more completely characterized.

Uncertainty in the dose-response evaluation includes determining a slope factor for the carcinogenic assessment and deriving an RfD for the noncarcinogenic assessment. The slope factor is an upper bound estimate of the human cancer risk per milligram of contaminant per milligram of body weight per day. The RfD is an estimate with uncertainty (spanning perhaps an order of magnitude of daily exposure to humans) below which a person is likely to be without appreciable risk of adverse effect over a lifetime. Uncertainty is introduced from interspecies (animal to human) extrapolation, which, in the absence of quantitative pharmacokinetic or mechanistic data, is usually based on consideration of interspecies differences in basal metabolic rate. Uncertainty also results from intraspecies variation. Most toxicity experiments are performed with animals that are similar in age and genotype so that intragroup biological variation is minimal, but the human population of concern may reflect a great deal of heterogeneity, including unusual sensitivity or tolerance to the COPC. Even toxicity data from human occupational exposure reflect a bias because only those individuals sufficiently healthy to attend work regularly (the "healthy worker effect") and those not unusually sensitive to the chemical are likely to be occupationally exposed. Finally, uncertainty arises from the quality of the key study from which the quantitative estimate is derived and from the database. For cancer effects, the uncertainty associated with dose-response factors is mitigated by assuming the 95 percent upper bound for the slope factor. Another source of uncertainty in carcinogenic assessment is the method by which data from high doses in animal studies are extrapolated to the dose range expected for environmentally exposed humans. The linearized multistage model, which is used in nearly all quantitative estimations of human risk from animal data, is based on a nonthreshold assumption of carcinogenesis. There is evidence to suggest, however, that epigenetic carcinogens, as well as many genotoxic carcinogens, have a threshold below which they are noncarcinogenic (William and

Weisburger, 1991); therefore, the use of the linearized multistage model is conservative for chemicals that exhibit a threshold for carcinogenicity.

For noncancer effects, additional uncertainty factors may be applied in deriving the RfD to mitigate poor quality of the key study or gaps in the database. Additional uncertainty for noncancer effects arises from the use of an effect level in estimating of an RfD, because this estimation is predicated on the assumption of a threshold below which adverse effects are not expected. Therefore, an uncertainty factor is usually applied to estimate a no-effect level. Additional uncertainty arises in estimating an RfD for chronic exposure from less-than-chronic data. Unless empirical data indicate that effects do not worsen with increasing duration of exposure, an additional uncertainty factor is applied to the no-effect level in the less-than-chronic study. Uncertainty in deriving RfDs is mitigated by the use of uncertainty and modifying factors that normally range between 3 and 10. The resulting combination of uncertainty and modifying factors may reach 1,000 or more.

Class C carcinogens are classified as possible human carcinogens because the evidence for their carcinogenicity in animals is limited. The inclusion of these compounds in estimating total carcinogenic risk adds to the uncertainty of the final risk numbers by potentially overestimating the human health effects.

The derivation of dermal RfDs and CSFs from oral values may cause uncertainty. This is particularly the case when no gastrointestinal absorption rates are available in the literature or when only qualitative statements regarding absorption are available.

Uncertainty also arises in the dose-response assessment for values derived for several principal chemicals of concern by using studies with limitations. For example, Class B2 PAHs for which no toxicity data are available are evaluated using benzo(a)pyrene toxicity data with estimated orders of potential potency. This may either underestimate or overestimate the carcinogenic risks associated with PAHs.

Some uncertainty is associated with the evaluation of chromium, which was assumed to be present in its hexavalent state. Since hexavalent chromium is considered to be more

toxic than the trivalent state, which is essentially more common, risks for this chemical are probably overestimated to some degree.

Uncertainty is associated with evaluating exposures to lead. Two methods have been used in this risk characterization to evaluate lead exposures. Exposures of children to lead are evaluated using EPA's IEUBK model. Uncertainty is associated with the use of default values for exposures to lead via pathways other than soil ingestion. The IEUBK model was developed based on children exposed in a residential scenario. Exposures of commercial workers to lead are evaluated by use of the EPA Technical Review Workgroup Model for lead. This approach focuses on estimating fetal blood-lead concentrations in women exposed to lead contaminated soils in non-residential scenarios. Uncertainty is associated with estimating maternal blood-lead concentrations and with the relationship between maternal blood-lead concentrations and fetal blood-lead concentrations.

Uncertainty in final calculations of risk results from assumptions made regarding additivity of effects from exposure to multiple compounds from various exposure routes. High uncertainty exists when cancer risks for several substances are summed across different exposure pathways. This assumes that each substance has a similar effect and/or mode of action. Often compounds affect different organs, have different mechanisms of action, and differ in their fate in the body, so additivity may not be an appropriate assumption. However, the assumption of additivity is made to provide a conservative estimate of risk.

Finally, the risk characterization does not consider antagonistic or synergistic effects. Little or no information is available to determine the potential for antagonism or synergism for the COPCs. Therefore, this uncertainty cannot be discussed for its impact on the risk assessment, since it may either underestimate or overestimate potential human health risk.

6.7 Summary of Human Health Risk Assessment

This section and Table 6-1 present a summary of major risk assessment findings for the Raybestos Memorial Ballfield Study Area. Three potential receptor groups were evaluated: current recreational users, future residents, and future commercial workers.

6.7.1 Noncarcinogenic Risks

The hazard index is less than unity for adult recreational users, indicating that adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment for these receptors. The hazard index for child recreational users is slightly greater than one. Further examination of these results reveals that no organ-specific hazard indices exceed unity, indicating that adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment for these receptors. HIs are greater than unity for future residential or commercial use of the site. Further examination of these results reveals that individual hazard quotients for total Aroclors exceed unity under either scenario. These exposures may result in adverse noncarcinogenic health effects to the skin and eye. For child residential exposures under the RME scenario, individual hazard quotients for barium and zinc also exceed unity. These exposures may result in adverse noncarcinogenic health effects to the cardiovascular system, kidney, and blood.

6.7.2 Carcinogenic Risks

The risk estimates for the child or lifetime resident scenario exceed the EPA target cancer risk range (1E-4 to 1E-6) when the RME case is evaluated. Risk estimates are within the EPA target cancer risk range but exceed 1E-5, the CT DEP target cancer risk level for lifetime recreational exposure (RME case), adult residential exposures (RME case), child and lifetime residential exposures (CTE case), and future commercial exposures (RME and CTE cases). Total Aroclors (PCBs), arsenic, and PAH compounds (benzo(a)pyrene and dibenz(a,h)anthracene) are predominant risk drivers.

6.7.3 Exposure to Lead

Exposures to lead were evaluated using two models. Exposure to lead in soil by a child was evaluated with the EPA IEUBK Model. The IEUBK Model presents a geometric mean blood-lead level for children and estimates the percentage of children expected to have

blood-lead levels greater than 10 ug/dl. The acceptable level established by EPA is 5 percent. Exposures to lead in soil for a pregnant adult were evaluated by using a slope-factor developed by the Technical Review Workgroup for Lead (EPA, December 1996b). The 95th percentile blood-lead level for women having site exposures and the 95th percentile blood-lead concentration among fetuses born to women having site exposures are estimated with this model.

The effect on children to exposure to lead in soil in a residential setting was evaluated by using the EPA IEUBK Model. The results of the IEUBK model indicate that adverse effects may occur for child residents exposed to lead in either surface soil (0 to 2 feet bgs) or "all soil" (0 to 15 feet bgs).

The effect on future commercial workers to exposure to lead in soil (0 to 15 bgs) was evaluated by using a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, December 1996d). The results of the slope-factor approach indicate that adverse effects may occur for fetuses of pregnant workers exposed to lead in soil.

The effect on adult recreational users to exposure to lead in surface soil (0 to 2 bgs) was evaluated by using a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, December 1996d). Fetuses of pregnant recreational users are the most sensitive population of all recreational users. The results of the slope-factor approach indicate that adverse effects are not likely to occur for adults but may occur for fetuses of pregnant recreational users exposed to lead in surface soil.

6.7.4 Exposure to Asbestos

Although quantitative risk estimates (inhalation risk estimates) cannot be developed for asbestos, it should be noted that asbestos-containing material is material containing more than 1 percent asbestos (Appendix A to Subpart M of 40 CFR 61). Asbestos is considered a potential inhalation hazard if it is "friable" (can be crumbled, pulverized, or reduced to powder) and, consequently, subject to entrainment/migration into the air.

Asbestos was detected in 118 of 193 solid matrix samples collected in the 0-to 15-foot depth interval at a concentration range of 0.9 to 60 percent. The average concentration was 6 percent. Asbestos was detected in 79 of 150 solid matrix samples collected in the 0 to 2-foot depth interval at a concentration range of 0.9 to 45 percent. The average concentration was 2 percent.

7.0 ECOLOGICAL EVALUATION

The objective of the Study Area ecological evaluation is to describe environmental conditions at the site before impacts occur from site investigation or remedial action activities. Remedial activities may result in the unavoidable loss of on-site resources. If significant ecological resources such as wetlands, streams, or threatened or endangered species are present, mitigation or restoration goals would need to be established. An evaluation of the current site conditions and site flora and fauna is necessary to help establish potential goals in the event on-site resources are unavoidably degraded or lost during response actions.

The ecological risk assessment is based on a site visit conducted on November 10, 1998. The evaluation includes a description of Study Area ecological habitats and a survey of vegetation and wildlife present in the Study Area. This ecological evaluation does not include an assessment of site contamination or potential risk to ecological receptors.

7.1 Characteristics of the Study Area

This section presents the characteristics of the study area that are relevant to the establishing the current on-site habitats.

The Study Area encompasses a total area of approximately 13.5 acres. It is bordered to the north/northwest by residences on Clinton Avenue; to the northeast by commercial/industrial properties on Frog Pond Lane; to the east/southeast by property owned by the State of Connecticut, Department of Transportation (railroad tracks), and the former Raymark facility; and to the southwest by the inactive Contract Plating facility (see Figure 7-1). The site includes the 3-acre Raybestos Memorial Field, an 8.5-acre vacant field, and a 2-acre densely wooded area. Most of the site is inactive except for a small paved area used by Daley Construction Company, located in the eastern corner of the site. Access to the Study Area is restricted by a chainlink fence that surrounds the property.

The site topography is relatively flat with a gradual embankment along the western portion of the open field. There is also a steep rise of approximately 10 to 15 feet at the western property boundary, where bedrock outcrops are evident.

7.2 Ecological Setting

The habitat types associated with the Study Area are characteristic of disturbed areas in New England. Much of the area surrounding the site consists of commercial, industrial, and residential properties with minimal habitat values (Figure 7-1). The majority of the Study Area has been disturbed by gravel pit operations, ballfield construction, waste disposal, and past removal actions. These activities have significantly impacted the site habitats (see Section 1.4).

The open field and ballfield habitat consist of early successional grassland with a few large red oak trees (*Quercus rubra*) located along the southern boundary of the Study Area. The open field vegetation is dominated by upland grasses, goldenrods (*Solidago* spp.), common ragweed (*Ambrosia artemisiifolia*), asters (*Aster* spp.), common milkweed (*Asclepius syriaca*), and horse nettle (*Solanum carolinense*). Bittersweet (*Celastrus spp.*) forms a thick cover on much of the ballfield's outfield fence and bleachers.

The wooded area in the southwest corner of the site is a deciduous forested area located on the top and along the steep sides of a ridge. The area is characterized by red oak, black cherry (*Prunus serotina*), black birch (*Betula lenta*), and sugar maple (*Acer sacchrum*), with a dense understory of bittersweet and common greenbriar (*Smilax rotundifolia*). The southern and western perimeter of the site have a narrow strip of forested and scrub/shrub habitat characterized by red oak, black cherry, black birch, Norway maple (*Acer plantonoides*), and tree-of-heaven (*Ailanthus altissima*). The soil in this area is relatively thin, with many areas of exposed bedrock.

No surface water bodies or state or federal jurisdictional wetlands were identified within the Study Area. The Housatonic River is located to the east and flows south. The river and its associated wetlands lie approximately 1,800 feet from the site. The river and

wetlands are separated from the Study Area by commercial properties and by Interstate Route 95.

7.2.1 Wildlife

An inventory of the Study Area wildlife was conducted during the initial site walkover and throughout site investigation activities from November 1998 to February 1999. Table 7-1 lists the wildlife species identified on site, based on actual sightings and/or on the observation of signs during the field activities. Table 7-1 also includes species that are expected to use the on-site habitats. These lists are useful indicators of the wildlife present in the area, but do not represent a comprehensive species inventory.

The open grassland and forested area habitats provide suitable conditions for a variety of small mammals, songbirds, reptiles, and insects, and other invertebrates commonly found in disturbed terrestrial habitats. The site fence and the dense development surrounding the Study Area preclude its use by mammals requiring a large habitat range. Those species with smaller habitat ranges and more general habitat requirements probably use the Study Area more frequently. It should also be noted that the quantity and quality of the upland habitat present on site might not be of sufficient size or complexity to support all species listed in Table 7-1.

7.2.2 Mammals

Small mammals observed within the Study Area include grey squirrels (*Sciurus carolinensis*), chipmunks (*Tamias striatus*), white-footed mice (*Peromyscus leucopus*), and short-tailed shrew (*Blarina brevicauda*). An inactive woodchuck (*Marmota monax*) burrow was identified along the perimeter fenceline, in an area without visible subsurface contamination. Other small mammals that may be using the Study Area habitat include opossum (*Didelphis virginiana*), eastern cottontail (*Sylvilagus floridanus*), and striped skunk (*Mephistis mephitis*).

7.2.3 Birds

Bird species are expected to use the Study Area, on a largely transient basis, for feeding and roosting. There is, however, sufficient habitat beyond the Study Area for nesting and breeding for species that do not require interior, isolated habitats.

Bird species observed at the site include red-tailed hawk (*Buteo jamaicensis*), black-capped chickadee (*Parus atricapillus*), common grackle (*Quisculus quiscula*), common crow (*Corvus brachyrhynchos*), and blue jay (*Cyanocitta cristata*). In conjunction with the adjacent tree perches, the areas of open space at the site make for ideal hunting conditions for raptors. Other openfield and edge species that may use the habitats are listed in Table 7-1.

7.2.4 Reptiles

No reptiles were observed on site during the field activities, probably due to the cool air temperatures at the time of the investigation (November through February). Reptile species that may potentially use the site for all or part of their life cycle include the eastern garter snake (*Thamnophis s. sirtalis*), eastern milk snake (*Lampropeltis t. triangulum*), eastern smooth green snake (*Opheodrys v. vernalis*), and northern brown snake (*Storeria d. dekayi*) (see Table 7-1).

7.3 Conclusions

The Study Area has been significantly disturbed in the past as a result of gravel pit operations, ballfield construction, waste filling, and remedial soil cover placement. Most of the habitat present at the Study Area represents an early successional habitat that has been recently established. The Study Area does provide habitat for a variety of terrestrial wildlife, however the habitats are not unique for this general region. No wetlands were identified at the site. The surrounding developed areas, isolation from other habitats, lack of a perennial surface water source, and contaminated subsurface soils limit the quality of the available habitat. In addition, the potential exists for wildlife to be impacted by

contaminated food sources or from direct contact, e.g., burrows, subsurface foraging, with contamination.

Based on information currently available, no state or federally listed threatened or endangered flora or fauna were identified.

Site Remediation/Restoration Potential

If further remedial actions are undertaken at the site, and if feasible, considerations could be made for restoring or re-creating the habitat previously provided by Frog Pond, which existed at the site years ago. Construction of a pond and associated wetlands would likely require establishing a drainage pathway from the site. Re-establishing an open water body and/or wetland in a remediated area could significantly enhance the on-site habitat values.

8.0 SUMMARY AND CONCLUSIONS

The Study Area consists of a 13.5 acre property that includes a 3-acre ballfield, 8.5-acre vacant field, and a 2-acre dense wooded area. It is located outside the 100-year floodplain but within the Housatonic River Basin, a tidally influenced system. The Study Area is bordered by residential properties on the north/northwest, commercial/industrial properties on the northeast, railroad tracks on the east/southeast, and an inactive industrial property on the south/southwest. The Study Area topography is relatively flat with steep slopes along the western edge and moderate slopes along the northern and southern edges.

This Draft RI report summarizes the activities performed under various investigation programs by federal, state, and private contractors. The validated analytical results are presented in Appendix C. Investigations have been performed by several entities over a 7-year period (1992-1999). However, only data from 1992, 1993, 1998 and 1999 is presented in this report. Other collected data was only used to develop a qualitative picture of Study Area activities. The medium being evaluated for this Study Area is soil. Groundwater is not included within the scope of this RI, but is being addressed under a separate work assignment (W.A. No. 029-RICO-01H3).

The objectives of this RI are to:

- Serve as the mechanism for compiling and evaluating all available data needed to characterize the Study Area conditions.
- To determine the nature and extent of contamination in the soil.
- Assess the risks to human health within the Study Area.

- Serve as the data resource for developing, screening, and evaluating a potential range of alternative remedial actions that address the contamination within the Study Area.

As detailed in Section 1.0, the Study Area is located north of the former Raymark Facility. This area was targeted for study because waste from the Raymark Facility was disposed of on the property. The Study Area received Raymark waste through direct disposal of waste-fill.

8.1 Nature and Extent of Contamination Summary

This section summarizes Section 4.0 of the RI by detailing the known nature and extent of the contamination.

Contaminants were compared to the Connecticut Pollutant Mobility Criteria (CT PMC) for GB aquifers or the Connecticut Direct Exposure Criteria for residential soil (CT DEC). These standards are more stringent than federal standards and are used as site screening levels for this Study Area.

8.1.1 Nature of the Contamination

The Study Area waste, referred to in this document as soil-waste/fill, contains volatile and semi-volatile organic compounds (VOCs and SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals (lead, copper, and barium), and asbestos. This soil-waste/fill was disposed of as fill material throughout the Study Area in an apparently random disposal pattern. Summary statistics of detected compounds are presented in Table 4-3 and 4-4 for surface and subsurface soils.

8.1.2 Extent of Contamination

The contamination in the Study Area soils is primarily the result of waste depositions as fill directly from the Raymark Facility.

The fill that was investigated in the Study Area is a mixture of natural and artificial materials placed as a result of human activity. Natural fill is made of clay, silt, sand, and gravel. Artificial fill consists of manufacturing and construction debris (see Section 3.7). The extent of selected contaminants is depicted on Figures 4-1 (a and b) through 4-9 (a and b).

8.1.3 Volatile Organic Compounds (VOCs)

VOCs are identified as contaminants within the Study Area for surface (0-2') and subsurface soils. No figure is presented depicting VOC contamination.

8.1.3.1 Nature of VOC Contamination

Only four VOCs were detected within the surface soils in the Study Area: 2-butanone, acetone, carbon disulfide, and chlorobenze. In addition to these, aromatic hydrocarbons (chlorobenzene, benzene, and xylenes) were also present in subsurface soils. Many of these are commonly used in industrial processes; they are also constituents of gasoline and petroleum fuels.

8.1.3.2 Extent of VOC Contamination

- Surface: All VOCs detected were low; CT PMC were not exceeded.

- Subsurface: Primarily aromatic hydrocarbons were detected in subsurface soils. The CT PMC only were exceeded in the southwestern portion of the Study Area; however, these contaminants were not identified in onsite groundwater sample.

8.1.4 Semivolatile Organic Compounds (SVOCs)

SVOCs are identified as contaminants within surface and subsurface Study Area soils. Total PAHs in surface and subsurface soils are depicted on Figures 4-1a and 4-1b, respectively.

8.1.4.1 Nature of SVOC Contamination

Two primary groups of SVOCs were detected within the Study Area: polynuclear aromatic hydrocarbons (PAHs), and phthalates. Many of these are common constituents of various industrial products, used in the manufacture of friction materials (such as those made at Raymark), and are associated with fuels, coal, and petroleum products. Phthalates were used as plasticizers in the manufacture of synthetic products (such as the synthetic resins made at Raymark).

8.1.4.2 Extent of SVOC Contamination

- Surface - SVOCs were distributed throughout the southern portion of the Study Area at low concentrations. SVOCs were infrequently detected in surficial soils at concentrations below the CT PMC except for dibenzo(a,h)antracene, indeno (1,2,3-cd)pyrene, and N-nitroso-di-n-propylamine.

- Subsurface – SVOCs were distributed throughout the southern portion of the Study Area. PAHs were the primary SVOC detected. PAHs were detected above CT PMC in the southern and western portions of the Study Area; however, these contaminants were not identified in onsite groundwater.

8.1.5 Pesticides

Pesticides are identified contaminants within the Study Area. No figures presenting the extent of pesticide contamination are included.

8.1.5.1 Nature of Pesticide Contamination

Pesticides are assumed to have been used at the Raymark Facility, as indicated by pest control practices common in manufacturing plants. Pesticides were detected in residential soil-waste stored at the Raymark Facility. Pesticides detected within the Study Area appear to be similar to those used for insect control when the ballfield was in use.

8.1.5.2 Extent of Pesticide Contamination

- Surface – Pesticides were frequently detected in surficial soils above average background but at low concentrations. The primary pesticides detected include: heptaclor epoxide, alpha chlordance, gamma chlordane, 4-4'-DDD, 4-4'-DDE, 4-4'-DDT, endrin, and endrin ketone. Pesticides exceeded CT PMC primarily in the playing area of the ballfield. Some pesticides were detected in the groundwater, but at low concentrations below MCLs.

- Subsurface – Pesticides were frequently detected in subsurface soils at levels above background and higher levels than in surface soils. In addition to the surface soil pesticides, aldrin, alpha-BHC, beta-BHC, delta-BHC, dieldrin, endosulfan I and II, and endrin aldehyde were detected at levels above average background in subsurface soils. Many pesticides exceeded CT PMC in the subsurface soils. Pesticides were detected in groundwater at low concentrations below MCLs.

8.1.6 Polychlorinated Biphenyls (PCBs)

PCBs are identified contaminants within Study Area. See Figures 4-2a and 4-2b for depiction of PCBs in surface and subsurface soils.

8.1.6.1 Nature of PCB Contamination

The PCBs identified within the Study Area consisted primarily of Aroclor 1262 and Aroclor 1268 with Aroclors 1016, 1242, and 1248 detected once each in the surface soils, and Aroclors 1232 and 1242 detected in subsurface soils. PCBs were typically used as plasticizers in the manufacture of brake linings, rubber gaskets, and synthetic resins (such as were made at Raymark).

8.1.6.2 Extent of PCB Contamination

- Surface – PCBs (primarily Aroclors 1262 and 1268) were frequently detected in surficial soils throughout the Study Area. Elevated concentrations were detected along the western boundary in the playing field, and in one sample each from the southwest corner and the southern portion of the Study Area.

- Subsurface – PCBs (primarily Aroclors 1262 and 1268) were frequently detected in subsurface soils throughout the Study Area. Elevated concentrations (greater than 1 ppm) were detected at most locations.

8.1.7 Metals

Metals have been identified as contaminants within Study Area. See Figures 4-3a and 4-3b for depiction of lead contamination. The extent of arsenic concentrations are depicted on Figures 4-4a and 4-4b; barium concentrations are depicted on Figures 4-5a and 4-5b; zinc concentrations are depicted on Figures 4-6a and 4-6b; copper concentrations are depicted on Figures 4-7a and 4-7b; and chromium concentrations are depicted on Figures 4-8a and 4-8b.

8.1.7.1 Nature of Metals Contamination

The metals detected within the Study Area include antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, thallium, vanadium, and zinc. The most prevalent of these metals present in the Study Area soils were lead, arsenic, barium, zinc, copper, and chromium.

Lead and copper are Raymark-related metals that have been detected within the Study Area. These metals are used in fabricating brake and friction products (such as were used at Raymark). The presence of these metals within the Study Area appears to be the result of deposition of Raymark-type waste in the Study Area.

8.1.7.2 Extent of Metals Contamination

- Surface – Metals were frequently detected in surficial soils throughout the Study Area. Lead was detected above the average background levels throughout the Study Area, exceeding the EPA criteria for lead (400 mg/kg) and the CT DEC along the western boundary of the Study Area. Similarly, arsenic, barium, zinc, copper, and chromium exceeded CT DEC along the western boundary of Study Area.

- Subsurface – Metals were frequently detected in subsurface soils throughout the Study Area. Lead, arsenic, barium, zinc, copper, and chromium were detected above background levels and above the CT DEC throughout the Study Area. In general, the levels of metals were higher in the subsurface soils than the surface soils.

8.1.8 Asbestos

Asbestos is an identified contaminant within the Study Area. See Figure 4-9a and 4-9b for depiction.

8.1.8.1 Nature of Asbestos Contamination

Asbestos-containing materials were a primary component of products manufactured at the Raymark Facility. Asbestos fibers were mixed with phenolic resins to manufacture brake pads, linings, clutches, transmission plates, and gaskets. Asbestos contamination is defined as greater than 1 percent.

8.1.8.2 Extent of Asbestos Contamination

- Surface – Asbestos was frequently detected at greater than 1 percent in surficial soils throughout the Study Area.

- Subsurface – Asbestos was frequently detected in subsurface soils throughout the Study Area. Average observable amounts of asbestos were higher in subsurface soils than in surface soils.

8.2 Contaminant Fate and Transport Summary

Contaminant fate and transport in the environment are controlled by a number of factors: chemical and physical properties of the contaminants, geologic formations, hydrologic conditions, aquifer conductivity, topography, precipitation, and tidal flow.

The contaminants identified in the nature and extent discussion are associated with the former Raymark Facility. The major pathway of migration within the Study Area is leaching of contaminants in soils. Chemicals are transported down through soils by precipitation. The placement of the contaminated waste in the Study Area has resulted in the direct contamination of the Study Area.

8.3 Risk Assessment Summary

The risk assessment for this RI focused on human health risks. No ecological risks were identified.

8.3.1 Human Health Risk Assessment

The Human Health Risk Assessment identified total PAHs; total PCBs; metals, lead, arsenic, and barium; and asbestos as the primary contaminants of concern within the Study Area. These contaminants were selected based on their toxicity, occurrence within the Study Area, and existence at the Raymark Facility. See Table 6-1 for a summary of the human health risks within the Study Area.

Based on the results of the risk assessment, the following risks are identified:

- Non-carcinogenic risks (total PCBs) are identified for both residential and commercial use of the Study Area.

- Potential non-carcinogenic risks (barium and zinc) have also been identified for child residential use of the Study Area.

- Potential carcinogenic risks exist for a future residential child use of the Study Area.

- Potential lead risks exist for residential children, future commercial worker, and adult recreational user.

- Asbestos contamination in the Study Area poses a potential inhalation risk when migrating through the air. No quantitative risk estimates are available.

8.3.2 Ecological Risk Evaluation

The Ecological Risk Evaluation indicated no ecological receptors of note within the Study Area.

8.4 Conclusions

The interpretation of the data and information compiled for this RI indicates that:

- Soil-waste/fill was disposed of as fill throughout the Study Area.

- Fill and natural soils throughout the Study Area are contaminated primarily with asbestos, metals (lead, arsenic), and PCBs. Limited SVOC contamination is also present.

- Analysis of soil samples reveals that there is limited contamination in surface soils. In most areas, the subsurface contamination is higher than the surface contamination.

- A cursory review of onsite groundwater data indicates that contaminants detected in Study Area soils are not contributing to groundwater contamination.

- Non-carcinogenic risks (total PCBs) exist at the Study Area, as well as potential risks from barium, zinc, lead, and asbestos.

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TABLES

TABLE 4-1
CHEMICAL COMPOUNDS USED OR HANDLED AT THE RAYMARK FACILITY
FINAL REMEDIAL INVESTIGATION REPORT
RAYMARK OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT

CHEMICAL COMPOUND/MATERIAL	DESCRIPTION	INFORMATION SOURCES			
		NO. 1	NO. 2	NO. 3	NO. 4
Acetone	2-Propanone	X		X	
Adhesive CR04					X
Alcohol			X		X
Aluminum	Alumina		X		X
Ammonia Aqua		X			X
Arco 4545					X
Asbestos			X	X	X
Boiler Feed Water		X			
1-Butanol	n-Butyl Alcohol			X	
2-Butanone	MEK			X	
n-Butyl Alcohol				X	
Carbon Tetrachloride	Perchloromethane			X	
Caustic	Sodium Hydroxide	X			X
Caustic Liquid/Sludge	Sodium Hydroxide				X
China Oil					X
Chinawood Oil	meta para Cresol; Phenolic Mixture	X			
Ching Oil					X
Chlorinated Fluorocarbons				X	
Coal	Natural Solid		X		
Coal Tar Resin	Petroleum-Like Fuel				X
Copper			X		
Cotton			X		
Cresolic Acid	Cresol; Methylphenol			X	
Cresylic Acid	Cresol; Methylphenol	X		X	X
Denatured Alcohol		X			
Denatured Ethanol					X
Dust (Dry)					X
Dust (Wet)					X
Fiberglass Fibers			X		
Fire Water		X			
Formaldehyde Resin					X
Formaldehyde (37%)		X		X	
#2 Fuel Oil	Diesel Oil	X			
#6 Fuel Oil	Diesel Oil	X	X		
Gilsonite	Asphaltic Material				X

TABLE 4-1 (Continued)
CHEMICAL COMPOUNDS USED OR HANDLED AT THE RAYMARK FACILITY
FINAL REMEDIAL INVESTIGATION REPORT
RAYMARK OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT

CHEMICAL COMPOUND/MATERIAL	DESCRIPTION	INFORMATION SOURCES			
		NO. 1	NO. 2	NO. 3	NO. 4
Graphite	Black Lead		X		
Hexamethylene Tetramine	Methanamine				X
Hycar Rubber			X		
Hydraulic Oil			X		
Iron Hydroxide Sludge			X		
Latex	Hydrocarbon Polymer	X	X		X
Lead			X	X	X
Linseed Oil	Flaxseed Oil	X			
Liquid Phenolic Resin	Condensation of Phenol with Aldehydes		X		
meta para Cresol	Phenolic Mixture	X			
Methanol	Methyl Alcohol				X
Methylbenzene	Toluene			X	
Methyl Chloride	Dichloromethane			X	
Methyl Chloroform	1,1,1-Trichloroethane		X	X	
Methylethyl Ketone	2-Butanone	X		X	X
Methylphenol	Cresol			X	
Mineral Spirits					X
Monochlorobenzene	Phenyl Chloride	X			X
Muriatic Acid	Hydrochloric Acid		X		
Naptha	Petroleum Product	X	X		
Nitric Acid		X	X		
Nylon					X
Phenol	Tung Oil	X	X	X	X
Phenol Formaldehyde Copolymer	Synthetic Thermosetting Polymer				X
Phenolic Resin	Condensation of Phenol with Aldehydes				X
Phenolic Resin 424					X
Phenolic Resin 439					X
Phenolic Resin 478					X
Pickle Liquor	Waste Acid Containing Dissolved Metals			X	
Polybutadiene Resin	Synthetic Thermoplastic Polymer				X
Powdered Metals					X
2-Propanone	Acetone	X		X	
Process CNSL		X			X

TABLE 4-1 (Continued)
CHEMICAL COMPOUNDS USED OR HANDLED AT THE RAYMARK FACILITY
FINAL REMEDIAL INVESTIGATION REPORT
RAYMARK OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT

CHEMICAL COMPOUND/MATERIAL	DESCRIPTION	INFORMATION SOURCES			
		NO. 1	NO. 2	NO. 3	NO. 4
Raw Cashew Nut Oil		X			X
RC 439	477 Saturant	X			
RC 845					X
Reclaimed City Water		X			
Red Oxide	Iron Oxide		X		
Resin Solution CR04					X
Rinsate Water					X
Rubber	Polyisoprene		X		
Rubber Cement			X		
Sartomer 845					X
Saturant 295E	90% Anacardic Acid; Sulfur Blistering Compound	X			
Saturant 439		X			
Saturant 451		X			X
Saturant 500-3					X
Saturant 500-F					X
Saturant 8240		X			
Saturant 850F					X
Saturant 851					X
Saturant RC 581					X
Scrap Resin	Petroleum and Mineral Spirits	X			
Scrap Saturant					X
#3 Sludge					X
Soap Saturant 850F					X
Solvent 204		X			
Steel			X		X
Steel Wool			X		
Sulfuric Acid	Battery Acid		X		
Tetrachloroethylene	Perchloroethylene (PCE)			X	
Textile Spirits					X
Toluene				X	X
Toluol	Cresol	X	X		
1,1,1-Trichloroethane (TCA)		X	X	X	
Trichloroethylene (TCE)				X	
Tung Oil		X			X

TABLE 4-1 (Continued)
CHEMICAL COMPOUNDS USED OR HANDLED AT THE RAYMARK FACILITY
FINAL REMEDIAL INVESTIGATION REPORT
RAYMARK OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT

CHEMICAL COMPOUND/MATERIAL	DESCRIPTION	INFORMATION SOURCES			
		NO. 1	NO. 2	NO. 3	NO. 4
Unleaded Gasoline		X			
Varsol	Petroleum Aliphatic Solvents				X
Varsol #18		X			X
Vegetable Oil					X
VMP Naptha	Varnish; Petroleum Spirits	X			
Waste Oil		X			
White Water		X	X		X

Information Sources:
No. 1 - Overall Site Plan, Sheet No. S1 (ELI, 1993).
No. 2 - RCRA Facility Investigation Report, Section 2.0 (ELI, 1995).
No. 3 - RCRA Application, Part A, 8/15/80.
No. 4 - RCRA Application, Draft Part B, 8/15/80.

TABLE 4-2
SUMMARY STATISTICS FOR BACKGROUND SOIL SAMPLES
FINAL REMEDIAL INVESTIGATION REPORT
RAYMARK OU4 - BALLIELD SITE
STRATFORD, CONNECTICUT

Parameter	Detections	Number of Samples Analyzed	Average Conc.[1]		Average Detected Conc.	Minimum Detected Conc.	Max. Detected Conc.
Metals (mg/kg)							
Aluminum	39	39	12917.59		12900	926 J	22600
Antimony	0	34	2.86	U	ND	ND	ND
Arsenic	39	39	5.67		5.7	0.62 J	11.6
Barium	39	39	57.47		57.5	5.3	329 J
Beryllium	34	39	0.72		0.79	0.26 J	1.3
Cadmium	8	39	0.40		0.83	0.43 J	1.4 J
Calcium	39	39	1597.62		1600	161 J	7420 J
Chromium	39	39	16.97		17	6.2	35.2
Cobalt	29	39	6.35		7.5	2.4 J	12.4
Copper	38	39	28.79		29.4	9.2 J	123 J
Iron	39	39	16045.13		16000	3110 J	24100
Lead	36	38	80.76		86.9	3.7 J	344 J
Magnesium	39	39	3251.49		3250	368 J	5690
Manganese	39	39	306.39		306	35.8 J	660 J
Mercury	25	39	0.11		0.15	0.07 J	0.28
Nickel	29	39	12.52		14.5	5.4 J	40.4 J
Potassium	24	39	961.14		1380	517	2680
Selenium	6	39	0.50		1.7	0.95 J	3.3 J
Silver	2	39	0.51		1.9	0.58 J	3.3 J
Sodium	21	34	76.43		112	66.4 J	246
Thallium	0	39	0.37		ND	ND	ND
Vanadium	38	39	34.21		35.1	6.5 J	81.9
Zinc	39	39	112.32		112	9.8 J	604 J
Pesticides (µg/kg)							
4,4'-DDD	0	35	4.60		ND	ND	ND
4,4'-DDE	12	34	16.71		41	2.2 J	240 J
4,4'-DDT	13	34	29.09		72	2	400 J
Aldrin	0	36	2.41		ND	ND	ND
alpha-BHC	0	36	2.41		ND	ND	ND
alpha-Chlordane	9	35	4.88		13	1.3 J	44 J
beta-BHC	0	35	2.39		ND	ND	ND
delta-BHC	1	36	2.32	U	1.3	1.3 J	1.3 J
Dieldrin	8	33	13.09		45	2.6 J	190 J
Endosulfan I	3	35	4.52		30	22	47 J
Endosulfan II	5	36	4.72		3.5	1.8 J	6 J
Endosulfan Sulfate	0	36	4.69		ND	ND	ND
Endrin	1	36	4.77		4.5	4.5 J	4.5 J
Endrin Aldehyde	1	36	4.56		3.7	3.7 J	3.7 J
Endrin Ketone	4	35	5.31		6.4	1.8 J	9.5 J
gamma-BHC	0	36	2.41		ND	ND	ND
gamma-Chlordane	6	33	2.67		5.6	1 J	13 J
Heptachlor	1	35	2.19		1	1 J	1 J
Heptachlor Epoxide	2	35	2.33		2	1.6 J	2.3 J
Methoxychlor	4	34	22.25	U	9.9	4.1 J	18 J
Toxaphene	2	36	236.45	U	3.6	1.4 J	5.7 J
PCBs (µg/kg)							
Aroclor-1016	0	37	49.93		ND	ND	ND
Aroclor-1221	0	37	93.03		ND	ND	ND
Aroclor-1232	0	37	47.05		ND	ND	ND
Aroclor-1242	0	37	46.11		ND	ND	ND
Aroclor-1248	0	37	46.11		ND	ND	ND
Aroclor-1254	0	37	46.11		ND	ND	ND
Aroclor-1260	0	37	46.11		ND	ND	ND
Aroclor-1262	0	27	36.81		ND	ND	ND
Aroclor-1268	0	37	46.11		ND	ND	ND

Notes:

(1) Average Concentrations are calculated using the sum of the detected values and 1/2 of the detection limits for non-detected values. If the compound is not detected, the average is generated using the sum of 1/2 of the detection limits. This method of calculation may result in an average concentration higher than the maximum detected value.

J - Quantitation approximate;ND - Not Detected

TABLE 4-3
SUMMARY STATISTICS FOR DETECTED COMPOUNDS - SURFACE SOILS (0'-2' BGS)
FINAL REMEDIAL INVESTIGATION REPOR
RAYMARK OU4 - BALLFIELD
STRATFORD, CONNECTICUT

Parameter	Positive Detections	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Max. Detected Conc.	Location of Max. Detection	Raymark Average Background	Number of Exceedances of Raymark Average Background	CT PMC	Number of Exceedances of CT PMC	CT DEC	Number of Exceedances of CT DEC
Asbestos (%)													
Asbestos	79	149	2	4	0.9	45	A002	NA		NA		NA	
Metals (mg/kg)													
Aluminum	14	14	12600	12600	8120	16200 J	RMF B+200	12,917.59	8	NA		NA	
Arsenic	16	35	4	7.6	1.6 J	27	BF006	5.67	11	NA		10	2
Barium	18	35	203	375	30.5 J	2755	BF021	57.47	14	NA		4700	0
Beryllium	12	35	0.56	0.74	0.34	1.2	RMF B+150	0.72	6	NA		2	0
Cadmium	7	35	0.48	0.61	0.47	0.81	SB-422	0.40	7	NA		34	0
Calcium	14	14	1750	1750	702 J	4590 J	SB-427	1,597.62	5	NA		NA	
Chromium	18	35	13.3	24.9	11	119	BF006	16.97	13	NA		100	1
Cobalt	18	35	6.5	8	4.4	25	BF006	6.35	12	NA		1000	0
Copper	17	35	287	586	9	4900	BF006	28.79	13	NA		2500	2
Iron	14	14	15800	15800	11000	18600 J	RMF E+100	16,045.13	9	NA		NA	
Lead	102	106	562	584	19.2 J	8270	BF006	80.76	86	NA		500	14
Magnesium	14	14	3740	3740	2480 J	6040	SB-427	3,251.49	10	NA		NA	
Manganese	18	35	165	319	162 J	560	BF023A	306.39	7	NA		1600	0
Mercury	6	14	0.072	0.13	0.08	0.15	RMF B+150, RMF C+250	0.11	4	NA		20	0
Nickel	18	35	20.6	36.3	9	351	BF006	12.52	12	NA		1400	0
Potassium	11	14	1610	2000	769 J	3400 J	SB-426	961.14	9	NA		NA	
Selenium	2	14	0.22	0.42	0.38 J	0.47	SB-422	0.50	0	NA		340	0
Silver	2	8	0.5	0.7	0.61	0.8	SB-425	0.51	2	NA		340	0
Sodium	14	14	131	131	33.2 J	304	SB-425	76.43	11	NA		NA	
Thallium	1	14	0.34	1.2	1.2 J	1.2 J	SB-421	0.37	1	NA		5.4	0
Vanadium	18	35	18.8	31.8	21.6	42.7	RMF C+250	34.21	8	NA		470	0
Zinc	18	35	140	270	28.8	3410	BF006	112.32	3	NA		20000	0
Semivolatile Organic Compounds (µg/kg)													
2-Methylnaphthalene	1	8	160	19	19 J	19 J	SB-425	NA		56000	0	1000000	0
Acenaphthene	1	8	160	18	18 J	18 J	SB-425	NA		84000	0	1000000	0
Acenaphthylene	5	8	93	41	20	68 J	SB-425	NA		84000	0	1000000	0

TABLE 4-3
SUMMARY STATISTICS FOR DETECTED COMPOUNDS - SURFACE SOILS (0'-2' BGS)
FINAL REMEDIAL INVESTIGATION REPORT
RAYMARK OU4 - BALLFIELD
STRATFORD, CONNECTICUT

Parameter	Positive Detections	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Max. Detected Conc.	Location of Max. Detection	Raymark Average Background	Number of Exceedances of Raymark Average Background	CT PMC	Number of Exceedances of CT PMC	CT DEC	Number of Exceedances of CT DEC
Anthracene	4	8	120	55	29 J	92 J	SB-425	NA		400000	0	1000000	0
Benzo(a)anthracene	7	8	140	140	31 J	280 J	SB-425	NA		1000	0	1000	0
Benzo(a)pyrene	8	8	150	150	65 J	320 J	SB-425	NA		1000	0	1000	0
Benzo(b)fluoranthene	8	8	140	140	58 J	230 J	SB-421, SB-424	NA		1000	0	1000	0
Benzo(g,h,i)perylene	8	8	140	140	49 J	390	SB-425	NA		40000	0	1000000	0
Benzo(k)fluoranthene	8	8	160	160	60 J	260 J	SB-424	NA		1000	0	8400	0
Butylbenzylphthalate	1	8	160	30	30 J	30 J	SB-423	NA		200000	0	1000000	0
Carbazole	3	8	120	24	21 J	27 J	SB-424	NA		360	0	31000	0
Chrysene	8	8	170	170	71 J	350 J	SB-425	NA		960	0	84000	0
Di-n-Butylphthalate	2	8	140	22	20	25 J	SB-426	NA		140000	0	1000000	0
Dibenzo(a,h)anthracene	5	8	98	50	25 J	78 J	SB-425	NA		0.96	5	84	0
Dibenzofuran	1	8	160	19	19 J	19 J	SB-425	NA		5600	0	270000	0
Fluoranthene	8	8	250	250	51 J	530	SB-424	NA		56000	0	1000000	0
Fluorene	1	8	160	34	34 J	34 J	SB-425	NA		56000	0	1000000	0
Indeno(1,2,3-cd)pyrene	8	8	120	120	51 J	300 J	SB-425	NA		9.6	8	840	0
N-Nitroso-di-n-propylamine	1	8	160	44	44 J	44 J	SB-427	NA		1	1	88	0
Naphthalene	1	8	160	22	22 J	22 J	SB-425	NA		56000	0	1000000	0
Phenanthrene	8	8	140	140	18 J	360 J	SB-425	NA		40000	0	1000000	0
Pyrene	8	8	310	310	87 J	720 J	SB-425	NA		40000	0	1000000	0
Total PAH	8	8	1800	1800	579	3842	SB-425	NA		NA	0	NA	0
Volatile Organic Compounds(µg/kg)													
2-Butanone	3	8	10	16	12	21	SB-426	NA		80000	0	500000	0
Acetone	2	8	47	130	82	180 J	SB-426	NA		140000	0	500000	0
Carbon Disulfide	1	8	6	0.6	0.6 J	0.6 J	SB-424	NA		140000	0	500000	0
Chlorobenzene	1	8	6	2	2 J	2 J	SB-421	NA		20000	0	500000	0
Pesticides (µg/kg)													
4,4'-DDD	8	13	13	14	0.24 J	42 J	RMF B+150	4.60	4	29	2	2600	0
4,4'-DDE	11	14	150	180	1.1 J	710 J	RMF C+250	16.71	7	21	7	1800	0
4,4'-DDT	13	14	94	100	1.2 J	560 J	RMF C+250	29.09	6	21	7	1800	0

TABLE 4-3
SUMMARY STATISTICS FOR DETECTED COMPOUNDS - SURFACE SOILS (0'-2' BGS)
FINAL REMEDIAL INVESTIGATION REPORT
RAYMARK OU4 - BALLFIELD
STRATFORD, CONNECTICUT

Parameter	Positive Detections	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Max. Detected Conc.	Location of Max. Detection	Raymark Average Background	Number of Exceedances of Raymark Average Background	CT PMC	Number of Exceedances of CT PMC	CT DEC	Number of Exceedances of CT DEC
alpha-Chlordane	4	14	5.2	11	0.6 J	31	SB-424	4.88	2	66	0	490	0
Dieldrin	2	14	4.7	2.8	0.44 J	5.1	SB-424	13.09	0	7	0	38	0
Endosulfan I	3	13	2.7	1.4	0.23 J	2.2 J	RMF E+100	4.52	0	8400	0	410000	0
Endosulfan Sulfate	1	13	5.2	0.3	0.3 J	0.3 J	SB-423	4.69	0	8400	0	410000	0
Endrin	1	14	5	0.61	0.61 J	0.61 J	SB-423	4.77	0	0	1	20000	0
Endrin Ketone	2	14	5.1	1.9	1 J	2.8	SB-422	5.31	0	0	2	20000	0
gamma-Chlordane	7	14	3.4	5.7	0.15 J	29	SB-424	2.67	2	66	0	490	0
Heptachlor	3	14	2.4	0.3	0.058 J	0.64 J	SB-421	2.19	0	13	0	140	0
Heptachlor Epoxide	3	14	3.4	5.2	4.2	6.5 J	RMF G+050	2.33	3	20	0	67	0
Methoxychlor	2	13	26	6.6	3.3 J	10 J	RMF G+050	22.25	0	8000	0	340000	0
PCBs (µg/kg)													
Aroclor, Total	43	106	1700	4100	182.1	35149	BF021	NA		NA		NA	
Aroclor-1016	1	36	25	200	200 J	200 J	SB-425	49.93	1	NA		1000	0
Aroclor-1242	1	68	520	3000	3000 F	3000 F	BF020	46.11	1	NA		1000	1
Aroclor-1248	1	68	20	160	160 J	160 J	SB-425	46.11	1	NA		1000	0
Aroclor-1262	12	68	32	75	6.6 J	180 J	SB-402	36.81	9	NA		1000	0
Aroclor-1268	40	106	2200	4100	49 J	35000	BF021	46.11	40	NA		1000	13

Notes:

J - Quantitation approximate

NA - Not Analyzed

CT PMC - Connecticut Pollutant Mobility Criteria for GB Aquifers

CT DEC - Connecticut Direct Exposure Criteria for Residential Soils

Average conc. Is calculated using the sum of all detected values and 1/2 of the detection limit for non-detected values.

TABLE 4-4
SUMMARY STATISTICS FOR DETECTED COMPOUNDS - SUBSURFACE SOILS (> 2' BGS)
FINAL REMEDIAL INVESTIGATION REPORT
RAYMARK OU4 - BALLFIELD
STRATFORD, CONNECTICUT

Parameter	Detections	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Max. Detected Conc.	Location of Max. Detection	Raymark Average Background	Number of Exceedances of Raymark Average Background	CT PMC	Number of Exceedances of CT PMC	CT DEC	Number of Exceedances of CT DEC
Asbestos (%)													
Asbestos	40	46	19	22	0.9	60	TP17	NA		NA		NA	
Metals (mg/kg)													
Aluminum	59	59	6250	6250	2100	13700	SB-424	12917.59	2	NA		NA	
Antimony	8	39	5.5	11.4	6.5 J	13.5 J	SB-426	2.8576923	8	NA		27	0
Arsenic	54	58	7.8	8.3	0.65 J	45.5 J	SB-427	5.6748718	26	NA		10	16
Barium	59	59	3530	3530	15.1	18800 J	TP15	57.466667	41	NA		4700	20
Beryllium	33	59	0.25	0.33	0.15 J	0.99	TP18	0.7189744	1	NA		2	0
Cadmium	37	59	3	4.6	0.19	19.3	SB-426	0.3965385	33	NA		34	0
Calcium	59	59	1850	1850	291	9100	TP09G	1597.6154	26	NA		NA	
Chromium	59	59	59.5	59.5	4 J	234	TP15	16.971795	35	NA		100	12
Cobalt	59	59	12.5	12.5	3	40.4	TP09G	6.3487179	32	NA		1000	0
Copper	58	59	25200	25700	10 J	193000 J	SB-426	28.79359	44	NA		2500	27
Iron	59	59	17200	17200	6610 J	96200 J	SB-421	16045.128	21	NA		NA	
Lead	51	59	15200	17500	3.3	172000 J	SB-421	80.758974	35	NA		500	30
Magnesium	59	59	22200	22200	1340 J	114000	TP15	3251.4872	38	NA		NA	
Manganese	59	59	239	239	89.7	1530 J	TP09G	306.39487	10	NA		1600	0
Mercury	27	58	0.39	0.8	0.057 J	6.2 J	SB-421	0.1105128	23	NA		20	0
Nickel	57	59	169	175	6	644	TP09G	12.516667	39	NA		1400	0
Potassium	59	59	1220	1220	147	3760 J	SB-424	961.13718	33	NA		NA	
Selenium	12	59	0.69	2	1 J	7.3 J	SB-421	0.4988462	12	NA		340	0
Silver	35	58	3.2	5.1	0.19 J	18.6	SB-426	0.5078205	29	NA		340	0
Sodium	48	57	203	237	42.8 J	1120	SB-424	76.428205	44	NA		NA	
Thallium	13	58	3.6	2.2	1 J	6.4	SB-421	0.3678205	13	NA		5.4	1
Vanadium	59	59	17.6	17.6	2.6	93.6	TP18	34.211538	5	NA		470	0
Zinc	53	59	3810	4240	20.7	23500	SB-426	112.32308	30	NA		20000	3
Semivolatile Organic Compounds (μg/kg)													
1,4-Dichlorobenzene	4	57	330	36	24 J	61 J	TP09G	NA		15000	0	26000	0
2,4-Dimethylphenol	24	58	1400	3200	81 J	35000 *	SB-426	NA		28000	1	1000000	0
2-Methylnaphthalene	28	58	270	320	24 J	1400	SB-426	NA		56000	0	1000000	0
2-Methylphenol	25	58	370	470	36 J	3100	SB-426	NA		70000	0	1000000	0
3,3'-Dichlorobenzidine	1	57	350	100	100 J	100 J	TP15	NA		16	1	1400	0
4-Methylphenol	27	58	640	1100	24 J	9500 *	SB-426	NA		7000	1	340000	0
Acenaphthene	18	58	280	170	37 J	750 J	SB-427	NA		84000	0	1000000	0
Acenaphthylene	10	57	350	230	24 J	1100	SB-421	NA		84000	0	1000000	0
Anthracene	25	58	360	370	40 J	2500	SB-421	NA		400000	0	1000000	0
Benzo(a)anthracene	31	58	470	620	20 J	5300	SB-421	NA		1000	10	1000	10
Benzo(a)pyrene	31	58	500	590	24 , J	4400	SB-421	NA		1000	6	1000	6

TABLE 4-4
SUMMARY STATISTICS FOR DETECTED COMPOUNDS - SUBSURFACE SOILS (> 2' BGS)
FINAL REMEDIAL INVESTIGATION REPORT
RAYMARK OU4 - BALLFIELD
STRATFORD, CONNECTICUT

Parameter	Detections	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Max. Detected Conc.	Location of Max. Detection	Raymark Average Background	Number of Exceedances of Raymark Average Background	CT PMC	Number of Exceedances of CT PMC	CT DEC	Number of Exceedances of CT DEC
Benzo(b)fluoranthene	31	57	440	520	29	3600	SB-421	NA		1000	8	1000	8
Benzo(g,h,i)perylene	32	57	360	420	24 J	2700 J	SB-424	NA		40000	0	1000000	0
Benzo(k)fluoranthene	20	57	470	610	36 J	3900	SB-421	NA		1000	3	8400	0
bis(2-Ethylhexyl)phthalate	14	58	470	740	250	2100 J	TP18	NA		11000	0	44000	0
Butylbenzylphthalate	4	57	340	58	36 J	83 J	SB-427	NA		200000	0	1000000	0
Carbazole	20	57	280	120	26 J	460 J	SB-425	NA		360	1	31000	0
Chrysene	36	58	590	770	24 J	5600	SB-421	NA		960	14	84000	0
Di-n-Butylphthalate	24	57	300	180	22 J	570	TP18	NA		140000	0	1000000	0
Di-n-octylphthalate	1	57	350	56	56 J	56 J	SB-401	NA		20000	0	1000000	0
Dibenzo(a,h)anthracene	14	57	340	240	32 J	800 J	SB-424	NA		0.96	14	84	8
Dibenzofuran	23	58	250	190	30 J	840	SB-427	NA		5600	0	270000	0
Diethylphthalate	3	57	340	58	20 J	120 J	TP18	NA		1100000	0	1000000	0
Fluoranthene	33	58	790	1200	18 J	14000	SB-421	NA		56000	0	1000000	0
Fluorene	23	58	310	260	42 J	1100	SB-427	NA		56000	0	1000000	0
Indeno(1,2,3-cd)pyrene	22	57	400	440	23 J	2200 J	SB-424	NA		9.6	22	840	4
N-Nitroso-diphenylamine	21	58	350	550	18 J	2000	SB-427	NA		1400	1	130000	0
Naphthalene	34	58	380	510	19 J	2700	SB-426	NA		56000	0	1000000	0
Pentachlorophenol	1	57	870	53	53 J	53 J	SB-426	NA		1000	0	5100	0
Phenanthrene	40	58	900	1200	22 , J	11000	SB-421	NA		40000	0	1000000	0
Phenol	22	58	2900	7300	31	110000	SB-425	NA		800000	0	1000000	0
Pyrene	38	58	1000	1400	18 J	12000	SB-421	NA		40000	0	1000000	0
Total PAH	43	58	5200	7000	22	68820	SB-421	NA		NA		NA	
Volatile Organic Compounds(μg/kg)													
1,1,1-Trichloroethane	1	58	100	1	1	1	SB-421	NA		40000	0	500000	0
1,1-Dichloroethane	2	58	100	1	1 J	1 J	SB-426	NA		14000	0	500000	0
1,2-Dichloroethene (total)	5	58	100	4	0.8 J	7 J	SB-426	NA		14000	0	500000	0
2-Butanone	6	58	110	20	13 J	31	SB-426	NA		80000	0	500000	0
Acetone	13	58	130	92	10 J	350 J	SB-425	NA		140000	0	500000	0
Benzene	22	59	250	640	0.4 J	7700 J	SB-425	NA		200	8	21000	0
Bromomethane	3	58	100	2	1 J	2 J	SB-426, SB-427	NA		NA		NA	
Carbon Disulfide	22	58	100	53	0.5 J	400 J	SB-425	NA		140000	0	500000	0
Chlorobenzene	12	58	1400	6800	0.5 J	47000	SB-427	NA		20000	1	500000	0
Chloroform	24	58	58	25	0.5 J	360 J	SB-425	NA		1200	0	100000	0
Ethylbenzene	15	59	390	1500	6 J	8600	SB-427	NA		10100	0	500000	0
Toluene	16	59	100	370	3 J	2100 J	SB-425	NA		67000	0	500000	0
Total Xylenes	20	59	1400	4100	0.8 J	43000 J	SB-425	NA		19500	2	500000	0
Trichloroethene	5	58	100	110	0.6 J	540 J	SB-421	NA		1000	0	56000	0

TABLE 4-4
SUMMARY STATISTICS FOR DETECTED COMPOUNDS - SUBSURFACE SOILS (> 2' BGS)
FINAL REMEDIAL INVESTIGATION REPORT
RAYMARK OU4 - BALLFIELD
STRATFORD, CONNECTICUT

Parameter	Detections	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Max. Detected Conc.	Location of Max. Detection	Raymark Average Background	Number of Exceedances of Raymark Average Background	CT PMC	Number of Exceedances of CT PMC	CT DEC	Number of Exceedances of CT DEC
Vinyl Chloride	3	58	100	1	1 J	1 J	SB-425, SB-426	NA		400	0	320	0
Pesticides (µg/kg)													
4,4'-DDD	15	59	17	13	0.07 J	76	SB-427	4.5958333	8	29	2	2600	0
4,4'-DDE	41	59	27	33	0.04 J	240	TP17	16.713889	17	21	16	1800	0
4,4'-DDT	24	59	47	64	0.2 J	710	TP18	29.093056	6	21	7	1800	0
Aldrin	3	59	7.7	1.7	0.61 J	3.9	SB-423	2.4111111	1	0.41	3	36	0
alpha-BHC	27	59	5.8	2.3	0.32	8.8 J	SB-426	2.4111111	7	1.1	15	97	0
alpha-Chlordane	12	59	9.9	14	0.8 J	130	SB-425	4.8805556	4	66	1	490	0
beta-BHC	13	59	5.6	2.6	0.059 J	14 J	SB-426	2.3861111	4	3.9	4	340	0
delta-BHC	4	59	7.6	1.2	0.044 J	3.9	SB-423	2.3166667	1	1.1	1	97	0
Dieldrin	23	59	16	22	0.073 J	130 J	TP14	13.093056	10	7	10	38	5
Endosulfan I	34	59	5.3	8	0.025 J	41 J	SB-426	4.5236111	17	8400	0	410000	0
Endosulfan II	4	59	15	22	1.9 J	39	TP17	4.7236111	3	8400	0	410000	0
Endosulfan Sulfate	4	59	15	1.3	0.28	2.7 J	SB-423	4.6916667	0	8400	0	410000	0
Endrin	22	59	15	17	0.082 J	170	SB-424	4.7708333	11	0	22	20000	0
Endrin Aldehyde	3	59	16	16	0.062	47	SB-427	4.5583333	1	0	3	20000	0
Endrin Ketone	32	59	32	24	0.71 J	530	TP09G	5.3069444	15	0	32	20000	0
gamma-BHC	21	59	4	1.3	0.021 J	6.7 J	SB-426	2.4111111	4	40	0	20000	0
gamma-Chlordane	36	59	12	15	0.039 J	220	SB-425	2.6722222	23	66	2	490	0
Heptachlor	18	59	8.8	8.5	0.036 J	130	SB-425	2.1861111	4	13	1	140	0
Heptachlor Epoxide	20	59	6	5.2	0.26 J	38	SB-425	2.3319444	10	20	1	67	0
Methoxychlor	2	59	76	2.9	0.7 J	5 J	SB-423	22.25	0	8000	0	340000	0
PCBs (µg/kg)													
Aroclor, Total	53	59	35000	38000	173.7	348000	SB-426	NA		NA		NA	
Aroclor-1016	1	59	150	18	18 J	18 J	TP11	49.932432	0	NA		1000	0
Aroclor-1221	7	59	300	32	22 J	47	SB-424	93.027027	0	NA		NA	
Aroclor-1232	3	59	160	160	110	210	SB-424	47.054054	3	NA		NA	
Aroclor-1242	4	59	170	330	13 J	750	SB-421	46.108108	2	NA		1000	0
Aroclor-1248	1	59	150	14	14 J	14 J	SB-425	46.108108	0	NA		1000	0
Aroclor-1262	46	59	11000	14000	7.2 J	110000 *J	SB-426	36.810811	38	NA		1000	28
Aroclor-1268	49	59	23000	27000	10 J	230000 *J	SB-426	46.108108	42	NA		1000	32

TABLE 4-4
SUMMARY STATISTICS FOR DETECTED COMPOUNDS - SUBSURFACE SOILS (> 2' BGS)
FINAL REMEDIAL INVESTIGATION REPORT
RAYMARK OU4 - BALLFIELD
STRATFORD, CONNECTICUT

Parameter	Detections	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Max. Detected Conc.	Location of Max. Detection	Raymark Average Background	Number of Exceedances of Raymark Average Background	CT PMC	Number of Exceedances of CT PMC	CT DEC	Number of Exceedances of CT DEC
TOTAL ORGANIC CARBON (mg/kg)													
Total Organic Carbon	4	4	41000	41000	221	158165 J	SB-425	NA		NA		NA	

J - Quantitation approximate
NA - Not Available
CT PMC - CT Pollutant Mobility Criteria for GB aquifers.
CT DEC - CT Direct Exposure Criteria for Residential Soils
Average concentration is calculated using the sum of all detected values and 1/2 of the detection limits for non-detected values.

TABLE 6-1
FINAL REMEDIAL INVESTIGATION REPORT
SUMMARY OF REMEDIAL INVESTIGATIONS AND RECOMMENDATIONS
OU#4, RAYBESTOS MEMORIAL BALLFIELD
STRATFORD, CONNECTICUT

Chemicals of Potential Concern	Receptor	Reasonable Maximum Exposure (RME) Risk Estimates						Lead	Asbestos
		ILCR	Risk Drivers			HI	Risk Drivers	Results (1) (2)	Results (3)
Surface Soil/Sediment (0 to 2 feet)	Frequent		$>10^{-4}$	$>10^{-5}$	$>10^{-6}$		>1.0	Slope Factor Approach - Fetal blood lead level (5.3 to 10.1 ug/dl) slightly exceeds the level of concern (10 ug/dl).	Asbestos was detected at an average concentration of 2 %. This exceeds the 1% concentration which defines an asbestos-containing material.
benzo(a)pyrene dibenzo(a,h)anthracene Aroclor (total) asbestos arsenic barium chromium lead	Recreational User (adult) (current/future)	4.39E-06	None	None	arsenic Aroclor (total)	0.132	None		
	Frequent Recreational User (child) (current/future)	9.57E-06	$>10^{-4}$ None	$>10^{-5}$ None	$>10^{-6}$ Aroclor (total) arsenic benzo(a)pyrene	1.13	>1.0 None	IEUBK -7.1 ug/dl was below the level of concern (10 ug/dl) for the residential child. However, 22.4% of the children would have a blood lead level above 10ug/dl.	
All Soil/Sediment (0 to15 feet)	Resident (adult) (future)	9.38E-05	$>10^{-4}$ None	$>10^{-5}$ Aroclor (total)	$>10^{-6}$ benzo(a)pyrene dibenzo(a,h)anthracene arsenic	6.32	>1.0 Aroclor (total)		Asbestos was detected at an average concentration of 6 %. This exceeds the 1% concentration which defines an asbestos-containing material.
benzo(a)anthracene benzo(a)pyrene benzo(b)fluoranthene dibenzo(a,h)anthracene indeno(1,2,3-cd)pyrene benzene chlorobenzene arsenic barium cadmium chromium, total lead zinc Aroclor (total) asbestos dieldrin heptachlor	Resident (child) (future)	1.99E-04	$>10^{-4}$ Aroclor (total)	$>10^{-5}$ arsenic	$>10^{-6}$ benzo(a)pyrene dibenzo(a,h)anthracene	53.6	>1.0 Aroclor (total) barium zinc	IEUBK -32.6 ug/dl was above the level of concern (10 ug/dl) for the residential child. 99.2% of the children would have a blood lead level above 10ug/dl.	
	Commercial Worker (future)	7.58E-05	$>10^{-4}$ None	$>10^{-5}$ Aroclor (total)	$>10^{-6}$ benzo(a)pyrene dibenzo(a,h)anthracene arsenic	4.89	>1.0 Aroclor (total)	Slope Factor Approach - The fetal blood lead level (26.6 to 64.9 ug/dl) exceeded the established level of concern (10 ug/dl).	

1 The risk from lead for an adult was evaluated following "Recommendations of the Technical Review Workgroup for Lead for the Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil", USEPA, December 1996, using the arithmetic mean soil lead concentrations.
2 The risk from lead exposure for a residential child was evaluated with the Integrated Exposure Uptake Biokinetic Model (IEUBK), EPA/540/R-93/081, 1994, using the arithmetic mean soil lead concentrations.
3 The National Emission Standards for Hazardous Air Pollutants - EPA regulation 40 CFR Subpart M, Part 61 (NESHAP) defines asbestos as material containing 1 percent asbestos and sets this valve as an abatement clearance level.

TABLE 7-1
ECOLOGICAL EVALUATION
FINAL REMEDIAL INVESTIGATION
RAYMARK OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT

VEGETATION

Common Name	Scientific Name	Status
Red oak	*Quercus rubra*	O
Goldenrod	*Solidago* spp.	O
Common ragweed	*Ambrosia artemisiifolia*	O
Asters	*Aster spp.*	O
Common milkweed	*Asclepius syriaca*	O
Horse nettle	*Solanum carolinense*	O
Bittersweet	*Celastrus orbiculatus*	O
Black cherry	*Prunus serotina*	O
Black birch	*Betula lenta*	O
Sugar maple	*Acer sacchrum*	O
Common greenbriar	*Smilax rotundifolia*	O
Norway maple	*Acer plantonoides*	O
Tree-of-heaven	*Ailanthus altissima*	O
Common evening primrose	*Oenothera biennis*	O
New York ironweed	*Vernonia noveboracenis*	O
White sweet clover	*Melilotus alba*	O
Common blackberry	*Rubus allegheniensis*	O
Queen Anne's Lace	*Daucus carota*	O
Honey locust	*Gleditsia triacanthos*	O
Common reed	*Phragmites australis*	O
Curled dock	*Rumex crispus*	O
Northern catalapa	*Catalap speciosa*	O
Red mulberry	*Morus rubra*	O
Unidentified upland grasses		

TABLE 7-1
ECOLOGICAL EVALUATION
FINAL REMEDIAL INVESTIGATION
RAYMARK OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT

MAMMALS

Common Name	Scientific Name	Status
gray squirrel	*Sciurus carolinensis*	O
chipmunks	*Tamias striatus*	O
white-footed mice	*Peromyscus leucopus*	O
short-tailed shrew	*Blarina brevicauda*	O
woodchuck	*Marmota monax*	old burrow
opossum	*Didelphis virginiana*	P
eastern cottontail	*Sylvilagus floridanus*	P
striped skunk	*Mephistis mephitis*	P

BIRDS

red-tailed hawk	*Buteo jamaicensis*	O
black-capped chickadee	*Parus atricapillus*	O
common grackle	*Quisculus quiscula*	O
common crow	*Corvus brachyrhynchos*	O
blue jay	*Cyanocitta cristata*	O
mourning dove	*Zenaida macroura*	P
Downy woodpecker	*Picoides pubescens*	P
Tree swallow	*Tachycineta bicolor*	P
Eastern bluebird	*Sialia sialis*	P
American robin	*Turdus migratorius*	P
Gray catbird	*Dumetella carolinensis*	P
Cedar waxwing	*Bombycilla cedrorum*	P

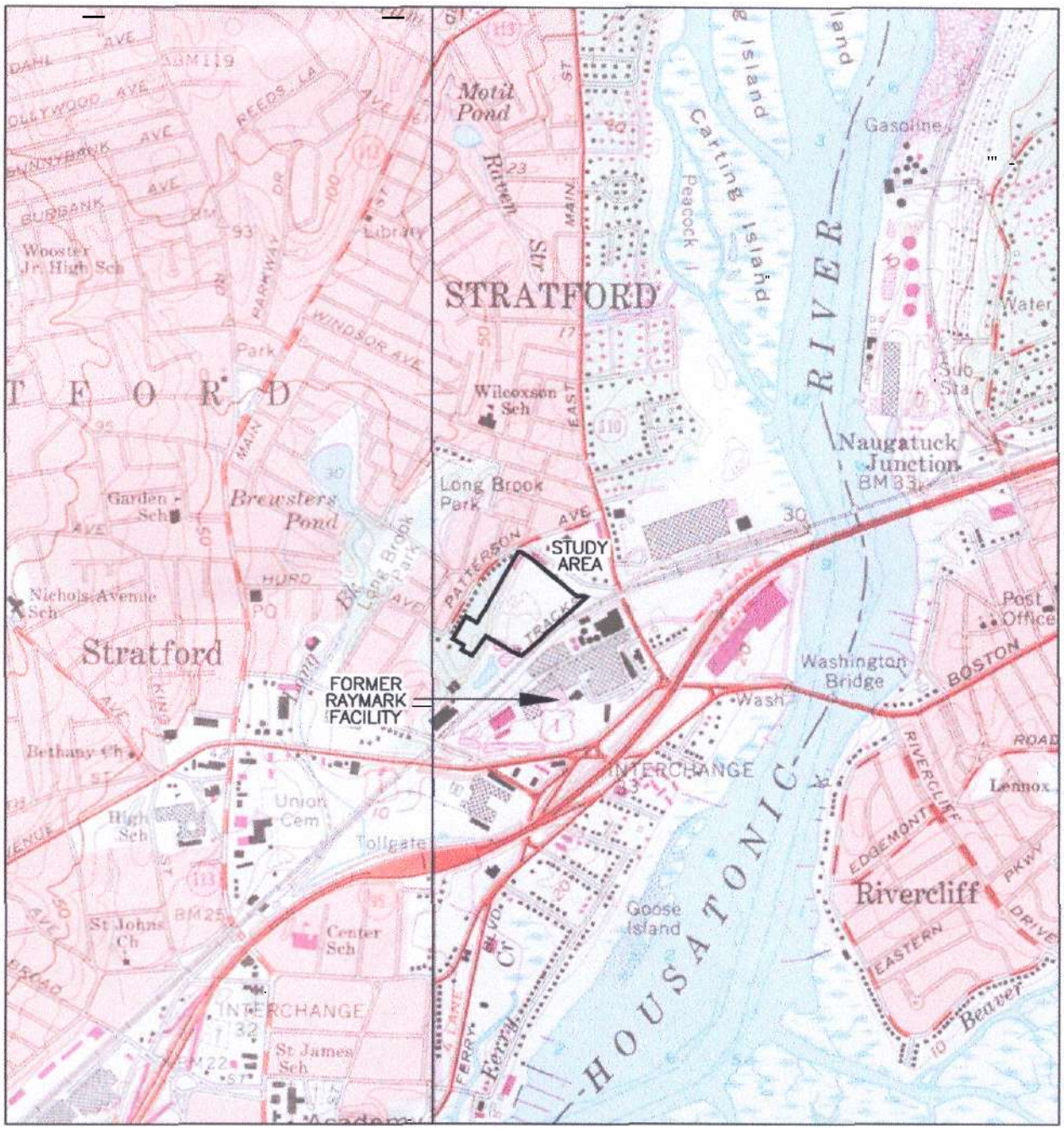
TABLE 7-1
ECOLOGICAL EVALUATION
FINAL REMEDIAL INVESTIGATION
RAYMARK OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT

BIRDS (Continued)

Common Name	Scientific Name	Status
European starling	*Sturnus vulgaris*	P
Northern flicker	*Colaptes auratus*	P
Least flycatcher	*Empidonax minimus*	P
Eastern kingbird	*Tyrannus tyrannus*	P
House wren	*Troglodytes aedon*	P
Yellow warbler	*Dendroica petechia*	P
American redstart	*Setophaga ruticilla*	P
Chipping sparrow	*Spizella passerina*	P
Field sparrow	*Spizella pusilla*	P
REPTILES		
eastern garter snake	*Thamnophis s. sirtalis*	P
eastern milk snake	*Lampropeltis t. triangulum*	P
eastern smooth green snake	*Opheodrys v. vernalis*	P
northern brown snake	*Storeria d. dekayi*	P

The wildlife species were observed (O) or may potentially be present (P) at the site

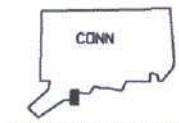
FIGURES



BASEMAP: PORTIONS OF THE FOLLOWING U.S.G.S. QUADRANGLE MAPS: BRIDGEPORT, CONN., 1970 (PHOTOREVISED: 1984) AND MILFORD, CONN., 1960 (PHOTOREVISED: 1984), SCALE ALTERED FOR CLARITY

0 — 1/2 — 1 MILE

1000 0 1000 2000 3000 4000 5000 FEET



QUADRANGLE LOCATION

SITE LOCUS – RAYMARK – OU4 – BALLFIELD	FIGURE 1–1
FINAL REMEDIAL INVESTIGATION / FEASIBILITY STUDY	TETRA TECH NUS, INC.
STRATFORD, CONNECTICUT	55 Jonspin Road Wilmington, MA 01887 (978)658–7899

DRAWN BY:	D.W. MACDOUGALL	REV.:	0
PROJECT MANAGER:	H. FORD	DATE:	JULY 29, 1999
SCALE:	AS SHOWN	ACAD NAME:	DWG\RAYMARK\OU4\USGSSTDY.DWG

Originals in color.

GRAPHIC SCALE

60′ 0′ 60′ 120′

1 INCH = 60 FEET

NOTES:

1. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
2. PLAN NOT TO BE USED FOR DESIGN.
3. BASE PLAN BY GEOD–PHOTOGRAMMETRIC SCIENCES SURVEY TECHNOLOGIES BY PHOTOGRAMETRIC METHODS BASED ON CONNECTICUT STATE PLANE (NAD 1927). BALLFIELD AREA AND WELLS SURVEYED BY CCA/LLC.
4. APPROXIMATE SEWER LINE LOCATION BASED ON TOWN MAP AND SURVEY OF MANHOLES.

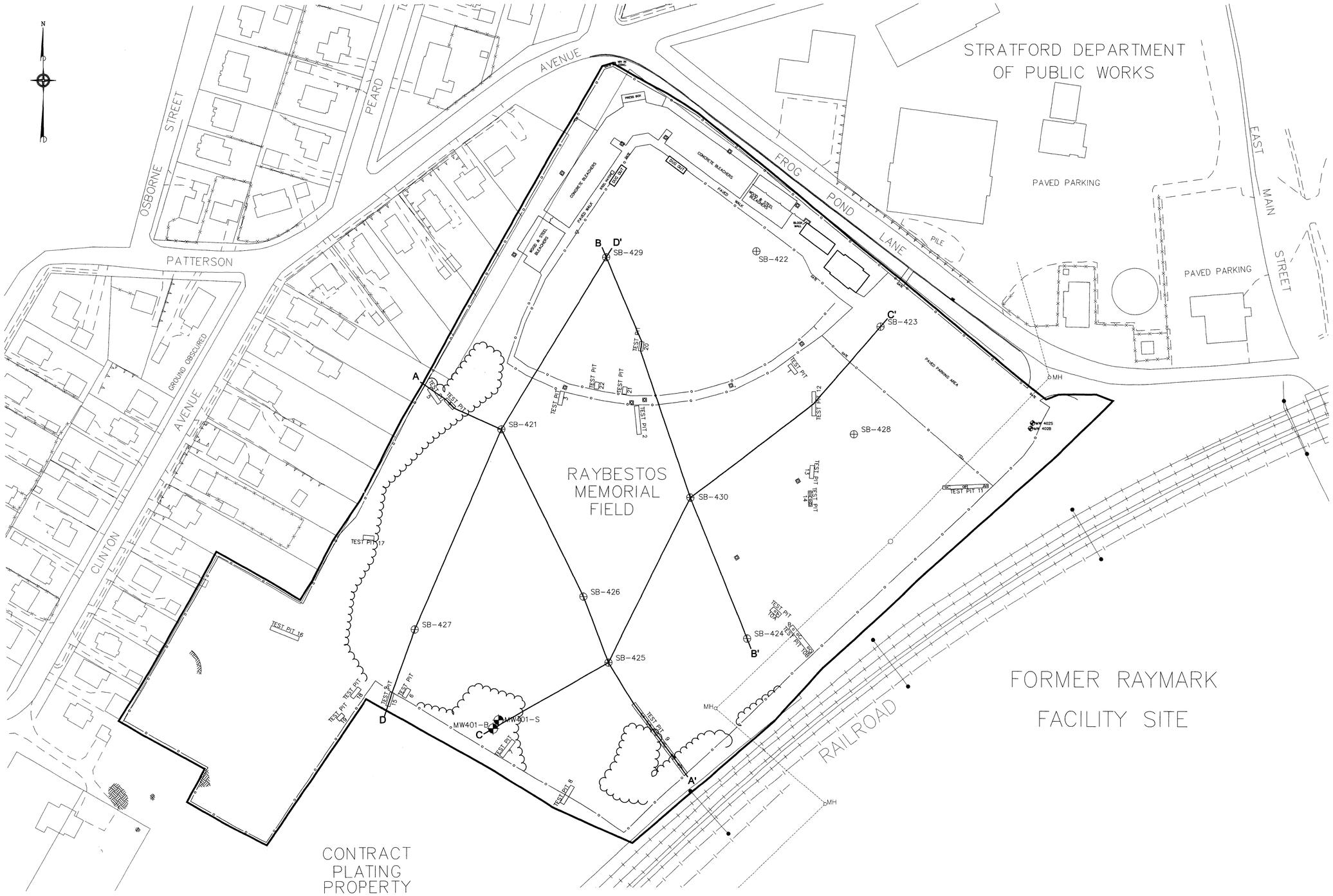
DRAWN BY: D.W. MACDOUGALL	TITLE: STUDY AREA RAYMARK – OU4 – BALLFIELD SITE FINAL REMEDIAL INVESTIGATION / FEASIBILITY STUDY STRATFORD, CONNECTICUT		TETRA TECH NUS, INC.
PREPARED BY: T. DORGAN			55 JONSPIN ROAD WILMINGTON, MASSACHUSETTS 01887 (978)658–7899
CHECKED BY: M. HEALEY	SOURCE: SEE NOTES		
	SCALE: 1″ = 60′	DATE: JULY 29, 1999	PROJ. NO: 0004
PROJECT MANAGER: H. FORD	FIGURE NO: 1–2	ACFILE NAME: DWG\RAYMARK\OU4\SITE.DWG	REV: 0
PROGRAM MANAGER: G. GARDNER			

NOTES:

1. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
2. PLAN NOT TO BE USED FOR DESIGN.
3. BASE PLAN BY GEOD-PHOTOGRAMMETRIC SCIENCES SURVEY TECHNOLOGIES BY PHOTOGRAMETRIC METHODS BASED ON CONNECTICUT STATE PLANE (NAD 1927). BALLFIELD AREA AND WELLS SURVEYED BY CCA/LLC.
4. APPROXIMATE SEWER LINE LOCATION BASED ON TOWN MAP AND SURVEY OF MANHOLES.
5. GPR LOCATION BOUNDARY AND APPROXIMATE AREA OF EM SURVEY TAKEN FROM HAGER-RICHTER GEOSCIENCE, JUNE 1999.

DRAWN BY: D.W. MACDOUGALL	TITLE: FIELD INVESTIGATION LOCATIONS RAYMARK – OU4 – BALLFIELD SITE FINAL REMEDIAL INVESTIGATION / FEASIBILITY STUDY STRATFORD, CONNECTICUT
PREPARED BY: T. DORGAN	
CHECKED BY: M. HEALEY	SOURCE: SEE NOTES
	SCALE: 1" = 60' / DATE: JULY 29, 1999 / PROJ. NO: 0004
PROJECT MANAGER: H. FORD	FIGURE NO: 2-1 / ACFILE NAME: DWG\RAYMARK\OU4\SAMPLES.DWG / REV: 0
PROGRAM MANAGER: G. GARDNER	

TETRA TECH NUS, INC.
55 JONSPIN ROAD
WILMINGTON, MASSACHUSETTS 01887
(978)658-7899



LEGEND

- MW401-B — MONITORING WELL INSTALLED BY TTNUS
- SB-430 — SOIL BORING INSTALLED BY TTNUS
- TEST PIT DUG BY TTNUS
- GRID POINT
- BALLFIELD LIGHT
- MH — MAN HOLE
- OLD MW — PRE-EXISTING MONITORING WELL
- PZ — PRE-EXISTING PIEZOMETER
- CHAIN LINK FENCE
- TREE LINE
- BEDROCK OUTCROPPING
- STUDY AREA BOUNDARY LINE
- MH — SEWER LINE

NOTES:

1. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
2. PLAN NOT TO BE USED FOR DESIGN.
3. BASE PLAN BY GEOD–PHOTOGRAMMETRIC SCIENCES SURVEY TECHNOLOGIES BY PHOTOGRAMETRIC METHODS BASED ON CONNECTICUT STATE PLANE (NAD 1927). BALLFIELD AREA AND WELLS SURVEYED BY CCA/LLC.
4. APPROXIMATE SEWER LINE LOCATION BASED ON TOWN MAP AND SURVEY OF MANHOLES.

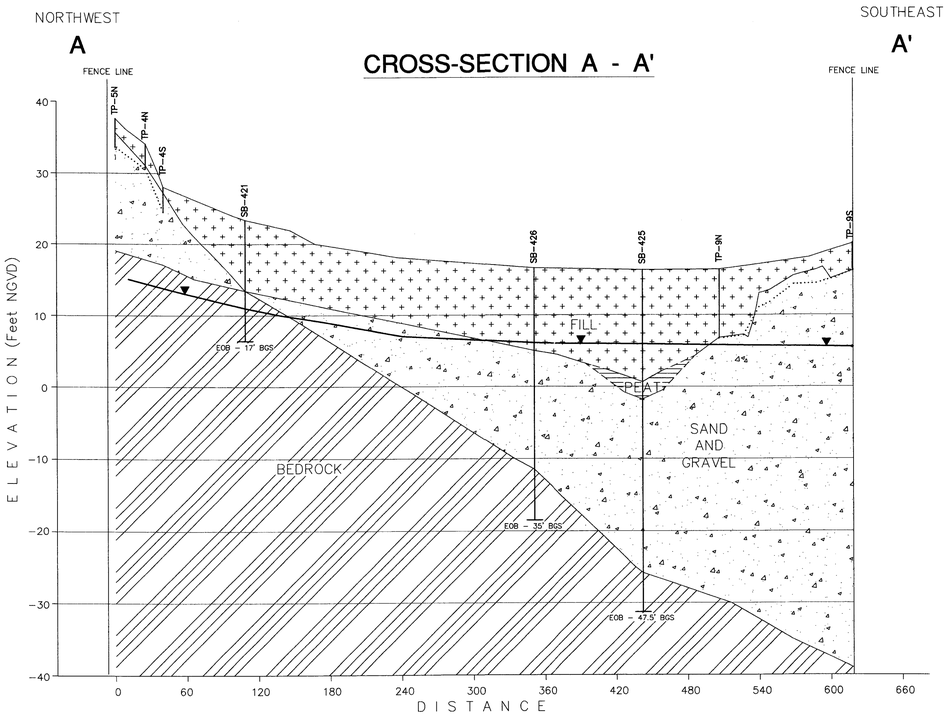
GRAPHIC SCALE

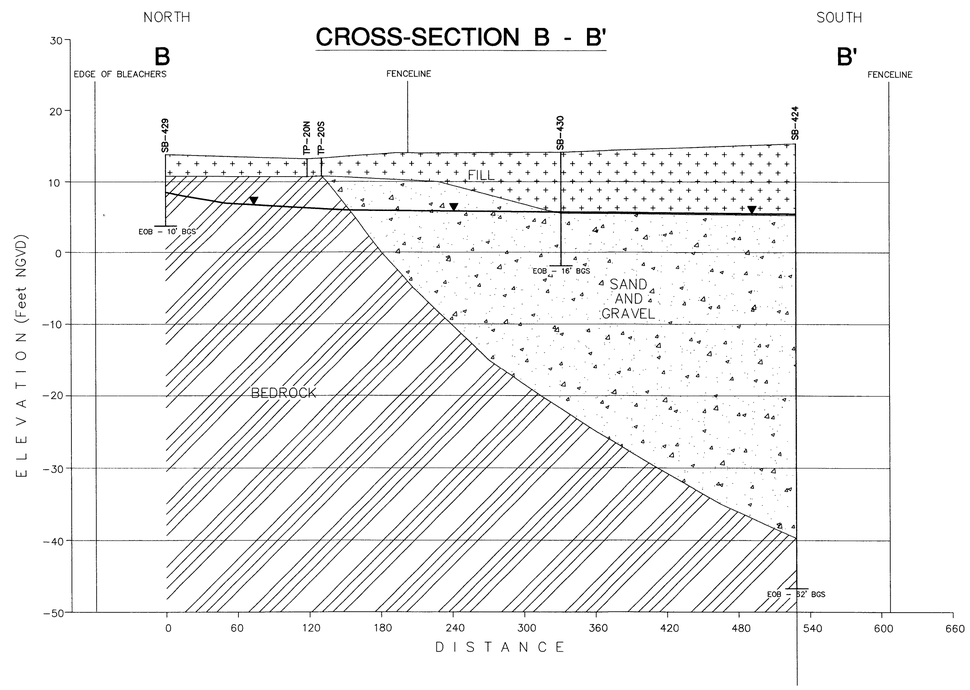
60′ 0′ 60′ 120′

1 INCH = 60 FEET

DRAWN BY: D.W. MACDOUGALL	TITLE: CROSS SECTION LOCATIONS RAYMARK – OU4 – BALLFIELD SITE FINAL REMEDIAL INVESTIGATION / FEASIBILITY STUDY STRATFORD, CONNECTICUT		
PREPARED BY: T. DORGAN			
CHECKED BY: M. HEALEY	SOURCE: SEE NOTES		
	SCALE: 1" = 60'	DATE: JULY 29, 1999	PROJ. NO: 0004
PROJECT MANAGER: H. FORD	FIGURE NO: 3–1	ACFILE NAME: DWG\RAYMARK\OU4\X-SECTIONS\XSECT.DWG	REV: 0
PROGRAM MANAGER: G. GARDNER			

TETRA TECH NUS, INC.
55 JONSPIN ROAD
WILMINGTON, MASSACHUSETTS 01887
(978)658–7899





LEGEND

FILL, May include topsoil and gravel (backfill and/or cover material), asbestos fibres, gasket material, metal debris, sludge, brake pads, glass, brick, asphalt, concrete.

PEAT, Reddish-brown organic debris (roots, matted plant fibers, etc.) with silt.

SAND and GRAVEL, Includes mixtures of sand and gravel with variable amounts of silt and clay.

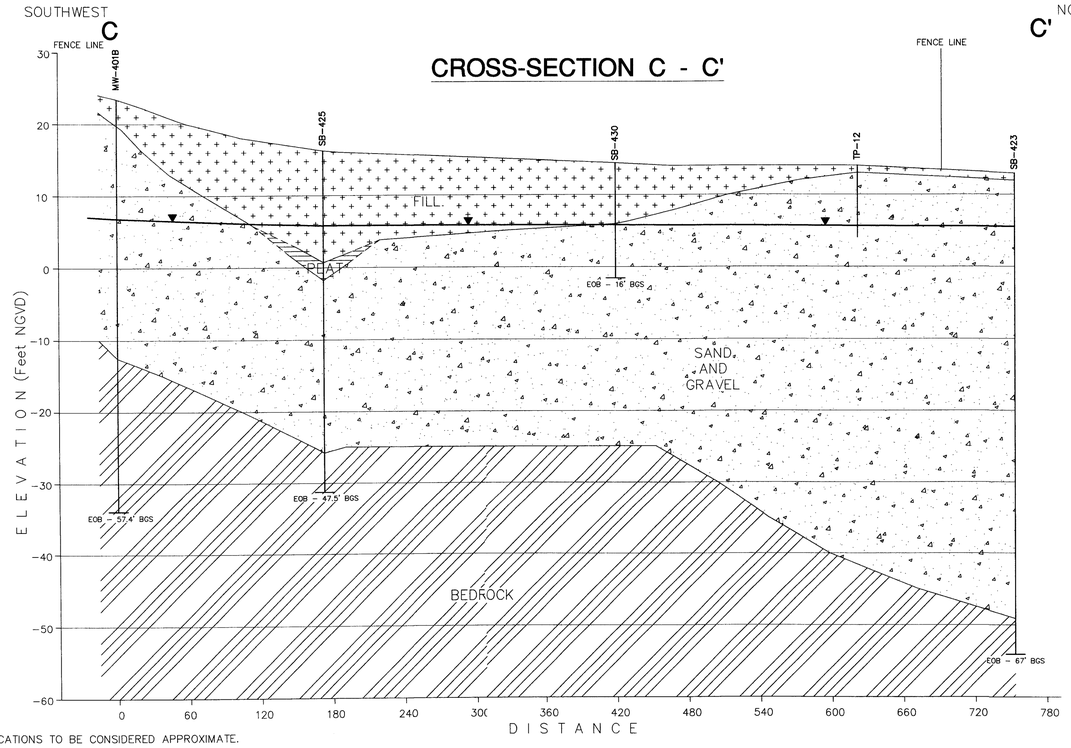
BEDROCK, Typically dark gray to dark green garnet, chlorite, mica, quartz schist with variable amounts of calcite and pyrite. Bedrock highly fractured with both high and low angle fractures. Secondary mineralization and oxidation staining noted along some fractures. Clay (gouge) filled and open fractures observed along foliation or schistostacy.

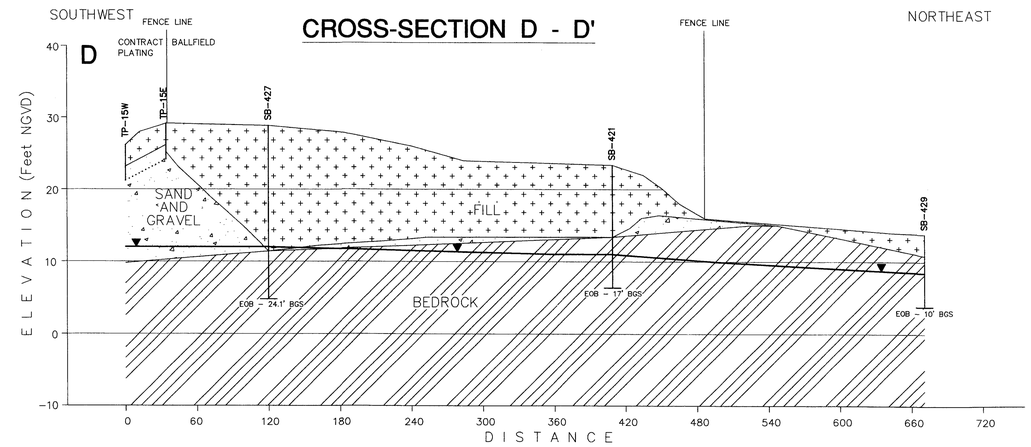
The geologic contacts shown in areas between borings and test pits are interpretations based on contour figures for the bedrock surface, and estimated thickness of Fill. The actual contact between geologic units in these areas may be different than indicated.

Bottom of Test Pit

EOB Defined as 'End Of Boring', it is depth below ground surface.

Water Table Elevation, based on water table elevation Figure 3-5 and data collected on 3-24-99.





NOTES:

1. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
2. PLAN NOT TO BE USED FOR DESIGN.
3. SAMPLING LOCATIONS OBTAINED FROM SURVEY CONDUCTED BY CCA/LLC.
4. ALL CONTACTS INFERRED FROM DATA OBTAINED DURING FIELD EFFORT.
5. BEDROCK ELEVATIONS BASED ON BEDROCK TOPOGRAPHY FIGURE. FILL ELEVATIONS BASED ON FILL TOPOGRAPHY FIGURE. WATER TABLE ELEVATIONS BASED ON WATER TABLE ELEVATION FIGURE.

HORIZONTAL GRAPHIC SCALE

60' 0' 60' 120'

1 INCH = 60 FEET

VERTICAL GRAPHIC SCALE

10' 0' 10'

1 INCH = 10 FEET

DRAWN BY: D.W. MACDOUGALL	TITLE: CROSS SECTIONS RAYMARK – OU4 – BALLFIELD SITE FINAL REMEDIAL INVESTIGATION / FEASIBILITY STUDY STRATFORD, CONNECTICUT		TETRA TECH NUS, INC.
PREPARED BY: T. DORGAN			
CHECKED BY: R. CLEAVER	SOURCE: SEE NOTES		55 JONSPIN ROAD WILMINGTON, MASSACHUSETTS 01887 (978)658-7899
	SCALE: 1" = 60'	DATE: JULY 29, 1999	PROJ. NO: N0004
PROJECT MANAGER: H. FORD	FIGURE NO: 3-2	ACFILE NAME: DWG\RAYMARK\OU4\X-SECTIONS\XSECTION..DWG	REV: 0
PROGRAM MANAGER: G. GARDNER			

NOTES:

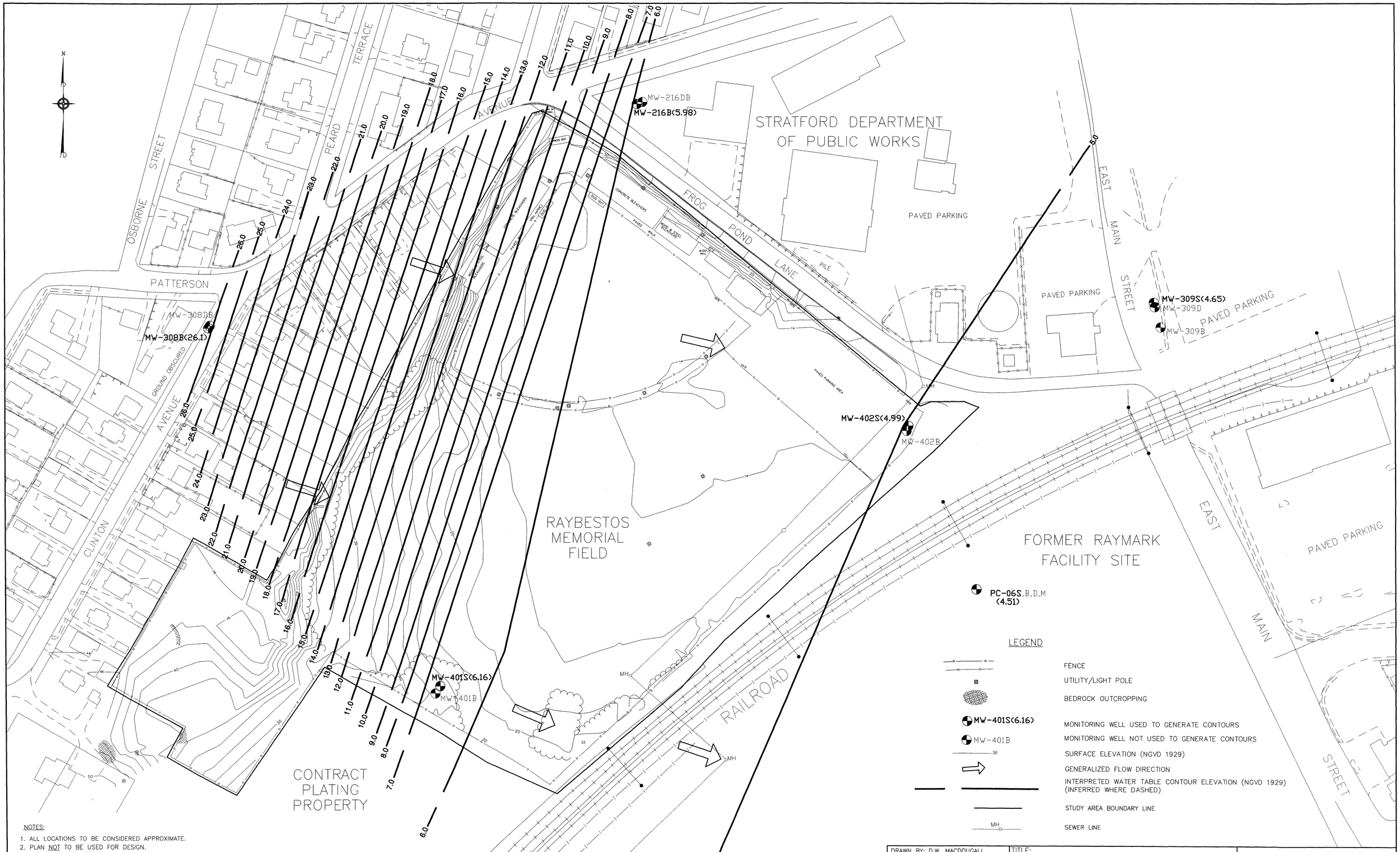
1. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
2. PLAN NOT TO BE USED FOR DESIGN.
3. BASE PLAN BY GEOD–PHOTOGRAMMETRIC SCIENCES SURVEY TECHNOLOGIES BY PHOTOGRAMETRIC METHODS BASED ON CONNECTICUT STATE PLANE (NAD 1927). BALLFIELD AREA AND WELLS SURVEYED BY CCA/LLC.
4. APPROXIMATE SEWER LINE LOCATION BASED ON TOWN MAP AND SURVEY OF MANHOLES.

DRAWN BY: D.W. MACDOUGALL	TITLE: ESTIMATED THICKNESS OF FILL RAYMARK – OU4 – BALLFIELD SITE FINAL REMEDIAL INVESTIGATION / FEASIBILITY STUDY STRATFORD, CONNECTICUT	TETRA TECH NUS, INC.
PREPARED BY: T. DORGAN	SOURCE: SEE NOTES	55 JONSPIN ROAD WILMINGTON, MASSACHUSETTS 01887 (978)658–7899
CHECKED BY: R. CLEAVER	SCALE: 1" = 60' / DATE: JULY 29, 1999 / PROJ. NO: 0004	
PROJECT MANAGER: H. FORD	FIGURE NO: 3–3 / ACFILE NAME: DWG\RAYMARK\OU4\FILLELEV.DWG / REV: 0	
PROGRAM MANAGER: G. GARDNER		

NOTES:

1. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
2. PLAN NOT TO BE USED FOR DESIGN.
3. BASE PLAN BY GEOD-PHOTOGRAMMETRIC SCIENCES SURVEY TECHNOLOGIES BY PHOTOGRAMETRIC METHODS BASED ON CONNECTICUT STATE PLANE (NAD 1927). BALLFIELD AREA AND WELLS SURVEYED BY CCA/LLC.
4. GROUND AND BEDROCK SURFACE ELEVATIONS IN FEET (NGVD 1929).
5. BEDROCK SURFACE ELEVATIONS ARE BASED ON DEPTHS TO BEDROCK IDENTIFIED VIA CONFIRMATORY CORING AT EACH BORING AND MONITORING WELL LOCATION. BEDROCK SURFACE ELEVATIONS ARE ALSO BASED ON OUTCROP EXPOSURES AND DEPTH TO BEDROCK AS ENCOUNTERED AT FOUR TEST PITS (TP-16, TP-17, TP-20, AND TP-22).
6. APPROXIMATE SEWER LINE LOCATION BASED ON TOWN MAP AND SURVEY OF MANHOLES.

DRAWN BY: D.W. MACDOUGALL	TITLE: BEDROCK SURFACE TOPOGRAPHY RAYMARK – OU4 – BALLFIELD SITE FINAL REMEDIAL INVESTIGATION / FEASIBILITY STUDY STRATFORD, CONNECTICUT		TETRA TECH NUS, INC.
PREPARED BY: T. DORGAN			55 JONSPIN ROAD WILMINGTON, MASSACHUSETTS 01887 (978)658-7899
CHECKED BY: R. CLEAVER	SOURCE: SEE NOTES		
	SCALE: 1" = 60'	DATE: JULY 29, 1999	PROJ. NO: 0004
PROJECT MANAGER: H. FORD	FIGURE NO: 3-4	ACFILE NAME: DWG\RAYMARK\OU4\BEDROCK.DWG	REV: 0
PROGRAM MANAGER: G. GARDNER			



NOTES:

1. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
2. PLAN NOT TO BE USED FOR DESIGN.
3. BASE PLAN BY GEOD–PHOTOGRAMMETRIC SCIENCES SURVEY TECHNOLOGIES BY PHOTOGRAMETRIC METHODS BASED ON CONNECTICUT STATE PLANE (NAD 1927). BALLFIELD AREA AND WELLS SURVEYED BY CCA/LLC.
4. WATER TABLE ELEVATION CONTOURS BASED ON WATER LEVEL MEASUREMENTS TAKEN AT OVERBURDEN WELLS SCREENED ACROSS THE WATER TABLE EXCEPT MW–308B AND MW–216B WHERE LITTLE OVERBURDEN IS PRESENT AND THE WATER TABLE IS LOCATED BELOW THE TOP OF BEDROCK.
6. APPROXIMATE SEWER LINE LOCATION BASED ON TOWN MAP AND SURVEY OF MANHOLES.

DRAWN BY: D.W. MACDOUGALL	TITLE: WATER TABLE ELEVATIONS (MARCH 24, 1999) CONTOUR MAP RAYMARK – OU4 – BALLFIELD SITE FINAL REMEDIAL INVESTIGATION / FEASIBILITY STUDY STRATFORD, CONNECTICUT
PREPARED BY: T. DORGAN	SOURCE: SEE NOTES
CHECKED BY: M. HEALEY	SCALE: 1" = 60' · DATE: JULY 29, 1999 · PROJ. NO: 0004
PROJECT MANAGER: H. FORD	FIGURE NO: 3–5 · ACFILE NAME: DWG\RAYMARK\OU4\H2O_ELEV.DWG · REV: 0
PROGRAM MANAGER: G. GARDNER	

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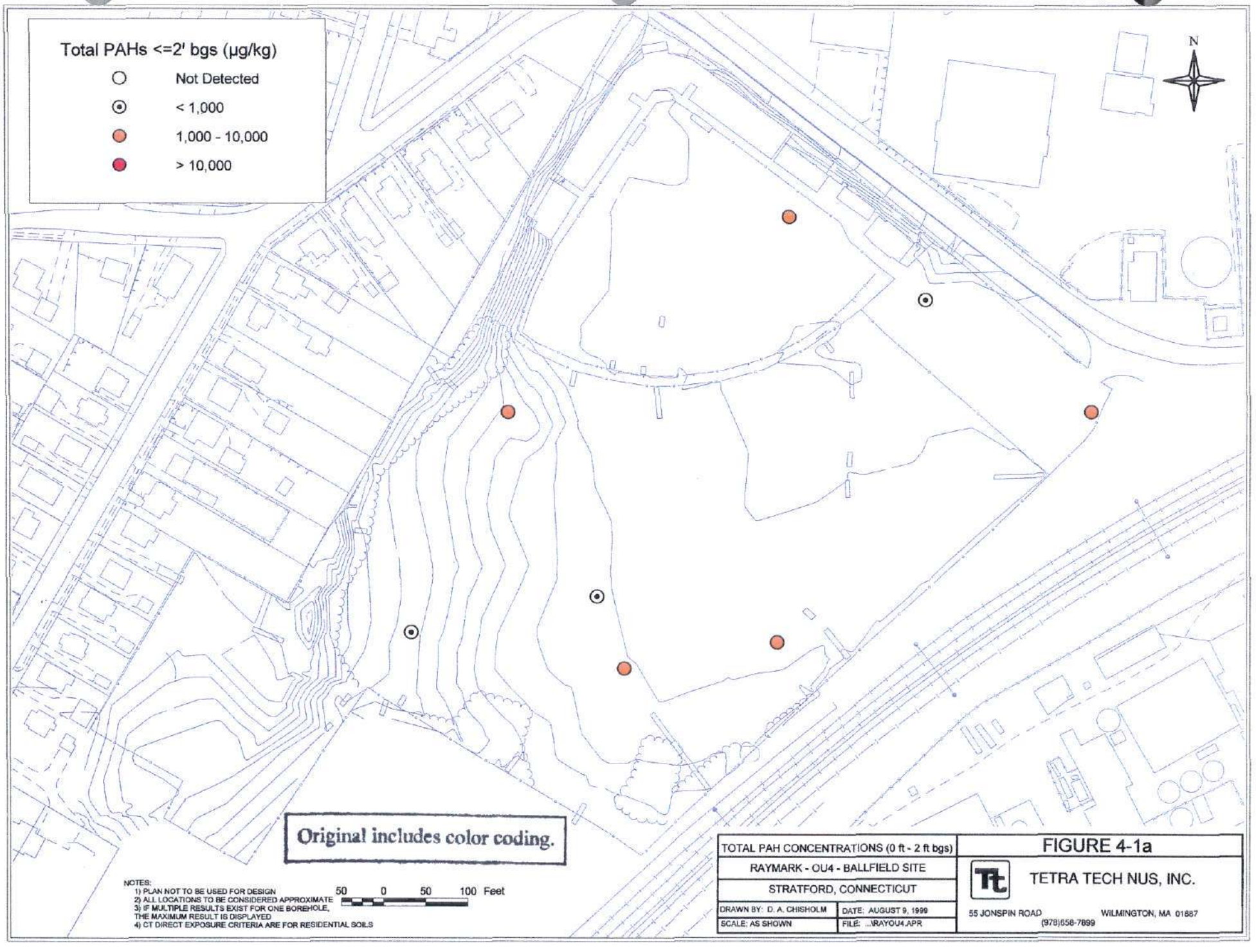
(978)658–7899


Total PAHs <=2' bgs (µg/kg)
Not Detected
< 1,000
1,000 - 10,000
> 10,000
N
Original includes color coding.
NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
3) IF MULTIPLE RESULTS EXIST FOR ONE BOREHOLE, THE MAXIMUM RESULT IS DISPLAYED
4) CT DIRECT EXPOSURE CRITERIA ARE FOR RESIDENTIAL SOILS
50 0 50 100 Feet
TOTAL PAH CONCENTRATIONS (0 ft - 2 ft bgs)
RAYMARK - OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT
DRAWN BY: D. A. CHISHOLM
DATE: AUGUST 9, 1999
SCALE: AS SHOWN
FILE: ...\RAYOU4.APR
FIGURE 4-1a
TETRA TECH NUS, INC.
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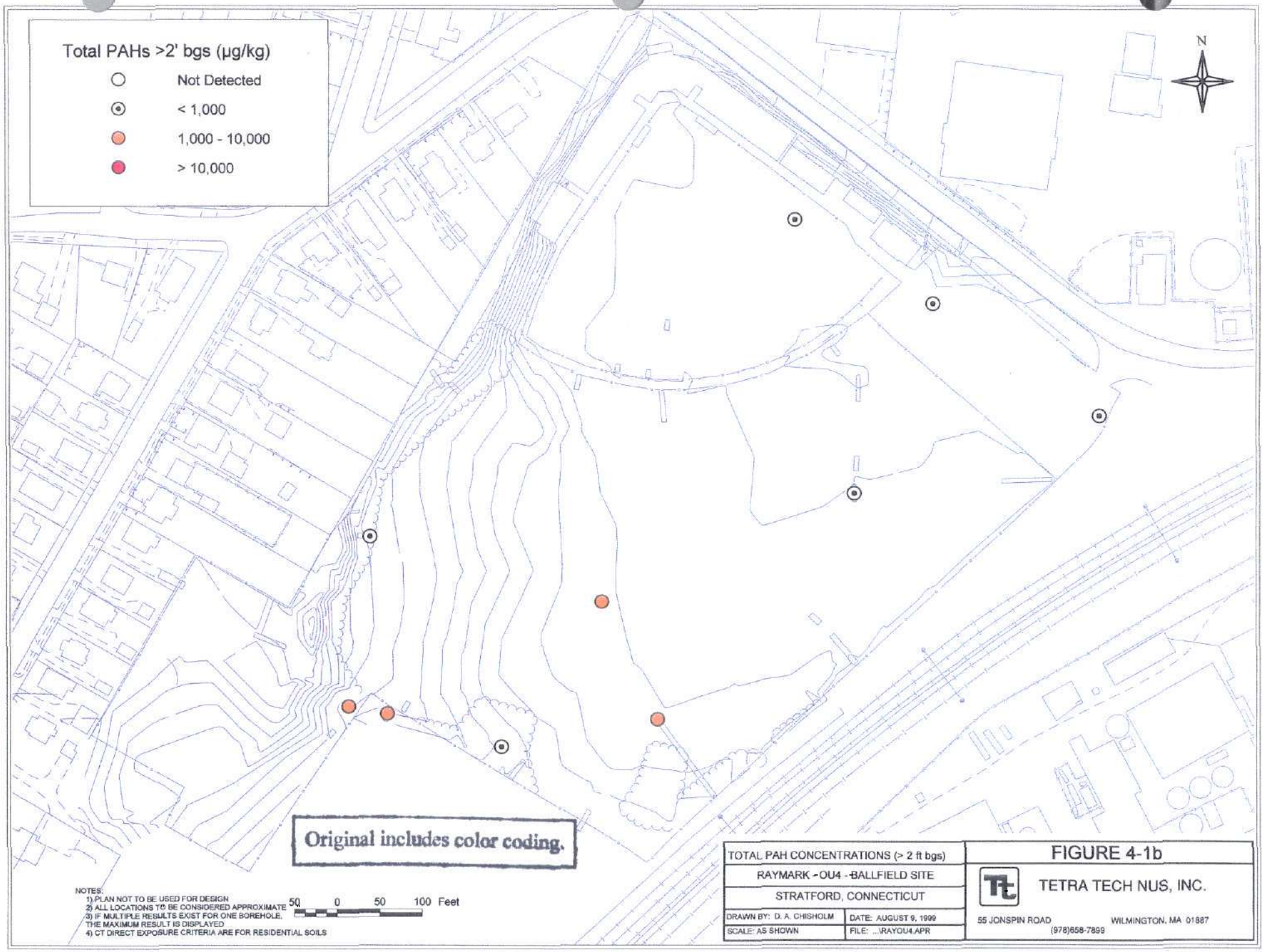
(978)658-7899


Total PAHs >2' bgs (µg/kg)
Not Detected
< 1,000
1,000 - 10,000
> 10,000
N
Original includes color coding.
NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
3) IF MULTIPLE RESULTS EXIST FOR ONE BOREHOLE, THE MAXIMUM RESULT IS DISPLAYED
4) CT DIRECT EXPOSURE CRITERIA ARE FOR RESIDENTIAL SOILS
50 0 50 100 Feet
TOTAL PAH CONCENTRATIONS (> 2 ft bgs)
RAYMARK - OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT
DRAWN BY: D. A. CHISHOLM
DATE: AUGUST 9, 1999
SCALE: AS SHOWN
FILE: ...\RAYOU4.APR
FIGURE 4-1b
TETRA TECH NUS, INC.
55 JONSPIN ROAD
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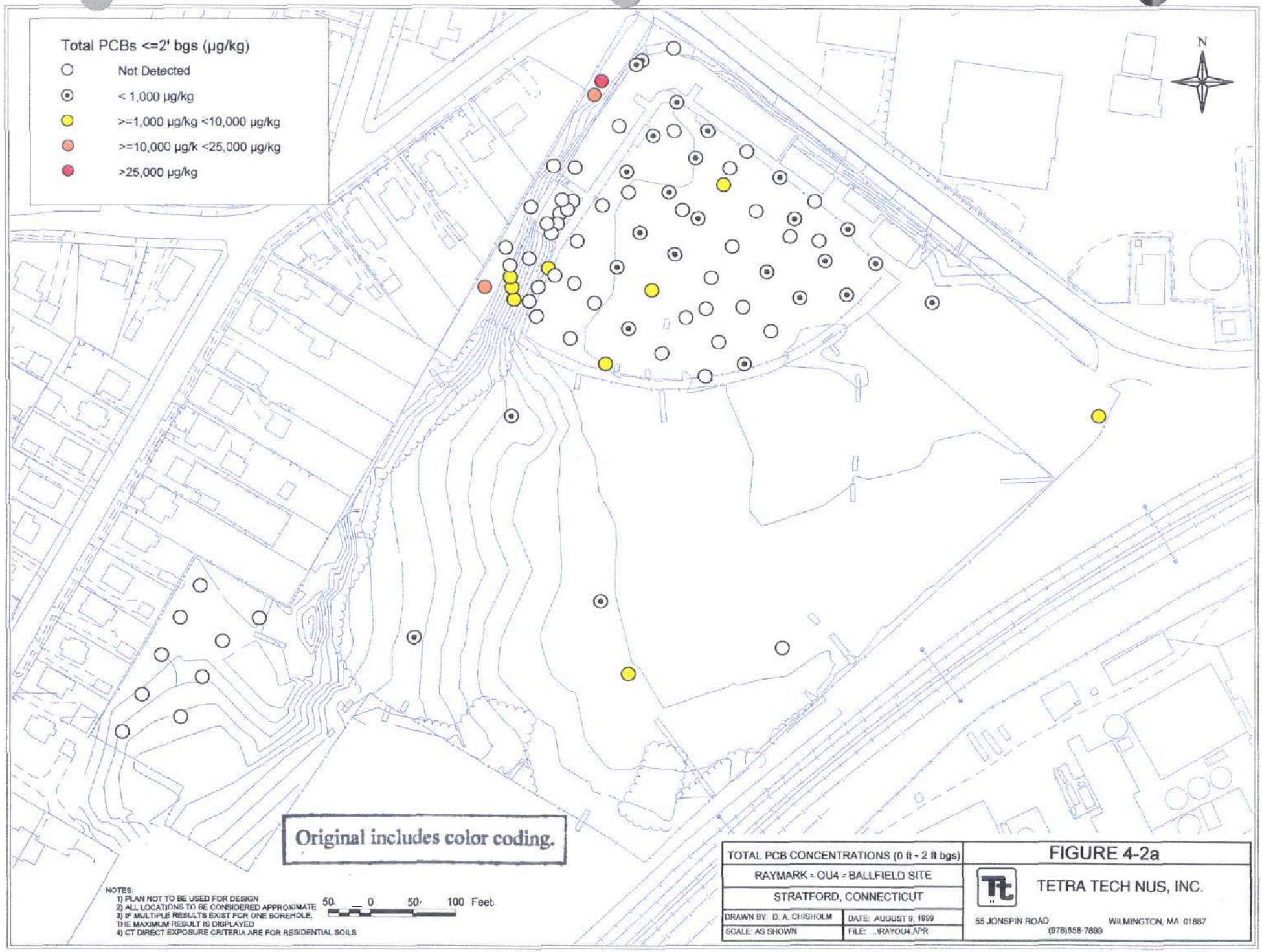
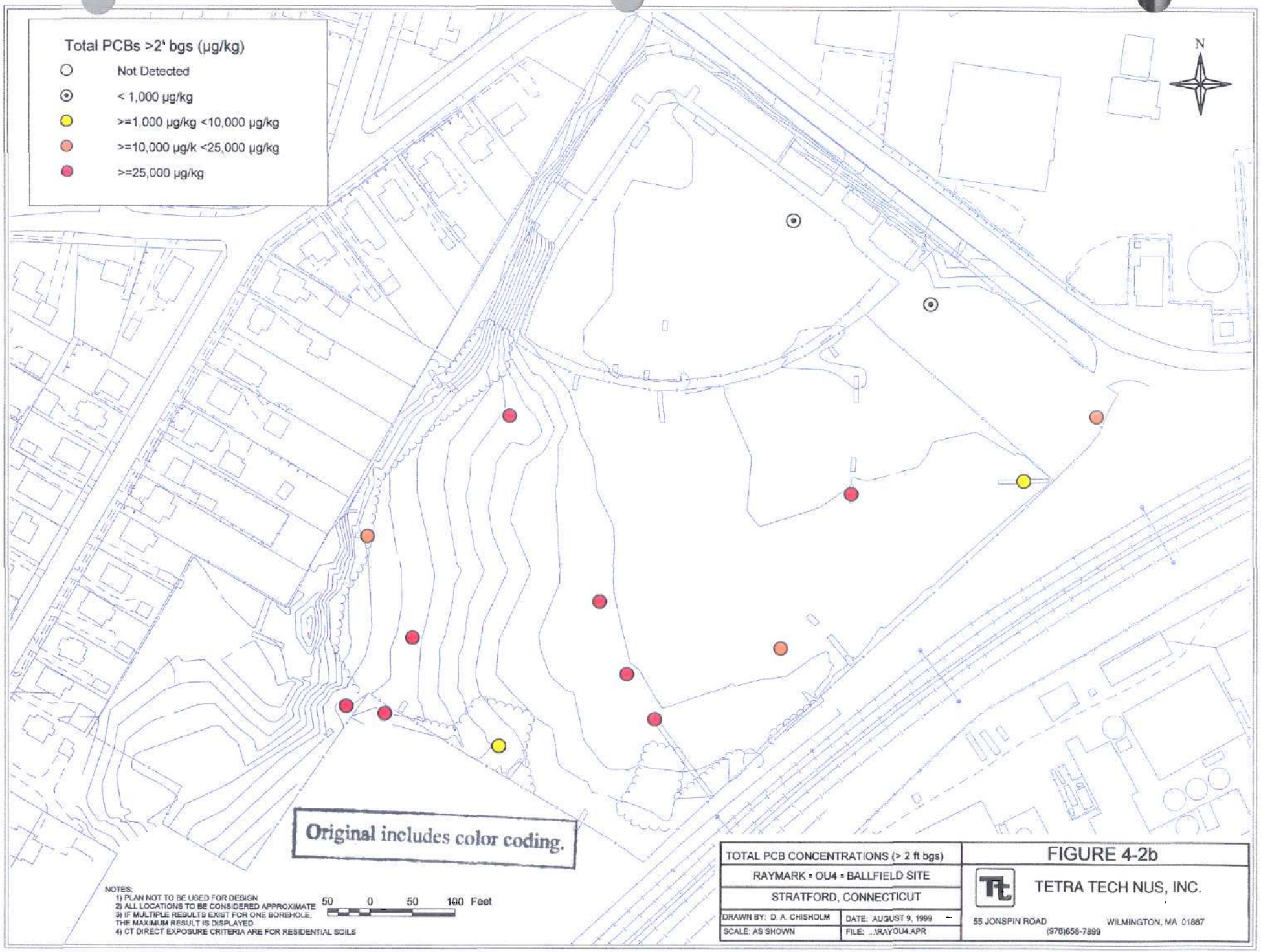
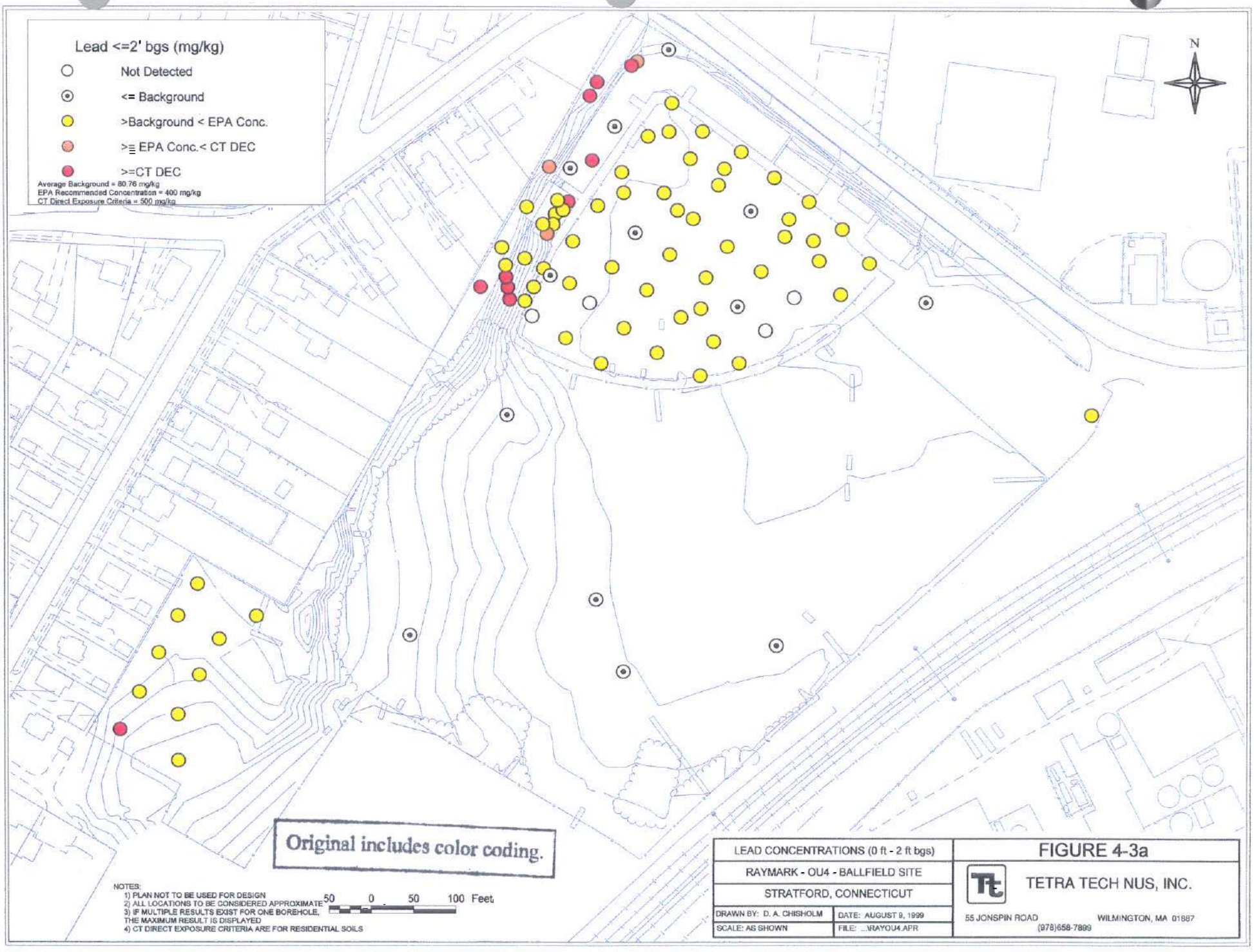
(978)658-7899


Total PCBs <=2' bgs (µg/kg)
Not Detected
< 1,000 µg/kg
>=1,000 µg/kg <10,000 µg/kg
>=10,000 µg/k <25,000 µg/kg
>25,000 µg/kg
N
Original includes color coding.
NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
3) IF MULTIPLE RESULTS EXIST FOR ONE BOREHOLE, THE MAXIMUM RESULT IS DISPLAYED
4) CT DIRECT EXPOSURE CRITERIA ARE FOR RESIDENTIAL SOILS
50 0 50 100 Feet
TOTAL PCB CONCENTRATIONS (0 ft - 2 ft bgs)
RAYMARK - OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT
DRAWN BY: D. A. CHISHOLM
DATE: AUGUST 9, 1999
SCALE: AS SHOWN
FILE: ...\RAYOU4.APR
FIGURE 4-2a
TETRA TECH NUS, INC.
55 JONSPIN ROAD
WILMINGTON, MA 01887
(978)658-7899


Total PCBs >2' bgs (µg/kg)
Not Detected
< 1,000 µg/kg
>=1,000 µg/kg <10,000 µg/kg
>=10,000 µg/k <25,000 µg/kg
>=25,000 µg/kg
N
Original includes color coding.
NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
3) IF MULTIPLE RESULTS EXIST FOR ONE BOREHOLE, THE MAXIMUM RESULT IS DISPLAYED
4) CT DIRECT EXPOSURE CRITERIA ARE FOR RESIDENTIAL SOILS
50 0 50 100 Feet
TOTAL PCB CONCENTRATIONS (> 2 ft bgs)
RAYMARK - OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT
DRAWN BY: D. A. CHISHOLM
DATE: AUGUST 9, 1999
SCALE: AS SHOWN
FILE: ...\RAYOU4.APR
FIGURE 4-2b
TETRA TECH NUS, INC.
55 JONSPIN ROAD
WILMINGTON, MA 01887
(978)658-7899


Lead <=2' bgs (mg/kg)
Not Detected
<= Background
>Background < EPA Conc.
>= EPA Conc.< CT DEC
>=CT DEC
Average Background = 80.76 mg/kg
EPA Recommended Concentration = 400 mg/kg
CT Direct Exposure Criteria = 500 mg/kg
N
Original includes color coding.
NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
3) IF MULTIPLE RESULTS EXIST FOR ONE BOREHOLE, THE MAXIMUM RESULT IS DISPLAYED
4) CT DIRECT EXPOSURE CRITERIA ARE FOR RESIDENTIAL SOILS
50 0 50 100 Feet
LEAD CONCENTRATIONS (0 ft - 2 ft bgs)
RAYMARK - OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT
DRAWN BY: D. A. CHISHOLM
DATE: AUGUST 9, 1999
SCALE: AS SHOWN
FILE: ...\RAYOU4.APR
FIGURE 4-3a
TETRA TECH NUS, INC.
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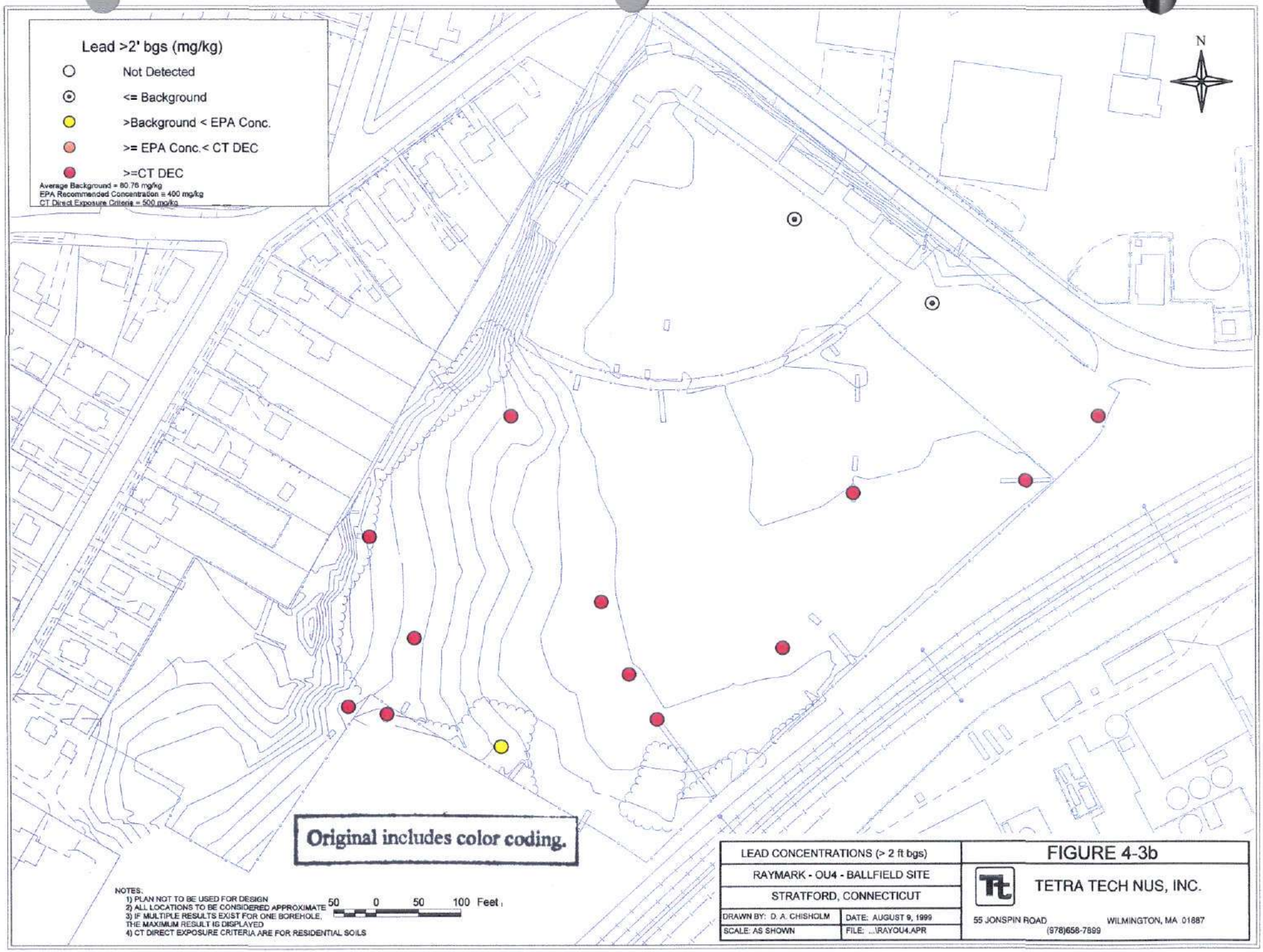
Lead >2' bgs (mg/kg)
Not Detected
<= Background
>Background < EPA Conc.
>= EPA Conc.< CT DEC
>=CT DEC
Average Background = 80.76 mg/kg
EPA Recommended Concentration = 400 mg/kg
CT Direct Exposure Criteria = 500 mg/kg
N
Original includes color coding.
NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
3) IF MULTIPLE RESULTS EXIST FOR ONE BOREHOLE, THE MAXIMUM RESULT IS DISPLAYED
4) CT DIRECT EXPOSURE CRITERIA ARE FOR RESIDENTIAL SOILS
50 0 50 100 Feet
LEAD CONCENTRATIONS (> 2 ft bgs)
RAYMARK - OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT
DRAWN BY: D. A. CHISHOLM
DATE: AUGUST 9, 1999
SCALE: AS SHOWN
FILE: ...\RAYOU4.APR
FIGURE 4-3b
TETRA TECH NUS, INC.
55 JONSPIN ROAD
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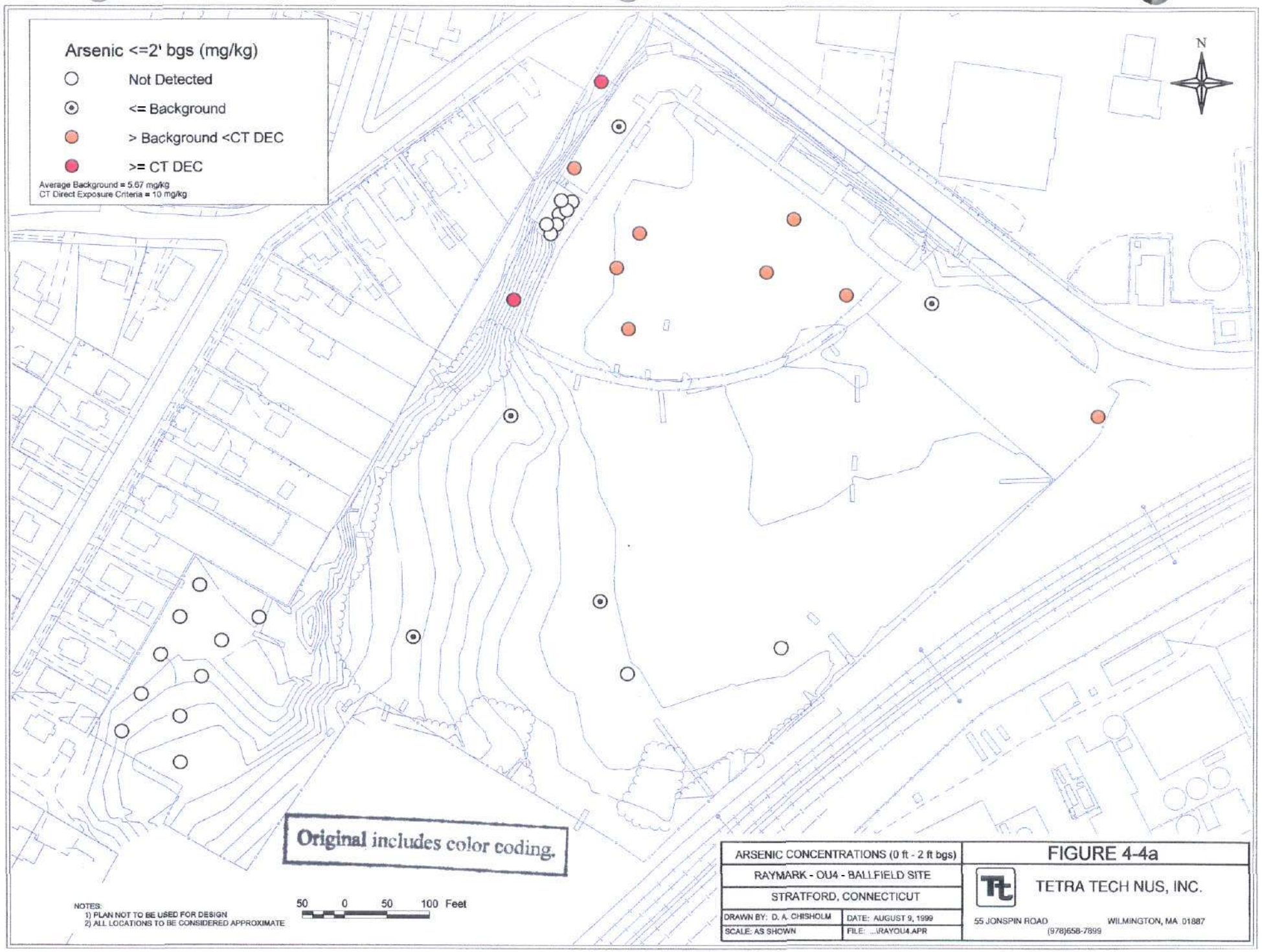
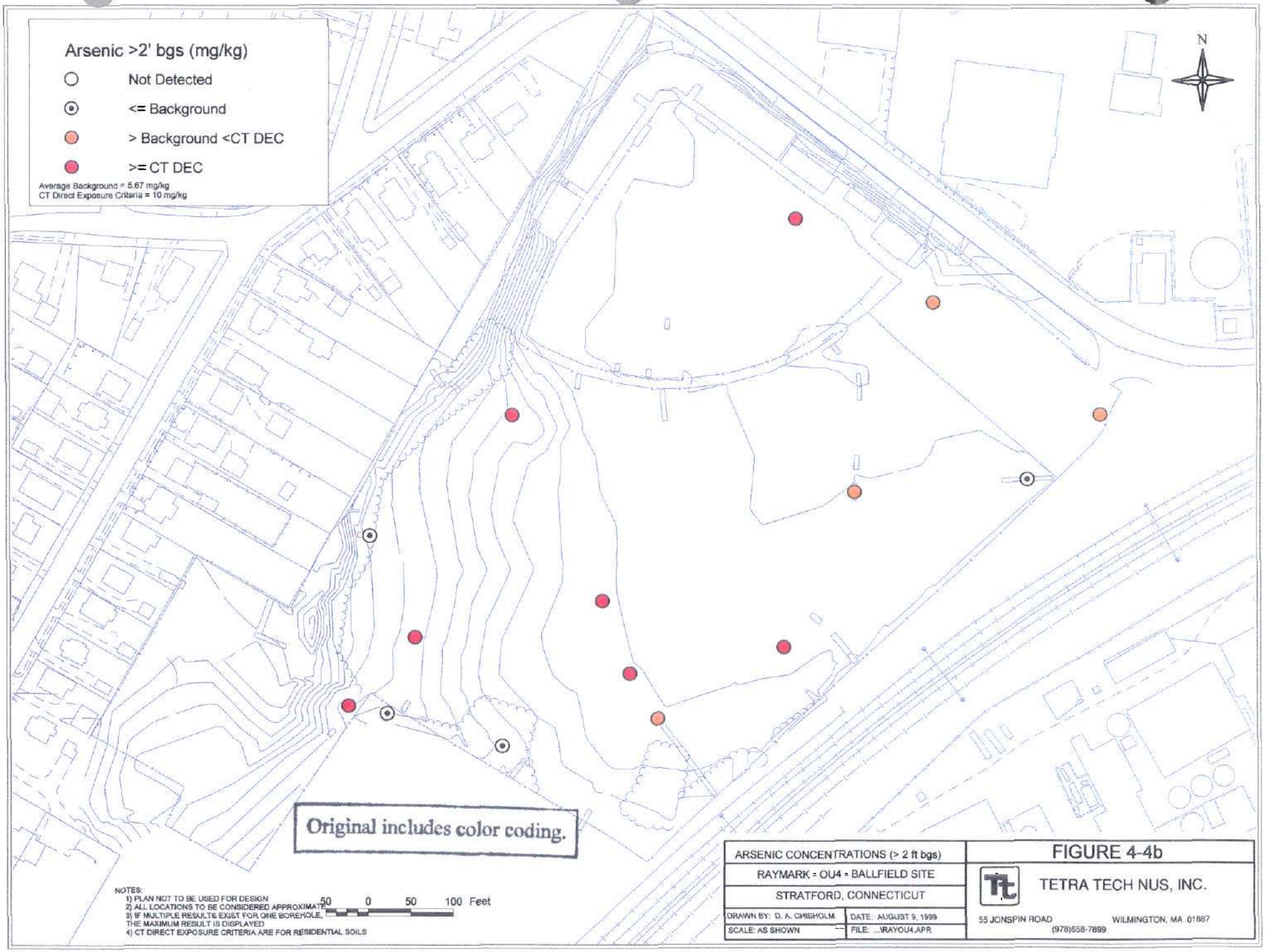
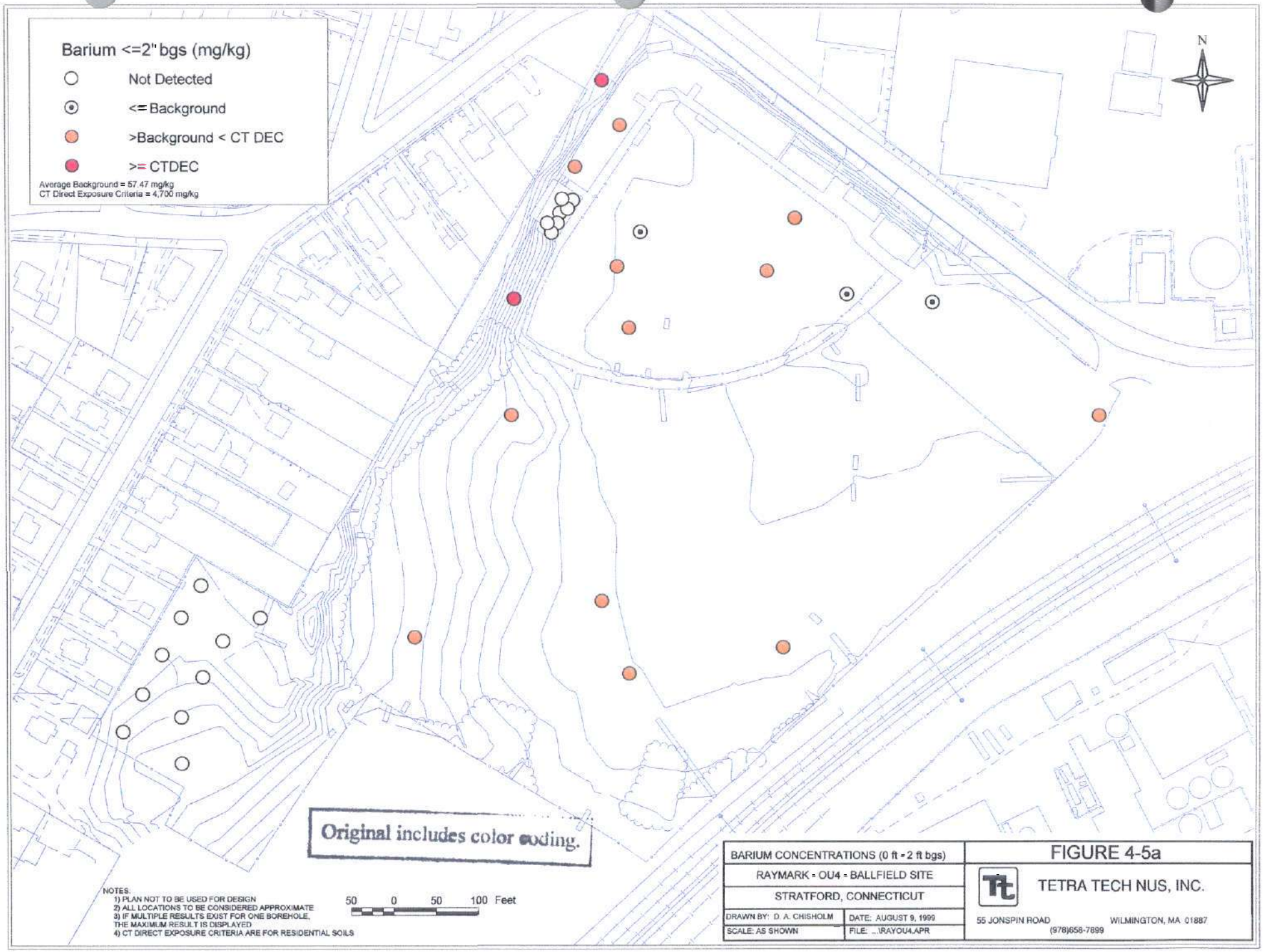
(978)658-7899


Arsenic <=2' bgs (mg/kg)
Not Detected
<= Background
> Background <CT DEC
>= CT DEC
Average Background = 5.67 mg/kg
CT Direct Exposure Criteria = 10 mg/kg
N
Original includes color coding.
NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
50 0 50 100 Feet
ARSENIC CONCENTRATIONS (0 ft - 2 ft bgs)
RAYMARK - OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT
DRAWN BY: D. A. CHISHOLM
DATE: AUGUST 9, 1999
SCALE: AS SHOWN
FILE: ...\RAYOU4.APR
FIGURE 4-4a
TETRA TECH NUS, INC.
55 JONSPIN ROAD
WILMINGTON, MA 01887
(978)658-7899


Arsenic >2' bgs (mg/kg)
Not Detected
<= Background
> Background <CT DEC
>= CT DEC
Average Background = 5.67 mg/kg
CT Direct Exposure Criteria = 10 mg/kg
N
Original includes color coding.
NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
3) IF MULTIPLE RESULTS EXIST FOR ONE BOREHOLE, THE MAXIMUM RESULT IS DISPLAYED
4) CT DIRECT EXPOSURE CRITERIA ARE FOR RESIDENTIAL SOILS
50 0 50 100 Feet
ARSENIC CONCENTRATIONS (> 2 ft bgs)
RAYMARK - OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT
DRAWN BY: D. A. CHISHOLM
DATE: AUGUST 9, 1999
SCALE: AS SHOWN
FILE: ...\RAYOU4.APR
FIGURE 4-4b
TETRA TECH NUS, INC.
55 JONSPIN ROAD
WILMINGTON, MA 01887
(978)658-7899


Barium <=2" bgs (mg/kg)
Not Detected
<= Background
>Background < CT DEC
>= CTDEC
Average Background = 57.47 mg/kg
CT Direct Exposure Criteria = 4,700 mg/kg
N
Original includes color coding.
NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
3) IF MULTIPLE RESULTS EXIST FOR ONE BOREHOLE, THE MAXIMUM RESULT IS DISPLAYED
4) CT DIRECT EXPOSURE CRITERIA ARE FOR RESIDENTIAL SOILS
50 0 50 100 Feet
BARIUM CONCENTRATIONS (0 ft - 2 ft bgs)
RAYMARK - OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT
DRAWN BY: D. A. CHISHOLM
DATE: AUGUST 9, 1999
SCALE: AS SHOWN
FILE: ...\RAYOU4.APR
FIGURE 4-5a
TETRA TECH NUS, INC.
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WILMINGTON, MA 01887
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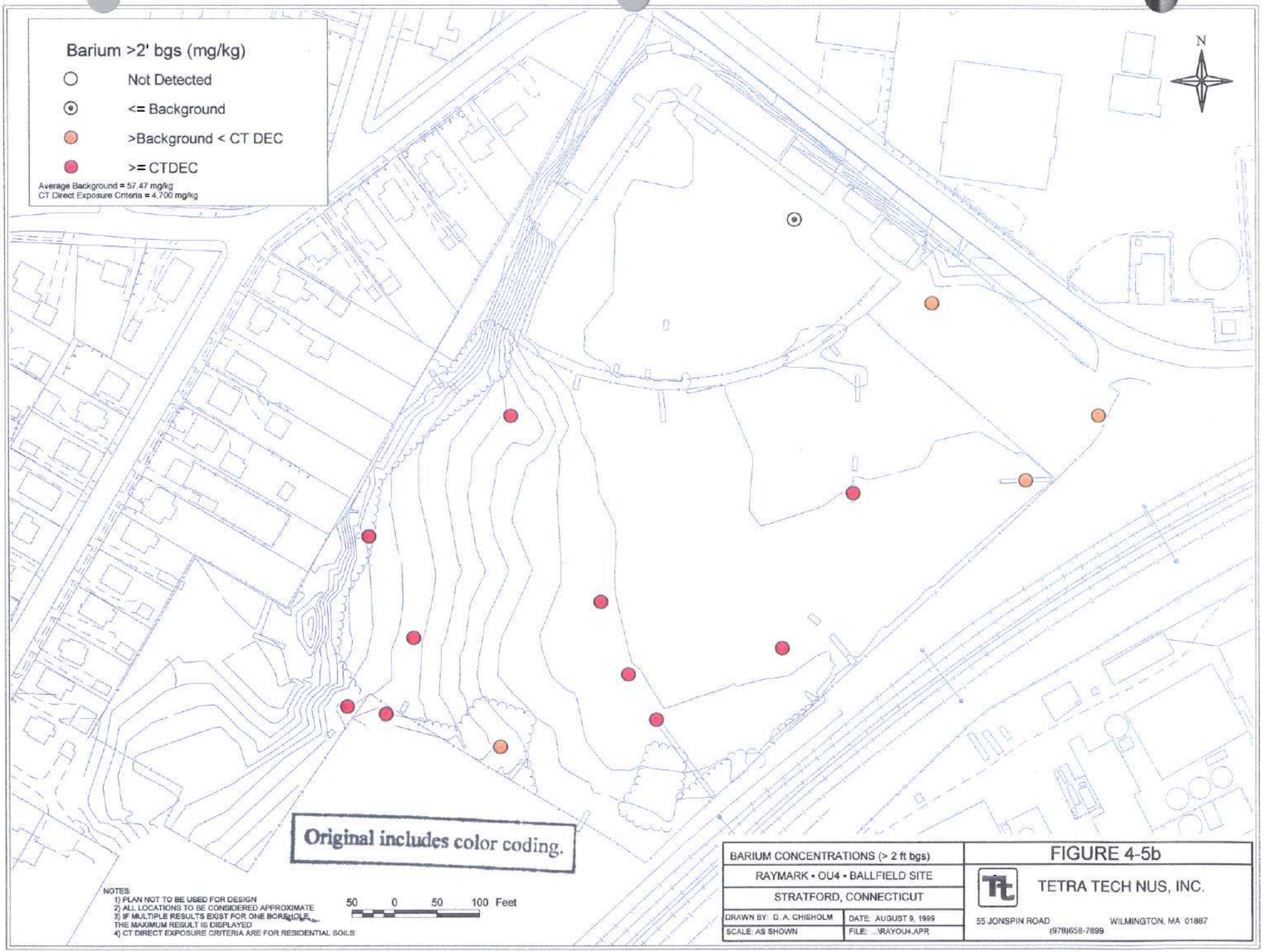
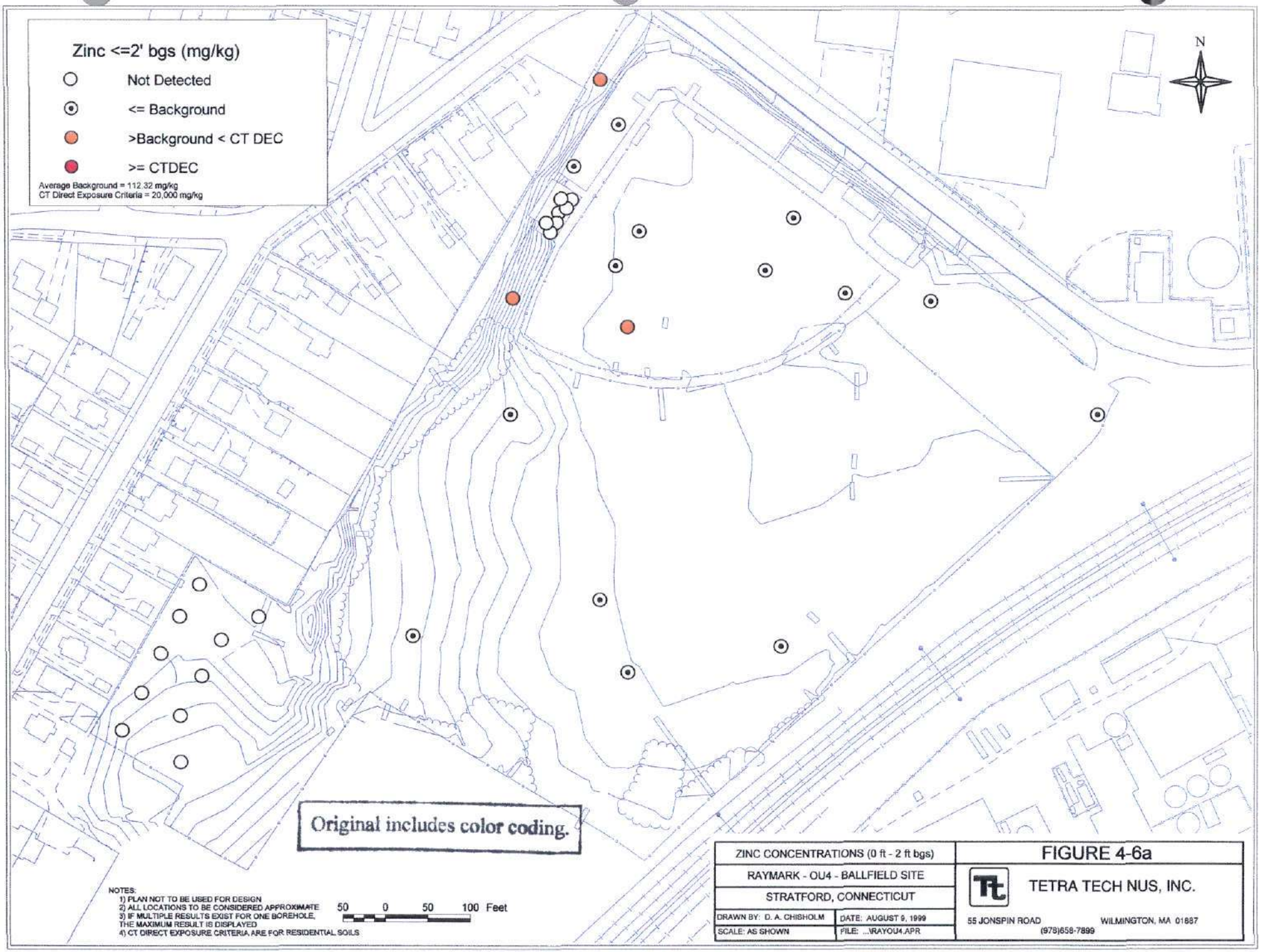

Barium >2' bgs (mg/kg)
Not Detected
<= Background
>Background < CT DEC
>= CTDEC
Average Background = 57.47 mg/kg
CT Direct Exposure Criteria = 4,700 mg/kg
N
Original includes color coding.
NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
3) IF MULTIPLE RESULTS EXIST FOR ONE BOREHOLE, THE MAXIMUM RESULT IS DISPLAYED
4) CT DIRECT EXPOSURE CRITERIA ARE FOR RESIDENTIAL SOILS
50 0 50 100 Feet
BARIUM CONCENTRATIONS (> 2 ft bgs)
RAYMARK - OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT
DRAWN BY: D. A. CHISHOLM
DATE: AUGUST 9, 1999
SCALE: AS SHOWN
FILE: ..\RAYOU4.APR
FIGURE 4-5b
TETRA TECH NUS, INC.
55 JONSPIN ROAD
WILMINGTON, MA 01887
(978)658-7899


Zinc <=2' bgs (mg/kg)
Not Detected
<= Background
>Background < CT DEC
>= CTDEC
Average Background = 112.32 mg/kg
CT Direct Exposure Criteria = 20,000 mg/kg
N
Original includes color coding.
NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
3) IF MULTIPLE RESULTS EXIST FOR ONE BOREHOLE, THE MAXIMUM RESULT IS DISPLAYED
4) CT DIRECT EXPOSURE CRITERIA ARE FOR RESIDENTIAL SOILS
50 0 50 100 Feet
ZINC CONCENTRATIONS (0 ft - 2 ft bgs)
RAYMARK - OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT
DRAWN BY: D. A. CHISHOLM
DATE: AUGUST 9, 1999
SCALE: AS SHOWN
FILE: ...\RAYOU4.APR
FIGURE 4-6a
TETRA TECH NUS, INC.
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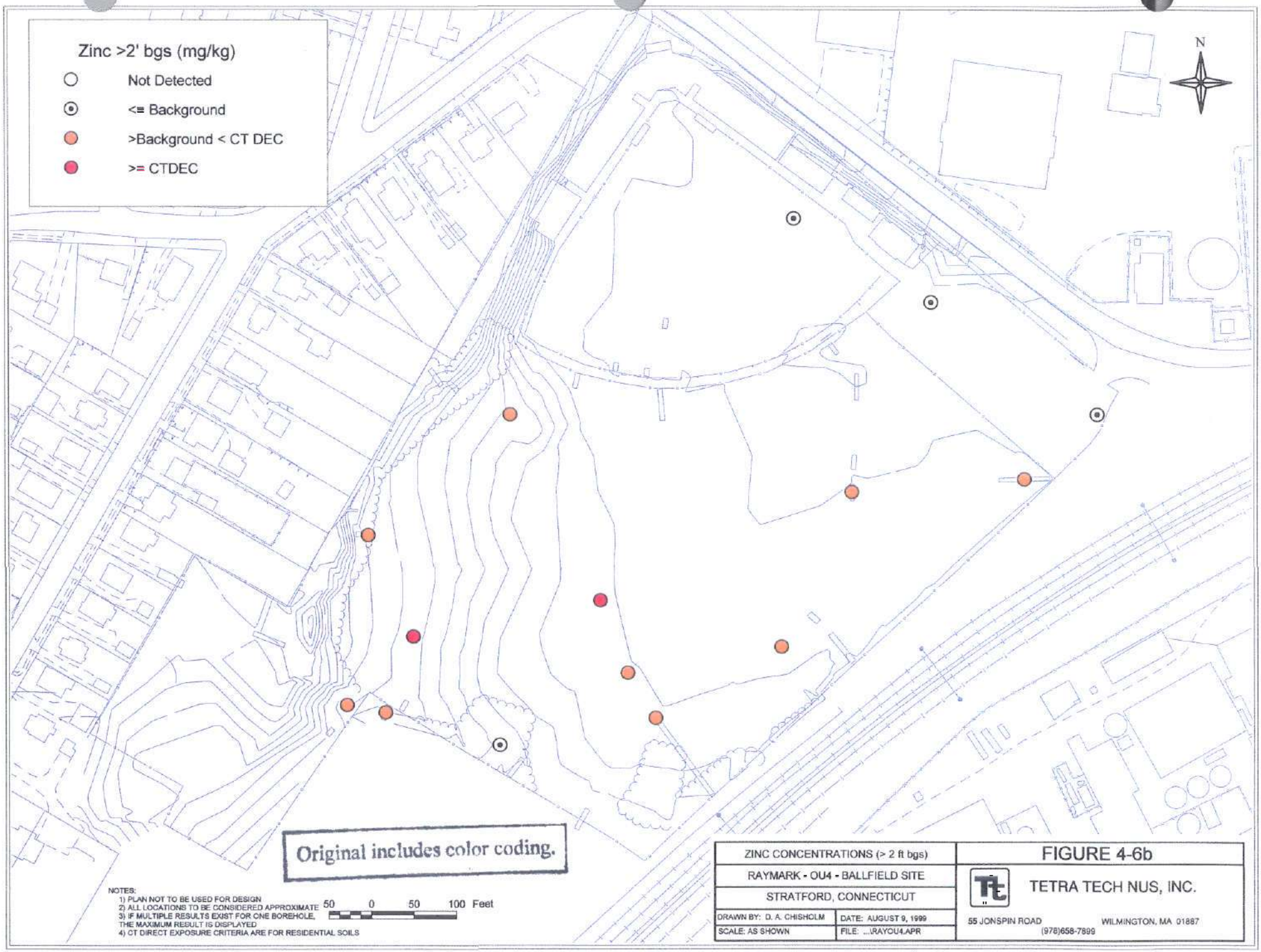
WILMINGTON, MA 01887
(978)658-7899


Zinc >2' bgs (mg/kg)
Not Detected
<= Background
>Background < CT DEC
>= CTDEC
N
Original includes color coding.
NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
3) IF MULTIPLE RESULTS EXIST FOR ONE BOREHOLE, THE MAXIMUM RESULT IS DISPLAYED
4) CT DIRECT EXPOSURE CRITERIA ARE FOR RESIDENTIAL SOILS
50 0 50 100 Feet
ZINC CONCENTRATIONS (> 2 ft bgs)
RAYMARK - OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT
DRAWN BY: D. A. CHISHOLM
DATE: AUGUST 9, 1999
SCALE: AS SHOWN
FILE: ...\RAYOU4.APR
FIGURE 4-6b
TETRA TECH NUS, INC.
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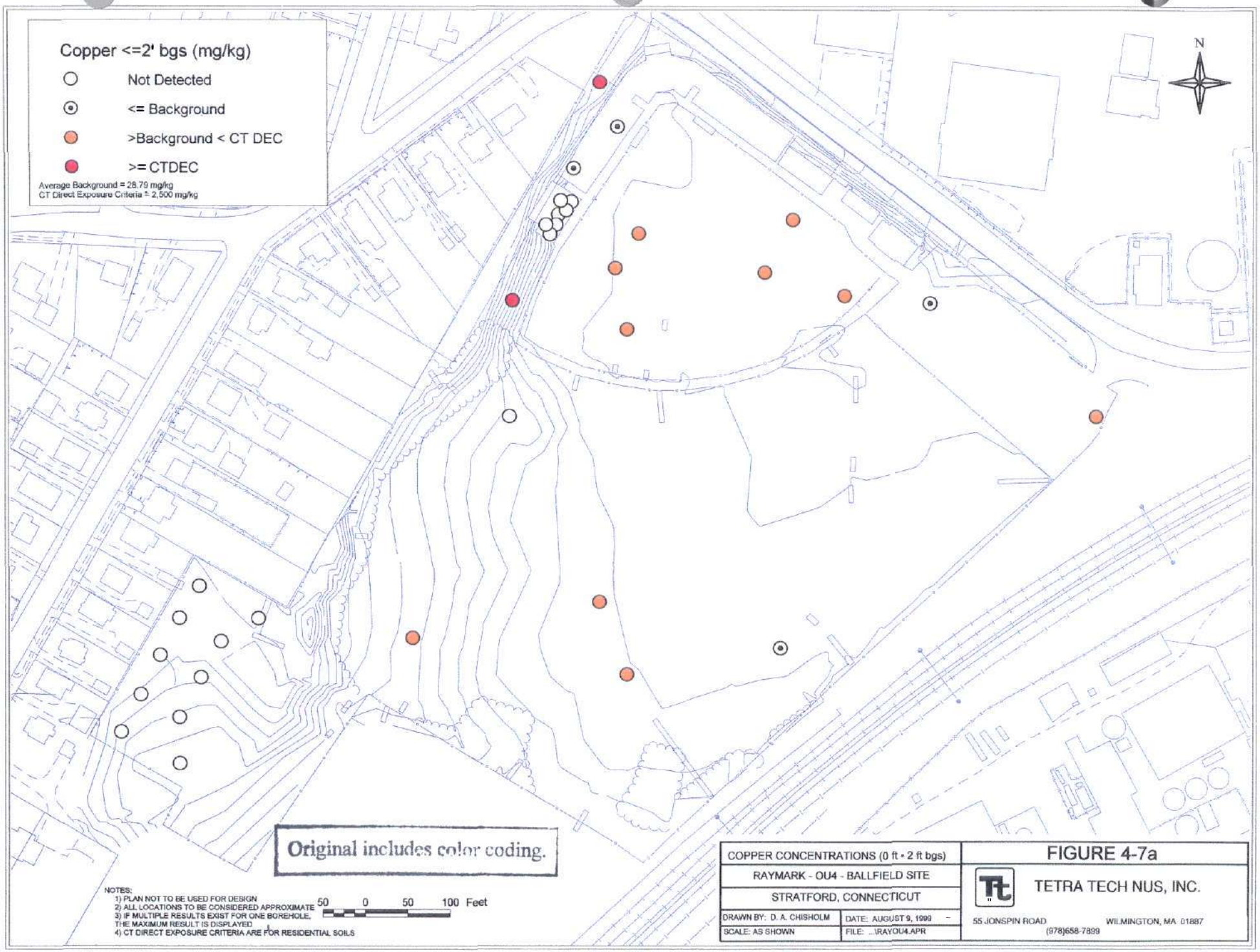
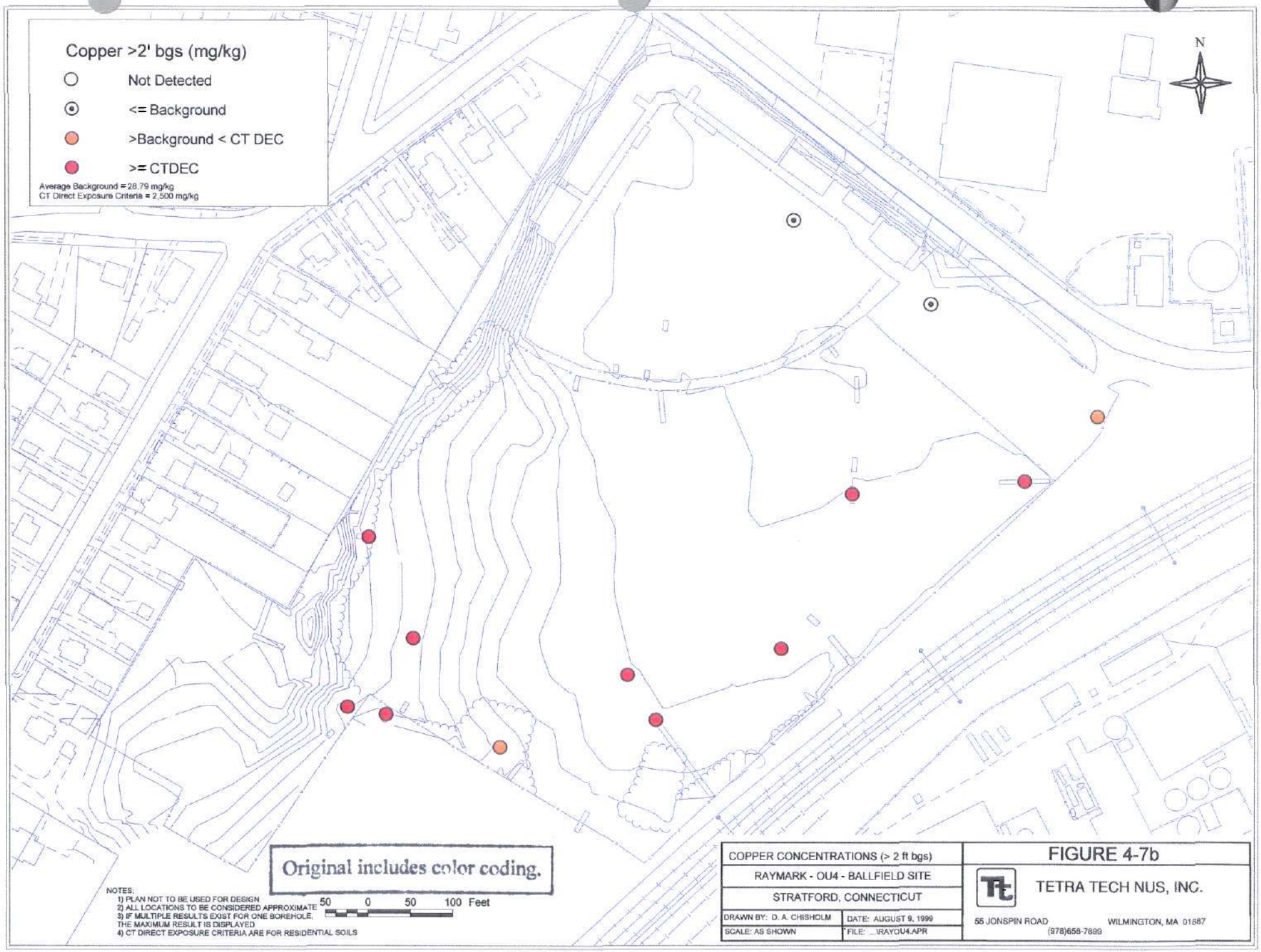
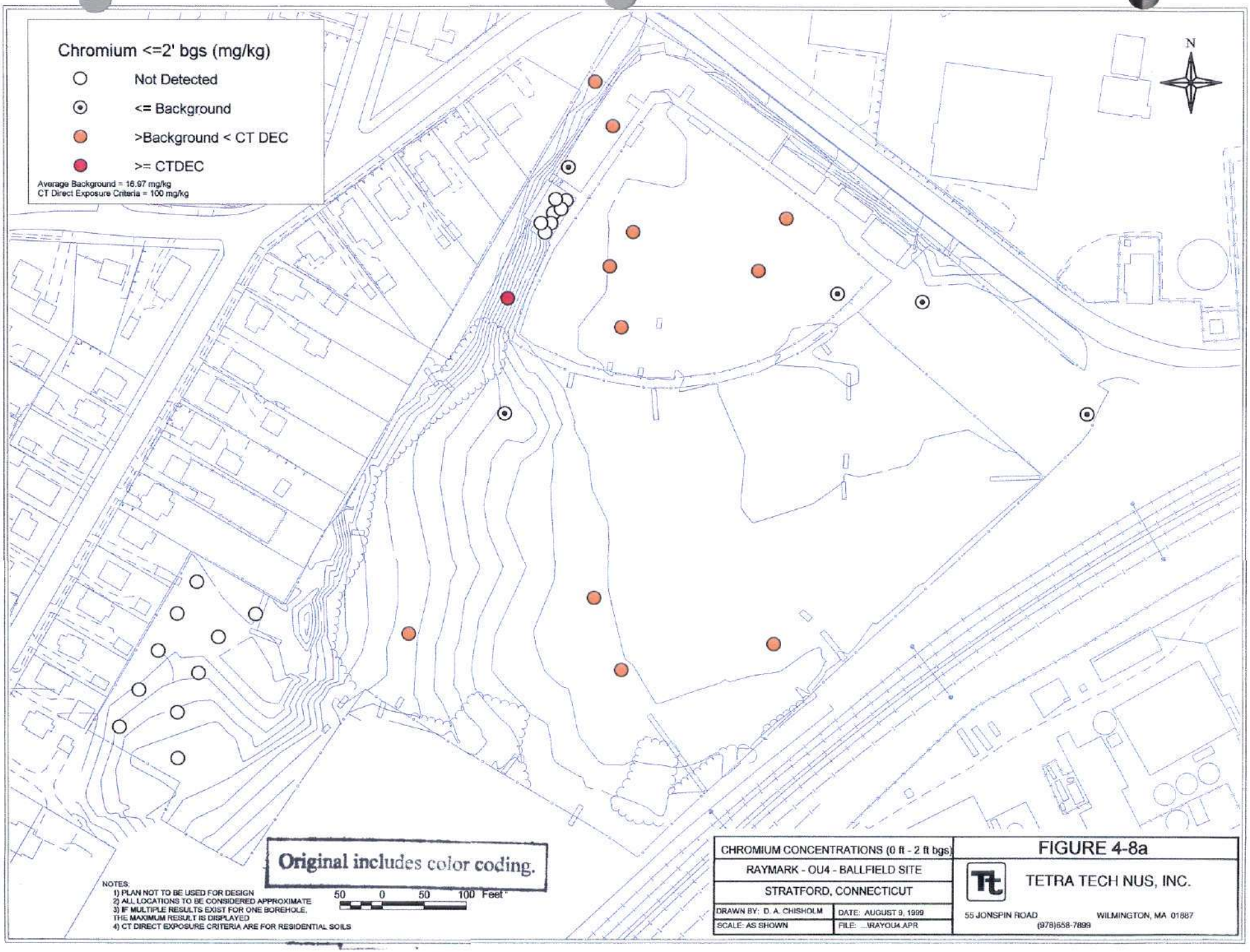
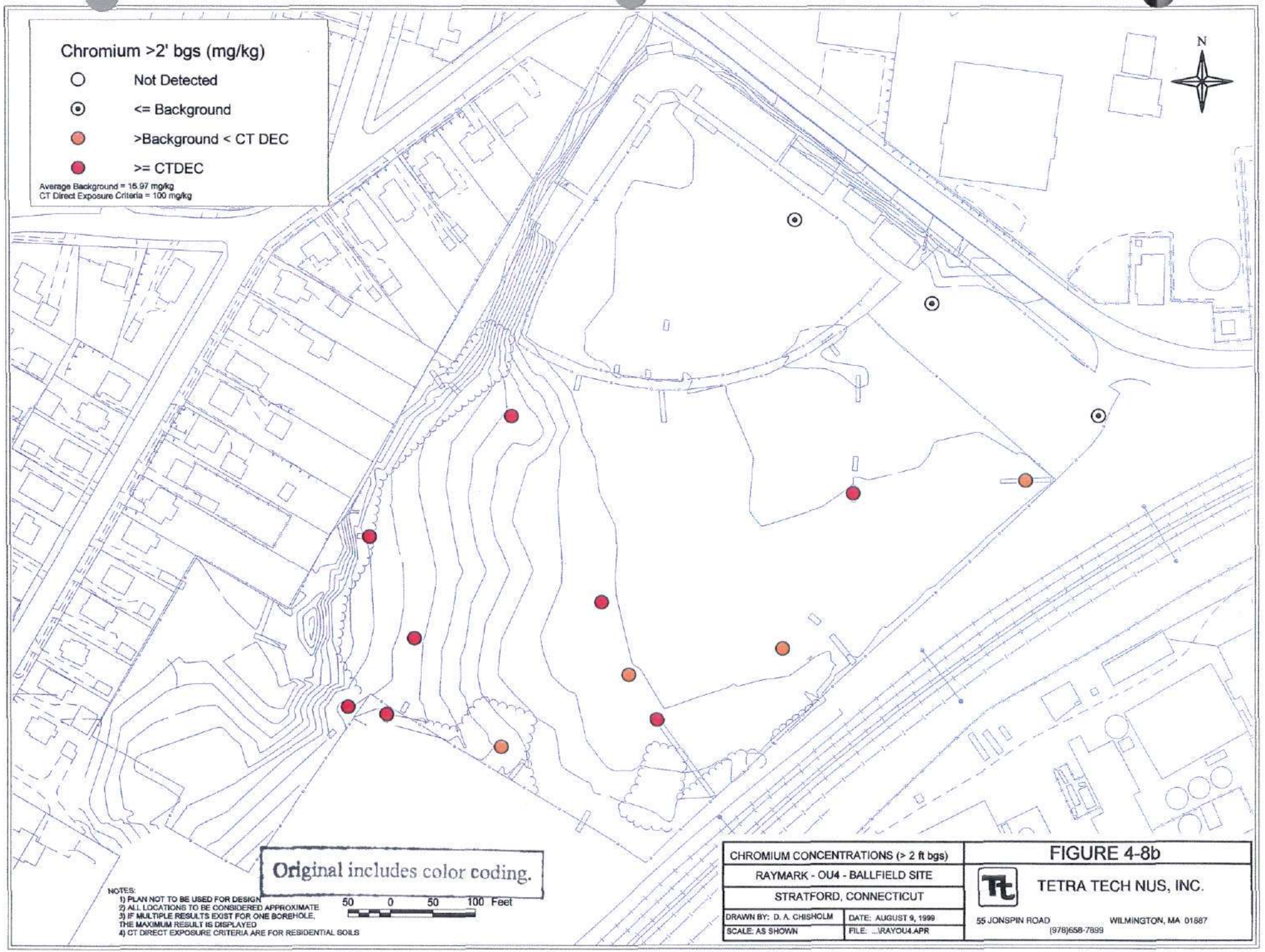
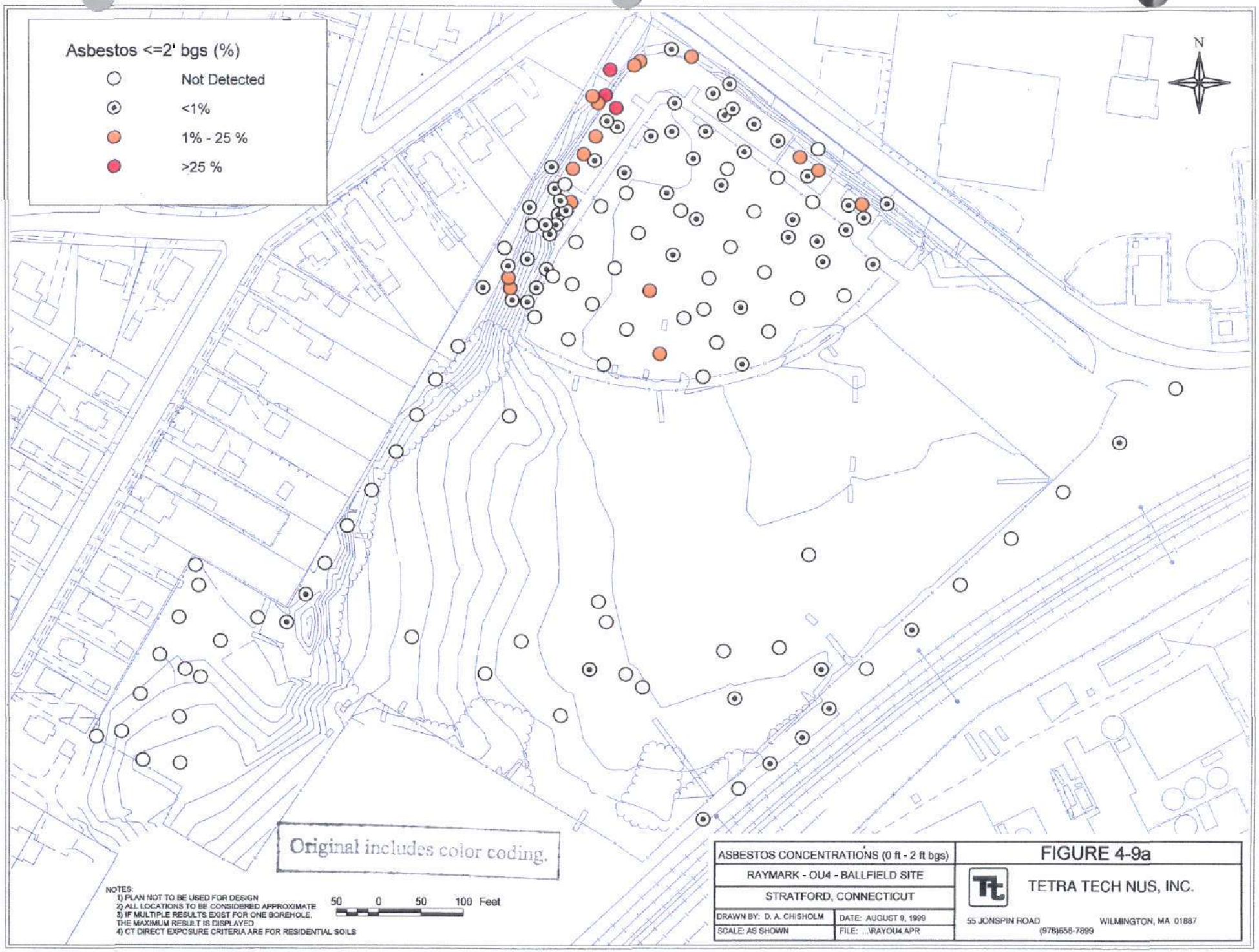
(978)658-7899

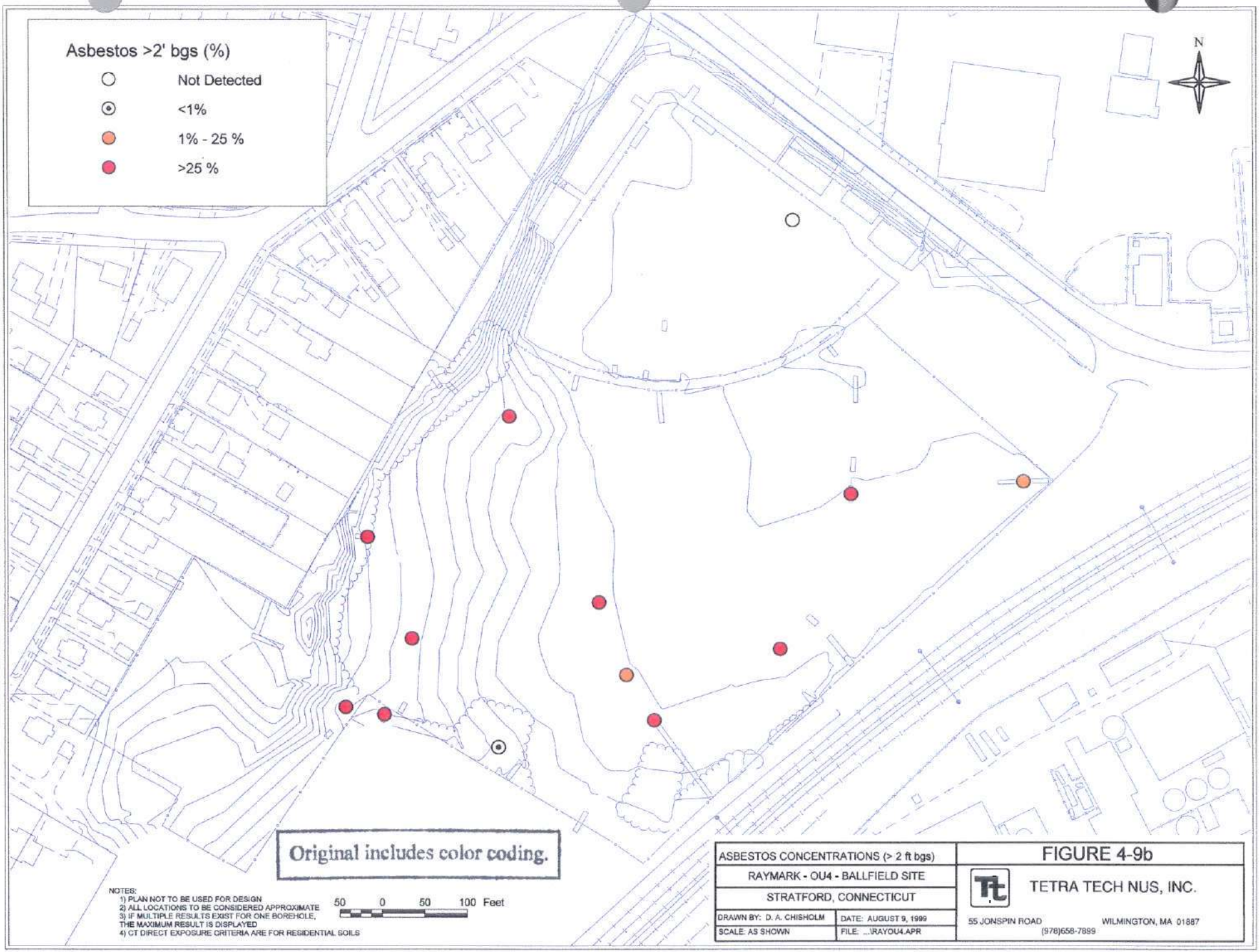

Copper <=2' bgs (mg/kg)
Not Detected
<= Background
>Background < CT DEC
>= CTDEC
Average Background = 28.79 mg/kg
CT Direct Exposure Criteria = 2,500 mg/kg
N
Original includes color coding.
NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
3) IF MULTIPLE RESULTS EXIST FOR ONE BOREHOLE, THE MAXIMUM RESULT IS DISPLAYED
4) CT DIRECT EXPOSURE CRITERIA ARE FOR RESIDENTIAL SOILS
50 0 50 100 Feet
COPPER CONCENTRATIONS (0 ft - 2 ft bgs)
RAYMARK - OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT
DRAWN BY: D. A. CHISHOLM
DATE: AUGUST 9, 1999
SCALE: AS SHOWN
FILE: ...\RAYOU4.APR
FIGURE 4-7a
TETRA TECH NUS, INC.
55 JONSPIN ROAD
WILMINGTON, MA 01887
(978)658-7899

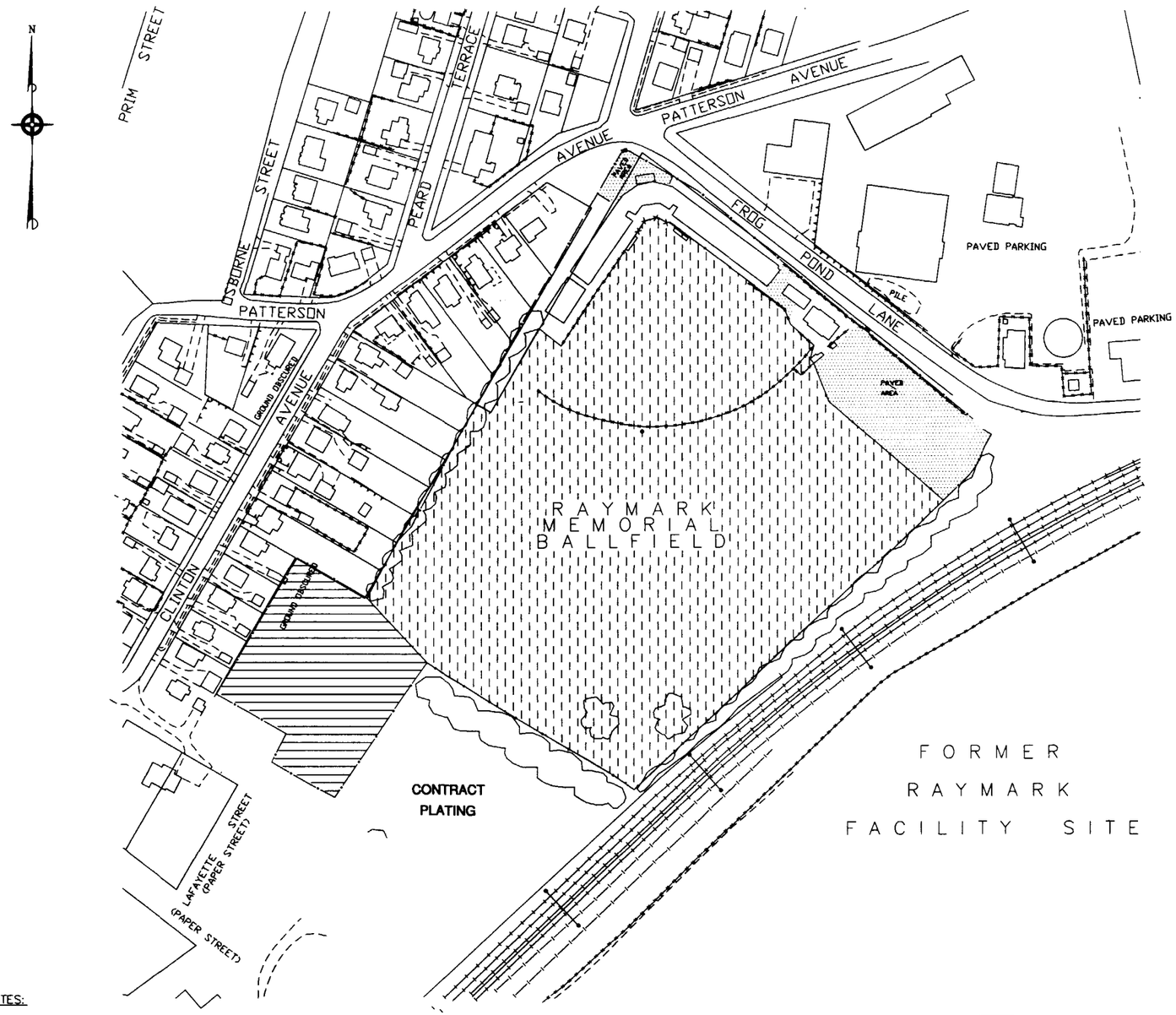

Copper >2' bgs (mg/kg)
Not Detected
<= Background
>Background < CT DEC
>= CTDEC
Average Background = 28.79 mg/kg
CT Direct Exposure Criteria = 2,500 mg/kg
N
Original includes color coding.
50 0 50 100 Feet
NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
3) IF MULTIPLE RESULTS EXIST FOR ONE BOREHOLE, THE MAXIMUM RESULT IS DISPLAYED
4) CT DIRECT EXPOSURE CRITERIA ARE FOR RESIDENTIAL SOILS
COPPER CONCENTRATIONS (> 2 ft bgs)
RAYMARK - OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT
DRAWN BY: D. A. CHISHOLM
DATE: AUGUST 9, 1999
SCALE: AS SHOWN
FILE: ...\RAYOU4.APR
FIGURE 4-7b
TETRA TECH NUS, INC.
55 JONSPIN ROAD
WILMINGTON, MA 01887
(978)658-7899


Chromium <=2' bgs (mg/kg)
Not Detected
<= Background
>Background < CT DEC
>= CTDEC
Average Background = 16.97 mg/kg
CT Direct Exposure Criteria = 100 mg/kg
N
Original includes color coding.
NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
3) IF MULTIPLE RESULTS EXIST FOR ONE BOREHOLE, THE MAXIMUM RESULT IS DISPLAYED
4) CT DIRECT EXPOSURE CRITERIA ARE FOR RESIDENTIAL SOILS
50 0 50 100 Feet
CHROMIUM CONCENTRATIONS (0 ft - 2 ft bgs)
RAYMARK - OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT
DRAWN BY: D. A. CHISHOLM
DATE: AUGUST 9, 1999
SCALE: AS SHOWN
FILE: ...\RAYOU4.APR
FIGURE 4-8a
TETRA TECH NUS, INC.
55 JONSPIN ROAD
WILMINGTON, MA 01887
(978)658-7899


Chromium >2' bgs (mg/kg)
Not Detected
<= Background
>Background < CT DEC
>= CTDEC
Average Background = 16.97 mg/kg
CT Direct Exposure Criteria = 100 mg/kg
N
Original includes color coding.
50 0 50 100 Feet
NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
3) IF MULTIPLE RESULTS EXIST FOR ONE BOREHOLE, THE MAXIMUM RESULT IS DISPLAYED
4) CT DIRECT EXPOSURE CRITERIA ARE FOR RESIDENTIAL SOILS
CHROMIUM CONCENTRATIONS (> 2 ft bgs)
RAYMARK - OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT
DRAWN BY: D. A. CHISHOLM
DATE: AUGUST 9, 1999
SCALE: AS SHOWN
FILE: ...\RAYOU4.APR
FIGURE 4-8b
TETRA TECH NUS, INC.
55 JONSPIN ROAD
WILMINGTON, MA 01887
(978)658-7899


Asbestos <=2' bgs (%)
Not Detected
<1%
1% - 25 %
>25 %
N
Original includes color coding.
NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
3) IF MULTIPLE RESULTS EXIST FOR ONE BOREHOLE, THE MAXIMUM RESULT IS DISPLAYED
4) CT DIRECT EXPOSURE CRITERIA ARE FOR RESIDENTIAL SOILS
50 0 50 100 Feet
ASBESTOS CONCENTRATIONS (0 ft - 2 ft bgs)
RAYMARK - OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT
DRAWN BY: D. A. CHISHOLM
DATE: AUGUST 9, 1999
SCALE: AS SHOWN
FILE: ...\RAYOU4.APR
FIGURE 4-9a
TETRA TECH NUS, INC.
55 JONSPIN ROAD
WILMINGTON, MA 01887
(978)658-7899


Asbestos >2' bgs (%)
Not Detected
<1%
1% - 25 %
>25 %
N
Original includes color coding.
NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
3) IF MULTIPLE RESULTS EXIST FOR ONE BOREHOLE, THE MAXIMUM RESULT IS DISPLAYED
4) CT DIRECT EXPOSURE CRITERIA ARE FOR RESIDENTIAL SOILS
50 0 50 100 Feet
ASBESTOS CONCENTRATIONS (> 2 ft bgs)
RAYMARK - OU4 - BALLFIELD SITE
STRATFORD, CONNECTICUT
DRAWN BY: D. A. CHISHOLM
DATE: AUGUST 9, 1999
SCALE: AS SHOWN
FILE: ...\RAYOU4.APR
FIGURE 4-9b
TETRA TECH NUS, INC.
55 JONSPIN ROAD
WILMINGTON, MA 01887
(978)658-7899



LEGEND

- ASPHALT PAVEMENT
- EARLY SUCCESSIONAL GRASSLAND
- DECIDUOUS FORESTED AREA
- APPROX. DECIDUOUS TREE LINE

NOTES:

1. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
2. PLAN NOT TO BE USED FOR DESIGN.
3. BASE MAP COMPILED FROM A PLAN BY GEOD PHOTOGRAMMETRIC SCIENCES SURVEY TECHNOLOGIES, NEWFOUNDLAND, NJ, DATED: 10-28-93, PORTIONS OF FENCING FROM A PLAN BY CCA, BROOKFIELD, CT, DATED: 3-30-99 AND TREELINE AND PORTIONS OF FENCE FROM FIELD OBSERVATION.

GRAPHIC SCALE

0' 200' 400'

1 INCH = 200 FEET

ECOLOGICAL EVALUATION – HABITAT MAP			FIGURE 7-1
FINAL REMEDIAL INVESTIGATION / FEASIBILITY STUDY			TETRA TECH NUS, INC.
RAYMARK OU4 – STRATFORD, CT			55 Jonspin Road Wilmington, MA 01887 (978)658-7899
DRAWN BY: R.G. DEWSNAP		REV.: 0	
CHECKED BY: K. O'NEILL		DATE: JULY 29, 1999	
SCALE: 1" = 200'		FILE NO.:DWG\RAYMARK\OU4\ECO_EVAL\ECO_1.DWG	

APPENDIX A

GEOPHYSICAL SURVEY REPORT

HAGER-RICHTER
GEOSCIENCE, INC.

GEOPHYSICAL SURVEY
OU4 BALLFIELD SITE
STRATFORD, CONNECTICUT

Raymark Superfund Site
Subcontract No. S98-RAC1-065

Prepared for:

Tetra Tech NUS, Inc.
55 Jonspin Road
Wilmington, Massachusetts 01887

Prepared by:

Hager-Richter Geoscience, Inc.
8 Industrial Way - D10
Salem, New Hampshire 03079

File 98G60
June, 1999

Geophysical Survey
OU4 Ballfield Site
Stratford, Connecticut
Subcontract No. S98-RAC1-065
File 98G60 June, 1999

0. EXECUTIVE SUMMARY

Hager-Richter Geoscience, Inc. conducted a geophysical survey at the Raymark Superfund Site, OU4 Ballfield Site in Stratford, Connecticut for Tetra Tech NUS, Inc. (TtNUS). The geophysical survey is part of an environmental investigation of the Raymark Superfund Site by TtNUS for the USEPA.

The Raymark Superfund Site is located at the mouth of the Housatonic River within the Town of Stratford, Connecticut. The area of interest for the geophysical survey was specified by TtNUS as the OU4 Ballfield Site. The area of interest is approximately 13 acres in size and is composed of an inactive baseball field and an open grassy field. The OU4 Ballfield Site is located northwest of the MetroNorth rail lines and the former Raymark Facility and south of Frog Pond Lane in Stratford, Connecticut. According to information provided by TtNUS, former ponds located on the OU4 Ballfield Site may have been filled with waste materials.

The geophysical survey was conducted using two complementary techniques: electromagnetic induction terrain conductivity (commonly called EM) and ground penetrating radar (GPR). The objectives of the geophysical survey were to determine the approximate lateral and vertical extent of the fill, and to characterize the contents of the fill, if possible.

The results of the reconnaissance geophysical survey at the OU4 Ballfield Site in Stratford, Connecticut are as follows:

- The approximate area of possible conductive fill was determined by the geophysical survey.
- Four areas of relatively thick possible conductive fill were identified on the basis of the geophysical data. The thickness of the fill is estimated to be about 9 feet in these areas, but the actual depth may vary depending on the dielectric properties of the subsurface materials.
- Nine areas of possible buried metal were detected within the survey area.
- Two possible utilities were identified within the survey area.

Geophysical Survey
OU4 Ballfield Site
Stratford, Connecticut
Subcontract No. S98-RAC1-065
File 98G60 June, 1999

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FIGURES

1. General Site Location
2. GPR Record of Possible Filled Pond

PLATES

1. Site Plan
2. Apparent Conductivity
3. In-Phase Component
4. GPR Survey & Integrated Interpretation

APPENDICES

EM Surveys
Ground Penetrating Radar Surveys

Geophysical Survey
OU4 Ballfield Site
Stratford, Connecticut
Subcontract No. S98-RAC1-065
File 98G60 June, 1999

1. INTRODUCTION

Hager-Richter Geoscience, Inc. conducted a geophysical survey at the Raymark Superfund Site, OU4 Ballfield Site in Stratford, Connecticut for Tetra Tech NUS, Inc. (TtNUS) of Wilmington, Massachusetts in November and December, 1998. The geophysical survey is part of an environmental investigation of the Raymark Superfund Site by TtNUS for the USEPA.

The Raymark Superfund Site is located at the mouth of the Housatonic River in the Town of Stratford, Connecticut. The area of interest for the geophysical survey was specified by TtNUS as the OU4 Ballfield Site. The OU4 Ballfield Site is located northwest of the MetroNorth rail lines and the former Raymark Facility and south of Frog Pond Lane, and its location is shown in Figure 1. The Site is approximately 13 acres in size and is composed of an inactive baseball field and an open grassy field. Plate 1 is a Site Plan. According to information provided by TtNUS, wastes from the Raymark facility may have been disposed of in former ponds located in the area of interest.

The geophysical survey was conducted using two complementary techniques: electromagnetic induction terrain conductivity (commonly called EM) and ground penetrating radar (GPR). The objectives of the geophysical survey were to determine the approximate lateral and vertical extent of the fill, and to characterize the contents of the fill, if possible.

Jeffrey Reid and James Coffman of Hager-Richter conducted the survey November 30-December 3, 1998. The project was coordinated with Mr. Michael Healy of TtNUS. Mr. Healy specified the area of interest and observed portions of the field operations. Preliminary plots of the geophysical data and interpretation were transmitted to TtNUS on December 9, 1998. Final data analysis and interpretation were completed at the Hager-Richter offices following receipt of Site Plans on June 1, 1999. Original data and field notes reside in the Hager-Richter files and will be retained for at least three years.

2. EQUIPMENT AND PROCEDURES

2.1 GENERAL

Two complementary techniques were used at the OU4 Ballfield Site: EM and GPR. The survey area was specified by TtNUS, and grids for the geophysical survey were established and staked by Hager-Richter personnel. The locations of some of the survey stakes were later surveyed by others and plotted on Plate 1.

2.2 ELECTROMAGNETIC INDUCTION TERRAIN CONDUCTIVITY

2.2.1 General. The EM survey was conducted using a Geonics EM31 terrain conductivity meter. A general description of the equipment, procedures, and limitations for the EM survey, as conducted by Hager-Richter, is contained in the Appendix.

2.2.2 Site Specific. Data for the terrain conductivity survey were recorded at approximately 1½-foot intervals along lines spaced 10 feet apart for the survey. The 12-foot long boom of the EM31-DL terrain conductivity meter was oriented perpendicular to the traverse lines. Data were recorded in the vertical dipole mode (nominal depth of exploration of 18 feet) for both the quadrature phase component (apparent conductivity) and in-phase component.

Data were re-measured along a baseline at the beginning and end of each field day to check for instrument drift. No significant instrument drift was detected. The EM data were processed in the field using a notebook computer to obtain preliminary contour plots. The plots were than used to focus the GPR survey.

2.3 GROUND PENETRATING RADAR

2.3.1 General. The ground penetrating radar (GPR) survey was conducted using a Geophysical Survey Systems SIR-2 digital GPR system. A general description of the equipment, procedures, and limitations for the GPR survey, as conducted by Hager-Richter, is contained in the Appendix.

2.3.2 Site Specific. GPR data were acquired in locations, selected with the concurrence on the TtNUS site representative, where the EM data indicated the presence of conductive materials in the subsurface. GPR traverses were oriented along the local geophysical survey grid in each of the

areas explored further with the GPR. The GPR antenna was pulled by hand for all traverses.

GPR data were acquired with a 300 MHz antenna and a 80 nsec time window. GPR signal penetration was generally good at the site. Based on handbook values of time-to-depth conversions for the GPR signal in average soils, the GPR signal penetration is estimated to have varied from approximately 10 feet to 12 feet.

3. RESULTS AND DISCUSSION

3.1 General

The geophysical survey was conducted using two complementary techniques: electromagnetic induction terrain conductivity (EM) and GPR. The area of interest for the survey was specified by TtNUS. The EM survey was conducted across the accessible portions of the specified area of interest. The GPR survey was focused at the locations of EM anomalies indicative of conductive subsurface materials.

Apparent conductivity data are useful for detecting the presence of anomalously conductive ground, which might be caused by the presence of objects with properties unlike those of the natural materials on site, such as fill. The in-phase component data, on the other hand, are *only* used to interpret the presence of metal objects. Where the metal objects are relatively small, the instrument must be located within a few feet of the objects in order to detect them.

3.2 EM Survey

The EM data are presented as color contour plots of the apparent conductivity and in-phase data in Plates 2 and 3, respectively. Data were collected for approximately 15,100 stations for the EM survey.

As can be seen on Plate 2, the apparent conductivity values in the southern portion of the area of interest are anomalously high and are represented by values exceeding 80 mmho/m and the colors yellow, red, and pink. No anomaly indicative of conductive materials (values greater than 80 mmho/m) is present within the ballfield and for most of the northern and western portions of the site.

As can be seen on Plate 3, in-phase component anomalies are concentrated mostly in the center of the Site. Note that the areas of anomalous apparent conductivity, have no in-phase anomalies present, indicating that there is no significant amount of buried metal in those areas.

The linear anomaly located along the southeastern side is coincident with the location of a utility crossing the Site, and we attribute the anomaly to a utility. A series of apparent conductivity anomalies that are roughly parallel to the outfield fence located within the ballfield area are also likely due to a utility.

Anomalous apparent conductivity and in-phase values are present along the southern and northern perimeter fences and along a portion of the western perimeter fence within the ballfield. These anomalies are attributed to the fence, and the presence or absence of buried metal or conductive ground in these areas cannot be determined on the basis of the geophysical data alone. Such areas are shown on Plate 4.

3.3 GPR Survey

The locations of the GPR traverses were selected on the basis of the results of the EM survey and are shown on Plate 4. The TtNUS site representative concurred with the detection of areas for the GPR survey. The GPR survey for the OU4 Ballfield site was focused on the areas exhibiting significant apparent conductivity anomalies to attempt to identify the locations of the former ponds. GPR signatures consistent with filled depressions were identified for the Site.

Figure 2 is a typical example of a GPR record crossing one of the inferred filled ponds. The record is interpreted as showing reflections from the bottom of a former pond that has been filled. The approximate depth of the bottom of the former pond, based on handbook values of time-to-depth conversions for the GPR signal in average soils, is about 9 feet, but could vary significantly depending on the depth of water table throughout the Site.

3.4 Integrated Interpretation

The integrated interpretation of the geophysical data for the Site is given in Plate 4. A large portion of the southern and central portions of the Site exhibits anomalous apparent conductivity values, interpreted to be caused by possible conductive fill. This area is shown as a stippled area on Plate 4. Four areas of relatively thick possible conductive fill were identified within the area of possible conductive fill based on the very high apparent conductivity values combined with GPR reflections interpreted to be due to former depressions that are now filled. These areas may be the locations of the former ponds and are shown as hatched areas on Plate 4.

Nine areas interpreted as containing possible buried metal were identified based on the geophysical data. Such areas are shown as crosshatched areas on Plate 4. Two possible utilities, one located in the ballfield and one located along the southeastern boundary of the Site were also identified on the basis of the geophysical survey.

4. CONCLUSIONS

The results of the geophysical survey at the OU4 Ballfield Site in Stratford, Connecticut are as follows:

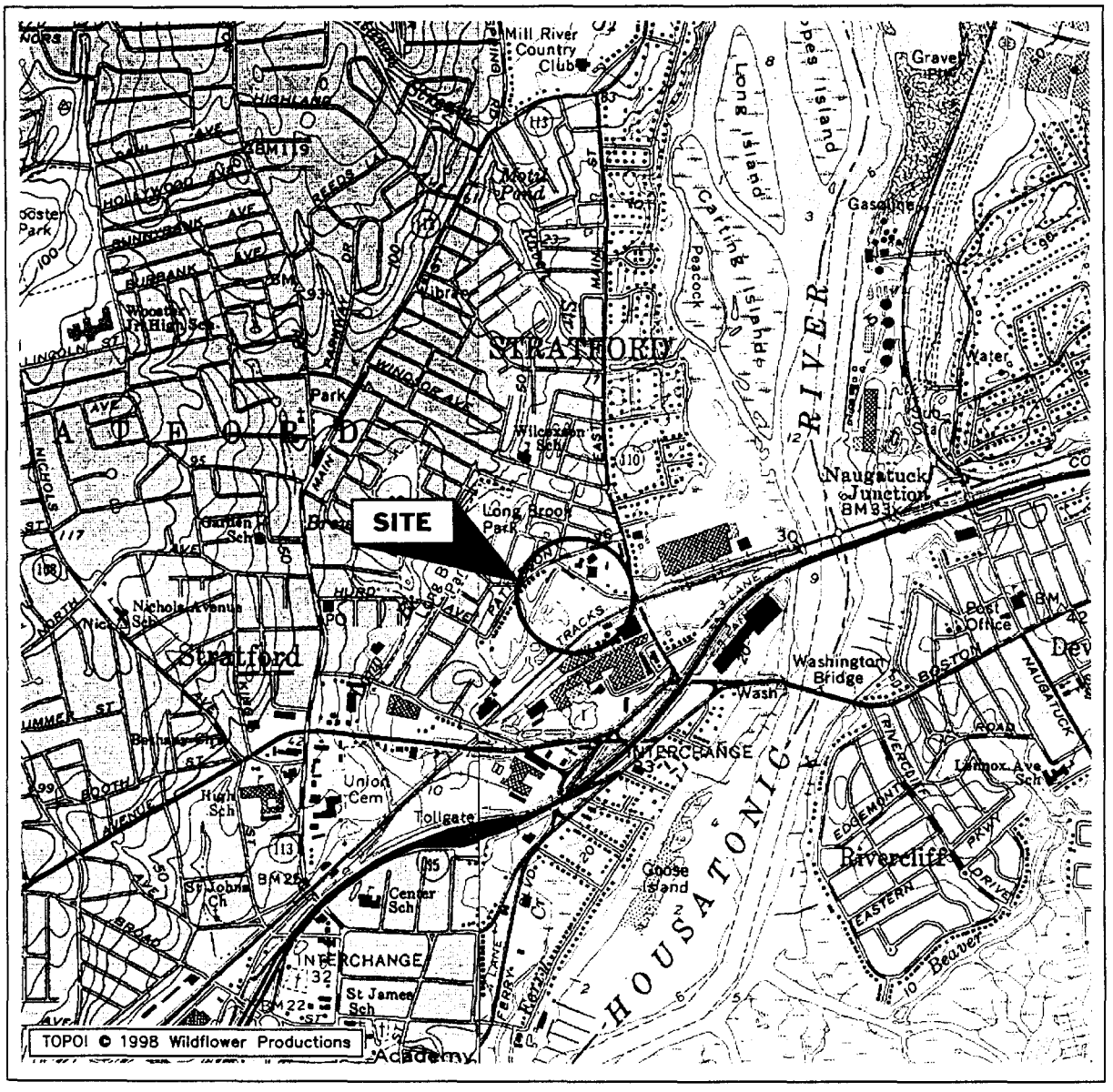
- The approximate area of possible conductive fill was determined by the geophysical survey.
- Four areas of relatively thick possible conductive fill were identified on the basis of the geophysical data. The thickness of the fill is estimated to be about 9 feet in these areas, but the actual depth may vary depending on the dielectric properties of the subsurface materials.
- Nine areas of possible buried metal were detected within the survey area.
- Two possible utilities were identified within the survey area.

5. LIMITATIONS

This report was prepared for the exclusive use of Tetra Tech NUS, Inc.(Client) and the USEPA. No other party shall be entitled to rely on this Report or any information, documents, records, data, interpretations, advice or opinions given to Client by Hager-Richter Geoscience, Inc. (H-R) in the performance of its work. The Report relates solely to the specific project for which H-R has been retained and shall not be used or relied upon by Client or any third party for any variation or extension of this project, any other project or any other purpose without the express written permission of H-R. Any unpermitted use by Client or any third party shall be at Client's or such third party's own risk and without any liability to H-R.

H-R has used reasonable care, skill, competence and judgment in the performance of its services for this project consistent with professional standards for those providing similar services at the same time, in the same locale, and under like circumstances. Unless otherwise stated, the work performed by H-R should be understood to be exploratory and interpretational in character and any results, findings or recommendations contained in this Report or resulting from the work proposed may include decisions which are judgmental in nature and not necessarily based solely on pure science or engineering. It should be noted that our conclusions might be modified if subsurface conditions were better delineated with additional subsurface exploration including, but not limited to, test pits, soil borings with collection of soil and water samples, and laboratory testing.

Except as expressly provided in this limitations section, H-R makes no other representation or warranty of any kind whatsoever, oral or written, expressed or implied; and all implied warranties of merchantability and fitness for a particular purpose, are hereby disclaimed.



N

LOCATION

SCALE (feet)

0 2000 4000

Figure 1
General Site Location
OU4 Ballfield Site
Stratford, Connecticut

File 98G60	June, 1999

HAGER–RICHTER GEOSCIENCE, INC.
Salem, New Hampshire

LEGEND

- UTILITY POLE
- FENCE
- LIGHT POLE
- MANHOLE
- SB-424 — SOIL BORING
- MW 402B — MONITORING WELL
- TRENCH 10A — TEST PIT TRENCHES
- GRID LOCATION
- FLAG POLE
- CONCRETE RETAINING WALL
- CATCH BASIN

SCALE (feet)

0 40 80

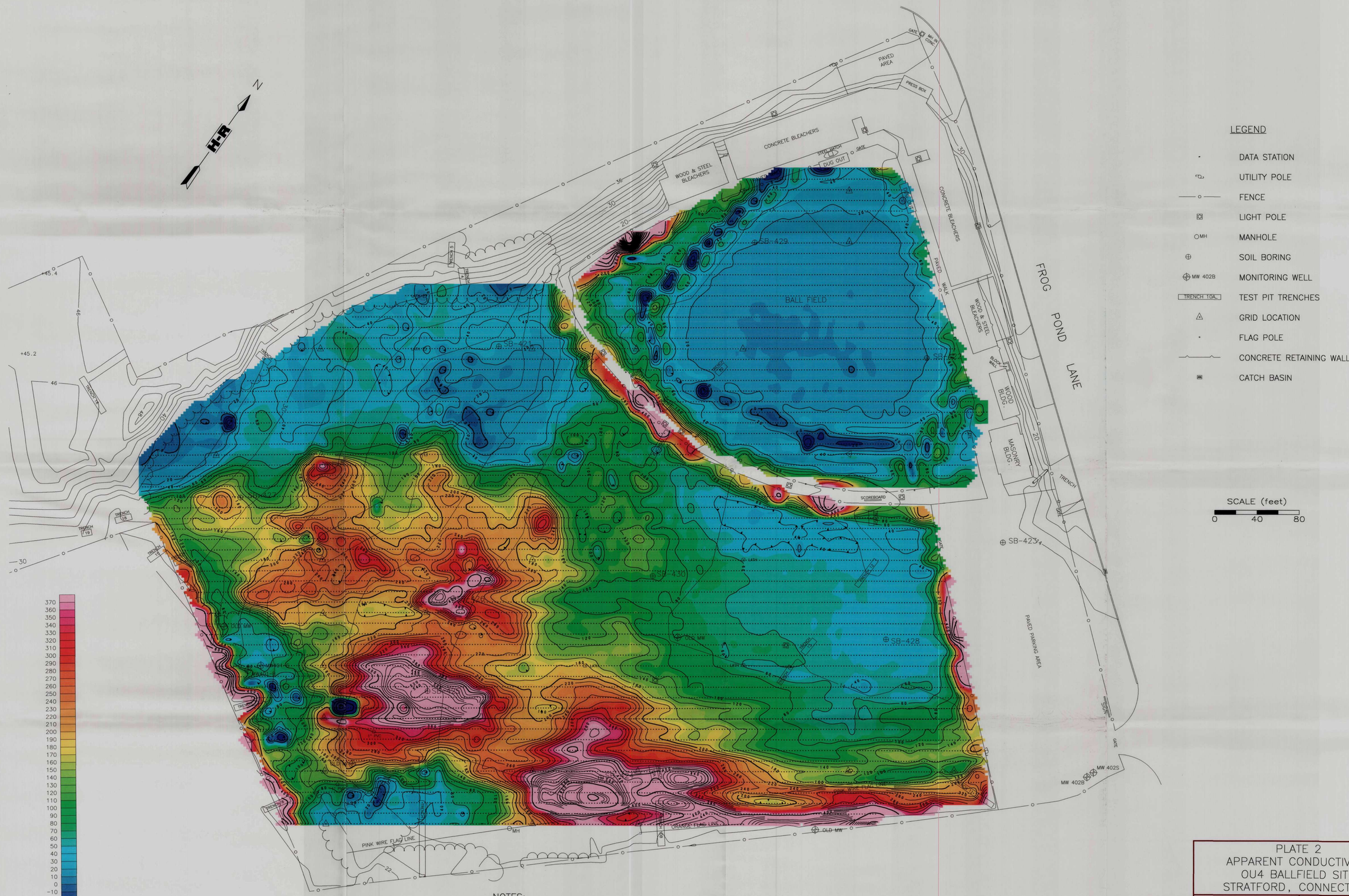
NOTE:

Base plan provided by Tetra Tech Nus, Inc.

PLATE 1
SITE PLAN
OU4 BALLFIELD SITE
STRATFORD, CONNECTICUT

FILE 98G60	JUNE, 1999

HAGER–RICHTER GEOSCIENCE, INC.
SALEM, NEW HAMPSHIRE



LEGEND

- DATA STATION
- UTILITY POLE
- FENCE
- LIGHT POLE
- MANHOLE
- SOIL BORING
- MONITORING WELL
- TEST PIT TRENCHES
- GRID LOCATION
- FLAG POLE
- CONCRETE RETAINING WALL
- CATCH BASIN

SCALE (feet)

0 40 80

NOTES:

1. Modified from base plan provided by Tetra Tech Nus, Inc.
2. Data were recorded with EM31 in vertical dipole mode with boom perpendicular to traverse line.
3. Contour Interval = 20 mmho/m. Color Contour Interval = 10 mmho/m.

PLATE 2
APPARENT CONDUCTIVITY
OU4 BALLFIELD SITE
STRATFORD, CONNECTICUT

FILE 98G60	JUNE, 1999

HAGER-RICHTER GEOSCIENCE, INC.
SALEM, NEW HAMPSHIRE

LEGEND

- DATA STATION
- UTILITY POLE
- FENCE
- LIGHT POLE
- MANHOLE
- SOIL BORING
- MONITORING WELL
- TEST PIT TRENCHES
- GRID LOCATION
- FLAG POLE
- CONCRETE RETAINING WALL
- CATCH BASIN

SCALE (feet)

0 40 80

NOTES:

1. Modified from base plan provided by Tetra Tech Nus, Inc.
2. Data were recorded with EM31 in vertical dipole mode with boom perpendicular to traverse line.
3. Contour Interval = 1 ppt. Color Contour Interval = .25 ppt.

PLATE 3
IN-PHASE COMPONENT
OU4 BALLFIELD SITE
STRATFORD, CONNECTICUT

FILE 98G60	JUNE, 1999

HAGER-RICHTER GEOSCIENCE, INC.
SALEM, NEW HAMPSHIRE

LEGEND

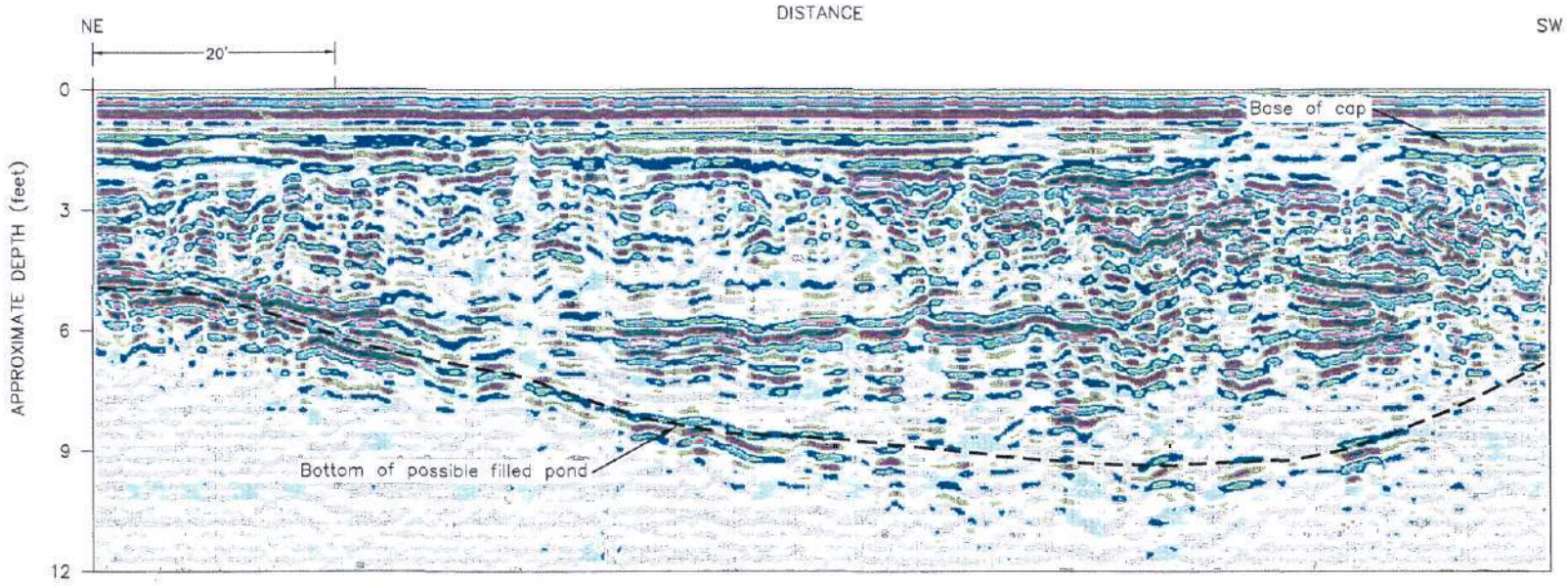
- GPR TRAVERSE
- AREA OF POSSIBLE BURIED METAL
- APPROXIMATE AREA OF RELATIVELY THICK POSSIBLE CONDUCTIVE FILL
- APPROXIMATE AREA OF POSSIBLE CONDUCTIVE FILL
- EM ANOMALY ATTRIBUTED TO FENCE. THE PRESENCE OR ABSENCE OF BURIED METAL WITHIN THIS AREA CANNOT BE DETERMINED ON THE BASIS OF THE GEOPHYSICAL DATA ALONE.
- POSSIBLE UTILITY
- UTILITY POLE
- FENCE
- LIGHT POLE
- MH — MANHOLE
- SB-424 — SOIL BORING
- MW 402B — MONITORING WELL
- TRENCH 10A — TEST PIT TRENCHES
- GRID LOCATION
- FLAG POLE
- CONCRETE RETAINING WALL
- CATCH BASIN

SCALE (feet)
0 40 80

NOTE:

Modified from base plan provided by Tetra Tech Nus, Inc.

PLATE 4 GPR SURVEY & INTEGRATED INTERPRETATION OU4 BALLFIELD SITE STRATFORD, CONNECTICUT	
FILE 98G60	JUNE, 1999
HAGER–RICHTER GEOSCIENCE, INC. SALEM, NEW HAMPSHIRE	



Original includes color coding.

NOTES:

1. The time-to-depth conversion for the GPR signal varies with the dielectric properties of the materials in the subsurface and is not necessarily uniform.
2. Colors represent relative amplitude of reflected signals. Grey and white are lowest amplitude; brightest colors are highest amplitude.
3. Accuracy of distances along GPR record is approximately ±1 foot.

Figure 2
GPR Record of Possible Filled Pond
OU4 Ballfield Site
Stratford, Connecticut

File 98G60	June, 1999

HAGER-RICHTER GEOSCIENCE, INC.
Salem, New Hampshire

HAGER-RICHTER
GEOSCIENCE, INC.

Geophysical Survey
OU4 Ballfield Site
Stratford, Connecticut
Subcontract No. S98-RAC1-065
File 98G60 June, 1999

APPENDICES

APPENDIX
TERRAIN CONDUCTIVITY (EM) SURVEYS

Field Work. We used a Geonics EM31-DL Terrain Conductivity Meter for the survey. This unit is an induction type instrument and provides measurement of both the quadrature-phase and in-phase components of terrain conductivity without ground electrodes or contact. The data for both components are recorded on a digital data logger. The EM31-DL is calibrated to read ground conductivity directly in millimhos per meter with a resolution of 2% of full scale and an accuracy of 1 mmho/meter.

The EM31-DL has coils mounted with a fixed separation of 12 feet in a rigid boom. In normal operation, it is used with a vertical dipole, and the nominal depth of earth sampled by the EM31-DL is about 18 feet. In the horizontal dipole mode, the nominal depth of earth sampled by the EM31-DL is about 9 feet.

Two components of the induced magnetic field measured by the EM31-DL are recorded: (1) the quadrature-phase component and (2) the in-phase component. The quadrature-phase component is a measure of the average terrain conductivity of the subsurface materials located between the receiver and transmitter of the EM31-DL. The in-phase component is a sensitive indicator of the presence of conductive metal objects; however, the exact identification of the object cannot be determined from the terrain conductivity data alone.

Data Analysis and Interpretation. Terrain conductivity data are most commonly plotted in either profile format or as contour maps, depending on the density of the data. At sites free of metal objects and other cultural interference, the terrain conductivity measured at a particular location is controlled by the subsurface fluid. The instrument response is more affected by near-surface material than by deeper material, particularly horizontal dipole data. In cases where the terrain conductivity meter coil is directly over a buried metal target, the apparent conductivity reading may be a negative number.

Terrain conductivity surveys are commonly included in environmental investigations because they can be used to determine the lateral extent of disposal areas and/or landfills, to detect buried metal objects, and to detect the presence of conductive leachate plumes. Typically, terrain conductivity values measured in disposal areas are irregular and highly variable over short distances due to the heterogeneous materials in the subsurface. The edges of disposal areas can be determined, then, where there is a change to smoothly varying values of terrain conductivity. In areas of buried metal objects, terrain conductivity meters commonly yield apparently negative values. Leachate plumes are generally recognized on the basis of terrain conductivity data as relatively smoothly varying, but anomalously elevated, values compared to the background values for a given site.

Limitations of the Method. As with any of the electrical geophysical methods, terrain conductivity data are subject to interference from such cultural features as buildings, fencing, and underground and overhead power lines. Thus, for certain sensitive geologic applications, the use of the terrain conductivity method in urban settings might be inappropriate.

The usefulness of terrain conductivity soundings for delineating stratigraphic changes with depth is limited by the relatively small combination of coil separations and dipole orientations available with Geonics' equipment. The instruments were not designed for detailed vertical soundings but, according to the manufacturer's literature (Geonics Technical Note TN-8, rev. 1983), give the most accurate results where the earth can be approximated by a two-layer model. Models of the earth calculated from terrain conductivity data are non-unique; in most cases, multiple models can satisfy the observed data.

The terrain conductivity meter instrument response varies with the orientation of the dipoles. In the horizontal dipole mode (coils vertical and co-planar), the instrument is more sensitive to near-surface conductive layers than it is in the vertical dipole mode (coils horizontal and co-planar). In the horizontal dipole mode, the high sensitivity to near-surface conductivity might mask the effects of changes at depth.

APPENDIX
GROUND PENETRATING RADAR SURVEYS

Field Work. A Geophysical Survey Systems, Inc. Model SIR-2 ground penetrating radar system was used for this survey. The SIR-2 is a fully digital system and includes a color monitor, grey-scale thermal printer, and 10-Gbyte digital tape backup system. The transmit/receive antenna is housed in a box that is moved across the surface. The antenna transmits electromagnetic signals into the subsurface and then detects, amplifies, and displays reflections of the signals in real-time on the color monitor. The result is a radar record of the subsurface.

The maximum depth of penetration of the GPR signal and the resolution of the reflections are controlled in part by the frequency of the antenna used and in part by the electrical properties of the subsurface. Hager-Richter owns antennas with the following center frequencies: 120 MHz, 300 MHz, 500 MHz, and 1000 MHz. The total time during which radar signals are recorded can be varied from a few to 1,000 nanoseconds (nsec). However, there is a trade-off between total time, corresponding to depth range, and resolution. As the total time of recording is increased, the resolution of the GPR records decreases. For a given site, the total time window is set to detect features located somewhat below the maximum expected target depths.

Interpretation. The horizontal axis of a GPR record represents distance across the surface and the vertical axis represents round-trip travel time of the radar signal. The round-trip travel time can be converted to approximate depth by correlating with reflections from targets of known depth or by using handbook values of velocities for materials in the subsurface. For those sites where the subsurface is electrically heterogeneous, the travel times of the radar signal may be different in the various materials, and the vertical scale for the radar records is not necessarily uniform with depth.

The reflections in a GPR record are produced by spatial changes in the physical properties (e.g., type of material, subsurface fluids, porosity, etc.) and related changes in the electrical properties (dielectric constant) of the subsurface materials in the path of the signals. The greater the difference in electrical properties between two materials in the subsurface, the stronger the reflection observed in the GPR record.

The size, shape, and amplitude of the GPR reflections are the characteristics that are considered in the interpretation of the data from any site. Because the electrical properties of metal USTs, utilities, and conduits different significantly from those of the soils in which they are buried, such objects produce GPR reflections with high amplitude and distinctive shapes that permit identification with a high degree of reliability. Most other objects, although readily detectable, require "ground truth" for identification. Only excavations provide positive identification for most objects identified in GPR surveys.

For GPR profiles oriented perpendicular to the long axis of a tank, the signature is similar to a hyperbola, the shape of which is a function of the diameter and depth of burial of the tank. For GPR profiles oriented parallel to the long axis of a tank, the signature is a set of parallel, high amplitude reflections that terminate sharply at the ends of the tank. GPR, then, is useful for determining the exact location and dimensions of USTs.

Limitations of the Method. The maximum depth to which GPR signals can penetrate depends on the electrical properties of the subsurface materials. The higher the electrical conductivity of the subsurface materials, the lower the radar signal penetration. Clay minerals and/or brackish water in the subsurface, for example, attenuate the GPR signal, so reflections are not received from materials at greater depths.

There are limitations of the GPR technique as used to detect and/or locate particular targets: (1) surface conditions, (2) electrical conductivity of the ground, (3) contrast of the electrical conductivities of the targets and the ground, and (4) spacing between lines. Of these limitations, only the fourth, line spacing, is controlled by the operator.

The condition of the ground surface can affect the quality of the GPR data and the depth of penetration of the GPR signal. Sites covered with high grass, bushes, landscape structures, debris, obstacles, soil mounds, etc. limit the survey access and the coupling of the GPR antenna with the ground. In many cases, the GPR signal will not penetrate below concrete pavement, and a target may not be detectable.

The electrical conductivity of the ground determines the attenuation of the GPR signals, and thereby limits the maximum depth of exploration. The GPR signal does not penetrate clay-rich soils, and targets buried in clay can be missed.

A contrast in the electrical conductivities of the ground and the target is required to obtain a reflection of the GPR signal. If the contrast is too small, possibly due to extremely corroded conditions of a metal target, then the reflection may be too weak to recognize, and the target can be missed.

The spacing between lines is under control of the GPR operator, and the design of the survey is based on the dimensions of the smallest target of interest. Targets with dimensions smaller than the spacing between GPR survey lines can be missed.

Accurate determination of the depth to any interface requires calibration of the site specific GPR signal velocity. Where targets of a known depth are not available at a site, the time-to-depth conversion of the GPR signal can be estimated from handbook values, but such depth estimations might contain significant error.

Interpretation of GPR data is subjective. As noted above, "ground truth" through correlation with borings and excavations is required for positive identification of most objects detected on the basis of GPR data.

APPENDIX B

GEOLOGIC LOGS

Well Construction Logs, Boring Logs, Test Pit Logs

FLUSH MOUNT MONITORING WELL CONSTRUCTION LOG

TETRA TECH NUS

PROJECT NAME: Raymark

PROJECT NO:

PROJECT LOCATION: Stratford, CT

WELL NO: 216B

CLIENT: US EPA , RAC I

BORING NO: 216B

CONTRACTOR: Alliance

DRILLER: Ben Grim

BORING LOCATION: Upgradient - on DPW land

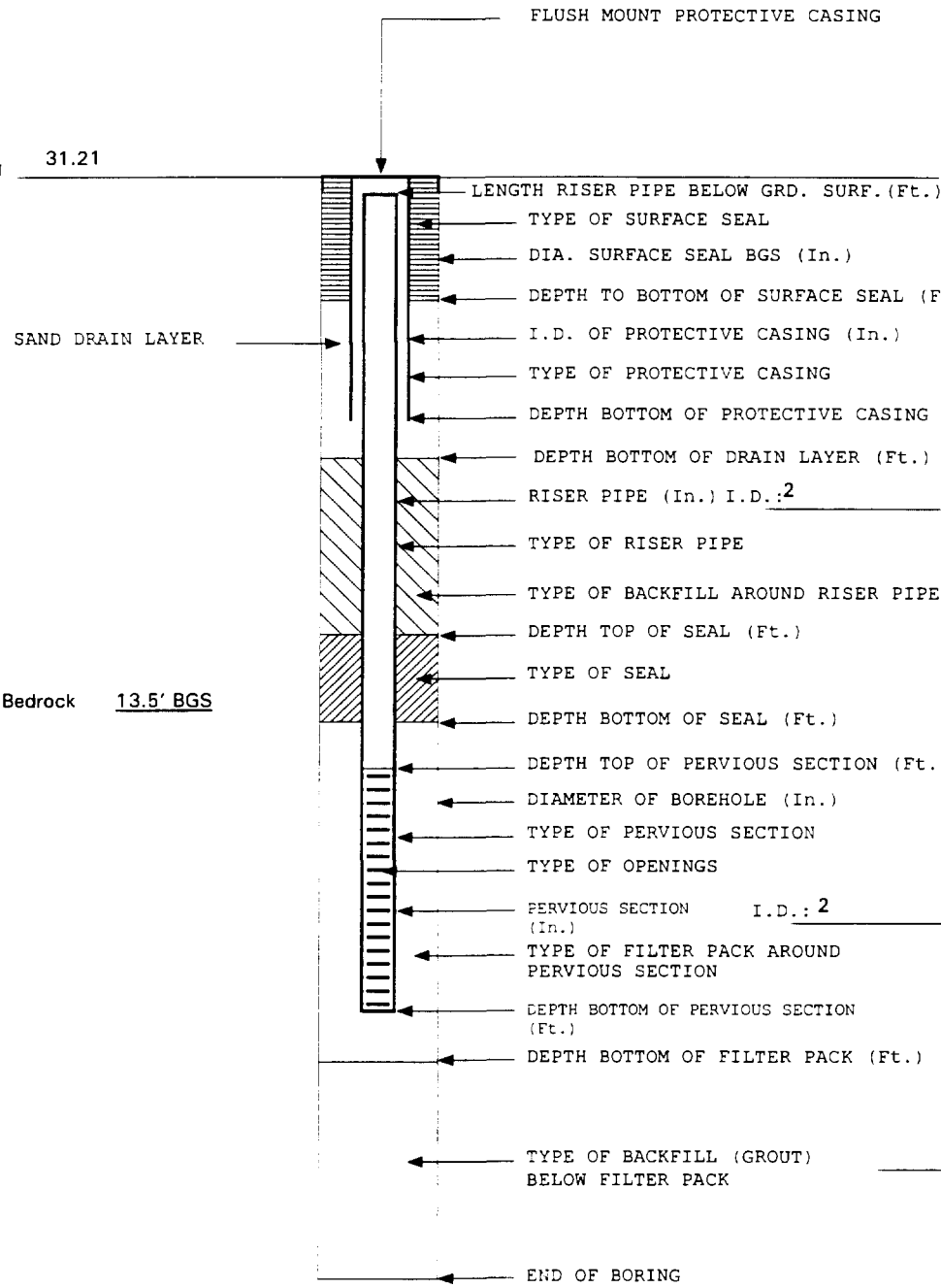
LOGGED BY: Joe Mello

DATE:

CHECKED BY:

DATE:

PAGE: 1 OF 1



LENGTH RISER PIPE BELOW GRD. SURF. (Ft.)	0.36
TYPE OF SURFACE SEAL	Quikrete cement
DIA. SURFACE SEAL BGS (In.)	18"x18"
DEPTH TO BOTTOM OF SURFACE SEAL (Ft.)	1.4
I.D. OF PROTECTIVE CASING (In.)	8
TYPE OF PROTECTIVE CASING	steel
DEPTH BOTTOM OF PROTECTIVE CASING (Ft.)	1.5
DEPTH BOTTOM OF DRAIN LAYER (Ft.)	2
RISER PIPE (In.) I.D.: 2	O.D.: 2.38
TYPE OF RISER PIPE	Scheudle 40 PVC
TYPE OF BACKFILL AROUND RISER PIPE	cement/bentonite/grout
DEPTH TOP OF SEAL (Ft.)	34'
TYPE OF SEAL	bentonite chips
DEPTH BOTTOM OF SEAL (Ft.)	36.5'
DEPTH TOP OF PERVIOUS SECTION (Ft.)	40.7
DIAMETER OF BOREHOLE (In.)	5
TYPE OF PERVIOUS SECTION	PVC
TYPE OF OPENINGS	0.010 slot
PERVIOUS SECTION (In.) I.D.: 2	O.D.: 2.38
TYPE OF FILTER PACK AROUND PERVIOUS SECTION	# 00
DEPTH BOTTOM OF PERVIOUS SECTION (Ft.)	65.7
DEPTH BOTTOM OF FILTER PACK (Ft.)	66.0
TYPE OF BACKFILL (GROUT) BELOW FILTER PACK	
END OF BORING	66.0

GENERAL NOTE

1. Entry of 0.00 for Ground Elevation Indicates that Surveyed Ground Elevation is NOT Available

BEDROCK MONITORING WELL CONSTRUCTION LOG

TETRA TECH NUS, INC.

PROJECT NAME:	Raymark	PROJECT NO:	
PROJECT LOCATION:	Stratford, CT	WELL NO:	MW-216DB
CLIENT:	US EPA – Region 1	BORING NO:	SB-216DB
CONTRACTOR:	Aquifer Drilling & Testing	DRILLER:	Marty Harrington
LOGGED BY:	Tracy Dorgan	DATE:	02/15/99
CHECKED BY:		DATE:	

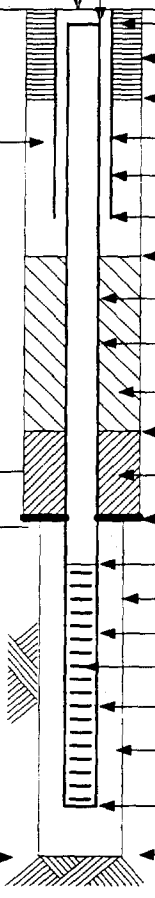
BORING LOCATION: DPW lawn ~ 8' north of MW-216B. 30-40' from bldg.

PAGE: 1 OF

ELEVATION TOP OF PROTECTIVE CASING 31.17'

ELEVATION TOP OF RISER PIPE 30.96'

GROUND ELEVATION 31.2'



FLUSH MOUNT PROTECTIVE CASING GROUND SURFACE (Ft.)	
LENGTH OF RISER PIPE BELOW GROUND SURFACE (Ft.)	0.24'
TYPE OF SURFACE SEAL	Cement
DIA. SURFACE SEAL BGS (In.)	18
DEPTH TO BOTTOM OF SURFACE SEAL (Ft.)	1.0
I.D. OF PROTECTIVE CASING (In.)	8
TYPE OF PROTECTIVE CASING	Steel Road Box
DEPTH BOTTOM OF PROTECTIVE CASING (Ft.)	1.9'
DEPTH BOTTOM OF DRAIN LAYER (Ft.)	5.0'
RISER PIPE (In.) I.D.: 2 O.D.: 2.3	
TYPE OF RISER PIPE	Schedule 40 PVC
TYPE OF BACKFILL AROUND RISER PIPE	Bentonite Chips
DEPTH TOP OF SEAL (Ft.)	5.0'
TYPE OF SEAL	Bentonite Chips
DEPTH BOTTOM OF SEAL (Ft.)	68.0
DEPTH TOP OF PERVIOUS SECTION (Ft.)	68.5
DIAMETER OF BOREHOLE (In.)	3.0
TYPE OF PERVIOUS SECTION	Schedule 40 PVC
TYPE OF OPENINGS	0.020 in slotted
PERVIOUS SECTION (In.) I.D.: 2 O.D.: 2.3	
TYPE OF FILTER PACK AROUND PERVIOUS SECTION	None
DEPTH BOTTOM OF PERVIOUS SECTION (Ft.)	98.5
DEPTH BOTTOM OF FILTER PACK (Ft.)	N/A

DEPTH TO BEDROCK (Ft.) 15

DEPTH TO RING (Ft.) 68

GENERAL NOTE:

1. Entry of 0.00 for Ground Elevation, Elev. Top of Riser Pipe & Elev. Top of Protective Casing indicates that Surveyed Ground Elevation Not Available.

BEDROCK MONITORING WELL CONSTRUCTION LOG

TETRA TECH NUS, INC.

PROJECT NAME:	Raymark	PROJECT NO:	
PROJECT LOCATION:	Stratford, CT	WELL NO:	308B
CLIENT:	US EPA - Region 1	BORING NO:	308B
CONTRACTOR:	Aquifer Drilling & Testing	DRILLER:	S.Bray
LOGGED BY:	D.Whalen	DATE:	02/04/99
CHECKED BY:		DATE:	

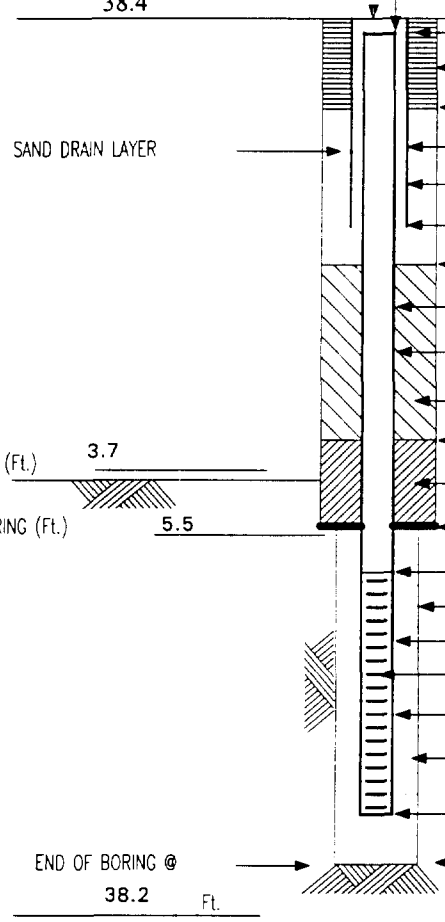
BORING LOCATION:

PAGE: 1 OF

ELEVATION TOP OF PROTECTIVE CASING 38.41'

ELEVATION TOP OF RISER PIPE 37.77'

GROUND ELEVATION 38.4'



FLUSH MOUNT PROTECTIVE CASING GROUND SURFACE (Ft.)	
LENGTH OF RISER PIPE BELOW GROUND SURFACE (Ft.)	0.63'
TYPE OF SURFACE SEAL	Concrete
DIA. SURFACE SEAL BGS (In.)	12
DEPTH TO BOTTOM OF SURFACE SEAL (Ft.)	0.4
I.D. OF PROTECTIVE CASING (In.)	8
TYPE OF PROTECTIVE CASING	Steel Flush Mount
DEPTH BOTTOM OF PROTECTIVE CASING (Ft.)	2
DEPTH BOTTOM OF DRAIN LAYER (Ft.)	2.8
RISER PIPE (In.) I.D.: 2	O.D.: 2.25
TYPE OF RISER PIPE	Schedule 40 PVC
TYPE OF BACKFILL AROUND RISER PIPE	Bentonite Chips
DEPTH TOP OF SEAL (Ft.)	3.5
TYPE OF SEAL	Bentonite Chips
DEPTH BOTTOM OF SEAL (Ft.)	5.3
DEPTH TOP OF PERVIOUS SECTION (Ft.)	5.5
DIAMETER OF BOREHOLE (In.)	3
TYPE OF PERVIOUS SECTION	Schedule 40 PVC
TYPE OF OPENINGS	0.02"
PERVIOUS SECTION (In.) I.D.: 2	O.D.: 2.25
TYPE OF FILTER PACK AROUND PERVIOUS SECTION	None
DEPTH BOTTOM OF PERVIOUS SECTION (Ft.)	35.5
DEPTH BOTTOM OF FILTER PACK (Ft.)	N/A

GENERAL NOTE:

1. Entry of 0.00 for Ground Elevation, Elev. Top of Riser Pipe & Elev. Top of Protective Casing Indicates that Surveyed Ground Elevation Not Available.

BEDROCK MONITORING WELL CONSTRUCTION LOG

TETRA TECH NUS, INC.

PROJECT NAME:	Raymark	PROJECT NO:	
PROJECT LOCATION:	Stratford, CT	WELL NO:	308DB
CLIENT:	US EPA – Region 1	BORING NO:	308DB
CONTRACTOR:	Aquifer Drilling & Testing	DRILLER:	S.Bray
LOGGED BY:	D.Whalen	DATE:	02/10/99
CHECKED BY:		DATE:	

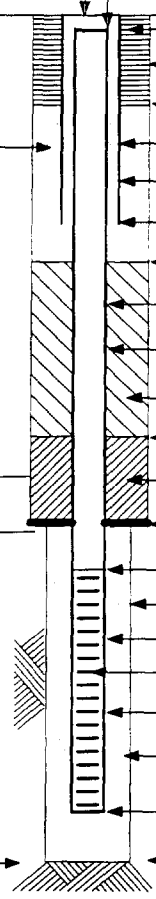
BORING LOCATION:

PAGE: 1 OF

ELEVATION TOP OF PROTECTIVE CASING 38.24'

ELEVATION TOP OF RISER PIPE 38.03'

GROUND ELEVATION 38.2'



DEPTH TO BEDROCK (Ft.) 3.7'

DEPTH TO RING (Ft.) 40

FLUSH MOUNT PROTECTIVE CASING GROUND SURFACE (Ft.)	
LENGTH OF RISER PIPE BELOW GROUND SURFACE (Ft.)	0.17'
TYPE OF SURFACE SEAL	Concrete
DIA. SURFACE SEAL BGS (In.)	12
DEPTH TO BOTTOM OF SURFACE SEAL (Ft.)	0.4
I.D. OF PROTECTIVE CASING (In.)	8
TYPE OF PROTECTIVE CASING	Steel Flush Mount
DEPTH BOTTOM OF PROTECTIVE CASING (Ft.)	2
DEPTH BOTTOM OF DRAIN LAYER (Ft.)	2.9'
RISER PIPE (In.) I.D.: 2	O.D.: 2.3
TYPE OF RISER PIPE	Schedule 40 PVC
TYPE OF BACKFILL AROUND RISER PIPE	Bentonite Chips
DEPTH TOP OF SEAL (Ft.)	2.9'
TYPE OF SEAL	Bentonite Chips
DEPTH BOTTOM OF SEAL (Ft.)	39.8
DEPTH TOP OF PERVIOUS SECTION (Ft.)	40
DIAMETER OF BOREHOLE (In.)	3
TYPE OF PERVIOUS SECTION	Schedule 40 PVC
TYPE OF OPENINGS	0.02"
PERVIOUS SECTION (In.) I.D.: 2	O.D.: 2.25
TYPE OF FILTER PACK AROUND PERVIOUS SECTION	None
DEPTH BOTTOM OF PERVIOUS SECTION (Ft.)	70
DEPTH BOTTOM OF FILTER PACK (Ft.)	N/A

GENERAL NOTE:

1. Entry of 0.00 for Ground Elevation, Elev. Top of Riser Pipe & Elev. Top of Protective Casing Indicates that Surveyed Ground Elevation Not Available.

BEDROCK MONITORING WELL CONSTRUCTION LOG

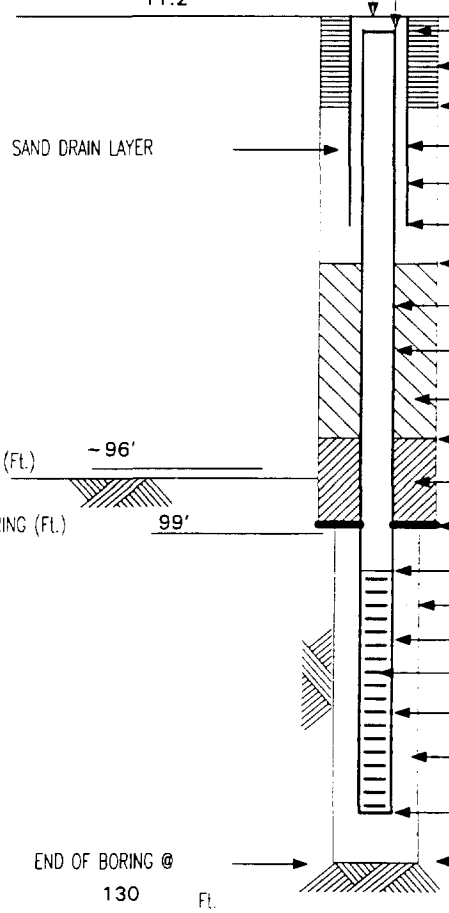
TETRA TECH NUS, INC.

PROJECT NAME:	Raymark	PROJECT NO:	
PROJECT LOCATION:	Stratford, CT	WELL NO:	MW 309B
CLIENT:	US EPA - Region 1	BORING NO:	SB 309B
CONTRACTOR:	Aquifer Drilling & Testing	DRILLER: Marty Harrington	BORING LOCATION: ~ 15' NE of E.Main St. in Front of Dresser Ind. & Frog Pond Bar
LOGGED BY:	Tracy Dorgan	DATE: 02/22/99	
CHECKED BY:		DATE:	PAGE: 1 OF

ELEVATION TOP OF PROTECTIVE CASING: 11.19'

ELEVATION TOP OF RISER PIPE: 10.89'

GROUND ELEVATION: 11.2'



FLUSH MOUNT PROTECTIVE CASING GROUND SURFACE (Ft.)	
LENGTH OF RISER PIPE BELOW GROUND SURFACE (Ft.)	0.31'
TYPE OF SURFACE SEAL	Cement
DIA. SURFACE SEAL BGS (In.)	1.0 ft.
DEPTH TO BOTTOM OF SURFACE SEAL (Ft.)	1.3
I.D. OF PROTECTIVE CASING (In.)	8
TYPE OF PROTECTIVE CASING	Steel Road Box
DEPTH BOTTOM OF PROTECTIVE CASING (Ft.)	2.0
DEPTH BOTTOM OF DRAIN LAYER (Ft.)	3.0
RISER PIPE (In.) I.D.: 2	O.D.: 2.3
TYPE OF RISER PIPE	Schedule 40 PVC
TYPE OF BACKFILL AROUND RISER PIPE	Quick Gel, Bent./Water Slurry
DEPTH TOP OF SEAL (Ft.)	94.7'
TYPE OF SEAL	Bentonite Chip
DEPTH BOTTOM OF SEAL (Ft.)	99.1'
DEPTH TOP OF PERVIOUS SECTION (Ft.)	99.1'
DIAMETER OF BOREHOLE (In.)	3 in.
TYPE OF PERVIOUS SECTION	Schedule 40 PVC
TYPE OF OPENINGS	0.020" Factory Slotted
PERVIOUS SECTION (In.) I.D.: 2	O.D.: 2.3
TYPE OF FILTER PACK AROUND PERVIOUS SECTION	N/A
DEPTH BOTTOM OF PERVIOUS SECTION (Ft.)	129.1
DEPTH BOTTOM OF FILTER PACK (Ft.)	N/A

GENERAL NOTE:

1. Entry of 0.00 for Ground Elevation, Elev. Top of Riser Pipe & Elev. Top of Protective Casing Indicates that Surveyed Ground Elevation Not Available.

FLUSH MOUNT MONITORING WELL CONSTRUCTION LOG — TETRA TECH NUS INC.

PROJECT NAME:	Raymark	PROJECT NO:	
PROJECT LOCATION:	Stratford, CT	WELL NO:	MW-309D
CLIENT:	U.S. EPA Region I	BORING NO:	SB-309D
CONTRACTOR:	Aquifer Drilling & Testing	BORING LOCATION:	~10' off E. Main St. in front of Dresser Ind. & Frog Pond Bar
DRILLER:	M.Harrington		
LOGGED BY:	Tracy Dorgan	DATE:	02/25/99
CHECKED BY:		DATE:	
		PAGE:	1 OF

LENGTH RISER PIPE BELOW GRD. SURF.(Ft.)	0.22'
TYPE OF SURFACE SEAL	Concrete/Cement
DIA. SURFACE SEAL BGS (In.)	1.5 ft.
DEPTH TO BOTTOM OF SURFACE SEAL (Ft.)	1.0
I.D. OF PROTECTIVE CASING (in.)	8 in
TYPE OF PROTECTIVE CASING	Steel Road - Box
DEPTH BOTTOM OF PROTECTIVE CASING (Ft.)	1.9'
DEPTH BOTTOM OF DRAIN LAYER (Ft.)	5.5'
RISER PIPE (in.) I.D.: 2"	O.D.: 2.3"
TYPE OF RISER PIPE	Schedule 40 PVC
TYPE OF BACKFILL AROUND RISER PIPE	Bentonite & Water Slurry
DEPTH TOP OF SEAL (Ft.)	79.0'
TYPE OF SEAL	Bentonite Chips
DEPTH BOTTOM OF SEAL (Ft.)	81.0 ft.
DEPTH TOP OF PERVIOUS SECTION (Ft.)	84.0 ft.
DIAMETER OF BOREHOLE (in.)	4 in.
TYPE OF PERVIOUS SECTION	Schedule 40 PVC
TYPE OF OPENINGS	0.010 in. slotted
PERVIOUS SECTION (in.) I.D.: 2"	O.D.: 2.3"
TYPE OF FILTER PACK AROUND PERVIOUS SECTION	No. 1 Silica Sand
DEPTH BOTTOM OF PERVIOUS SECTION (Ft.)	94.0 ft.
DEPTH BOTTOM OF FILTER PACK (Ft.)	94.2 ft.
TYPE OF BACKFILL (GROUT) BELOW FILTER PACK	N/A
END OF BORING	94.2'

Note:
2 Stainless Steel centralizers placed on top and bottom of screen.

GENERAL NOTE:

1. Entry of 0.00 for Ground Elevation indicates that Surveyed Ground Elevation is NOT Available.

FLUSH MOUNT MONITORING WELL CONSTRUCTION LOG

TETRA TECH NUS INC.

PROJECT NAME:	Raymark	PROJECT NO:	
PROJECT LOCATION:	Stratford, CT	WELL NO:	MW-309S
CLIENT:	U.S. EPA Region I	BORING NO:	SB-309S
CONTRACTOR:	Aquifer Drilling & Testing	DRILLER: M.Harrington	BORING LOCATION: Approx. 6-8' from 309D 10' From E. Main St. in front of Dresser Ind.
LOGGED BY:	Tracy Dorgan	DATE: 02/26/99	
CHECKED BY:		DATE:	PAGE: 1 OF

GROUND ELEVATION	11.7'
LENGTH RISER PIPE BELOW GRD. SURF.(Ft.)	0.52'
TYPE OF SURFACE SEAL	Concrete
DIA. SURFACE SEAL BGS (In.)	18 in.
DEPTH TO BOTTOM OF SURFACE SEAL (Ft.)	1.0'
I.D. OF PROTECTIVE CASING (In.)	8 in.
TYPE OF PROTECTIVE CASING	Steel Road Box
DEPTH BOTTOM OF PROTECTIVE CASING (Ft.)	2.0'
DEPTH BOTTOM OF DRAIN LAYER (Ft.)	2.5'
RISER PIPE (In.) I.D.: 2" O.D.:	2.3"
TYPE OF RISER PIPE	Schedule 40 PVC
TYPE OF BACKFILL AROUND RISER PIPE	N/A
DEPTH TOP OF SEAL (Ft.)	2.5'
TYPE OF SEAL	Bentonite Chips
DEPTH BOTTOM OF SEAL (Ft.)	3.8'
DEPTH TOP OF PERVIOUS SECTION (Ft.)	5.0'
DIAMETER OF BOREHOLE (In.)	4 in.
TYPE OF PERVIOUS SECTION	Schedule 40 PVC
TYPE OF OPENINGS	0.010 in. slotted
PERVIOUS SECTION (In.) I.D.: 2" O.D.:	2.3
TYPE OF FILTER PACK AROUND PERVIOUS SECTION	No. 1 Silica Sand
DEPTH BOTTOM OF PERVIOUS SECTION (Ft.)	20.0'
DEPTH BOTTOM OF FILTER PACK (Ft.)	20.3'
TYPE OF BACKFILL (GROUT) BELOW FILTER PACK	N/A
END OF BORING	20.3'

Note:
2 Stainless Steel centralizers placed on top and bottom of well screen.

GENERAL NOTE

1. Entry of 0.00 for Ground Elevation indicates that Surveyed Ground Elevation is NOT Available.

BEDROCK MONITORING WELL CONSTRUCTION LOG

TETRA TECH NUS, INC.

PROJECT NAME:	Raymark	PROJECT NO:	
PROJECT LOCATION:	Stratford, CT	WELL NO:	MW-401B
CLIENT:	US EPA Region 1	BORING NO:	401B
CONTRACTOR:	Aquifer Drilling & Testing	BORING LOCATION:	OU4 Memorial Ballfied near S. fence & border w/contract plating
LOGGED BY:	Tracy Dorgan	DATE:	12/19/98
CHECKED BY:		DATE:	
		PAGE:	1 OF

ELEVATION TOP OF PROTECTIVE CASING: 25.69'

ELEVATION TOP OF RISER PIPE: 25.36'

GROUND ELEVATION: 23.4'

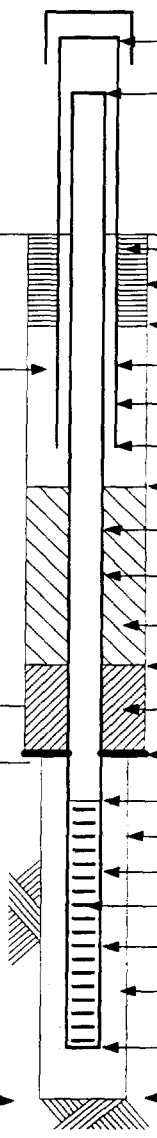
SAND DRAIN LAYER

DEPTH TO BEDROCK (Ft.): ~36'

DEPTH TO RING (Ft.): 37.0'

PVC ring is 0.3' long

END OF BORING @ 57.4 Ft.



LENGTH OF PROTECTIVE CASING ABOVE GROUND SURFACE (Ft.)	2.19
LENGTH OF RISER PIPE ABOVE GROUND SURFACE (Ft.)	1.74
TYPE OF SURFACE SEAL	Concrete
DIA. SURFACE SEAL BGS (In.)	5 in.
DEPTH TO BOTTOM OF SURFACE SEAL (Ft.)	1.5
I.D. OF PROTECTIVE CASING (In.)	4
TYPE OF PROTECTIVE CASING	Steel Pipe
DEPTH BOTTOM OF PROTECTIVE CASING (Ft.)	2.5
DEPTH BOTTOM OF DRAIN LAYER (Ft.)	3.6
RISER PIPE (In.) I.D.: 2 O.D.: 2.25	
TYPE OF RISER PIPE	Schedule 40 PVC
TYPE OF BACKFILL AROUND RISER PIPE	Bent.& Water Slurry
DEPTH TOP OF SEAL (Ft.)	34.2'
TYPE OF SEAL	Bentonite
DEPTH BOTTOM OF SEAL (Ft.)	36.7'
DEPTH TOP OF PERVIOUS SECTION (Ft.)	37.5'
DIAMETER OF BOREHOLE (In.)	3.0
TYPE OF PERVIOUS SECTION	Schedule 40 PVC
TYPE OF OPENINGS	0.020" factory slottted
PERVIOUS SECTION (In.) I.D.: 2 O.D.: 2.25	
TYPE OF FILTER PACK AROUND PERVIOUS SECTION	None
DEPTH BOTTOM OF PERVIOUS SECTION (Ft.)	57
DEPTH BOTTOM OF FILTER PACK (Ft.)	No filter pack

GENERAL NOTE:

1. Entry of 0.00 for Ground Elevation, Elev. Top of Riser Pipe & Elev. Top of Protective Casing Indicates that Surveyed Ground Elevation Not Available.

OVERBURDEN MONITORING WELL CONSTRUCTION LOG

TETRA TECH NUS, INC.

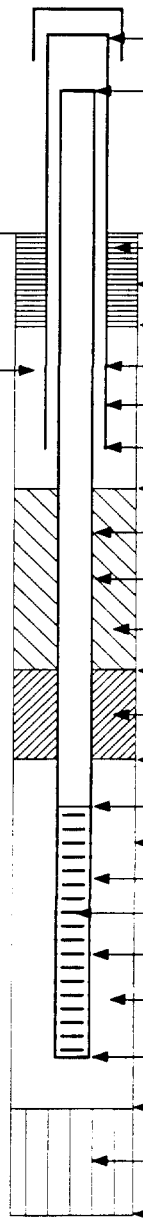
PROJECT NAME:	Raymark	PROJECT NO:	
PROJECT LOCATION:	Stratford, CT	WELL NO:	401S
CLIENT:	U.S. EPA Region 1	BORING NO:	SB-401S
CONTRACTOR:	Aquifer Drilling & Testing	DRILLER:	K.Kutarnia
LOGGED BY:	A.Putnam	DATE:	01/27/99
CHECKED BY:		DATE:	
BORING LOCATION:	Memorial Ballfield off Frog Pond Lane		

PAGE: 1 OF 1

ELEVATION TOP OF PROTECTIVE CASING 25.12'

ELEVATION TOP OF RISER PIPE 24.77'

GROUND ELEVATION 23.0'



2 Stainless Steel centralizers placed on well screen.

LENGTH OF PROTECTIVE CASING ABOVE GROUND SURFACE (Ft.)	2.12'
LENGTH OF RISER PIPE ABOVE GROUND SURFACE (Ft.)	1.72
TYPE OF SURFACE SEAL	Concrete
DIA. SURFACE SEAL BGS (In.)	8"
DEPTH TO BOTTOM OF SURFACE SEAL (Ft.)	1.2'
I.D. OF PROTECTIVE CASING (In.)	4 ¼"
TYPE OF PROTECTIVE CASING	Steel
DEPTH BOTTOM OF PROTECTIVE CASING (Ft.)	2'
DEPTH BOTTOM OF DRAIN LAYER (Ft.)	4'
RISER PIPE (In.) I.D.: 2" O.D.: 2.3"	
TYPE OF RISER PIPE	Schedule 40 PVC
TYPE OF BACKFILL AROUND RISER PIPE	Bentonite Chips
DEPTH TOP OF SEAL (Ft.)	10'
TYPE OF SEAL	Bentonite Chips
DEPTH BOTTOM OF SEAL (Ft.)	12.5'
DEPTH TOP OF PERVIOUS SECTION (Ft.)	15'
DIAMETER OF BOREHOLE (In.)	4"
TYPE OF PERVIOUS SECTION	Schedule 40 PVC
TYPE OF OPENINGS	10 Slot 0.010"
PERVIOUS SECTION (In.) I.D.: 2" O.D.: 2.3"	
TYPE OF FILTER PACK AROUND PERVIOUS SECTION	Sand
DEPTH BOTTOM OF PERVIOUS SECTION (Ft.)	15'
DEPTH BOTTOM OF FILTER PACK (Ft.)	26.4'
TYPE OF BACKFILL BELOW FILTER PACK	---------
END OF BORING(Ft.)	26.4'

GENERAL NOTE:

1. Entry of 0.00 for Ground Elevation, Elev. Top of Riser Pipe & Elev. Top of Protective Casing Indicates that Surveyed Ground Elevation Not Available.

BEDROCK MONITORING WELL CONSTRUCTION LOG

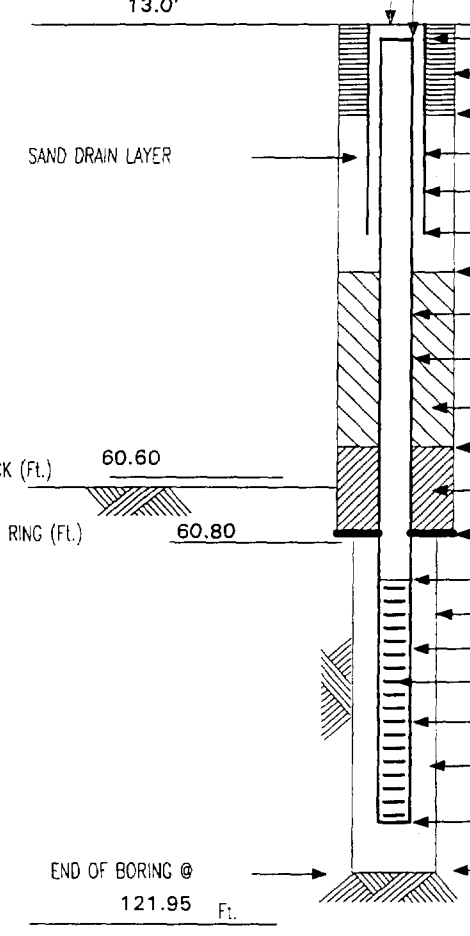
TETRA TECH NUS, INC.

PROJECT NAME:	Raymark	PROJECT NO:	
PROJECT LOCATION:	Stratford, CT	WELL NO:	MW-402B
CLIENT:	US EPA – Region 1	BORING NO:	SB-402B
CONTRACTOR:	Aquifer Drilling & Testing	DRILLER: Scott Bray	BORING LOCATION: Daley Construction Yard
LOGGED BY:	John R. Trottier	DATE: 01/19/99	
CHECKED BY:		DATE:	PAGE: 1 OF

ELEVATION TOP OF PROTECTIVE CASING 12.98'

ELEVATION TOP OF RISER PIPE 12.67'

GROUND ELEVATION 13.0'



DEPTH TO BEDROCK (Ft.) 60.60

DEPTH TO RING (Ft.) 60.80

FLUSH MOUNT PROTECTIVE CASING GROUND SURFACE (Ft.)	
LENGTH OF RISER PIPE BELOW GROUND SURFACE (Ft.)	0.33'
TYPE OF SURFACE SEAL	Concrete
DIA. SURFACE SEAL BGS (in.)	12"
DEPTH TO BOTTOM OF SURFACE SEAL (Ft.)	1.0
I.D. OF PROTECTIVE CASING (in.)	8 in.
TYPE OF PROTECTIVE CASING	Flush Mount
DEPTH BOTTOM OF PROTECTIVE CASING (Ft.)	2
DEPTH BOTTOM OF DRAIN LAYER (Ft.)	3
RISER PIPE (in.) I.D.: 2	O.D.: 3.25
TYPE OF RISER PIPE	Schedule 40 PVC
TYPE OF BACKFILL AROUND RISER PIPE	Bentonite Slurry
DEPTH TOP OF SEAL (Ft.)	58.80
TYPE OF SEAL	Bentonite Chips (hydrated)
DEPTH BOTTOM OF SEAL (Ft.)	60.80
DEPTH TOP OF PERVIOUS SECTION (Ft.)	61.10
DIAMETER OF BOREHOLE (In.)	3
TYPE OF PERVIOUS SECTION	Schedule 40 PVC
TYPE OF OPENINGS	0.02" factory slotted
PERVIOUS SECTION (In.) I.D.: 2"	O.D.: 2.25
TYPE OF FILTER PACK AROUND PERVIOUS SECTION	None
DEPTH BOTTOM OF PERVIOUS SECTION (Ft.)	121.10
DEPTH BOTTOM OF FILTER PACK (Ft.)	121.95

GENERAL NOTE:

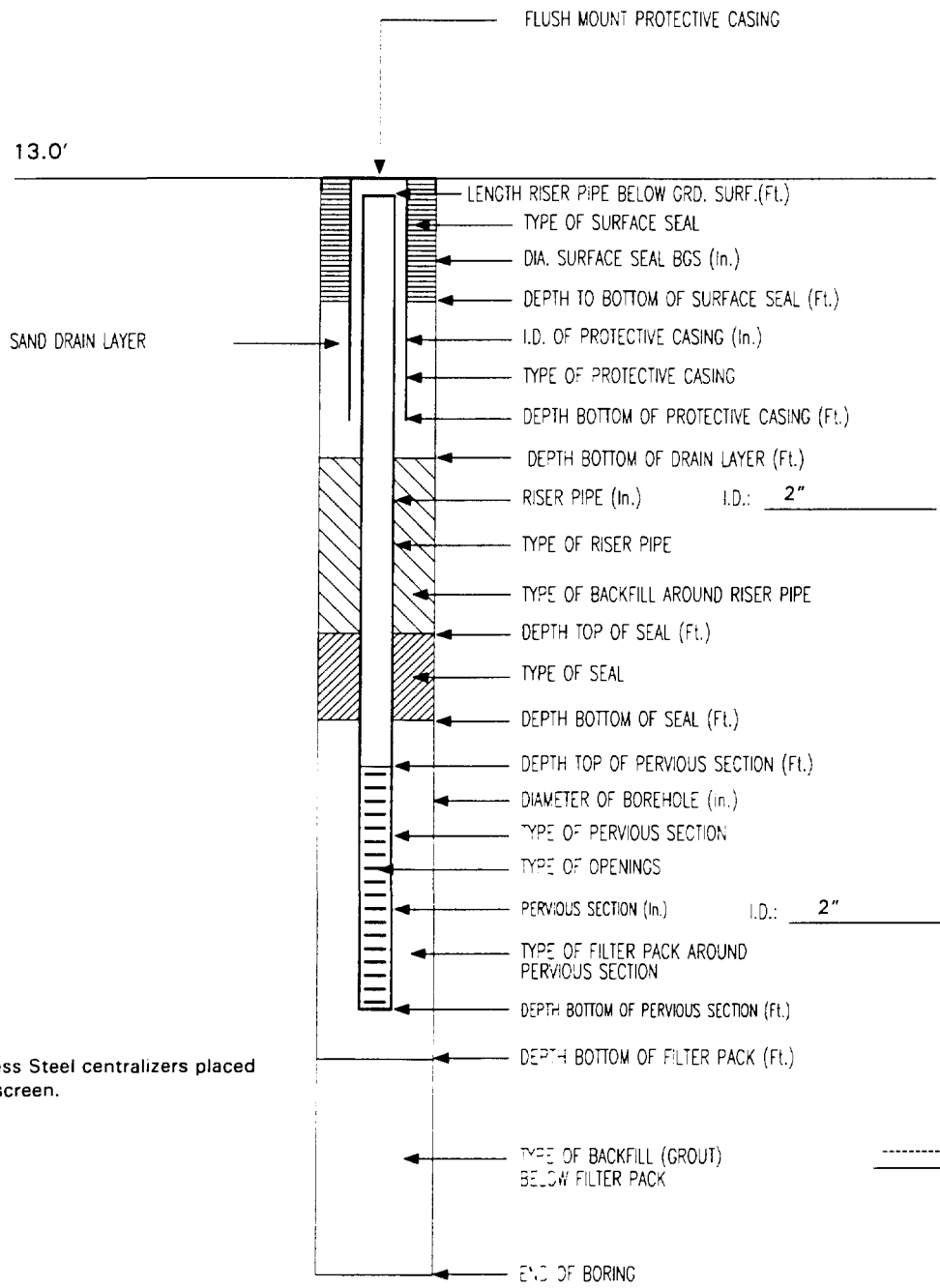
1. Entry of 0.00 for Ground Elevation, Elev. Top of Riser Pipe & Elev. Top of Protective Casing Indicates that Surveyed Ground Elevation Not Available.

FLUSH MOUNT MONITORING WELL CONSTRUCTION LOG

TETRA TECH NUS INC.

PROJECT NAME:	Ravmark	PROJECT NO:	
PROJECT LOCATION:	Stratford, CT	WELL NO:	MW-402S
CLIENT:	U.S. EPA Region I	BORING NO:	SB-402S renumbered 01/27/99
CONTRACTOR:	Aquifer Drilling & Testing	DRILLER:	K.Kutarnia
LOGGED BY:	A.Putnam	DATE:	01/22/99
CHECKED BY:		DATE:	
BORING LOCATION:	OU4 Ballfield just inside the Entrance gate		

PAGE: 1 OF



LENGTH RISER PIPE BELOW GRD. SURF.(Ft.)	4"
TYPE OF SURFACE SEAL	Concrete
DIA. SURFACE SEAL BGS (In.)	10"
DEPTH TO BOTTOM OF SURFACE SEAL (Ft.)	1'
I.D. OF PROTECTIVE CASING (In.)	8 ¼"
TYPE OF PROTECTIVE CASING	Steel Flush Mount
DEPTH BOTTOM OF PROTECTIVE CASING (Ft.)	2'
DEPTH BOTTOM OF DRAIN LAYER (Ft.)	2.9'
RISER PIPE (In.) I.D.: 2" O.D.:	2.3"
TYPE OF RISER PIPE	Schedule 40 PVC
TYPE OF BACKFILL AROUND RISER PIPE	---------
DEPTH TOP OF SEAL (Ft.)	2.9'
TYPE OF SEAL	Bentonite Chips
DEPTH BOTTOM OF SEAL (Ft.)	3.9'
DEPTH TOP OF PERVIOUS SECTION (Ft.)	5'
DIAMETER OF BOREHOLE (In.)	4"
TYPE OF PERVIOUS SECTION	Schedule 40 PVC
TYPE OF OPENINGS	10 Slot 0.010"
PERVIOUS SECTION (In.) I.D.: 2" O.D.:	2..3"
TYPE OF FILTER PACK AROUND PERVIOUS SECTION	Sand
DEPTH BOTTOM OF PERVIOUS SECTION (Ft.)	20'
DEPTH BOTTOM OF FILTER PACK (Ft.)	21.2'
TYPE OF BACKFILL (GROUT) BELOW FILTER PACK	---------
END OF BORING	21.2'

Note:
2 Stainless Steel centralizers placed on well screen.

GENERAL NOTE:

1. Entry of 0.00 for Ground Elevation indicates that Surveyed Ground Elevation is NOT Available.

FOSTER WHEELER ENVIRONMENTAL CORPORATION
470 ATLANTIC AVENUE
BOSTON, MASSACHUSETTS 02210

MONITORING WELL CLUSTER: PC-06
RAYMARK INDUSTRIES FACILITY SITE - D.O. NO. 11
STRATFORD, CONNECTICUT

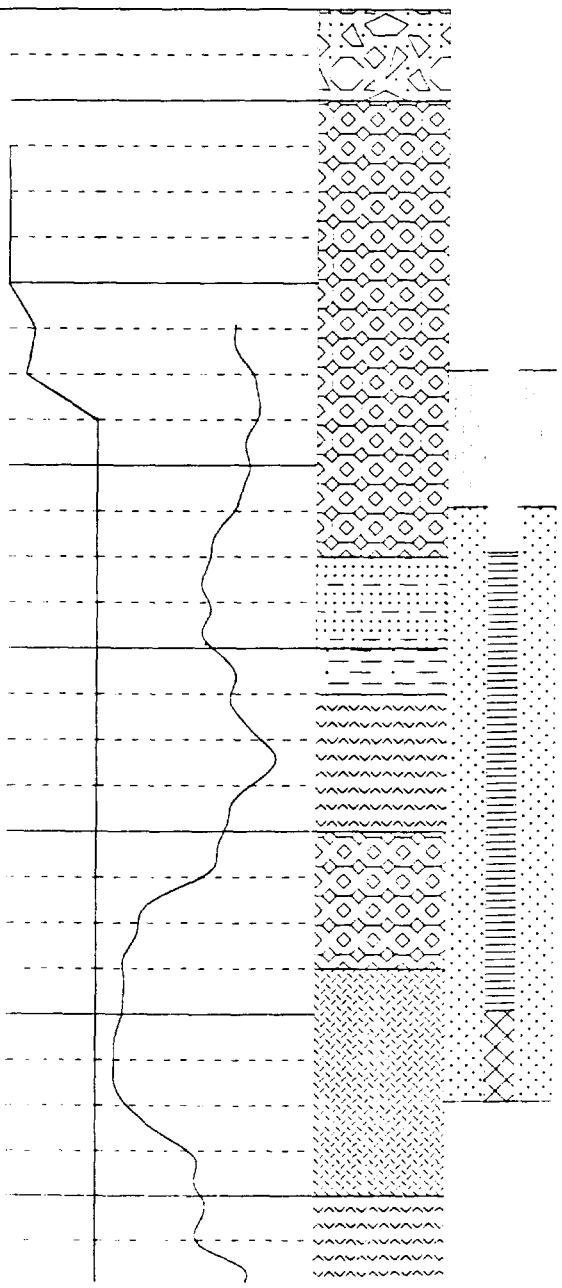
DATE STARTED: 01/14/97
DATE COMPLETED: 03/04/97
GEOLOGIST: KERNEN/ANDERSON
INSTALLED BY MAHER ENVIRONMENTAL
2-INCH ID, 316 STAINLESS STEEL

WELL ID	LOCATION	TIC ELEVATION (FT-MSL)	SCREEN INT. (FT-MSL)
PC-06S	898478.30, 634704.37	17.43 FT-MSL	6.1 to -3.9
PC-06M	898475.50, 634709.12	17.48 FT-MSL	-32.5 to -42.5
PC-06D	898471.78, 634706.36	17.52 FT-MSL	-52.7 to -62.7
PC-06B	898474.39, 634702.26	17.41 FT-MSL	-91.3 to -106.3

FEET-MSL	ASTM CLASS.	LITHOLOGIC DESCRIPTION	FID (PPM)
16	FILL	clean FILL	
14			0
			6.5
			7.5
12			1.5
			300
10			200
			1000
8			1000
			1000
6	SP-SM	brown-black oil stained fine-medium SAND with 5% silt	1000
			1000
4	GP	fine-coarse red/black GRAVEL with 30-40% coarse sand	1000
	SP	black process fill - medium to coarse SAND with 30-40% fine gravel	1000
2			1000
			1000
0	SM	gray fine-medium SAND with 10-20% silt	1000
			1000
-2			1000
	OL	dark brown PEAT with large woody roots	1000
-4			1000
			1000
-6	SP		1000
			1000
-8		gray medium-coarse SAND with 20% silt	1000
			1000

FID (PPM) 0 – 1000

GAMMA LOG 0 – 75



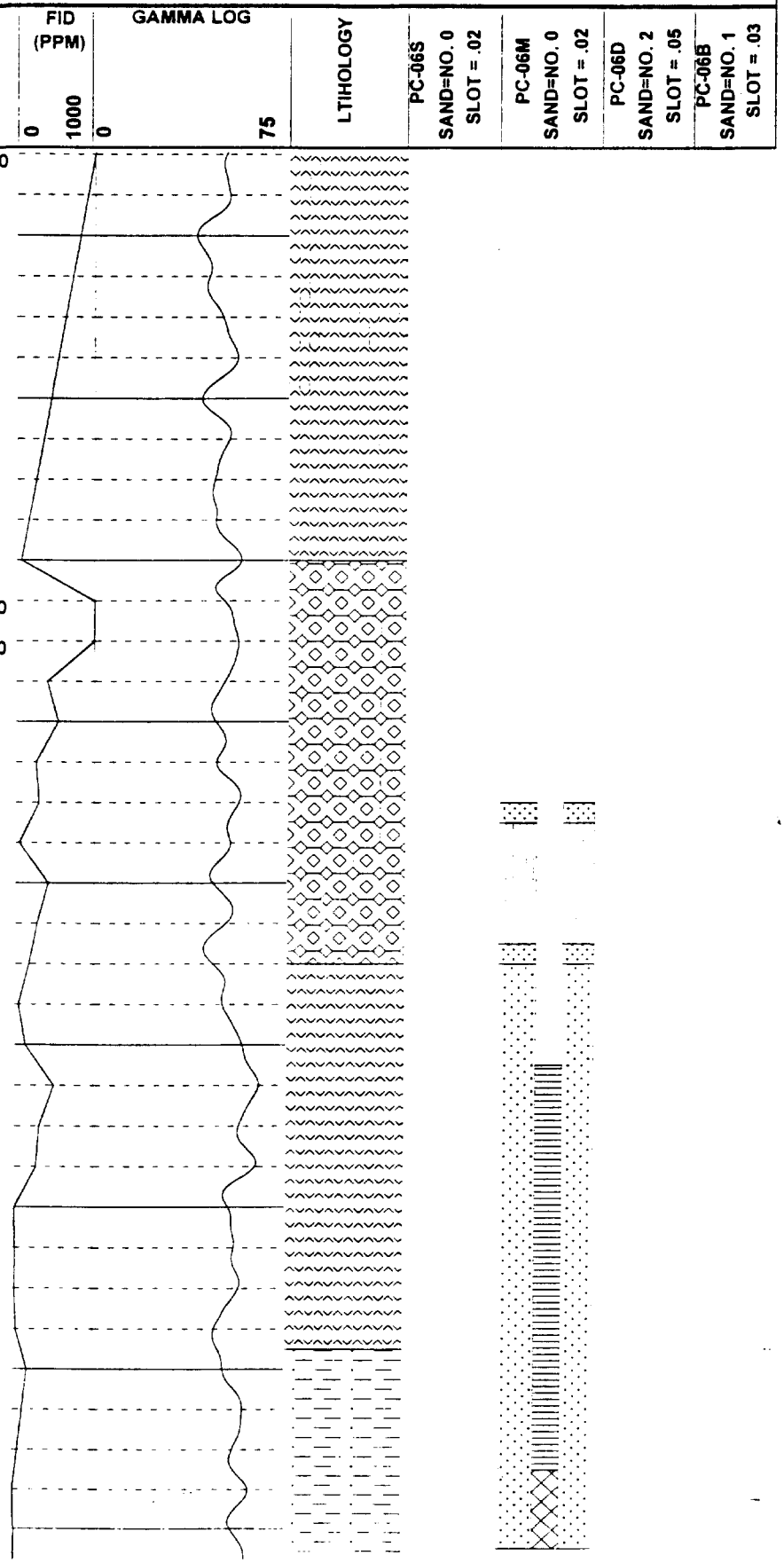
'LER ENVIRONMENTAL CORPORATION
AVENUE
CHUSETTS 02210

MONITORING WELL CLUSTER: PC-06

RAYMARK INDUSTRIES FACILITY SITE - D.O. NO. 11

STRATFORD, CONNECTICUT

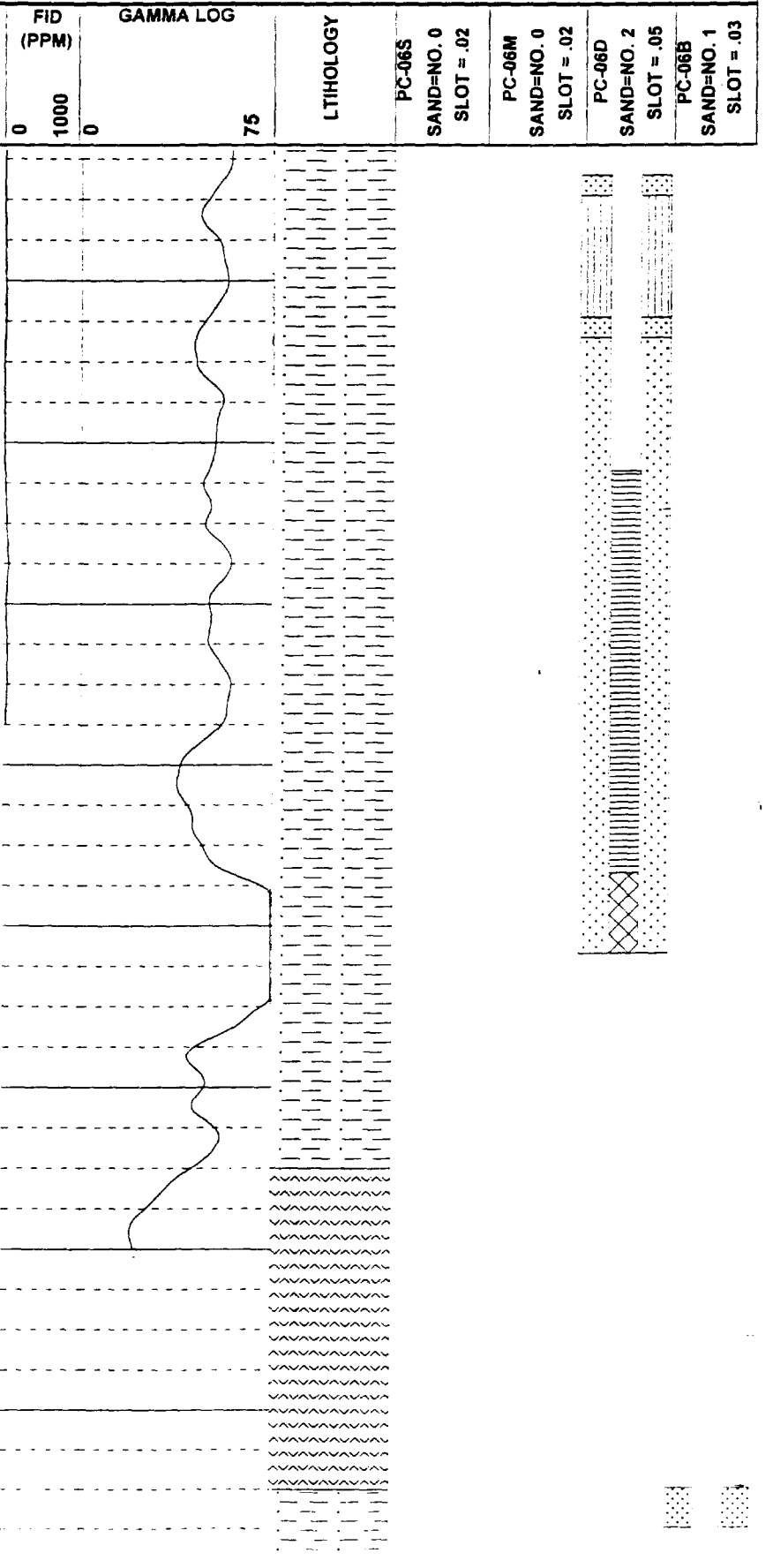
FEE	ASTM CL	LITHOLOGIC DESCRIPTION	FID (PPM)
-10			1000
-12			
-14			
		gray medium-coarse SAND	
-16			
-18			
-20	SM	fine brown SAND with 25-35% silt aand 5-15% fine gravel	60
			1000
-22	SM	brown fine-coarse SAND with 15-25% silt and 15-25% fine-coarse gravel	1000
			400
-24			540
			260
-26			300
			50
-28			420
			280
-30	SP	fine-medium brown-gray SAND	180
			50
-32			140
			500
-34			320
			280
-36	SP	brown medium-coarse SAND with 35-45% fine gravel	16
			20
-38			22
			40
-40	GP	fine-coarse GRAVEL with 10-20% sand and cobbles	180
-42			
			10
-44			26



FOSTER WHEELER ENVIRONMENTAL CORPORATION
470 ATLANTIC AVENUE
BOSTON, MASSACHUSETTS 02210

MONITORING WELL CLUSTER: PC-06
RAYMARK INDUSTRIES FACILITY SITE - D.O. NO. 11
STRATFORD, CONNECTICUT

FEET-MSL	ASTM CLASS.	LITHOLOGIC DESCRIPTION	FID (PPM)
			15
-46			10
		cobles - round with 10-20% fine-coarse gravel and 5% medium coarse sand	18
-48			20
			24
-50			5
			10
-52			8
	GP	fine-coarse gravel with 35-45% fine medium sand	20
-54			40
		fine-coarse GRAVEL with 10-20% sand, occasional cobble	62
-56			28
			48
-58			50
			30
-60		boulder - gneiss-schist	
-62			
-64			
-66			
-68			
-70	SP		
-72			
-74			
		brown medium-coarse SAND with 15-25% rounded fine-coarse gravel	
-76			
-78	GP	coarse rounded GRAVEL with 10-20% sand	



FOSTER WHEELER ENVIRONMENTAL CORPORATION
470 ATLANTIC AVENUE
BOSTON, MASSACHUSETTS 02210

MONITORING WELL CLUSTER: PC-06

RAYMARK INDUSTRIES FACILITY SITE - D.O. NO. 11
STRATFORD, CONNECTICUT

FEET-MSL	ASTM CLASS.	LITHOLOGIC DESCRIPTION	FID (PPM)	FID (PPM) 0 1000	GAMMA LOG 0 75	LITHOLOGY	PC-06S SAND=NO. 0 SLOT = .02	PC-06M SAND=NO. 0 SLOT = .02	PC-06D SAND=NO. 2 SLOT = .05	PC-06B SAND=NO. 1 SLOT = .03
-80		weathered bedrock - fractured bedrock fragments with medium-coarse SAND and gravel								
-82	BR	competent bedrock								
-84										
-86										
-88										
-90										
-92										
-94										
-96										
-98										
-100										
-102										
-104										
-106										
-108										
-110										

FOSTER WHEELER ENVIRONMENTAL CORPORATION
470 ATLANTIC AVENUE
BOSTON, MASSACHUSETTS 02210

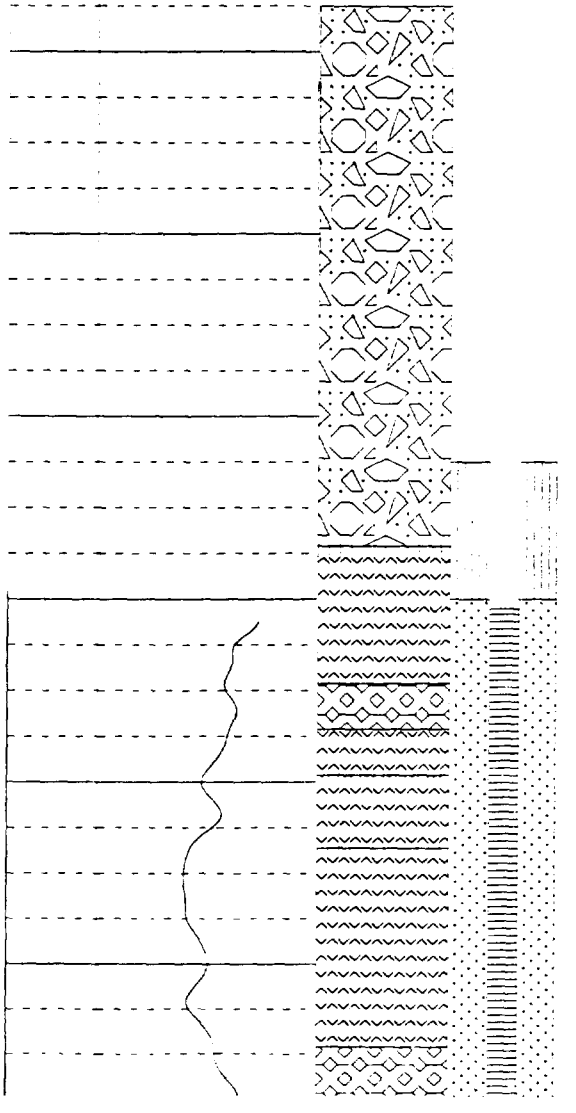
MONITORING WELL CLUSTER: PC-10
RAYMARK INDUSTRIES FACILITY SITE - D.O. NO. 11
STRATFORD, CONNECTICUT

DATE STARTED: 12/13/96
DATE COMPLETED: 01/07/97
GEOLOGIST: KERNEN/ANDERSON
INSTALLED BY MAHER ENVIRONMENTAL
2-INCH ID, 316 STAINLESS STEEL

WELL ID	LOCATION	TIC ELEVATION (FT-MSL)	SCREEN INT. (FT-MSL)
PC-10S	897888.97, 634232.13	20.72 FT-MSL	(15.75 to 0.75)
PC-10M	897885.95, 634229.0	20.71 FT-MSL	(-12.07 to -22.07)
PC-10D	897890.24, 634226.86	20.73 FT-MSL	(-41.45 to -56.45)
PC-10B	897892.24, 634230.06	20.73 FT-MSL	(-69.45 to -84.45)

FEET-MSL	ASTM CLASS.	LITHOLOGIC DESCRIPTION	FID (PPM)
24			
22			
20		clean FILL	
18			
16			
14			
12			
10			
8	SP	fine-coarse brown-black SAND with 5-15% subangular gravel	0
			0
6	SM	black process fill with string material	0
	SP	fine-medium SAND with 20-30% fine-coarse gravel	0
4	SP	fine-medium gray SAND with 15-25% fine-coarse gravel	0
		fine-medium brown SAND	0
2	SP		0
			0
0			0
			0
-2	SM	fine-medium SAND with 20-30% silt	0

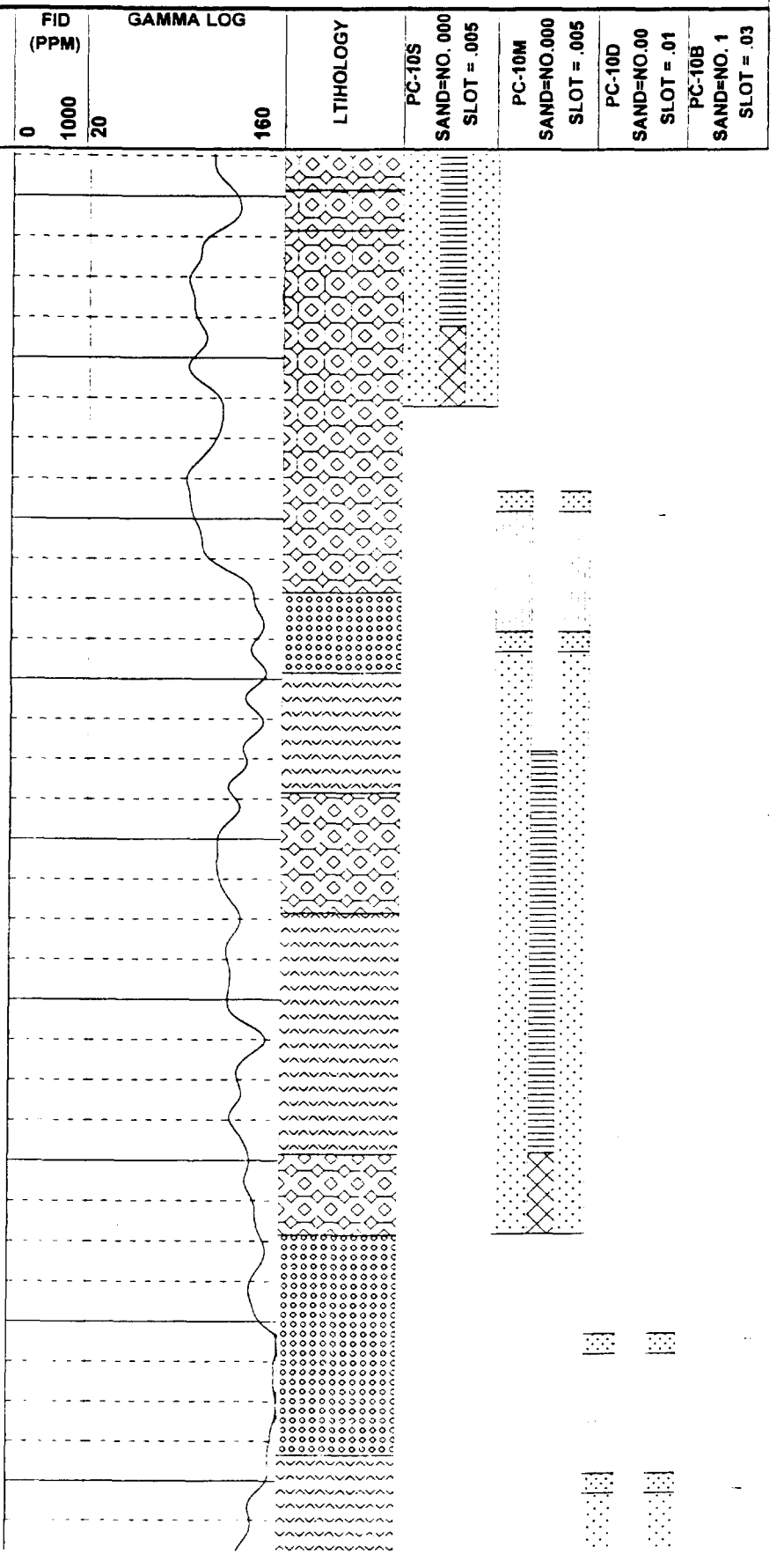
FID (PPM) 0 – 1000; GAMMA LOG 20 – 160



FOSTER WHEELER ENVIRONMENTAL CORPORATION
470 ATLANTIC AVENUE
BOSTON, MASSACHUSETTS 02210

MONITORING WELL CLUSTER: PC-10
RAYMARK INDUSTRIES FACILITY SITE - D.O. NO. 11
STRATFORD, CONNECTICUT

FEET-MSL	ASTM CLASS.	LITHOLOGIC DESCRIPTION	FID (PPM)
			0
-4	SM	fine brown SAND with 30-40% silt	0
	SM	brown fine-medium SAND with 15-25% silt	0
-6			0
			0
-8			0
			0
-10			0
			0
-12			0
			0
-14	ML	brown SILT with 30-40% fine sand -15.84 brown-gray fine-medium SAND	0
			3.5
-16	SP		0
			9
-18			4
	SM	fine brown SAND with 30-40% brown silt	3.5
-20			2.5
			0
-22	SP	brown medium-coarse SAND with 20-30% fine-coarse subangular gravel	0
			0
-24			1.5
			4.5
-26			1.2
			0.5
-28	SP-SM	brown fine-coarse SAND with 5-15% silt	0
			0
-30	ML	brown SILT with 15-25% fine sand	0
			0
-32			0
			0
-34			0
			4
-36	SP	gray-brown medium-coarse SAND with 30-40% fine-coarse gravel	8.5
			6.5



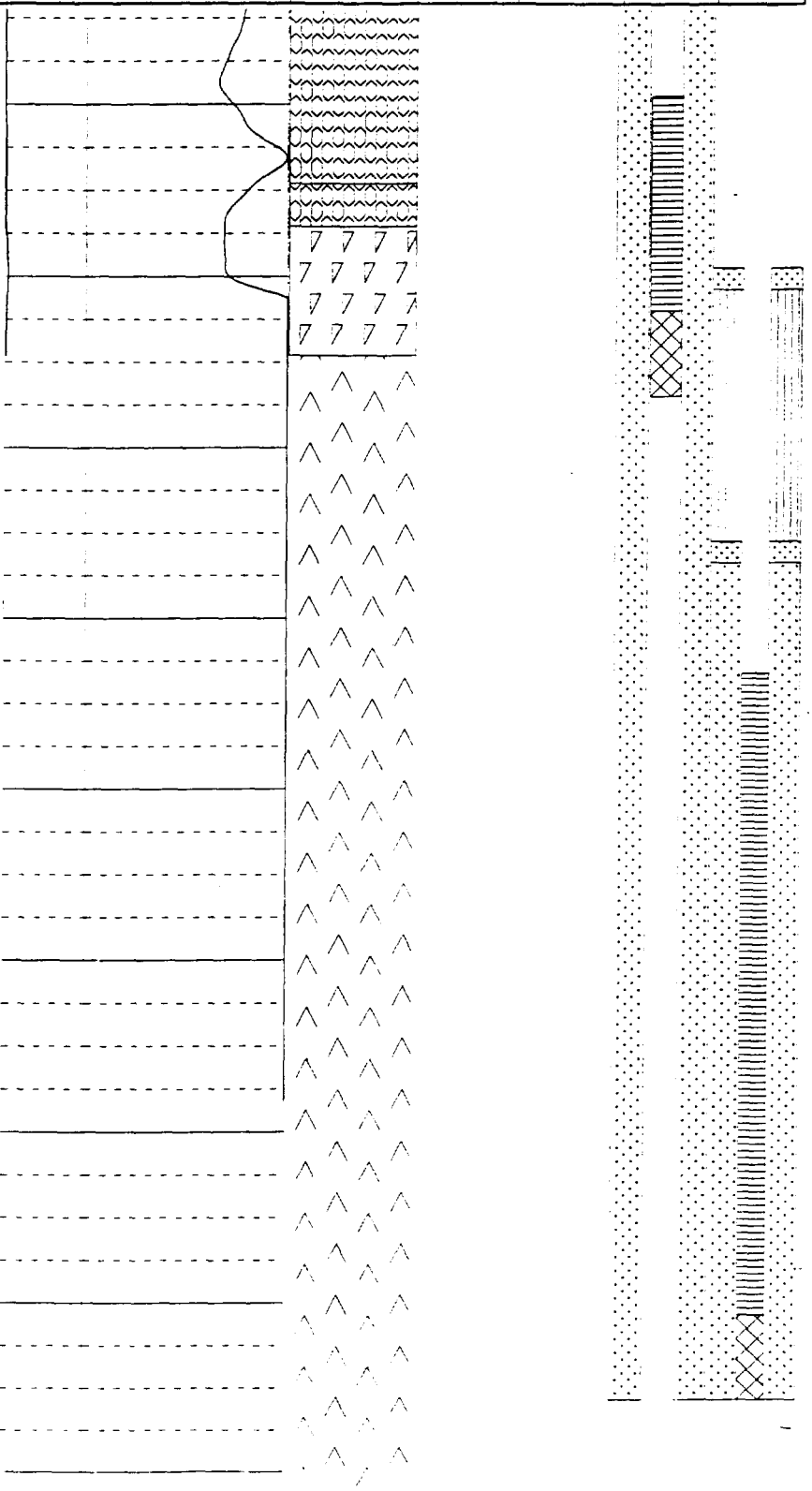
FOSTER WHEELER ENVIRONMENTAL CORPORATION
470 ATLANTIC AVENUE
BOSTON, MASSACHUSETTS 02210

MONITORING WELL CLUSTER: PC-10

RAYMARK INDUSTRIES FACILITY SITE - D.O. NO. 11

STRATFORD, CONNECTICUT

FEET-MSL	ASTM CLASS.	LITHOLOGIC DESCRIPTION	FID (PPM)
-38			0
			2
-40			0
			9
-42	SP	red-brown fine-medium SAND	10
	MH	blue-gray clay with fragments of weathered bedrock	15
-44			38
			22
-46	BR	competent bedrock	14



FOSTER WHEELER ENVIRONMENTAL CORPORATION
470 ATLANTIC AVENUE
BOSTON, MASSACHUSETTS 02210

MONITORING WELL CLUSTER: PC-10
RAYMARK INDUSTRIES FACILITY SITE - D.O. NO. 11
STRATFORD, CONNECTICUT

FEET-MSL	ASTM CLASS.	LITHOLOGIC DESCRIPTION	FID (PPM)	FID (PPM) 0 1000	GAMMA LOG 20 160	LTIHOLOGY	PC-10S SAND=NO. 000 SLOT = .005	PC-10M SAND=NO.000 SLOT = .005	PC-10D SAND=NO.00 SLOT = .01	PC-10B SAND=NO. 1 SLOT = .03
-74										

BORING LOG FOR:	Raymark			BORING NO.:	SB-216B
PROJECT NO.:				START DATE:	9-23-97
LOGGED BY:	Joe Mello	TRANSCRIBED BY:	FMD	COMPLETION: DATE:	9-23-97
DRILLED BY (Company/Driller):	Alliance / Ron Ball			MON. WELL NO.:	MW-216B
GRD. SURFACE ELEVATION:	31.21	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET) 0	PID PER 6" (ppm) Screening	SAMP REC. / SAMP LENG.(ft)	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L(ft)	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = (PID, Jar HS)
1	5.1 NA	3'/3'	S-1 1100	9"		Dark brown	Organics, (f) SAND & SILT	Topsoil OL-SM	Moist Topsoil	0.0
2	4.5 6.1					Red brown	Silty, (f) SAND, trace gravel (subrounded)	SM	Dry fill?	
3	5.6 4.0			2'6"		Light gray	(f-c) SAND, (f-c) GRAVEL(<3"O.D.) (sub-rounded/subangular)	SP-GM	Dry	
4	0.0	3'/3'	S-2 1130 - 0305 TOC			Yellow-orange		SP	Dry	
5										0.0
6										
7	5.3	8.5'/8.5'	S-3 1200 - 0709 TOC (w/Dup)							
8	0.0 3.6									0.0
9	0.0 1.8									
10	0.0		-1012 TOC							
11										0.0
12										
13	NA			12'6"		Light gray	SILT, trace gravel (?3 O.D., subrounded), trace Fine sand	ML	Dry, weathered rock/ rock flour	0.0
14				13'6"		Dark gray	SCHIST (vert. foliations, mica rich)	Rock		0.0
15			C1							
16										

TYPE OF DRILLING RIG:	Sonic		*Tetra Tech NUS, Inc.*
METHOD OF ADVANCING BORING:	Advance and wash 6" I.D – 10' long outer casing		
METHOD OF SOIL SAMPLING:	4.75" O.D - 10' long sample casing w/rotating bit		
METHOD OF ROCK CORING:	Same as soil sampling except water is added		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB 216	PAGE: 1 OF 4

BORING LOG FOR:	Raymark			BORING NO.:	SB-216B
PROJECT NO.:				START DATE:	9-23-97
LOGGED BY:	Joe Mello	TRANSCRIBED BY:	FMD	COMPLETION: DATE:	9-23-97
DRILLED BY (Company/Driller):	Alliance / Ron Ball			MON. WELL NO.:	MW-216B
GRD. SURFACE ELEVATION:	31.21	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	PID PER 6" (ppm)	SAMP REC. / SAMP LENG.(ft)	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L(ft)	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = (PID, Jar HS)
16										
17	NA	5'/5'	C1 (cont.)		0% RQD	Dark gray	Schist (vert. foliations, mica rich)	Rock		
18										
19										
20										
21										
22		5'/5'	C2						Iron-oxide staining, trace white crystalline quartz	
23										
24										
25										
26		7.5'/10'	C3							
27										
28										
29										
30									Rapid rock coring	
31										
32										

TYPE OF DRILLING RIG:	Sonic		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	6" + 8" vibrate, spin, and wash		
METHOD OF SOIL SAMPLING:	4" vibrate + spin		
METHOD OF ROCK CORING:	4" vibrate + spin + wash		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB 216	PAGE 2 OF 4

BORING LOG FOR:	Raymark			BORING NO.:	SB-216B
PROJECT NO.:				START DATE:	9-23-97
LOGGED BY:	Joe Mello	TRANSCRIBED BY:	FMD	COMPLETION: DATE:	9-23-97
DRILLED BY (Company/Driller):	Alliance / Ron Ball			MON. WELL NO.:	MW-216B
GRD. SURFACE ELEVATION:	31.21	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	PID PER 6" (ppm)	SAMP REC. / SAMP LENG.(ft)	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L(ft)	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA METHOD = [PID, Jar HS]
32										
33			C-3 (cont.)		0% RQD	DK gray	Schist (vert. folliations, mica rich)	Bedrock		
34										
35										
36										
37			C-4							
38		7'/10'								
39										
40										
41										
42										
43										
44										
45										
46										
47			C-5							
48										

TYPE OF DRILLING RIG:	Sonic
METHOD OF ADVANCING BORING:	6" + 8" vibrate, spin, and wash
METHOD OF SOIL SAMPLING:	4" vibrate + spin
METHOD OF ROCK CORING:	4" vibrate + spin + wash
GROUNDWATER LEVELS:	
OTHER OBSERVATIONS:	

BORING NO.: SB-216

Tetra Tech NUS, Inc.

BORING LOG FOR:	Raymark			BORING NO.:	SB-216B
PROJECT NO.:				START DATE:	9-23-97
LOGGED BY:	Joe Mello	TRANSCRIBED BY:	FMD	COMPLETION: DATE:	9-23-97
DRILLED BY (Company/Driller):	Alliance / Ron Ball			MON. WELL NO.:	MW-216B
GRD. SURFACE ELEVATION:	31.21	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET) 48	PID PER 6" (ppm)	SAMP REC. / SAMP LENG.(ft)	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L(ft)	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA METHOD = (PID, Jar HS)
49			C-5 (cont.)			Dark gray	Schist (vert. folliations, mica rich)	BR		
50										
51		6'/10'								
52									Quartz Vein 1" thick	
53										
54										
55										
56										
57			C-6							
58		8"/10"								
59										
60										
61									trace pyrite crystals	
62										
66			EOB = 66 fbgs							

TYPE OF DRILLING RIG:	Sonic
METHOD OF ADVANCING BORING:	6" + 8" vibrate, spin, and wash
METHOD OF SOIL SAMPLING:	4" vibrate + spin
METHOD OF ROCK CORING:	4" vibrate + spin + wash
GROUNDWATER LEVELS:	
OTHER OBSERVATIONS:	

BORING NO.: SB 216

Tetra Tech NUS, Inc.

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-216DB
PROJECT NO.:				START DATE:	02/10/99
LOGGED BY:	T. DORGAN	TRANSCRIBED BY:	MES	COMPLETION: DATE:	02/11/99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/M.Harrington			MON. WELL NO.:	MW-216DB
GRD. SURFACE ELEVATION:	31.2 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA METHOD = [FID, (PPM)]
0							Grass surface			
5									D & W 4 in.	
10									Casing to 16'	
15										
20							Top of bedrock at ~ 15 ft.		No water loss	
25							Core to 68. Core from 68 to 98.8 ft.			
30										
35							Roller bit 3 7/8" to 68 ft.			
40							Roller bit 2 7/8" to clean out bore hole to 100 ft. bgs Bedrock = chlorite, quartz, mica, SCHIST with minor pyrite			
45										
50										
55										
60							1 set slickensides noted @ ~ 56-60' minor calcite		Lost ~ 100 gal. @ 57 Ft. cont. loosing water ~ 250 gal. Lost 57-60'	
							Deposition along slick's.			
62									steady water loss.	
64										

TYPE OF DRILLING RIG:	Mobile Drill – B59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4 in. ID Drive and Wash Casing		
METHOD OF SOIL SAMPLING:	N/A		
METHOD OF ROCK CORING:	NQ wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:	Refer to back of page of orig. log for additional core run times	BORING NO.: SB 216DB	PAGE: 1 OF 4

BORING LOG FOR:	RAYMARK		
PROJECT NO.:			
LOGGED BY:	T. DORGAN	TRANSCRIBED BY:	MES
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/M.Harrington		
GRD. SURFACE ELEVATION:	31.2 ft.	ELEVATION FROM:	NGVD 1929

BORING NO.:	SB-216DB
START DATE:	02/10/99
COMPLETION: DATE:	02/11/99
MON. WELL NO.:	MW-216DB
CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
64										
		←	CORE TIME						Steady water loss	
66										
									↓	
68									Lost 600 gal. From 57'-68'	
		2:50	C-1 = 68-71.3 PEN = 3.3 REC = 3.0 RQD length = 18in RQD = 45%			Dark Grey	Garnet, quartz, biotite, SCHIST. Aphanitic with ~ 65° Angle foliation (to core direction)			
70		3:07				↓	Mut. Frac. Parallel to foliation @ 68.5"		Lost 150 gal. During C-1	
		3:34					Mult. Tight fractures paralled to foliation 69.8-71'			
72		2:45	C-2 = 71.3'-79 PEN = 7.7 ft. REC = 7.6' RQD length = 72" RQD = 77%							
		3:00				↓	↓			
74		3:30				Grey & Gold	73-76.5' = QUARTZ (smokey) intrusion ? includes Significant qty. of well formed pyrite x-tals vuggy.			
		2:47				↓	SCHIST similar to above.			
76		4:10				↓	Numerous high angle frac. Parallel to foliation			
		5:02				Dark Grey				
78		4:08				↓				
		4:15				↓				
80		3:02	C-3 = 79'-88.9'			↓	↓ Horiz. Frac. With oxidation @ 79.5'			

TYPE OF DRILLING RIG:	Mobile Drill - B59
METHOD OF ADVANCING BORING:	4 in. ID Drive and Wash Casing
METHOD OF SOIL SAMPLING:	N/A
METHOD OF ROCK CORING:	NQ wireline
GROUNDWATER LEVELS:	
OTHER OBSERVATIONS:	

Tetra Tech NUS, Inc.

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-216DB
PROJECT NO.:				START DATE:	02/10/99
LOGGED BY:	T. DORGAN	TRANSCRIBED BY:	MES	COMPLETION: DATE:	02/11/99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/M.Harrington			MON. WELL NO.:	MW-216DB
GRD. SURFACE ELEVATION:	31.2 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
80										
		3:48	C-3 = 79'-88.9' PEN = 9.9' REC = 10.0' RQD length = 101.5" RQD = 85% Water loss ~300 gal				High angle frac. @ 80.5'			
82		4:12					Solid core to 85.2'			
		3:47								
84		3:13								
		3:05								
86		3:58					Horiz. and high angle frac. - 85.2'-86'			
		4:08								
88		5:09					Mult. High angle and horiz. Frac. 87.5' to 90.5' with White gouge on faces	VBR	Gouge composed of mica.	
		6:39								
90		5:43	C-4 = 88.9'-98.9							
		4:30	PEN = 10.0'				High angle frac. @ 91'			
92		4:48	REC = 10.2'							
		4:19	RQD length = 106"				Smokey QUARTZ. From 92-93'			
94		5:07	RQD = 88%				High angle frac. @ 93'			
							Mult. Frac. @ 94-95'			
96							Smokey QUARTZ. And feldspar. From 95-96'			

TYPE OF DRILLING RIG:	Mobile Drill - B59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4 in. ID Drive and Wash Casing		
METHOD OF SOIL SAMPLING:	N/A		
METHOD OF ROCK CORING:	NQ wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB-216DB	PAGE: 3 OF 4

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-216DB
PROJECT NO.:				START DATE:	02/10/99
LOGGED BY:	T. DORGAN	TRANSCRIBED BY:	MES	COMPLETION: DATE:	02/11/99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/M.Harrington			MON. WELL NO.:	MW-216DB
GRD. SURFACE ELEVATION:	31.2 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA METHOD = [FID, (PPM)]
96									Gouge on frac. faces	
98							Mult. High angle frac. @ 97.5'-98.25'			
100							EOB @ 98.9' bgs.			
							Noted = during coring, after pump stopped, water Return up casing would continue for 3-5 min. Sometimes returning 80-100 gallons back into washtub			

TYPE OF DRILLING RIG:	Mobile Drill - B59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4 in. ID Drive and Wash Casing		
METHOD OF SOIL SAMPLING:	N/A		
METHOD OF ROCK CORING:	NQ wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB-216DB	PAGE: 4 OF 4

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-308B
PROJECT NO.:				START DATE:	02/03/99
LOGGED BY:	D.WHALEN	TRANSCRIBED BY:	MES	COMPLETION: DATE:	02/04/99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/S.BRAY			MON. WELL NO.:	MW-308B
GRD. SURFACE ELEVATION:	38.4 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR Black	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
0.0							Asphalt pavement			
			No sample taken 0-2'							
2.0										
	12	16"	OU4-SO-308-0204			Light				
	46					Brown	Well graded GRAVEL and SAND, tr. silt	GW	Damp	
	38	20"				Green-				FID: 0 ppm
4.0	50		0824 S-1			gray	Weathered chlorite, mica, SCHIST		Spoon refusal at 3.7'	
6.0										
					5:17	Gray	(chlorite), mica, SCHIST, weathered, high angle foliation	VBR BR	Most rock surfaces have brown/rust – colored alteration	FID: 0 ppm Bz for entire boring
8.0					4:15					
		36"	C-1-6.0'-11.0'		3:03					
10.0		60"	RQD = 15%		3:40					
					7:30			VBR		
12.0					5:10	Gray	Mica, SCHIST, some quartz and feldspar, high angle Foliation.	BR		
		36"	C-2-11.0'-14.5'		4:12			VBR BR	Soft rock at 12.3'	
14.0		42"	RQD = 14%		6:53					
			C-3-14.5'-17.5'		3:46					
16.0			RQD = 54%		4:29					

TYPE OF DRILLING RIG:	Mobile Drill – B59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4 in. ID drive and wash casing		
METHOD OF SOIL SAMPLING:	2 in. split-barrel sampler driven with a 140 lb. Hammer with a 30 in. drop		
METHOD OF ROCK CORING:	NQ wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:	Split spoon refusal at 3.7'; 4" roller bit to 6'; core from 6' to 38'	BORING NO.: SB-308B	PAGE: 1 OF 3

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-308B
PROJECT NO.:				START DATE:	02/03/99
LOGGED BY:	D.WHALEN	TRANSCRIBED BY:	MES	COMPLETION: DATE:	02/04/99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/S.BRAY			MON. WELL NO.:	MW-308B
GRD. SURFACE ELEVATION:	38.4 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6" RQD	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA METHOD = [FID, (PPM)]
					4:10	Gray	Mica SCHIST, some quartz and feldspar, high angle foliation			
18.0		12" / 12"	C-4-17.5'-18.5' RQD = 0%		6:14			BR		
					8:39					
20.0		34" / 42"			6:37			VBR	Very broken from 19.2-22'	
			C-5 = 18.5'-22' RQD = 17%		5:28				Lose water 19'-20' no return.	
22.0					12:19					
		16" / 18"	C-6 = 22'-23.5' RQD = 22%		9:36			BR		
24.0					13:25					
		18" / 18"	C-7 = 23.5'-25' RQD = 33%		7:37			VBR	Very broken from 24.5-25.5 Rust staining at 26' high angle fractures	
26.0					6:14	Gray	Mica SCHIST, some quartz and feldspar, high angle foliation	BR		
		24" / 36"	C-8 = 25'-28' RQD = 0%		6:17			VBR		
28.0					8:47					
					11:00	Gray to Yellow		BR		
30.0		33" / 42"	C-9 = 28'-31.5' RQD = 24%		14:32	gray				
					15:33		Quartz vein at 30'	VBR		
32.0					18:07			BR	Rust staining 31.5	

TYPE OF DRILLING RIG:	Mobile Drill – B 59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4 in. ID drive and wash casing		
METHOD OF SOIL SAMPLING:	2 in. split-barrel sampler driven with a 140 lb. Hammer with a 30 in. drop		
METHOD OF ROCK CORING:	NQ wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB-308B	PAGE: 2 OF 3

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-308B
PROJECT NO.:				START DATE:	02/03/99
LOGGED BY:	D.WHALEN	TRANSCRIBED BY:	MES	COMPLETION: DATE:	02/04/99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/S.BRAY			MON. WELL NO.:	MW-308B
GRD. SURFACE ELEVATION:	38.4 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6" RQD	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
		60" / 60"	C-10 = 31.5'-36.5' Rqd = 90%		8:56	Gray	Mica SCHIST, some quartz and feldspar high angle foliation	BR BL	32.7 high angle frac., rusty vugs at 32 and 32.5'	
34.0					9:03					
					9:10					
36.0					8:54			VBR	Some rust stains 35.5' and 36.5'	
		19" / 18"	C-11 = 36.5-38' Rqd = 100%		3:24			BL	High angle frac. 36.5 rust stained	
38.0					3:18					
							EOB @ 38.0' BGS			

TYPE OF DRILLING RIG:	Mobile Drill – B59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4 in. ID drive and wash casing		
METHOD OF SOIL SAMPLING:	2 in. split-barrel sampler driven with a 140 lb. Hammer with a 30 in. drop		
METHOD OF ROCK CORING:	NQ wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB-308B	PAGE: 3 OF 3

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-308DB
PROJECT NO.:				START DATE:	02/08/99
LOGGED BY:	D. WHALEN	TRANSCRIBED BY:	MES	COMPLETION: DATE:	02/10/99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING - S.BRAY			MON. WELL NO.:	MW-308DB
GRD. SURFACE ELEVATION:	38.2 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET) 0.0	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA METHOD = [FID, (PPM)]
10.0							No soil samples or rock cores taken 0' to 40' (5" Roller bit)			
20.0							SEE LOG FOR SB-308B			
30.0										
40.0								BR		
		16" / 16"	C-1-40'-41.3' RQD=81%		6:39	Gray	Mica SCHIST, some quartz and small garnets; high angle Foliation.			FID = 0 ppm BZ For entire boring
42.0		24" / 24"	C-2-41.3'-43.3' RQD=33%		5:22				Rust stained frac. 42'	
					6:23			VBR	Rust stained frac. 43'	
44.0			C-3-43.3'-51' RQD=87%		9:52			VBR/BR BR		
					7:02				45' high angle break	
46.0					8:26				45.7 low angle break	
		87" / 92"			6:37					
48.0					12:49				Some rust staining 48'	
					11:29					
50.0					9:08				Rust stained frac. 49.2'	
					8:31					
52.0		12" / 12"	C-4=51'-52' RQD=42%		8:17			VBR/BR	Rust stained frac. 51.5'	

TYPE OF DRILLING RIG:	Mobile Drill - B59			Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	5 in. ID drive and wash casing			
METHOD OF SOIL SAMPLING:	2 in. split-barrel sampler driven with a 140 lb. Hammer with a 30 in. drop			
METHOD OF ROCK CORING:	NQ wireline			
GROUNDWATER LEVELS:				
OTHER OBSERVATIONS:	5" roller bit 0' - 40'; core 40' - 72'	BORING NO.:	SB-308DB	PAGE: 1 OF 3

BORING LOG FOR:	RAYMARK	BORING NO.:	SB-308DB
PROJECT NO.:		START DATE:	02/08/99
LOGGED BY:	D. WHALEN	TRANSCRIBED BY: MES	COMPLETION: DATE: 02/10/99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING - S.BRAY	MON. WELL NO.:	MW-308DB
GRD. SURFACE ELEVATION:	38.2 ft.	ELEVATION FROM: NGVD 1929	CHECKED BY:

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
52.0										
		110"	C-5 = 52'-61'		8:30	Gray-Dk. Grn.	Chlorite, mica SCHIST, high angle foliation w/ quartz and Small garnets		Rust stained frac 52.3'	
54.0		108"	RQD = 97%		8:45		Mica schist — less foliation	BL		
					5:54					
56.0					6:42		Chlorite-mica SCHIST w/quartz and small garnets High angle foliation			
					6:30			BR		
58.0					6:23		less foliation	BL		
					6:46				Rust stained frac. 59.5'	
60.0					6:37		Chlorite- Mica SCHIST w/quartz and small garnets	BR		
					6:25		High angle foliation			
62.0		119"	C-6 = 61'-70.8'		6:45				61.3' high angle frac. - some rust	
		117"	RQD = 88%		8:31			BR		
64.0					8:11			BL		
					7:38					
66.0					6:58			VBR/ BR		
					6:02				66.5 high angle break	
68.0					7:36			BL		

TYPE OF DRILLING RIG:	Mobile Drill – B59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	5 in. ID drive and wash casing		
METHOD OF SOIL SAMPLING:	2 in. split-barrel sampler driven with a 140 lb. Hammer with a 30 in. drop		
METHOD OF ROCK CORING:	NQ wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB-308DB	PAGE: 2 OF 3

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-308DB
PROJECT NO.:				START DATE:	02/08/99
LOGGED BY:	D. WHALEN	TRANSCRIBED BY:	MES	COMPLETION: DATE:	02/10/99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING - S.BRAY			MON. WELL NO.:	MW-308DB
GRD. SURFACE ELEVATION:	38.2 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA METHOD = [FID, (PPM)]
68.0										
					8:50	Gray	Chlorite, Mica, SCHIST	BL		
70.0					8:36			BR		
			C-7 = 70.8'-72'		8:05		SCHIST/GNEISS	BL		
72.0		15 / 15	RQD = 100%		8:48		Mica, quartz, black mineral (pyroxene?) some small garnets.			

TYPE OF DRILLING RIG:	Mobile Drill – B59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	5 in. ID drive and wash casing		
METHOD OF SOIL SAMPLING:	2 in. split-barrel sampler driven with a 140 lb. Hammer with a 30 in. drop		
METHOD OF ROCK CORING:	NQ wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB-308DB	PAGE: 3 OF 3

BORING LOG FOR:	RAYMARK	BORING NO.:	SB-309B
PROJECT NO.:		START DATE:	02/16/99
LOGGED BY:	T. DORGAN	TRANSCRIBED BY: MES	COMPLETION: DATE: 02/18/99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/M. Harrington	MON. WELL NO.:	MW-309B
GRD. SURFACE ELEVATION:	11.2 ft.	ELEVATION FROM: NGVD 1929	CHECKED BY:

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
0										
2										
	5	0.6' / 2.0'	OU2-S0-309-0204			Dark Brown	SAND. Mostly f-c sand, little rounded gravel	SW	**Strong natural-gas odor**	FID = 4,292
	9									
4	5		1245 S-1							PID = 0.5
	2									
	2	1.4' / 2.0'	OU2-S0-309-0406			Light Olive – br.			Saturated	FID = 4,290
	2									
6	3		1255 S-2							PID = 0.4
	5									
	5	1.0' / 2.0'	OU2-S0-309-0608				SAND. Mostly f-med. Sand, fining into a poorly graded Fine sand.	SP		FID = 4,200
	5									
8	7		1308 S-3							PID = 0.4
	9									
	11	1.2' / 2.0'	OU2-S0-309-0810				Fine poorly graded SAND. Trace silt.	SP		FID = 35
	13									
10	10		1320 S-4			Oxidation Orange	Inc. ½" thick fine sandy SILT. With minor bedding Noted.		Fine bedding layers & oxidation	PID = 0.3
	14									
	8	1.8' / 2.0'	OU2-S0-309-1012			Lt. Olive Brown	SAND, mostly fine poorly graded sand, trace silt, trace med. Sand.	SP		FID = 100
	9									
12	11		1335 S-5							PID = 0.5
	13									
	22	1.1' / 2.0'	OU2-S0-309-1214			Brown w/ Minor	S-6A = 0.4' similar to above	SW / GW		FID = 23
	23									
14	25		1410 S-6			Red-Orange (inc. blk)	S-6B = 0.7' gravely, f-coarse SAND		Minor oxidation in S-6B	PID = 0.2
	23									
	21	1.3' / 2.0'	OU2-S0-309-1416				Gravelly, med.-coarse SAND	GW		FID = 15.4
	12									
16	14		1425 S-7					SP		PID = 0.2
	18									

TYPE OF DRILLING RIG:	Mobile Drill – B 59	**1315 radio K.O. to notify gas co. of poss. Leak & request PID. 1400 scg onsite to check for gas leaks FID = 4,000 ppm., SCG meter = 0.5%, title-probe holes nearby = 6%-50% beside frog pond bar.**	*Tetra Tech NUS, Inc.*
METHOD OF ADVANCING BORING:	4 in. ID drive and wash casing		
METHOD OF SOIL SAMPLING:	2 in. split-barrel sampler driven with a 140 lb. Hammer with a 30 in. drop		
METHOD OF ROCK CORING:	NQ wireline		
GROUNDWATER LEVELS:	Water Level measure @ 10' bgs on 02/17/99 in A.M. W.L. meas. 6.5' BGS on 02/18/99		
OTHER OBSERVATIONS:		BORING NO.: SB-309B	PAGE: 1 OF 9

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-309B
PROJECT NO.:				START DATE:	02/16/99
LOGGED BY:	T. DORGAN	TRANSCRIBED BY:	MES	COMPLETION: DATE:	02/18/99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/M. Harrington			MON. WELL NO.:	MW-309B
GRD. SURFACE ELEVATION:	11.2 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
16										
	16	1.4' / 2.0'	OU2-SO-309-1618			Brown -	GRAVEL and SAND, sand is med-coarse gravel is	GW	Saturated	Lost ~ 30-
	16					Black w/	f-c subrounded.			50 gal. H_2O
	16					Minor				@ 16'
18	16		1440 S-8			Oxidation		SP		FID = 12
	8	1.0' / 2.0'	OU2-SO-309-1820							PID = 0.2
	12					Brown	Similar to above			
	14									FID = 6.3
20	16		1450 S-9							PID = 0.2
									Begin standard int. Sampling D&W to 24'	
22										
24										
	21	0.8' / 2.0'	OU2-SO-309-2426							
	14					Brown	Similar to S-9 above	GW	Saturated	FID = 9.8
	15									PID = 0.1
26	14		1515 S-10					SP		
28										
30	18	0.7' / 2.0'	OU2-SO-309-2931			Brown -	Gravelly, f-c well graded SAND, some f-c rounded	SW	Saturated – no odor	FID = 72
	9									
	10					Light				PID-0.4
	12		1535 S-11			Gray				
32										

TYPE OF DRILLING RIG:	Mobile Drill – B 59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4 in. ID drive and wash casing		
METHOD OF SOIL SAMPLING:	2 in. split-barrel sampler driven with a 140 lb. Hammer with a 30 in. drop		
METHOD OF ROCK CORING:	NQ wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB-309B	PAGE: 2 OF 9

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-309B
PROJECT NO.:				START DATE:	02/16/99
LOGGED BY:	T. DORGAN	TRANSCRIBED BY:	MES	COMPLETION: DATE:	02/18/99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/M. Harrington			MON. WELL NO.:	MW-309B
GRD. SURFACE ELEVATION:	11.2 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
32										
34										
	8	0.9' / 2.0'	Ou2-so-309-3436			Brown -	Gravelly, med-coarse SAND	SW	Losing water 32-36' ~ 30 gallons	FID = 32
	7									
	5					Light	Gravel are f-c well rounded			
36	9		1555 S-12			Gray				PID = 0.2
38										
	8	0.6' / 2.0'	OU2-SO-309-3941							
40	10					Brown	Similar to S-12 above	SW	Saturated	FID = 28
	11									
	12		1615 S-13							PID = 0.2
42										
44										
	13	0.4' / 2.0'	OU2-SO-309-4446							
	15					Brown-	Gravelly, f-c SAND	SW		FID = 8.0
	16					Light				
46	16		1640 S-14			Gray				PID = 1.2
48										

TYPE OF DRILLING RIG:	Mobile Drill – B 59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4 in. ID drive and wash casing		
METHOD OF SOIL SAMPLING:	2 in. split-barrel sampler driven with a 140 lb. Hammer with a 30 in. drop		
METHOD OF ROCK CORING:	NQ wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:	Stop 2/16 w/ casing @ 44 and last sample = 4446	BORING NO.: SB-309B	PAGE: 3 OF 9

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-309B
PROJECT NO.:				START DATE:	02/16/99
LOGGED BY:	T. DORGAN	TRANSCRIBED BY:	MES	COMPLETION: DATE:	02/18/99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/M. Harrington			MON. WELL NO.:	MW-309B
GRD. SURFACE ELEVATION:	11.2 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
48										
50	16 16 15 14	0.7' / 2.0'	OU2-SO-309-4951 0820 S-15			Light Brown	SAND and GRAVEL—well graded f-c sand and well Graded f-c gravel rounded	SW / GW		FID = 9.5 PID = 0.0
52										
54										
56	7 9 13 21	1.2' / 2.0'	OU2-SO-309-5456 0844 S-16			Light Brown	SAND, mostly fine poorly graded sand, trace silt	SP	Bedding layers noted	FID = 18.1 PID = 1.6
58										
60	9 12 15 18	1.0' / 2.0'	OU2-SO-309-5961 0920 S-17			Light Brown	Similar to S-16 above. Sands are mica rich	SP	Fine bedding noted (x-bedding?)	FID = 24.1 PID = 4.0
62										
64										

TYPE OF DRILLING RIG:	Mobile Drill – B 59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4 in. ID drive and wash casing		
METHOD OF SOIL SAMPLING:	2 in. split-barrel sampler driven with a 140 lb. Hammer with a 30 in. drop		
METHOD OF ROCK CORING:	NQ wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB-309B	PAGE: 4 OF 9

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-309B
PROJECT NO.:				START DATE:	02/16/99
LOGGED BY:	T. DORGAN	TRANSCRIBED BY:	MES	COMPLETION: DATE:	02/18/99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/M. Harrington			MON. WELL NO.:	MW-309B
GRD. SURFACE ELEVATION:	11.2 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
64										
	4	1.0' / 2.0'	OU2-SO-309-6466			Light Brown	SAND, mostly f-c well graded sand, trace fine gravel	SW	No structure	FID = 10.0 PID = 4.8
	10									
	15									
66	14		1045 S-18							
68										
									Harder driving @ 68.5	
	34	0.8' / 2.0'	OU2-SO-309-6971			Light Brown to	Gravelly, SAND = S-19A - 0.4' f-c well graded SAND w/little fine subang. Gravel	SW		FID = 4.0 PID = 2.5
70	50									
	29		1105 S-19			Light gray	S-19B = SAND and GRAVEL, trace silt, comact grvl. Is Angular phyllite	GW / SW	S-19B - till? Wash H_2O color change from brown to olive-green	
	30									
72										
74										
	16	0.1' / 2.0'	OU2-SO-309-7476				Poor recovery only f-c gravel fragments		Poss. coarse gravel or cobbles?	FID & PID = Not done Poor recovery
	18									
	30									
76	24		1150 S-20							
78										
	15	0.7' /	OU2-SO-309-7981			Olive Brown	Gravelly f-c SAND, gravel is f-c subrounded	SW		FID = 14.8 PID = 5.0
80	17		S-21							

TYPE OF DRILLING RIG:	Mobile Drill - B 59
METHOD OF ADVANCING BORING:	4 in. ID drive and wash casing
METHOD OF SOIL SAMPLING:	2 in. split-barrel sampler driven with a 140 lb. Hammer with a 30 in. drop
METHOD OF ROCK CORING:	NQ wireline
GROUNDWATER LEVELS:	
OTHER OBSERVATIONS:	

Tetra Tech NUS, Inc.

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-309B
PROJECT NO.:				START DATE:	02/16/99
LOGGED BY:	T.DORGAN	TRANSCRIBED	MES	COMPLETION: DATE:	02/18/99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/M. Harrington			MON. WELL NO.:	MW-309B
GRD. SURFACE ELEVATION:	11.2 ft.	ELEVATION	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA METHOD = [FID, (PPM)]
80										
	28		OU2-SO-309-7981			Olive				FID = 14.8
	21	2.0'	1320 S-21			Brown	Gravelly f-c SAND, gravel is f-c subrounded	SW	Mixed gravel rock types	PID = 5.0
82										
84										
	100/.1	0.0'	OU2-SO-309-8486	Boulder	No Recovery Spoon Refusal		No Recovery		Spoon refusal drill (roller bit & D&W) through boulder 83.5 86'	
86		0.1'	1340 S-22							
88									D&W to 89'	
90	23	1.0'	OU2-SO-309-8991			Gray	SAND and GRAVEL, mixture of f-c sand, and f-c subang - angular gravel	GW/SW		FID = 6.0
	12									
	18	2.0'	1435 S-23							PID = 2.4
	22									
92										
94										
	23	1.0'	OU2-SO-309-9496				Sandy, GRAVEL. Mostly f-c subang.	GW		FID = 10.8
	18		Grain-size collected							
	17	2.0'								
96	72		1540 S-24				Subrounded gravel. little f-c sand, trace silt			PID = 2.5

TYPE OF DRILLING RIG:	Mobile Drill - B59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4 in. ID drive and wash casing		
METHOD OF SOIL SAMPLING:	2 in. split-barrel sampler driven with a 140 lb. Hammer with a 30 in. drop		
METHOD OF ROCK CORING:	NQ wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB-309B	PAGE: 6 OF 9

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-309B
PROJECT NO.:				START DATE:	02/16/99
LOGGED BY:	T.DORGAN	TRANSCRIBED	MES	COMPLETION: DATE:	02/18/99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/M. Harrington			MON. WELL NO.:	MW-309B
GRD. SURFACE ELEVATION:	11.2 ft.	ELEVATION	NGVD 1929	CHECKED BY:	

DEPTH (FEET) 96	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
									Roller bit to 99', fresh uniform rock cuttings from 97-99' Seat casing @ 96' in top 0.2-0.5' of bedrock = casing refusal	
98										
100			C-1 = 99'-99.5' PEN = 0.5' REL = 0.3' Water loss = ~ 50 gal. RQD = 0%			Dark Gray & white	Quartz, biotite, SCHIST& GNEISS with variable quantities of chlorite, minor garnet and Pyrite. High angle to vert. Foliation and folded, minor calcite veining. Abundant quartz veins.		C-1 water loss ~50 gallons slight bend or angle change in boring @ 101FT	
					4:15					
102			C-2 = 99.5-109' PEN = 9.5' REC = 9.5' RQD length = 88" RQD = 77% Water loss 500 gallons		3:50					
					3:05				C-2 water loss = ~500 gallons	
104					3:20		- High angle fracture's @ 103-104'			
					2:00		- Multiple high and low angle frac. 104-105.5'			
106					2:30					
					3:05		- high angle fractures along foliation 106-107'			
108					3:40					
					3:00		- high angle frac. @ 109'			
110			C-3 = 109'-119'		2:40				C-3 water loss	
			PEN = 10.0 REC = 9.5 RQD = 88% Water loss = 300		2:00		- numerous low angle horiz. Frac. From 110.2-112.2'		= 300 gallons	
112					2:20					

TYPE OF DRILLING RIG:	Mobile Drill - B59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4 in. ID drive and wash casing		
METHOD OF SOIL SAMPLING:	2 in. split-barrel sampler driven with a 140 lb. Hammer with a 30 in. drop		
METHOD OF ROCK CORING:	NQ wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB 309B	PAGE: 7 OF 9

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-309B
PROJECT NO.:				START DATE:	02/16/99
LOGGED BY:	T.DORGAN	TRANSCRIBED	MES	COMPLETION: DATE:	02/18/99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/M. Harrington			MON. WELL NO.:	MW-309B
GRD. SURFACE ELEVATION:	11.2 ft.	ELEVATION	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
112										
					2:20	Dk. Gry & white	Similar rock type as above			
114					2:35		- High angle fracture @ 113.2'			
					2:20		- horiz. Jagged frac. @ 114.25'			
116					2:40					
					2:30		- High angle frac. @ 116.1' and 117'			
118					2:35					
					2:25		- High fractured high angle and low angle			
120			C-4 = 119'-124' PEN = 6.0 REC = 6.2 RQD length = 28.5" RQD = 47%		2:45		From 118.25 – 121.5'		C-4 water loss ~ 300-400 gal.	
					3:30					
122					3:45		- Mult. Low angle to 45° frac. 121'			
					3:45					
124					3:40		- Mult. High angle frac. 123'-124.5'			
			C-5 = 124-130 PEN = 6.0 REC = 6.0' RQD length = 53" RQD = 85%		3:35		- Numerous horiz. Jagged frac's 125-126.7'		C-5 water loss = 250 gal	
126					4:00					
					4:15	Lt. Gry w/ Pnk&white	- Quartz vein with potassium feldspar, pink And white 126.2'-127.			
128					4:05	Dk. Gray & white	High angle frac. @ 127'			

TYPE OF DRILLING RIG:	Mobile Drill ~ B59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4 in. ID drive and wash casing		
METHOD OF SOIL SAMPLING:	2 in. split-barrel sampler driven with a 140 lb. Hammer with a 30 in. drop		
METHOD OF ROCK CORING:	NQ wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB-309B	PAGE: 8 OF 9

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-309B
PROJECT NO.:				START DATE:	02/16/99
LOGGED BY:	T.DORGAN	TRANSCRIBED	MES	COMPLETION: DATE:	02/18/99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/M. Harrington			MON. WELL NO.:	MW-309B
GRD. SURFACE ELEVATION:	11.2 ft.	ELEVATION	NGVD 1929	CHECKED BY:	

DEPTH (FEET) 128	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
					3:50	Dark gray & white	Similar rock type as above.			
130					4:00				Total water loss = approx. 1,500 gal.	
							End of Boring at 130 ft.			
							Construct bedrock well screened from 99'-129'			

TYPE OF DRILLING RIG:			Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:			
METHOD OF SOIL SAMPLING:	Refer to page 1 of 9		
METHOD OF ROCK CORING:			
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB-309B	PAGE: 9 OF 9

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-309S
PROJECT NO.:				START DATE:	02/25/99 @1610
LOGGED BY:	T. DORGAN	TRANSCRIBED BY:	MES	COMPLETION: DATE:	02/26/99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/M. Harrington			MON. WELL NO.:	MW-309S
GRD. SURFACE ELEVATION:	11.7 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET) 0	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION Grass Surface	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
2							No samples taken.			
4							Refer to SB-309B log for details			
6							D & W to 20'			
8										
10										
12										
14										
16										
18										
20										
							EOB @ 20'			
							Construct well with screen from 5-20' bgs.			

TYPE OF DRILLING RIG:	Mobile Drill – B59			*Tetra Tech NUS, Inc.*
METHOD OF ADVANCING BORING:	*4 in. ID drive and wash casing*			
METHOD OF SOIL SAMPLING:				
METHOD OF ROCK CORING:				
GROUNDWATER LEVELS:				
OTHER OBSERVATIONS:	Water level in MW-309D ~ 6' away = 7.5' bgs	BORING NO.:	SB-309S	PAGE: 1 OF 1

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-309D
PROJECT NO.:				START DATE:	02/24/99
LOGGED BY:	T. DORGAN	TRANSCRIBED BY:	MES	COMPLETION: DATE:	02/25/99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/M. Harrington			MON. WELL NO.:	MW-309D
GRD. SURFACE ELEVATION:	11.6 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET) 0	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION Grass surface	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering, etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
10							No samples collected.		Advanced 4" casing to 94 ft. bgs.	
20							Refer to log for 309B for details.			
30										
40										
50										
60										
70										
80										
90										
100										
							EOB @ 94. Ft. bgs. Construct well from			
							84 to 94 ft. BGS.			

TYPE OF DRILLING RIG:	Mobile Drill – B59		*Tetra Tech NUS, Inc.*
METHOD OF ADVANCING BORING:	4 in. ID drive and wash casing.		
METHOD OF SOIL SAMPLING:			
METHOD OF ROCK CORING:			
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB 309D	PAGE: 1 OF 1

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-401S
PROJECT NO.:				START DATE:	1/27/99
LOGGED BY:	A. Putnam	TRANSCRIBED BY:	LAC	COMPLETION: DATE:	1/27/99
DRILLED BY (Company/Driller):	Aquifer Drilling & Testing Inc./K. Kutarnia			MON. WELL NO.:	MW-401S
GRD. SURFACE ELEVATION:	23.0 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
0							No soil samples taken, refer to boring log 401B for description.			
10										
									FID = 0.0 in B.Z.	
20										
25										

TYPE OF DRILLING RIG:	CME			*Tetra Tech NUS, Inc.*
METHOD OF ADVANCING BORING:	4 in. ID Drive & Wash Casing.			
METHOD OF SOIL SAMPLING:				
METHOD OF ROCK CORING:				
GROUNDWATER LEVELS:				
OTHER OBSERVATIONS:	FID = 0.0 PPM in B.Z.	BORING NO.:	SB-401S	PAGE: 1 OF 1

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-401B
PROJECT NO.:				START DATE:	12-18-98
LOGGED BY:	Tracy Dorgan / Amy Putnam	TRANSCRIBED BY:	LJD	COMPLETION: DATE:	12-19-98
DRILLED BY (Company/Driller):	Aquifer Drilling and Testing			MON. WELL NO.:	MW-401B
GRD. SURFACE ELEVATION:	23.4 FT.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
0							Grass Surface			
	3 / 8	1.6 / 2.0	OU4-S0-401-0002		Med. Dense	Red Brown / Light Brown	S-1A = 0.5' – silty, F-Med. Poorly graded SAND. Abundant roots	SM	S-1A = Damp, Compact S-1B = Damp, Loose	FID = 0.2
2	9 / 9		0820 S-1			Brown	S-1b = 1.1' – SAND. Mostly F-C well graded sand. Trace fine gravel	SW		PID = 0.0
	4 / 6	.8 / 2.0	OU4-S0-401-0204			Brown	S-2A = 0.5' SAND, fine gravel, trace silt, well graded	SW	½" Root in nose of spoon S-2A = Saturated dry, possible old ground surface	0.0 IN BZ
4	7 / 8		0845 S-2			Dark Brown	S-2B = 0.3' Pieces of plastic, organic, peat(?), leaves and root layer. Silty, F.-MED SAND.	PT? / SM		FID = 0.0 PID = 0.0
	3 / 5	1.0 / 2.0	OU4-S0-401-0406			Brown	Poorly graded. Med-coarse SAND, trace root fibers	SP	Loose	0.0 IN BZ FID = 0.0
6	7 / 9		0900 S-3							PID = 7.2 (H_2O vapor?)
	7 / 11	.9 / 2.0	OU4-S0-401-0608			Light Brown	Well-graded fine to coarse SAND trace fine gravel	SW	5" Casing to 9' Telescope w/4" Casing	FID 0.0
8	13 / 14		0915 S-4							PID = 7.1 (H_2O vapor?)
	6 / 8	.75 / 2.0	OU4-S0-401-0810			Brown	Silty Fine-Medium SAND, trace root fibers	SM	Gravel slough,moist/damp	FID = 0.0
10	11 / 11		0933 S-5							PID = 22.0 (H_2O vapor?)
	9 / 14	1.1 / 2.0	OU4-S0-401-1012		Med. Dense	Brown Brown	S-6A = .4' fine medium SAND-similar to above. S-6B = 0.25' root fibers, silt, fine SAND, org. debris	SM SM	Sharp contact between S-6A & S-6B @ 30° angle, compact, sharp contact betw. S-6B & S-6C @ 30° angle S-6C is bone dry	FID = 0.0
12	16 / 16		0950 S-6		loose	White	S-6C = .6' Poorly graded fine SAND, trace organic debris	SP		Pid = 7.6 (H_2O vapor?)
	5 / 11	.8 / 2.0	OU4-S0-401-1214			Light Brown	Fine-Medium SAND, trace silt, horizontal bedding evidence	SP	Damp, Loose	FID = 0.0
14	12 / 15		1014 S-7							PID = 0.0
	9 / 11	.55 / 2.0	OU4-S0-401-1416			Brown	Coarse SAND & poorly graded fine-med. angular GRAVEL	SP/GP	Loose, Moist	FID = (Not Meas.)
16	14 / 8		1026 S-8							PID = ↓

TYPE OF DRILLING RIG:	Mobile B-59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4" and 5" inside diameter Drive & Wash Casing		
METHOD OF SOIL SAMPLING:	S1-S9 3" split-barrel sampler drive w/300 lb hammer w/18" drop.. S-10 – S-12 2" split barrel sampler w/140 lb. Hammer, 30" drop		
METHOD OF ROCK CORING:	NQ-WIRELINE		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:	Drove 5" Casing down to 9.5'. FID B, PID D	BORING NO.: SB 401B	PAGE: 1 OF 4

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-401B
PROJECT NO.:				START DATE:	12-18-98
LOGGED BY:	Tracy Dorgan / Amy Putnam	TRANSCRIBED BY:	LJD	COMPLETION: DATE:	12-19-98
DRILLED BY (Company/Driller):	Aquifer Drilling and Testing			MON. WELL NO.:	MW-401B
GRD. SURFACE ELEVATION:	23.4 FT.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
16										
	14 / 14	0.0 / 2.0	NO RECOVERY				Poss. Pushing cobble, no recovery		Gravel slough, possibly pushing a cobble	
18	14 / 17									
	6 / 8	.75 / 2.0	OU4-S0-401-1820			Brown	Med-Coarse SAND, w/trace fine gravel 1" band of fine-medium sand.	SW	Moist	FID = 0.0
20	10 / 10		1107 S-9							PID = 0.0
							No sampler from 20 to 24'		D + W to 24' begin standard int. samp.	
22										
24										
	4 / 10	1.1 / 2.0	OU4-S0-401-2426			Light Brown	Fine, medium poorly graded SAND w/ silt	SM	Damp.	FID = 0.0
26	15 / 18		1140 S-10						D & W to 29'.	PID = 0.0
28										
30	7 / 15	1.0 / 2.0	OU4-S0-401-2931			Light Brown	S-11A = .4' fine, poorly graded SAND w/silt, similar to above	SM	Saturated	FID = 0.4
	31 / 38		1149 S-11			Orange Brown	S-11B = 0.6' fine to coarse well graded SAND w/ trace fine	SW	Casing harder to drive @ 30'	PID = 0.0
32									Harder driving @ 32'	

TYPE OF DRILLING RIG:	Mobile B-59
METHOD OF ADVANCING BORING:	4" and 5" inside diameter Drive & Wash Casing
METHOD OF SOIL SAMPLING:	S1-S9 3" split-barrel sampler drive w/300 lb hammer w/18" drop.. S-10 – S-12 2" split barrel sampler w/140 lb. Hammer, 30" drop
METHOD OF ROCK CORING:	NQ-WIRELINE
GROUNDWATER LEVELS:	
OTHER OBSERVATIONS:	Drove 5" Casing down to 9.5'. FID B, PID D

BORING NO.: SB 401B

Tetra Tech NUS, Inc.

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-401B
PROJECT NO.:				START DATE:	12-18-98
LOGGED BY:	Tracy Dorgan / Amy Putnam	TRANSCRIBED BY:	LJD	COMPLETION: DATE:	12-19-98
DRILLED BY (Company/Driller):	Aquifer Drilling and Testing			MON. WELL NO.:	MW-401B
GRD. SURFACE ELEVATION:	23.4 FT.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6" Core Run Times	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
32									Casing refusal @ 33.7 roller bit to 35'. Poss. cobbles or boulder to 34.5'. Wash ind. Gravel.	
34										
		0.3 / 0.6	OU4-SO-401-3536						Pop-out @ 34.5'/ wash ind. gravel Lost 50 gal. Water @ 33.5 – 34.5.	
36	30 / 50/1"		1354 S-12			Brown / Dk. gray	Gravelly, SAND (sand is med – coarse) weathered STET in bottom 0.1'			PID = 0.0 / FID = 0.1
				Top of Bedrock					Seat casing @ 37'	
38	6:23		C – 1 = 37.0-41.5 Pen = 4.5' Rec = 4.2' total # in > 4" = 40" RQD = 74%				C-1 = SEMI-SCHIST?/ GNEISS. Mafic, with calcite veins & pea size garnet crystals.		Little – no water loss in C – 1 or C – 2 until 47'	
	4:32									
40	4:40									
	5:02									
42	2:41 / 5:25		C – 2 = 41.5 – 47'				C – 2 = Calcite, chlorite, garnet, quartz, mica, SCHIST			
	4:50		Pen = 5.5 ft. Rec = 5.8 ft. (picked up C-1 remnant) Total # in > 4in. = 64.5 RQD = 97% inc. pen = 92.5% inc rec				High Angle foliation. Quartz & Calcite veins throughout. Crinkle folding in small zones.			
44	6:20						4" milky quartz vein @ 44'.			
	6:04									
46	6:05									
	3:38		C – 3 = 47.0 – 50.5 Pen = 3.5', Rec = 3.4' RQD length = 37" RQD = 88%						Lost all water in casing @ 47' (200 gal?) inc tank. Driller noted drop in casing @ same time ~0.1'	
48	2:40 / 3:10						Poss. Void or large open fracture @ 47'. Oxidation halo & rounded edges.			

TYPE OF DRILLING RIG:	Mobile B-59
METHOD OF ADVANCING BORING:	4" and 5" inside DIA Drive & Wash Casing
METHOD OF SOIL SAMPLING:	S-10 – S-12, 2"split barrel sampler w/140 lb. hammer, 30" drop
METHOD OF ROCK CORING:	
GROUNDWATER LEVELS:	
OTHER OBSERVATIONS:	

BORING NO.: SB 401B

Tetra Tech NUS, Inc.

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-401B
PROJECT NO.:				START DATE:	12-18-98
LOGGED BY:	Tracy Dorgan / Amy Putnam	TRANSCRIBED BY:	LJD	COMPLETION: DATE:	12-19-98
DRILLED BY (Company/Driller):	Aquifer Drilling and Testing			MON. WELL NO.:	MW-401B
GRD. SURFACE ELEVATION:	23.4 FT.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID,(PPM)]
48										
	2:50		Stop and lift to check water @ 48.5'				Horiz. Frac. W/oxidation, rounded edges & soft rock @ 48.25' C-3 similar to C-2 rock, foliation is high angle to vertical 2 high angle fractures with abundant oxidation stains and calcite @ 50 & 50.5'.		Note a sheen on wash-tub, But we are drilling w/out wash return. Find leak in gear-box. No use of wash-tub, direct feed H_2O from rig-tank & support truck. Stop C-3 @ 50; out of water. Used ~500 gal. For 3' pen. w/no return up casing.	
	3:00									
50										
	5:10		C - 4 = 50.5-51.5 Pen = 1.0 Rec. = .8 RQD = 100%				C - 4 similar to C - 3			
	4:50								C-4 used ~250 gal. w/out return. core blocked, 1' run.	
52			C-5 = 51.5-57.5' Pen = 6.0 Rec. = 5.9' Total RQD in = 64" RQD = 88%							
	4:10						Highly weathered - unsound core @ 52.5 - 53.5'.			
	4:30									
54										
	4:25						Mult. Horiz. Frac. w/ heavy oxidation & rounded edges @ 55.8 - 55.9'			
	4:20									
56										
	4:00						Open fracture @ 56.7 VUG's in calcite vein connected to frac. running nearly vertical.		Total water loss from 46.5' - EOB = approx. 1,600 gal with no return up casing	
	2:05						EOB @ 57.4' bgs			
58							Cored 20.5' NQ wireline core. Top of bedrock @ ~ 36'.			

TYPE OF DRILLING RIG:	Mobile B-59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4" and 5" inside DIA Drive & Wash Casing		
METHOD OF SOIL SAMPLING:			
METHOD OF ROCK CORING:			
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB 401B	PAGE: 4 OF 4

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-402S
PROJECT NO.:				START DATE:	1/22/99
LOGGED BY:	A. Putnam	TRANSCRIBED BY:	LAC	COMPLETION: DATE:	1/22/99
DRILLED BY (Company/Driller):	Aquifer Drilling & Testing Inc./K. Kutarnia			MON. WELL NO.:	MW-402S
GRD. SURFACE ELEVATION:	13.0'	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
0							No soil samples taken refer to boring log 402B for description.			
21										

TYPE OF DRILLING RIG:	Mobile Drill - B 59		*Tetra Tech NUS, Inc.*
METHOD OF ADVANCING BORING:	4 in. ID Drive & Wash Casing		
METHOD OF SOIL SAMPLING:	2 in. split-barrel sampler driven with a 140 lb. hammer with a 30 in. drop.		
METHOD OF ROCK CORING:			
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB-402S	PAGE: 1 OF 1

BORING LOG FOR:	RAYMARK			BORING NO.:	SB - 402B
PROJECT NO.:				START DATE:	1-8-99
LOGGED BY:	J. TROTTIER/ J. MELLO	TRANSCRIBED BY:	LJD	COMPLETION: DATE:	1-14-99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/ S. Bray			MON. WELL NO.:	MW-402B
GRD. SURFACE ELEVATION:	13.0'	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
0							Asphalt surface			
	42 / 57	17" / 24"	OU4-SO-402-0002	Fill natural			SILT and GRAVEL, 3" diameter, angluar GRAVEL.		Dry	FID = 0.0
2	19 / 7		0935			Brown	SILT	ML	Dry	PID = 0.0
	5 / 6	24" / 24"	OU4-SO-402-0204				SILT, some clay, organic or asbestos fibers		Fibers look like hairs	FID = 0.0
4	8 / 10		1000			yellowish orange	(M) to (F) SAND, trace silt	SP	Fining downwards bedding visible	PID = 0.0
	8 / 10	15" / 24"	OU4-SO-402-0406				(F) SAND, trace (M) sand, trace silt	SP	Bedding 3" thick	FID = 0.0
6	10 / 11		DUP 1100				SILT, trace clay (M) SAND, trace (F) sand, trace silt	ML SP		PID = 0.0
	8 / 10	12" / 24"	OU4-SO-402-0608				(F) SAND, some (M) sand	SP	10 mm brown beds every 1"	
8	11 / 13		1110							
	6 / 9	15" / 24"	OU4-SO-402-0810							
10	9 / 13		1130				Trace silt 1" layer		Bottom 10 mm staining	
	7 / 9	12" / 24"	OU4-SO-402-1012				(F) SAND		1" red staining	
12	11 / 12		1135				(M) SAND on bottom			
	6 / 7	13" / 24"	OU4-SO-402-1214			Greenish Gray	(F) SAND, trace silt	SP	10 mm black bedding 3"	
14	7 / 8		1150							
	5 / 6	15" / 24"	OU4-SO-402-1416						2 - 10mm beds w/60% mica grains	
16	7 / 8		1200			Yellowish orange				

TYPE OF DRILLING RIG:	Mobile Drill B-59
METHOD OF ADVANCING BORING:	4 in. ID Drive & Wash Casing
METHOD OF SOIL SAMPLING:	3 in. split-barrel sampler driven with a 300 lb. Hammer with a 18 in. drop to 16 fbgs; switch to 5' int. w/2"/140lb. & 30 in drop
METHOD OF ROCK CORING:	NQ Wireline
GROUNDWATER LEVELS:	
OTHER OBSERVATIONS:	

BORING NO.: SB-402B

Tetra Tech NUS, Inc.

BORING LOG FOR:	RAYMARK			BORING NO.:	SB – 402B
PROJECT NO.:				START DATE:	1-8-99
LOGGED BY:	J. TROTTIER/ J. MELLO	TRANSCRIBED BY:	LJD	COMPLETION: DATE:	1-14-99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/ S. Bray			MON. WELL NO.:	MW-402B
GRD. SURFACE ELEVATION:	13.0'	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
16										
18										
20										
	10	22"/24	OU4-SO-402-2022			Yellow/ Orange	Med. Dense fine SAND, trace silt	SP	wet	
22	10 / 12 / 14		1130							PID = 0.0
24										
26	11 / 9	20"/24"	OU4-SO-402-2527			Yellow/ Orange	Med. Dense fine SAND, trace silt	SP	wet	PID = 1.7
	11 / 10		1245							
28										
30										
	11 / 14	13"/24"	OU4-SO-402-3032							
32	17 / 17		1330			Yellow/ orange	Dense fine SAND, trace silt	SP	wet	FID = 0.0

TYPE OF DRILLING RIG:	Mobile Drill B-59
METHOD OF ADVANCING BORING:	4 in. ID Drive & Wash Casing
METHOD OF SOIL SAMPLING:	3 in. split-barrel sampler driven with a 300 lb. Hammer with a 18 in. drop to 16 fbgs; switch to 5' intervals w/2"/140lb. & 30 in. drop.
METHOD OF ROCK CORING:	NQ Wireline
GROUNDWATER LEVELS:	H2O LEVEL @ 10.4 FT. INSIDE CASING FOLLOWING SITTING OVER WK. END
OTHER OBSERVATIONS:	

Tetra Tech NUS, Inc.

BORING LOG FOR:	RAYMARK			BORING NO.:	SB - 402B
PROJECT NO.:				START DATE:	1-8-99
LOGGED BY:	J. TROTTIER/ J. MELLO	TRANSCRIBED BY:	LJD	COMPLETION: DATE:	1-14-99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/ S. Bray			MON. WELL NO.:	MW-402B
GRD. SURFACE ELEVATION:	13.0'	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
32										
34										
	20		OU4-SO-402-3537		v.dense	Yellow	Fine SAND, trace silt	SM/	Wet	FID = 18.3
36	40	16"				orange	Trace fine to coarse sand	SP		
	35	24"	1400							
	35									
38										
40										
	30		OU4-SO-402-4042		dense	Yellow	Sandy, GRAVEL, trace silt	GM	Wet	FID = 3.4
	20	9"				orange	½ weathered rock in sample			
	13	24"								
42	28		1430							
44										
	13		OU4-SO-402-4547		dense	Yellow	Sandy GRAVEL, trace silt, some coarse sand & fine	GM	Wet	FID = 9.0
46	17	18"				orange	Well rounded			
	15	24"	1505							
	13									
48										

OTYPE OF DRILLING RIG:	Mobile Drill B-59
METHOD OF ADVANCING BORING:	4 in. ID Drive & Wash Casing
METHOD OF SOIL SAMPLING:	*2 in. split-barrel sampler driven with a 140 lb. Hammer with a 30 in. drop .*
METHOD OF ROCK CORING:	NQ Wireline
GROUNDWATER LEVELS:	
OTHER OBSERVATIONS:	

BORING NO.: SB 402B

Tetra Tech NUS, Inc.

BORING LOG FOR:	RAYMARK			BORING NO.:	SB – 402B
PROJECT NO.:				START DATE:	1-8-99
LOGGED BY:	J. TROTTIER/ J. MELLO	TRANSCRIBED BY:	LJD	COMPLETION: DATE:	1-14-99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/ S. Bray			MON. WELL NO.:	MW-402B
GRD. SURFACE ELEVATION:	13.0′	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering, etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
48										
50										
	41	19" / 24"	OU4-SO-402-5052		Dense	Yellow/ orange	Well graded SANDS Little to no fine	SW		FID = 3.1
	19									
	14									
52	26		1540							
54										
	20	9" / 24"	OU4-SO-402-5557		Dense	Light Brown	Med. SAND w/gravel, rounded gravel	SP		FID = 0.0
56	20									
	16		0755							
	12									
58										
60									Casing to 60.5 FT.	
	100/2"	2" / 2"	OU4-SO-402-6062	Top Of Bedrock @ 60		Gray	weathered rock @ tip of spoon		Roller-bit to 61.2 FT. Top of Bedrock @ 60′.	FID = 0.0
62			0850		11 mpf	Dark green-Gray	chlorite, mica, SCHIST, no oxidation noted in fractures. W/some quartz veins, pea-sized garnets		62-62.5 high angle fracture	
					7 mpf		↓		63.6 horizontal fracture	
64					8 mpf					

TYPE OF DRILLING RIG:	Mobile Drill B-59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4 in. ID Drive & Wash Casing		
METHOD OF SOIL SAMPLING:	2" split-barrel sampler driven with a 140 lb. Hammer with a 30 in. drop .		
METHOD OF ROCK CORING:	NQ Wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB-402B	PAGE: 4 OF 8

BORING LOG FOR:	RAYMARK			BORING NO.:	SB 402B
PROJECT NO.:				START DATE:	1-8-99
LOGGED BY:	J. TROTTIER/ J. MELLO	TRANSCRIBED BY:	LJD	COMPLETION: DATE:	1-14-99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/ S. Bray			MON. WELL NO.:	MW-402B
GRD. SURFACE ELEVATION:	13.0 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL D ENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA METHOD = [FID, (PPM)]
64										
			C-1 61.2-71.2' Pen. = 120" Recovery = 120" RQD (in) 117" RQD (%) 97.5%		6 mpf	Dk. Gray& Dk. green	65.0 jagged frac? SCHIST, chlorite/biotite		High angle wavy schistocity	
66					5 mpf		65.7 horizontal frac w/pea-sized garnets 65.9 hammer break			
					6 mpf		66.8 jagged frac.			
68					7 mpf		68.0 30° frac.			
					7 mpf		68.6 30° frac.			
70					6 mpf		69.5 & 70.1 45° frac			
					6 mpf	Dk. Gray-Lt. gray	SCHIST inter layered w/quartz 70.6 30° frac. veins		More feldspar/quartz at 70'	
72			C-2 71.2-81.2 Pen 120" Recovery 120" RQD(in) 76" RQD(%) 71%		6 mpf		71.4 30° frac. 72.2 horizontal frac.			
					7 mpf		72.5 & 72.6 45° frac. GNESSIS/SCHIST,chlorite Biotite		Less foliation	
74					7 mpf		73.6 horizontal frac. trace quartz, calcite, garnets up to 1 cm.			
					5 mpf		74 & 74.4 45° frac. 74.9 jagged 45° frac.			
76					7 mpf		75.6 near vert. frac.			
					6 mpf					
78					6 mpf		77.1 30° frac			
					3 mpf	Dk. gray Dark grn.	78.2 – 78.9 core in layers/ broken. SCHIST-chlorite/biotite		More foliation, wavy	
80					5 mpf	To gray	79.5 30° frac.			

TYPE OF DRILLING RIG:	Mobile Drill B-59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4in. ID Drive and Wash Casing		
METHOD OF SOIL SAMPLING:			
METHOD OF ROCK CORING:	NQ Wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB-402B	PAGE: 5 OF 8

BORING LOG FOR:	RAYMARK			BORING NO.:	SB 402B
PROJECT NO.:				START DATE:	1-8-99
LOGGED BY:	J. TROTTIER/ J. MELLO	TRANSCRIBED BY:	LJD	COMPLETION: DATE:	1-14-99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/ S. Bray			MON. WELL NO.:	MW-402B
GRD. SURFACE ELEVATION:	13.0 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
80										
					4 mpf		81.2 jagged 30° break Chlorite/biotite, SCHIST, trace garnets			
82			C-3 81.2-91.2 Pen 120" Recovery 120" RQD (in)80" RQD(%) 67%		6 mpf		81.9 to 82.4 45° frac			
					7 mpf					
84					5 mpf					
					6 mpf		84.7 45° frac.			
86					6 mpf		86.1 hammer break		Near vertical foliation	
					5 mpf		86.75 & 87.4 jagged breaks			
88					6 mpf		88.3 horiz. frac			
					7 mpf		89 to 89.7 45° frac			
90			C-4 91.2 – 101.2 Pen. – 120" Recovery – 120" RQD (in) – 91" RQD % - 76"		5 mpf		90.7 to 91.2 core broke			
					8 mpf					
92					10 mpf		92.7 30° frac			
					12 mpf		93.2 30° frac			
94					5 mpf		93.5 30° frac			
					6 mpf		95.8 10° frac			
96					7 mpf		96.2 horiz. frac			

TYPE OF DRILLING RIG:	Mobile Drill B-59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4in. ID Drive and Wash Casing		
METHOD OF SOIL SAMPLING:			
METHOD OF ROCK CORING:	NQ Wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB-402B	PAGE: 6 OF 8

BORING LOG FOR:	RAYMARK			BORING NO.:	SB 402B
PROJECT NO.:				START DATE:	1-8-99
LOGGED BY:	J. TROTTIER/ J. MELLO	TRANSCRIBED BY:	LJD	COMPLETION: DATE:	1-14-99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/ S. Bray			MON. WELL NO.:	MW-402B
GRD. SURFACE ELEVATION:	13.0 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
96										
					7 mpf		96.6 30° frac.			
98					10 mpf					
					11 mpf		99.6 high angle frac			
100					8 mpf		100.3 jagged frac. 30°			
			C-5 101.1 - 111.2		8 mpf		100.6 30° frac. Chlorite, mica, SCHIST, w/peasized And smaller garnets, some quartz veins.		Near verticle foliation	
102			Pen 120" Recovery 115" RQD(in) 101" RQD (%) 88%		12 mpf		100.75 & 101 45° Frac.			
					9 mpf		102.8 horiz. Frac.		Foliation not well defined	
104					11 mpf					
					8 mpf		105.45 hammer break			
106					8 mpf		106 10° frac			
					14 mpf		106.85 horiz. Break			
108					9 mpf					
					10 mpf		108.6 10° jagged frac			
110					7 mpf		110.2 30° frac		Near vertical foliation	
					8 mpf		110.8 30° frac 111.7 10° frac.			
112			C-6 111.2-121.2		11 mpf		112.5 high angle frac			

TYPE OF DRILLING RIG:	Mobile Drill B-59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4in. ID Drive and Wash Casing		
METHOD OF SOIL SAMPLING:			
METHOD OF ROCK CORING:	NQ Wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB-402B	PAGE: 7 OF 8

BORING LOG FOR:	RAYMARK			BORING NO.:	SB 402B
PROJECT NO.:				START DATE:	1-8-99
LOGGED BY:	J. TROTTIER/ J. MELLO	TRANSCRIBED BY:	LJD	COMPLETION: DATE:	1-14-99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/ S. Bray			MON. WELL NO.:	MW-402B
GRD. SURFACE ELEVATION:	13.0 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
112										
			C-6 (cont.) Pen. 120" Rec. - 120" RQD (in) 80" RQD % - 67%		11 mpf		Chlorite, mica, SCHIST w/pea-sized and smaller garnets		High angle foliation	
114					12 mpf					
					11 mpf		115.1 10° frac.			
116					11 mpf		116.5 45° frac.			
					18 mpf		117.2 to 118.1 high angle frac.			
118					18 mpf					
					13 mpf		119.5 to 120 high angle frac.			
120					11 mpf					
					12 mpf					
122				EOB 121.95			End Of Boring @ 121.95' BGS			

TYPE OF DRILLING RIG:	Mobile Drill B-59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4in. ID Drive and Wash Casing		
METHOD OF SOIL SAMPLING:			
METHOD OF ROCK CORING:	NQ Wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB-402B	PAGE: 8 OF 8

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-421
PROJECT NO.:				START DATE:	12/20/98
LOGGED BY:	Tracy Dorgan/A. Putnam	TRANSCRIBED BY:	LAC	COMPLETION: DATE:	12/20/98
DRILLED BY (Company/Driller):	Aquifer Drilling and Testing, Inc.			MON. WELL NO.:	None
GRD. SURFACE ELEVATION:	23.4 FT.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6" & Core Times	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
0							Grass Surface			
	4	1.5 / 2.0	OU4-SO-421-0002			Brown-	S-1A = 1.1'—Silty, f-c SAND. Trace f-c gravel.		S-1A = dense & compact,	
	9					Dark Brown	Abundant roots in top 8 in.	SM	damp.	FID = 0.0
	12					Light	S-1B = SAND. Well graded f-c SAND.		S-1B = Dry & loose.	
2	12		1115 S-1			Brown	1/8" oxidation layer @ contact of S-1A & B.	SW		PID = 0.5
	8	0.5 / 2.0	OU4-SO-421-0204	Waste/		Dark gray	Sand & gravel with broken brade pad fragments &		Waste fill.	
	23			Fill		& yellow	asbestos containing material.	Fill/		FID = 0.0
	24					Red-		Waste		
4	12		1130 S-2			orange				PID = 0.1
	9	.75 / 2.0	OU4-SO-421-0406			Dark	S-3A = 0.25'. Similar to above.		Poss. sludge waste?	
	9		OU4-SO-DUP-04@			green-				FID = 0.0
	6		1155			gray &	S-3B = 0.5'—silt & f. SAND size material with			
6	5		1145 S-3			black	gasket & asbestos material & brade pad frag.			PID = 0.4
	6	0.0 / 2.0	OU4-SO-421-0608						No sample recovery	
	5			No			No recovery			
	18			recovery					~7.8'-8.0'—driller drove	
8	20		1200 S-4						casing through	
	30	0.2 / 2.0	OU4-SO-421-0810			Dark gray	1 lg. piece of steel in spoon.		abstruction. Noted strong	
	20					to black	Brade pad, gasket material, felt-like material with		solvent odor Checked	FID = 0.0
	16						& fine SAND.		B.Z. w/FID = 0.0 ~1 min.	
10	10		1220 S-5						later. Abundant asbestos	PID = 0.8
	22	1.0 / 1.25	OU4-SO-421-1012	Poss.			S-6A = 0.1'—similar to above.			
	56			top of			S-6B = saprolitic SCHIST.			
	50/3"			weathered						
12			1245 S-6	bedrock						
			C-1 12.0'-15.0'				SCHIST with vertical foliation highly weathered,			
	4:03		PEN = 3'				fragments.			
			REC = 3'				High mica content. Highly fractured (high angle to		RAPID water loss at 14'	
14	3:19		RQD = 0%				horiz.)		(~200 gallons)	
							SCHIST with near vertical foliation, iron oxides and			
	3:03						weathering core is pitted & vuggy in places.			
			C-2 15-17, RQD = 29%							
16	1:46		PEN = 2', REC = 2'							

TYPE OF DRILLING RIG:	Mobile B-59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	5" and 4" inner diameter casing, Drive and Wash		
METHOD OF SOIL SAMPLING:	3" split-barrel spoon driven w/ 300 lb. hammer, 18" drop;		
METHOD OF ROCK CORING:	NQ wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB-421	PAGE: 1 OF 2

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-421
PROJECT NO.:				START DATE:	12/20/98
LOGGED BY:	Tracy Dorgan/A. Putnam	TRANSCRIBED BY:	LAC	COMPLETION: DATE:	12/20/98
DRILLED BY (Company/Driller):	Aquifer Drilling and Testing, Inc.			MON. WELL NO.:	None
GRD. SURFACE ELEVATION:	23.4 FT.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
16										
	2:02									
18										
							End Of Boring at 17.0' BGS			

TYPE OF DRILLING RIG:	Mobile B-59
METHOD OF ADVANCING BORING:	5" and 4" inner diameter casing. Drive and wash
METHOD OF SOIL SAMPLING:	3" split-barrel spoon driven w/300 lb. Hammer, 18" drop;
METHOD OF ROCK CORING:	NQ Wireline
GROUNDWATER LEVELS:	
OTHER OBSERVATIONS:	

Tetra Tech NUS, Inc.

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-422
PROJECT NO.:				START DATE:	12/16/98
LOGGED BY:	TRACY DORGAN	TRANSCRIBED BY:	LAC	COMPLETION: DATE:	12/17/98
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING			MON. WELL NO.:	NONE
GRD. SURFACE ELEVATION:	13.0 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
0							Grass surface			
	1 2	1.6 / 2.0	OU4-SO-422-0002 OU4-SO-DUP-02 1445 1435 S-1	LOAM		Brown	S-1A = 1.0' – silty, fine poorly graded SAND. Abundant grass roots.	SM	Loam = S-1A. Dry-damp.	FID = 0.0
2	3 6			SAND & GRAVEL		Light brown/tan	S-1B = 0.6' – fine SAND, poorly graded, trace silt.	SP	Dry & loose.	PID = 0.0
	4 6	0.9 / 2.0	OU4-SO-422-0204			Brown	GRAVEL AND SAND. Sand is f-c well graded, gravel is rounded and coarse, trace silt.	GM/SW	Saturated (from wash water)	FID = 0.0
4	7 10		1505 S-2			↓				PID = 0.0
	14 21	1.1 / 1.75	OU4-SO-422-0406			↓	Silty, sandy, GRAVEL. Gravel is f-c rounded.	GM	Saturated	FID = 0.0
6	23 50/3"		1520 S-3			Dk. Gray	Schist in nose.			PID = 0.0
			C-1-6'→8.5' PEN = 2.5'	COBBLES & BOULDERS	2:05		Cored through 3 cobbles (1 each, schist, gneiss, & granite.)		~6.5' popped through @ 6.7' = cobble	
8					2:10 1:22/1/2'		D&W casing to 17' & sample.		Poor seal, poor water return, trace sand in wash.	
							Cobbles & boulders.		Lost ~100 gal. To overburden.	
10							↓		Cobbles &/or boulders from ~6'→11.5'. Roller bit to	
									12' & sample. Lost 200 gal. total.	
12							↓			
	13 8	0.5 / 2.0	OU4-SO-422-1214	GRAVEL & SAND		Lt. brown	Sandy, coarse GRAVEL. Gravels are well	GP	Saturated	FID = 0.0
14	8 10		1635 S-4							PID = 0.0
	4 6	1.0 / 2.0	OU4-SO-422-1416			Brown/ Red-orange	Gravelly, SAND. Mostly f-c well graded sand. Some coarse rounded gravel.	SW	Significant oxidation stains on/in gravels & sand.	FID = 0.0
16	12 23		1650 S-5							PID = 0.0

TYPE OF DRILLING RIG:	Mobile drill B-59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4" diameter drive & wash casing.		
METHOD OF SOIL SAMPLING:	3 in. split-barrel driven with a 300 lb. hammer & 18" drop – S-1→S-5. S-6 & S-7 = 2" sampler driven w/ 140 lb. hammer & 30 in. drop.		
METHOD OF ROCK CORING:	NQ wireline.		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:	FID – B; PID - E	BORING NO.: SB-422	PAGE: 1 OF 2

BORING LOG FOR:	RAYMARK	BORING NO.:	SB-422
PROJECT NO.:		START DATE:	12/16/98
LOGGED BY:	TRACY DORGAN	TRANSCRIBED BY: LAC	COMPLETION: DATE: 12/17/98
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING	MON. WELL NO.:	NONE
GRD. SURFACE ELEVATION:	13.0 ft.	ELEVATION FROM: NGVD 1929	CHECKED BY:

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
16										
	21	0.75 / 2.0	OU4-SO-422-1618	SAND		Dk.	Crushed gravel fragments over fine-coarse well graded sand w/ minor bedding layers noted.	SW	Saturated. Minor bedding noted.	FID = 2.3
	26									
	36					Lt. brown				
18	37		0745 S-6							PID = 0.4
	12	0.8 / 1.15	OU4-SO-422-1820				Similar to S-6 above.		Spoon refusal @ 19.25'. Begin standard int. sampling. D & W to 22.5' = casing refusal. Roller-bit ahead & D & W to 23.5'. Poss. top of bedrock.	Fid = 0.2
	51									
	100/3"									PID = inop. Due to rain
20			0810 S-7							
			No sample 20-23.5'.	Top of weathered bedrock ~ 22-23' bgs						
22										
24			C-1 = 23.5-26.5' PEN = 3.0' REC. = 3.0' TOTAL # IN. > 4" = 25" % RQD = 69%				Quartzite? Granofels. Fine grained with inc. Feldspar crystals with depth.		Smooth coring until 26.0' bgs, popped in & out of Void or fracture zone. Lost ~60 gal. & cored last ½' in 5 sec.	
	3:50					Gray – lt. Green w/ white feldspa	2 horiz. fractures w/ staining @ 24.3' & 24.8'.			
	3:20									
26	1:20						Heavily fractured (horiz. & vert.) zone from approx. 26'-27' w/ staining & halo's along fracture face.			
	3:10		C-2 = 26.5-29.5 PEN = 3.0' REC = 3.0' TOTAL # IN. > 4" = 13.25" RQD = 36.8%						Wash return turned white from lt. brown @ ~27.75' bgs.	
28	3:30						Horiz. frac. @ 27.5& 28'.			
	3:28						Vert. $CaCO_3$ vein from 28.5 to EOB inside core.			
30							Becomes open frac. (high angle) @ 29.3-EOB. Tranistion into a chlorite, quartz mafic (horneblende)			
							Gneiss? EOB @ 29.5' bgs.			

TYPE OF DRILLING RIG:	Mobile Drill D-59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4" diameter drive and wash casing		
METHOD OF SOIL SAMPLING:	3 in. split-barrel driven with a 300 lb Hammer and 18" drop-S-1→S-5,S-6,&S-7 = 2" sampler driven w/140 lb.		
METHOD OF ROCK CORING:	NQ wireline. Hammer & 30 in. drop		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:	FID – C; PID - D	BORING NO.: SB-422	PAGE: 2 OF 2

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-423
PROJECT NO.:				START DATE:	1-5-99
LOGGED BY:	J. MELLO	TRANSCRIBED BY:	LJD	COMPLETION: DATE:	1-7-99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/ S. BRAY			MON. WELL NO.:	N/A
GRD. SURFACE ELEVATION:	12.9 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
0							Asphalt surface			
	7	21.5" / 24"	OU4-SO-423-0002			Yellow brown	(F) SAND trace silt	SP	Dry, homogenous	FID = 0.0 #B
	7									
	9									PID = 0.0 (1,700*)
2	12		1520							
	5	6" / 15"	OU4-SO-423-0204							FID = 0.0
	5									
	30/3"									PID = 0.0 (1,100*)
4			1530							
	4	12" / 24"	OU4-SO-423-0406							FID = 0.0
	5									
	6					Brown	(F) sandy, SILT, trace clay	ML	Moist	PID = 0.0
6	6		1540							
	7	12" / 24"	OU4-SO-423-0608			Yellow-Brown	Silty, (F) SAND	SM	Dry	FID = 0.0
	7									
	7								Moist	PID = 0.0
8	7		1600							
	5	11" / 24"	OU4-SO-423-0810 01/06/99 DUP							FID = 0.0 #A
	5									
	6									PID = 0.0 #D
10	5		0840							
	5	6" / 24"	OU4-SO-423-1012							FID = 0.0
	4									
	6									PID = 0.0
12	5		0920							
	4	16" / 24"	OU4-SO-423-1214				Trace clay			FID = 0.0
	5									
	7									PID = 0.0
14	8		0950 MS/MSD						Thin, bedding visible	
	6	8" / 24"	OU4-SO-423-1416				No clay		Collecting VOC Screening, samples only,	FID = 0.0
	10									
	13								Switch to 2" diam. spoon	PID = 0.0
16	13		1010							

TYPE OF DRILLING RIG:	Mobile Drill B-59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4 in. ID Drive & Wash Casing		
METHOD OF SOIL SAMPLING:	3" split-barrel sampler driven with a 300 lb. Hammer with a 30 in. drop.(0-16') 2" split-barrel driven w/a 140 lb. Hammer and 30 in.		
METHOD OF ROCK CORING:	NQ Wireline	drop 16'-61'.	
GROUNDWATER LEVELS:	5.7 fbgs. 1020 hrs. H_2O level @ well located in the center of ball field 14fbgs. 7.4fbgs 1045		
OTHER OBSERVATIONS:	*Retaken w/PID #E Note: no washing fluids were lost from 0-16	BORING NO.: SB 423	PAGE: 1 OF 4

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-423
PROJECT NO.:				START DATE:	1-5-99
LOGGED BY:	J. MELLO	TRANSCRIBED BY:	LJD	COMPLETION: DATE:	1-7-99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/ S. BRAY			MON. WELL NO.:	N/A
GRD. SURFACE ELEVATION:	12.9 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
16										
	15	14"/24"	OU4-SO-423-1618			Yellow-brown	Silty, (F) SAND, trace clay, 1-piece of 1" diam. Subrounded gravel.	SM		FID = 0.0
	10									
	12									PID = 0.0
18	13		1105							
	10	11"/24"	OU4-SO-423-1820							FID = 0.0
	9									
	18						No gravel			PID = 0.0
20	20		1115							
22										
									NOTE: Break in depth from 22-25'.	
25										
	30	10"/24"	OU4-SO-423-2527				2" interbedded (M) SAND and (F) sand, both with gravel (subrounded 1" diam. max), trace silt	SP		FID = 2.1
	38									
	42									PID = 0.0
27	25		1250							
29										
	24	17"/24"	OU4-SO-423-2931						Low-med, plasticity	FID = 0.0
	20									
	14						Silty SAND (F)	SM		PID = 0.0
31	15		1315				(F) sandy SILT, trace clay	ML		

TYPE OF DRILLING RIG:	Mobile Drill B-59
METHOD OF ADVANCING BORING:	4 in. ID Drive & Wash Casing
METHOD OF SOIL SAMPLING:	3" split-barrel sampler driven with a 300 lb. Hammer with a 30 in. drop. (0-16') 2" split-barrel driven w/a 140 lb. Hammer and 30 in.
METHOD OF ROCK CORING:	NQ Wireline drop 16'-61'.
GROUNDWATER LEVELS:	
OTHER OBSERVATIONS:	

Tetra Tech NUS, Inc.

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-423
PROJECT NO.:				START DATE:	1-5-99
LOGGED BY:	J. MELLO	TRANSCRIBED BY:	LJD	COMPLETION: DATE:	1-7-99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/ S. BRAY			MON. WELL NO.:	N/A
GRD. SURFACE ELEVATION:	12.9 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
34										
	15	17" / 24"	OU4-SO-423-3436			Yellowish Brown to Lt. Gray	SILT, some clay	ML	Bedding visible Med. Plasticity	FID = 0.0
	18									
	42						(F – C) SAND, trace fines, trace (F) gravel	SW		PID = 0.0
36	35		1340							
									NOTE: break in depth.	
39										
	24	9" / 24"	OU4-SO-423-3941			Lt. Brown	(F – C) SAND and (F) GRAVEL, trace silt Gravel (subrounded, 1" diameter max)	SW		FID = 2.8 PID = 0.0
	14									
	16									
41	16		1440							
									NOTE: break in depth.	
44										
	25	12" / 24"	OU4-SO-423-4446							FID = 1.5
	24									
	23									PID = 0.0
46	22		1522				-more silt			
			1-7-99						NOTE: break in depth.	
49										
	20	0" / 24"	OU4-SO-423-4951				A piece of rounded, 1.5" diam., white quartzite Stuck in spoon tip. A matrix of sand and gravel			FID = (N/A)
	22									
	32						Surrounded the quartzite rock			PID = (N/A)
51	29		0750							
						Reddish Brown			(f) gravel in wash H_2O	

TYPE OF DRILLING RIG:	Mobile Drill B-59
METHOD OF ADVANCING BORING:	4 in. ID Drive & Wash Casing
METHOD OF SOIL SAMPLING:	(0-16') 2" split barrel driven w/ a 140 lb. Hammer and 30 in. drpo 16'-61'.
METHOD OF ROCK CORING:	NQ Wireline
GROUNDWATER LEVELS:	
OTHER OBSERVATIONS:	

BORING NO.: SB 423

Tetra Tech NUS, Inc.

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-423
PROJECT NO.:				START DATE:	1-5-99
LOGGED BY:	J. MELLO	TRANSCRIBED BY:	LJD	COMPLETION: DATE:	1-7-99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/ S. BRAY			MON. WELL NO.:	N/A
GRD. SURFACE ELEVATION:	12.9 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
54										
	25	10" / 24"	OU4-SO-423-5456			Yellowish	(F-C) sand and (F) gravel, little fines	SW/	Some weathering of	FID = 0.0
	18					Gray	Pieces of 1"diam. subangular schist rocks	GP	gravel pieces	#C
	19									PID = 0.0
56	17		0830							#D
									NOTE: break in depth.	
59										
	25	12" / 24"	OU4-SO-423-5961			Yellow-orng	(F-C) sand & gravel (< 1.5" diam. subangular) little	SW/GP	COBBLES?	FID = 0.4
	18					Lt. Brown	Fines (M-C) sand, trace ½" diam. subrounded gravel	SP		
	22					Reddish	Silty (F) sand, a piece of 1.5" diam. subrounded	SM		PID = 0.0
61	59		1020			Brown	gravel		COBBLES?	
62		60"								
			12:39 Start		7:30		Pyrite, Mica, Hornblende, SCHIST < 0.5" quartz	BR		
			C-1 (62-67)				veins		75° FOLIATION	
					6:45				20 GAL OF WASH H_2O	
64									LOST IN 2FT CORING	
					7:30		% RQD = 90			
					5:45					
66		60"								
			PAUSE		5:50		< 0.25" Quartz veins			
67			13:14 STOP						50° FOLIATION	
							EOB @ 67' BGS.			

TYPE OF DRILLING RIG:	Mobile Drill B-59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4 in. ID Drive & Wash Casing		
METHOD OF SOIL SAMPLING:	3" split-barrel sampler driven with a 300 lb. Hammer with a 30 in. drop.		
METHOD OF ROCK CORING:	NQ Wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:	BOREHOLE COMPLETED W/ Bentonite slurry	BORING NO.: SB 423	PAGE: 4 OF 4

BORING LOG FOR:	RAYMARK	BORING NO.:	SB-424
PROJECT NO.:		START DATE:	12/15/98
LOGGED BY:	T. DORGAN	TRANSCRIBED BY: LAC	COMPLETION: DATE: 12/16/98
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING	MON. WELL NO.:	NONE
GRD. SURFACE ELEVATION:	15.3 ft.	ELEVATION FROM: NGVD 1929	CHECKED BY:

DEPTH (FEET)	BLOWs PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
0							Grass surface			
	3	1.6 / 2.0	OU4-SO-424-0002	COVER		Brown	S-1A = 0.5' – silty, fine poorly graded SAND. Organic rich.	SM	Moist. Abundant roots. SW = loose & dry fill?, More dense	FID = 0.0
	9			FILL		Lt. gray	S-1B = 0.8' – gravelly, f-c well graded SAND.	SW		PID = 12.0
2	9 / 12		0830 S-1	FILL		Dark brown	S-1C = 0.3' – silty, gravelly, f-c SAND. Trace wood.	SM		0.0 in B.Z.
	12	1.0 / 1.35	OU4-SO-424-0204				Similar to S-1C above.		Fill inc. plastic, rounded gravel & trace metal wire.	FID = 23.3
4	41 / 50/4"		0855 S-2			Dk. gray	- Inc. metal wire & plastic debris.			PID = 19.1
	19	1.2 / 2.0	OU4-SO-424-0406			Dark gray to black	SAND & GRAVEL, trace silt. Gravel is f-c subang.-subrounded. Trace woody debris.	GM/ SW	Damp-dry. Compact fill. Inc. woody stems & black sludge? small qty. of asbestos fibers, damp.	FID = 2,640
6	21 / 21 / 3		0912 S-3							PID = 12.1
	12	0.75 / 2.0	OU4-SO-424-0608			Red & gray blotches	Silty, SAND. Trace gravel. Abundant asbestos matting, poss. gasket material.	SM	Fill. Asbestos easily seen w/ eye.	FID 1,669 PID = 138
8	13 / 14 / 14		0945 S-4	WASTE / FILL						FID in B.Z. peak of 1.8
	5	0.6 / 2.0	OU4-SO-424-0810				Mostly gasket material & asbestos fiber matting. Trace brake shoe & metal debris (steel plate & wire). In silty, sand matrix.		Fill. Wet.	FID = 1,427
10	11 / 14 / 12		0957 S-5							PID = 38
	3	1.5 / 2.0	OU4-SO-424-1012			Olive-gray	Silty, fine –coarse SAND. Abundant root fibers.	SM	Native? Out of man-made fill.	
	3		OU4-SO-DUP-01 (TOC/G.S.) 1020							FID = 1,773
12	3 / 4		1015 S-6							PID = 249
	6	0.5 / 2.0	OU4-SO-424-1214	SAND			Silty, f-med. SAND. Trace root fibers.		Saturated	
	6									FID = 364
14	8 / 9		1034 S-7							PID = 118
	18	1.2 / 2.0	OU4-SO-424-1416				Fine poorly graded SAND, trace silt, trace fine gravel.	SP	Saturated	FID = 1,032
16	19 / 6 / 21		1200 S-8							PID = 201

TYPE OF DRILLING RIG:	Mobile Drill B-59 truck mounted
METHOD OF ADVANCING BORING:	5" & 4" diameter threaded flush–joint casing (Drive & Wash)
METHOD OF SOIL SAMPLING:	3" split-barrel driven w/ 300 lb. hammer & 18" drop for S-1→S-10. S-11–S-14 = 2" split barrel driven w/300 lb. hammer & 18" fall (driller missing sub for 140 lb. hammer until S-15.
METHOD OF ROCK CORING:	NQ wire line core
GROUNDWATER LEVELS:	
OTHER OBSERVATIONS:	

BORING NO.: SB-424

Tetra Tech NUS, Inc.

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-424
PROJECT NO.:				START DATE:	12/15/98
LOGGED BY:	T. DORGAN	TRANSCRIBED BY:	LAC	COMPLETION: DATE:	12/16/98
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING			MON. WELL NO.:	NONE
GRD. SURFACE ELEVATION:	15.3 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
16										
	18		OU4-SO-424-1618			Olive-gray	Similar to S-8 above. Fine poorly graded SAND, trace silt.	SP	Saturated	
	15	0.9 / 2.0								FID = 706
	15									
18	15		1215 S-9							PID = 40
	5		OU4-SO-424-1820							
	5	1.0 / 2.0								FID = 560
	5									
20	6		1230 S-10							
22										
24										
	5 *		OU4-SO-424-2426			Olive-gray	Similar to S-10 above.	SP	*Saturated. No structure noted.*	
	8	0.6 / 2.0								FID = 379
	8									
26	6		1350 S-11							PID = 8.5
28										
	11 *		OU4-SO-424-2931							
30	10	1.1 / 2.0								
	7		1405 S-12			Olive-gray	SAND. Mostly f-c well graded sand, trace silt.	SW	*Coarsing downward.*	FID = 492
	8									
32										PID = 15

TYPE OF DRILLING RIG:	SEE P. 1		*Tetra Tech NUS, Inc.*
METHOD OF ADVANCING BORING:			
METHOD OF SOIL SAMPLING:			
METHOD OF ROCK CORING:			
GROUNDWATER LEVELS:	*Cal check PID & FID @ 1330 (after samp. 0-20') FID—96.8 w/ 98.6 PPM span gas & PID = 86 w/100 PPM span gas.*		
OTHER OBSERVATIONS:	* SEE NOTES ON P. 1	BORING NO.: SB 424	PAGE: 2 OF 4

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-424
PROJECT NO.:				START DATE:	12/15/98
LOGGED BY:	T. DORGAN	TRANSCRIBED BY:	LAC	COMPLETION: DATE:	12/16/98
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING			MON. WELL NO.:	NONE
GRD. SURFACE ELEVATION:	15.3 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
32										
34										
	5 *	1.0 / 2.0	OU4-SO-424-3436			Olive-gray	S-13A = 0.5' – fine interbedded silts & fine SANDS.	SM	Fine bedding layers noted.	FID = 0.0
36	8 / 8 / 11		1420 S-13				S-13B = 0.5' – well graded f-c SAND w/ trace fine subrounded gravel.	SW		PID = 17.0
38										
40	6 * / 8	0.65 / 2.0	OU4-SO-424-3941			Olive-Gray	Similar to S-13B above.	SW	Loose, saturated.	FID = 10.0
	8 / 7		1440 S-14							PID = 26.5
42										
44										
	12 / 19	0.7 / 2.0	OU4-SO-424-4446			Olive-gray to lt. brown	Similar to S-13B & S-14 above.	SW	Saturated. No structure.	FID = 17.2
46	13 / 10		1510 S-15				Slight inc. in gravel.			PID = 16.5
48										

TYPE OF DRILLING RIG:	SEE P. 1		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	2 in. split-barrel driven w/ 40 lb. hammer & 30" fall from S-15→S-17.		
METHOD OF SOIL SAMPLING:			
METHOD OF ROCK CORING:			
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:	* SEE NOTES ON P.1	BORING NO.: SB-424	PAGE: 3 OF 4

BORING LOG FOR:	RAYMARK	BORING NO.:	SB-424
PROJECT NO.:		START DATE:	12/15/98
LOGGED BY:	T. DORGAN	TRANSCRIBED BY: LAC	COMPLETION: DATE: 12/16/98
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING	MON. WELL NO.:	NONE
GRD. SURFACE ELEVATION:	15.3 ft.	ELEVATION FROM: NGVD 1929	CHECKED BY:

DEPTH (FEET) 48	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
	15		OU4-SO-424-4951			Light brown Olive gray				
50	17	1.0 / 2.0					Gravelly, f-c SAND. Gravels are subrounded f-c.	SW		FID = 7.0
	26									
	30		1536 S-16							PID = 19.0
52									Hard driving casing @ ~52-52.5'. Easier 52.5-53.5. Hard driving 53.5-54.0'.	
54										
	64	0.3 / 7	OU4-SO-424-5455			Light Brown & dk. gray	Angular fine-c GRAVEL. In silty, fine sand matrix.	GM		FID = 0.0
56	50/1"		1610 S-17						Roller bit ahead of casing to 57.0'. cuttings in wash indicate weathered rock to ~54-55', fresh rock to 57'.	PID = 22.0
							57'→57.5' smokey QUARTZ w/ pyrite deposits. Phaneritic, quartz, hornblende (?)			

58			C-1 = 57.0 →62.0
			PEN = 5.0'
			REC = 4.7'
			Total # in. > 4" = 41.5'
			RQD = 69%
			% REC = 94%
					6:12		58'→59' numerous high angle fractures (45° or >) calcite & pyrite deposits, oxidation weathering chlorite, gneiss or hornblende (?)		Picking up a sheen in washing @ 58.5'.	FID = 0.3

					6:02					
60					5:45		60' horizontal fracture. Oxidation 60.25' high angle fracture. Calcite deposits, high amount of weathering/oxidation.		Approximately 100 gal lost in 3' of coring.	
					6:33					FID = 0.2
62		4.7 / 5.0			7:30		61' horizontal fracture. Pyrite, calcite, oxidation present 61'-61.5' high angle fracture.			
		pen					61.2-61.4 smoky quartz w/ pyrite deposits.			
							EOB @ 62' bgs.			

TYPE OF DRILLING RIG:	SEE P. 1 & 3	*Tetra Tech NUS, Inc.*
METHOD OF ADVANCING BORING:		
METHOD OF SOIL SAMPLING:		
METHOD OF ROCK CORING:	NQ - wireline	
GROUNDWATER LEVELS:		
OTHER OBSERVATIONS:	12/16/98 0840 started confirmatory core run—possible sand layer above rock @ 57'. 12/16/98 0915 head space on washtub w/FID = 1.8	BORING NO.: SB-424

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-425
PROJECT NO.:				START DATE:	12/15/98
LOGGED BY:	JOE MELLO	TRANSCRIBED BY:	LAC	COMPLETION: DATE:	12/16/98
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/S. BRAY			MON. WELL NO.:	N/A
GRD. SURFACE ELEVATION:	16.2 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
0							Grass surface			
	4	13"/18"	OU4-SO-425-0002	Cov. fill	Med.	Dk. brown	0-6" topsoil, fines and organic matter.	topsoil	OL wet fill (c&d) damp	FID = 0.6
	18			0.5'			6-18" silty SAND some gravel.	SM		
	50/4"				V. Dense					
2			0845 S-1			Brown	- asphalt in bottom of barrel shoe.			PID = 0.0
	7	13"/24"	OU4-SO-425-0204		Med.	Dark				
	14						- piece of concrete			FID = 64
	15			Fill						
4	18		0900 S-2							PID = 0
	28	6"/24"	OU4-SO-425-0406		Med.					
	73				Dense					FID = 65.3
	48									
6	36		0950 S-3				- trace brick			PID = 0
	7	10"/24"	OU4-SO-425-0608			Dk. gray/		ML	Waste fill	
	2					Black	f) sandy, SILT and			FID = 1,329
	13						- asbestos materials (50%) multi-colored board		Wash H_2O color change	
8	15		1000 S-4				Shaped, felt & brake pads.		dk. brown-dk. gray.	PIF = 15.5
	8	10"/24"	OU4-SO-425-0810		Loose/		- Trace glass		Wet/moist	
	9				Med.					FID = 1,250
	8			Waste			- trace steel nut, steel tool			
10	11		1030 S-5	Fill						PID = 23.2
	3	1"/24"	OU4-SO-425-1012							
	4		No samples collected				All waste:			FID = 440
	4									
12	5		1040 S-6				* 60%-80% suspect asbestos materials.			PID = 29.1
	3	3"/24"	OU4-SO-425-1214						**Composited sample from 12-16'.**	FID = 2,140
	4									
	5								Wet	
14	6		1140 S-7				- trace metal, glass			
	9	5"/24"	OU4-SO-425-1416							PID = 26.0
	5						- suspect asbestos cloth			
	3									
16	3		1150 S-8	Peat		Brown/red	PEAT and fines.	PT	Moist natural	

TYPE OF DRILLING RIG:	Mobile B-59		*Tetra Tech NUS, Inc.*
METHOD OF ADVANCING BORING:	Drive & Wash 5" diameter and 4" diameter casing		
METHOD OF SOIL SAMPLING:	3" and 2" diameter split barrel samplers		
METHOD OF ROCK CORING:	NQ rock coring		
GROUNDWATER LEVELS:	PID – E:FID - B		
OTHER OBSERVATIONS:	**All "waste" fill samples were homogenized, all large pieces of suspect ACM were removed from the sample**	BORING NO.: SB-425	PAGE: 1 OF 3

BORING LOG FOR:	RAYMARK	BORING NO.:	SB-425
PROJECT NO.:		START DATE:	12/15/98
LOGGED BY:	JOE MELLO	TRANSCRIBED BY: LAC	COMPLETION: DATE: 12/16/98
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/S. BRAY	MON. WELL NO.:	N/A
GRD. SURFACE ELEVATION:	16.2 ft.	ELEVATION FROM: NGVD 1929	CHECKED BY:

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
16										
	4	9" / 24"	OU4-SO-425-1618	Peat/silt	Soft	Reddish brown	Fibrous organic matter/silt.	PT/OL	Natural	FID = 1,952
	4		Toc/grain size							
	3						- trace metal			
18	3		1215 S-9				- trace (f-m) sand in tip of barrel			PID = 1.2
	4	8" / 24"	OU4-SO-425-1820	SANDS	V. Loose	Greenish gray	(f-m) SAND	SP/SM		FID = 506
	3									
	2						- trace silt, 1-3" long semi-rounded vertical granite rock.			
20	1		1330 S-10							PID = 0
22										
24										
	22	14" / 24"	OU4-SO-425-2426		Med.		Silty/clayey (f-c) SAND and (f) gravel	SM/SC	Change to 2" diameter barrel	FID = 82
	21									
	21						- subangular gravel			
26	26		1440 S-11							PID = 0
28										
30										
	29	10" / 24"	OU4-SO-425-3032		Med.	Reddish brown	Silty (f-c) SAND and (f) gravel	SM	Wash H_2O color change to red-brown	FID = 38
	58									
	76									
32	90		1530 S-12		V. Dense		- subangular gravel			PID = 0

TYPE OF DRILLING RIG:	Mobile B-59
METHOD OF ADVANCING BORING:	Wash & Drive 5" diameter to 18 fbgs. 4" diameter to 18 fbgs→bedrock
METHOD OF SOIL SAMPLING:	3" diameter split-barrel w/18" drop 300 lb. hammer to 20 fbgs, 2" diameter split barrel 24 fbgs→bedrock
METHOD OF ROCK CORING:	N/A
GROUNDWATER LEVELS:	
OTHER OBSERVATIONS:	

Tetra Tech NUS, Inc.

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-425
PROJECT NO.:				START DATE:	12/15/98
LOGGED BY:	JOE MELLO	TRANSCRIBED BY:	LAC	COMPLETION: DATE:	12/16/98
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/S. BRAY			MON. WELL NO.:	N/A
GRD. SURFACE ELEVATION:	16.2 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
32										
34										
35										
	35	13"/24"	OU4-SO-425-3537		Dense	Lt. brown	(vf) sandy SILT, some gravel, some clay	ML	Fining upwards/ downwards sequences	
	32					yellowish-orange	(f) SAND, some silt	SP		FID = 47
	39									
37	35		1600 S-13			lt. brown	(f-c) SAND some silt	SW		PID = 0
40										
	78	15"/24"	OU4-SO-425-4042		V. Dense		Similar to above		Fining upwards/ downwards sequences	
	89									
	83								Man-made debris inc. 1 bolt noted	
42	100/4		0750 S-14			Black	Bolt - 3" weathered SCHIST vert. foliation			
				Weathered bedrock						
44			C-1 1052	Competent bedrock			Pyrite, garnet, quartz, chlorite (dk. Mineral) SCHIST, 0-70° foliation		43.5 fbgs	
	6:30								Competent bedrock according to drilling pressure	
46	8:30						Iron oxide staining @ fracture @ 45 and 45.5 fbgs			
	8:30						EOB 47.5			
48	8:00									

TYPE OF DRILLING RIG:	Mobile B-59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	Drive & Wash to 43.2 fbgs w/ 4" diameter casing		
METHOD OF SOIL SAMPLING:			
METHOD OF ROCK CORING:	Roller bit to 44.5 fbgs into bedrock		
GROUNDWATER LEVELS:	Approx. 12 fbgs 12/16/98 0700		
OTHER OBSERVATIONS:	Day 2 starts @ 40 fbgs. FID # "C", PID # "D"	BORING NO.: SB-425	PAGE: 3 OF 3

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-426
PROJECT NO.:				START DATE:	12/16/98
LOGGED BY:	AMY PUTNAM/JOE MELLO	TRANSCRIBED BY:	LAC	COMPLETION: DATE:	12/18/98
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/S.BRAY			MON. WELL NO.:	N/A
GRD. SURFACE ELEVATION:	16.5 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
0							Grass layer			
	7	1.33'/2'	OU4-SO-426-0002		Med.	Light	Top .8' organic layers, top soil , fines, SAND with	SM/	Wet, natural	
	10				Dense	Brown	trace silt and trace gravel, well graded.	SP		FID = 0 PPM
	12									
2	15		0750 S-1							PID = 0 PPM
	5	2'/2'	OU4-SO-426-0204	2.5'	Med.	Light	2'-2.5' poorly graded SAND with trace silt.	SM	Moist	
	10				dense	Brown				FID = 77.8 PPM
	12						2.5'-4.0' asbestos fill, brake pad material, fine fibers,		Waste fill	
4	14		0825 S-2				some rust clr.			PID = 0.1 PPM
	8	.5'/2'	OU4-SO-426-0406			Dk. Gray	Asbestos fill, SAND w/ fine angular gravel, well		Wet	
	9					Black	graded			FID = 90.6
	5									
6	6		0900 S-3							PID = 1.6
	12	.5'/2'	OU4-SO-426-0608				Piece of metal, asbestos fill, w/ sand & gravel, similar			
	16						to above.			FID = 184.5
	9									
8	6		0915 S-4							PID = 2.6
	13	1'/2'	OU4-SO-426-0810			Dk. Gray	Asbestos fibers, fine gravel. Similar to above. Silty	SM		
	9						sand.			FID = 220.6
	6						Piece of hard cloth w/ metal inside. Piece of wood.			
10	4		0950 S-5							PID = 14.6
	5	1.2'/2'	OU4-SO-426-1012				Fibers, fill as above.			PID = 10.3
	3			11.5						FID = 130.2
	3					Light gray	Silty fine SAND, trace subrounded gravel. Piece of	SM		PID = 6.3
12	5		1005 S-6				Plant root			FID = 126.2
	14	1.1'/2'	OU4-SO-426-1214				Silty fine SAND. Trace fine gravel.		Natural	
	22									PID = 5.6
	25						Similar to above.			
14	30		1025 S-7				Coarse SAND w/ gravel.			FID = 251.3
	29	.8'/2'	OU4-SO-426-1416			Olive gray	Coarse, well graded SAND w/ fine-medium	SW	Fill	
	40						subrounded gravel.			FID = 31.6
	35									
16	30		1345 S-8				Piece of metal, fill.			PID = 72.8

TYPE OF DRILLING RIG:	Mobile B-59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	Drive & Wash 5" diameter casing to 18 fbgs, 4" diameter casing to 28 fbgs, roller bit to 30 fbgs		
METHOD OF SOIL SAMPLING:	3" and 2" split barrel samples		
METHOD OF ROCK CORING:	NQ wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB-426	PAGE: 1 OF 3

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-426
PROJECT NO.:				START DATE:	12/16/98
LOGGED BY:	AMY PUTNAM/JOE MELLO	TRANSCRIBED BY:	LAC	COMPLETION: DATE:	12/18/98
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/S.BRAY			MON. WELL NO.:	N/A
GRD. SURFACE ELEVATION:	16.5 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
16										
	25	1.1 / 2	OU4-SO-426-1618		Med. dense/ loose	Brown	Coarse SAND w/ fine to medium angular gravel, well graded.	SW	Wet	PID = 1.8
	23									
	24									
18	25		1505 S-9							FID = 4.8
20										
	27	.6 / 2	OU4-SO-426-2022		Low dense/ loose		Coarse SAND w/ gravel, similar to above.	SW/ GW	Wet	PID = 0.2
	37									
	21									
22	25		1610 S-10							FID = 0.3
24										
	75	10" / 24"	OU4-SO-426-2527		V. dense		(f-c) SAND and GRAVEL, similar to above.	SW/ GW	Brown wash H_2O	FID = 14
26	71									
	40						- broken-up granite cobble			
	17		0810 S-11							PID = 0
28							- trace silt		Greenish gray wash H_2O	
29				Weathered bedrock		Gray				
30				Competent bedrock						
			C-1						Gray wash H_2O	
	6:30	5' / 5'	(5')				SCHIST 70-80° foliation, some ribbon folds, 85% mica, trace garnet, trace pyrite, 14% quartz.			
32	9:00	RQD = 83%								

TYPE OF DRILLING RIG:	See page 1 roller bit 28-30 fbgs		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:			
METHOD OF SOIL SAMPLING:			
METHOD OF ROCK CORING:	NQ wireline		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:	Change from 3" diameter split barrels to 2" diameter @ 20 fbgs. 12/17/98—start @ 25 fbgs.	BORING NO.: SB-426	PAGE: 2 OF 3

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-426
PROJECT NO.:				START DATE:	12/16/98
LOGGED BY:	AMY PUTNAM/JOE MELLO	TRANSCRIBED BY:	LAC	COMPLETION: DATE:	12/18/98
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/S.BRAY			MON. WELL NO.:	N/A
GRD. SURFACE ELEVATION:	16.5 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"/ Time per foot	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (*moisture condition; odors;* geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
32										
	8:50		C-1 (cont.)	bedrock		Gray	2" quartz vein @ 31.5 fbgs		No H_2O loss	FID = 0
34	8:00									PID = 0
	7:00						Bottom 1' broken into 4 pieces			
36							- slight iron oxide staining			
							No H_2O bearing zones identified			
							EOB @ 35 FBGS			

TYPE OF DRILLING RIG:	Mobile B-59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	SEE P. 1		
METHOD OF SOIL SAMPLING:			
METHOD OF ROCK CORING:			
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:		BORING NO.: SB-426	PAGE: 3 OF 3

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-427
PROJECT NO.:				START DATE:	12-19-98
LOGGED BY:	A. PUTNAM	TRANSCRIBED BY:	LJD	COMPLETION: DATE:	12-20-98
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/S. BRAY			MON. WELL NO.:	N/A
GRD. SURFACE ELEVATION:	28.9 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
0							Grass surface			
	3	21"/24"	OU4-S0-427-0002	Cov. fill		Dk. brown	S-1A 7" organic material, root fibers	SW	S-1A moist	PID = 6.6
	5			f-c sand		Lt. Brown	S-1B 10" fine to coarse well graded SAND w/fine		S-1B loose	(H_2O vapor?)
	9				S-1C	Brown-	angular gravel			FID = 0.0
2	11		0845 S - 1		dense	Reddish	S-1C 4" organic rich, silt-sand, root fibers present			
	6	6"/24"	OU4-S0-427-0204			Reddish-	Poorly graded fine SAND, with trace coarse sand to	SM/	Dry, loose	FID = 0.0
	12					Brown	Fine gravel, silt, and fine sand	ML		
	9									PID = 5.4
4	5		0900 S - 2	Fine						(H_2O vapor?)
	15	3"/24"	OU4-S0-427-0406	sand		Dk. Gray	Organic fibers, fines, SILT		Moist, low recovery	FID = 11.8
	28									
	22						Cobbles in spoon – low recovery			PID = 10.2
6	13		0950 S - 3							(H_2O vapor?)
	8	8"/24"	OU4-S0-427-0608				Waste material, fibers, pad material with silty sand		Waste fill, wet	FID = 78.3
	7									
	7									PID = 26.4
8	5		1015 S - 4	Waste/						
	5	5"/24"	OU4-S0-427-0810	fill		Dk. Gray	Waste material w/silt, SAND, trace fine gravel			FID = 17.9
	16									
	5					Dk. Gray	Piece of cloth			PID = 7.3
10	6		1046 S - 5							
	4	12"/24"	OU4-S0-427-1012				Waste material – similar to above piece of wood, piece			FID = 60.2
	7		OU4-S0-DUP				of metal			
	5									PID = 35.7
12	5		1119 S - 6							
	3	3"/24"	OU4-S0-427-1214				Waste material. Similar to above		Small recovery	FID = 16.1
	4									
	3						Piece of metal			PID = 11.7
14	3		1245 S - 7							
	12	4.5"/24"	OU4-S0-427-1214				Waste material, wood chunks and splinters, small			FID = 4.3
	4						amount silty sand.			
	4						Pieces of metal wire			PID = 8.3
16	5		1309 S – 8							(H_2O vapor?)

TYPE OF DRILLING RIG:	Mobile B-59
METHOD OF ADVANCING BORING:	4" and 5" inner Dia. Casing, Drive and Wash
METHOD OF SOIL SAMPLING:	3" split-barrel sampling spoon driven by 300lb. Weight w/18" drop & 2" split-barrel sampling spoon driven by 140lb. Weight w/30" drop
METHOD OF ROCK CORING:	
GROUNDWATER LEVELS:	NQ wireline
OTHER OBSERVATIONS:	

BORING NO.: SB-427

Tetra Tech NUS, Inc.

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-427
PROJECT NO.:				START DATE:	12-19-98
LOGGED BY:	A. PUTNAM	TRANSCRIBED BY:	LJD	COMPLETION: DATE:	12-20-98
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING/S. BRAY			MON. WELL NO.:	N/A
GRD. SURFACE ELEVATION:	28.9 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [*FID, (PPM)*]
16										
	12		OU4-S0-427-1618			Dk. Gray	Waste material as described above with small pieces of glass, metal		Wash water very dark	FID = 42.6
	17	11" / 24"								
	20					Lt. Gray	2" of spoon = coarse sand to fine gravel w/fines	Bed Rock		PID = 9.8
18	27		1335 S - 9	Top of bedrock			17.5-18' weathered rock			
			C - 1				SCHIST 19.1-20.6' many horizontal fractures, horizontal			
20			INTERVAL : 19.1" - 24.1' Pen: 60" Rec: 60" RQD = 56%				Foliation, significant iron oxide staining, weathering 20.6'-24.1' angular (~80°) foliation 21.6' - visible			
	10:15						Fractures, iron oxide staining, 0.5" thick			
22	9:26						23.1' fractures, iron oxide staining, high angle fract.		No water loss	
	9:08						22.6' - very small quartz veins, high mica content (~80%)			
24	7:30									
	5:38						EOB at 24.1' bgs.			

TYPE OF DRILLING RIG:	Mobile B-59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4" and 5" inner Dia. Casing, Drive and Wash		
METHOD OF SOIL SAMPLING:	3" split-barrel sampling spoon driven by 300lb. Weight w/18" drop & 2" split-barrel sampling spoon driven by 140lb. Weight w/30" drop		
METHOD OF ROCK CORING:			
GROUNDWATER LEVELS:	NO - WIRELINE		
OTHER OBSERVATIONS:		BORING NO.: SB-427	PAGE: 2 OF 2

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-428
PROJECT NO.:				START DATE:	1/4/99
LOGGED BY:	A. Putnam/J. Mello	TRANSCRIBED BY:	LJD	COMPLETION: DATE:	1/4/99
DRILLED BY (Company/Driller):	AQUIFER DRILLING & TESTING ADT-2/ S. Bray			MON. WELL NO.:	N/A
GRD. SURFACE ELEVATION:	13.2 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
0										
	5	17"/24"	OU4-SO-428-0002	Fill	MED DENSE	Dk. BRN Reddish	S-1A = 4" rich organic, root fibers		Dry = S-1C	FID = 0.0
	7						S-1B = 9" poorly graded medium SANDw/ trace coarse sand			
	14					BRN				PID = 0.0
2	14					Lt. BRN	S-1C = 4" poorly graded Fine - Med SAND			
	11	16"/24"	OU4-SO-428-0204			Lt. Brown	Poorly graded fine to medium SAND w/trace silts	SP		FID = 0.0
	21									
	21			Natural Soils						PID = 0.0
4	23									
	12	10"/24"	OU4-SO-428-0406			Lt. BRN	Poorly graded (F) SAND, trace (M) sand, trace silt	SP	Dry, 0.5" beds	FID = 0.0
	11									
	11									PID = 0.0
6	9		1400							
	10	16"/24"	OU4-SO-428-0608			Yellow Orange	Silty (F) SAND	SM	wet	FID = 0.0
	12						(F) SAND, trace silt, trace (M) sand, silt, tr. clay,	SP		
	20							ML/SM		PID = 0.0
8	23		1410							
	9	19"/24"	OU4-SO-428-0810						**Composite sample from 8-12'**	FID = 0.0
	10									
	11									PID = 0.0
10	16		1425							
	15	14"/24"	OU4-SO-428-1012				Fine SAND and SILT	SM/ML	1. med. Dry strength 2. soft weak thread 3.fast RXN to shake	FID = 0.0
	21									
	38									PID = 0.0
12	45		1440							
	6	14"/24"	OU4-SO-428-1214				(F-M) SAND, trace silt	SP		FID = 0.0
	8									
	14									PID = 0.0
14	12		1505							
	7	18"/24"	OU4-SO-428-1416				(F) SAND, little fines	SP	2mm layers of Fines every 1"; bedding visible	FID = 0.0
	13									
	23									PID = 0.0
16	28		1520							

TYPE OF DRILLING RIG:	MOBLIE B-59		*Tetra Tech NUS, Inc.*
METHOD OF ADVANCING BORING:	DRIVE AND WASH, 5" AND 4" INNER DIAMETER CASING		
METHOD OF SOIL SAMPLING:	2" SPLIT BARREL SAMPLING SPOON DRIVEN BY 140LB. HAMMER W/30" DROP		
METHOD OF ROCK CORING:	N/A		
GROUNDWATER LEVELS:	DTW 6.4 fbgs @ 1530 1/4/99		
OTHER OBSERVATIONS:	EOB 14 fbgs w/4" casing, boring completed/ filled w/ bentonite slurry	BORING NO.: SB-428	PAGE: 1 OF 1

BORING LOG FOR:	RAYMARK			BORING NO.:	SB-429
PROJECT NO.:				START DATE:	12/20/98
LOGGED BY:	Tracy Dorgan	TRANSCRIBED BY:	LAC	COMPLETION: DATE:	12/20/98
DRILLED BY (Company/Driller):	Aquifer Drilling & Testing			MON. WELL NO.:	None
GRD. SURFACE ELEVATION:	13.8 ft.	ELEVATION FROM:	NGVD 1929	CHECKED BY:	

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA METHOD = [FID, (PPM)]
0							Grass Surface			
	1	0.5' / 2.0'	OU4-SO-429-0002			Brown	S-1A = 0.25' – silty, fine SAND. Abundant grass roots.	SM		PID = 0.0
	7									
	35					Gray-brown	S-1B = 0.25' – gravelly, SAND. Sand is f-c, gravels are coarse.	SW	Poss. cobbles due to poor recov. & broken gneiss in nose	
2	50		1450 S-1							
	40	0.4' / 0.75'	OU4-SO-429-0203			Reddish gray	Poss. weathered rock in nose.		Drive casing to 3.5' Roller-bit to 4.0'	PID = 0.0
	50/3"		1520 S-2							
4			C-1 = 4.0→9.8 PEN = 5.9 REC = 5.78 Total in. > 4" = 59" RQD = 83%	Top of Bedrock						
	>5:45					Dark gray	Chlorite, mica, SCHIST. - horiz. frac. at 4.9', high angle frac. w/ oxidation & alteration product from 5.0-5.7'		Lost approx. 30 gal. in top 2' of C-1.	
6	>5:50									
	>4:30						Solid core from 5.7'-10'.		Continue loosing H_2O	
8	>4:40								Total water loss = 50-60 gal.	
9	>2:50									
10	>3:20									
							End of boring at 10' bgs			

TYPE OF DRILLING RIG:	Mobile drill B-59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4 in. diameter drive & wash casing		
METHOD OF SOIL SAMPLING:	2 in. split-barrel sampler driven with a 140 lb. hammer & 30" drop.		
METHOD OF ROCK CORING:	NQ wireline core.		
GROUNDWATER LEVELS:			
OTHER OBSERVATIONS:	Water level inside casing in a.m. on 12/21/98 prior to grouting hole = 4.0' bgs. PID = E	BORING NO.: SB-429	PAGE: 1 OF 1

BORING LOG FOR:	RAYMARK	BORING NO.:	SB-430
PROJECT NO.:		START DATE:	1/5/99
LOGGED BY:	J. Mello	TRANSCRIBED BY: LAC	COMPLETION: DATE: 1/5/99
DRILLED BY (Company/Driller):	Aquifer Drilling & Testing Inc./S. Bray	MON. WELL NO.:	N/A
GRD. SURFACE ELEVATION:	14.1 ft.	ELEVATION FROM: NGVD 1929	CHECKED BY:

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]
0							Grass surface			
	3		OU4-SO-430-0002	Top soil			Organic SILT, little organic debris.	OL	Topsoil, dry	
	5	17" / 24"		Fill	Loose	Dk. Brn				FID (CNS) #B
	7								Fill, dry	
2	9		0912		Medium		Silty (f) SAND, trace <0.5" coarse gravel	SM		PID (0.0) #D
	21		OU4-SO-430-0204							
	35	12" / 24"		waste fill	V. Dense	Brown				FID (CNS)
	35				↓	Dark reddish				
4	37		0920				Asbestos (assumed) materials w/ 20% silt matrix		Dry	PID (0.0)
	9		OU4-SO-430-0406		Medium	Brown				
	10	6" / 24"					Flat, 2mm to 1 cm, flexible to rigid material		Wet (due to drill method?)	FID (CNS)
	12									
6	9		1010							PID (0.0)
	9		OU4-SO-430-0608			Dk brown to black				*
	6	2" / 24"								FID (4.8)
	9									
8	12		1015							PID (0.0)
	9		OU4-SO-430-0810			Black to dk gray			2mm black beds every 2".	
	10	13" / 24"		Natural soils			Silty fine, SAND, trace <0.75" subrounded gravel,	SP		FID (16.8)
	11						plasticity			
10	8		1035							PID (0.0)
	8		OU4-SO-430-1012			Black	Organic fibers, hard, thin, rectangular material }		Wash?/Pushed cobble?	
	18	1" / 24"								FID (17.6)
	36									
12	38		1040		V. Dense					PID (2.8)
	13		OU4-SO-430-1214			Dk gray	Silty (f) SAND, subrounded 2" x 1.5" gneiss gravel	SP		
	9	9" / 24"			Medium	Black				FID (100.6)
	13						Organic sitly, (f-c) SAND and (f) GRAVEL	SW	No sheen,	
14	10		1110							PID (0.0)
	12		OU4-SO-430-1416			Gray	Silty (f-m) SAND, trace (c) sand	SM	from spoon tip	
	12	0" / 24"								FID (12)
	13									
16	14		1130							PID (0.0)

TYPE OF DRILLING RIG:	Mobile Drill – B-59		Tetra Tech NUS, Inc.
METHOD OF ADVANCING BORING:	4 in. ID Drive & Wash Casing.		
METHOD OF SOIL SAMPLING:	2 in. split-barrel sampler driven with a 140 lb. hammer with a 30 in. drop.		
METHOD OF ROCK CORING:	NA		
GROUNDWATER LEVELS:	9 fbgs @1200 1/5/99, 10.5 fbgs @ 1245 1/5/99 EOB – 14 fbgs w/4" casing, completed w/ bentonite pellets		
OTHER OBSERVATIONS:	CNS – Could not start (too cold?) *checked PID w/ sharpie – reaction ok	BORING NO.: SB-430	PAGE: 1 OF 1

FOSTER WHEELER ENVIRONMENTAL CORPORATION
470 ATLANTIC AVENUE
BOSTON, MASSACHUSETTS 02210

MONITORING WELL CLUSTER: PC-06
RAYMARK INDUSTRIES FACILITY SITE - D.O. NO. 11
STRATFORD, CONNECTICUT

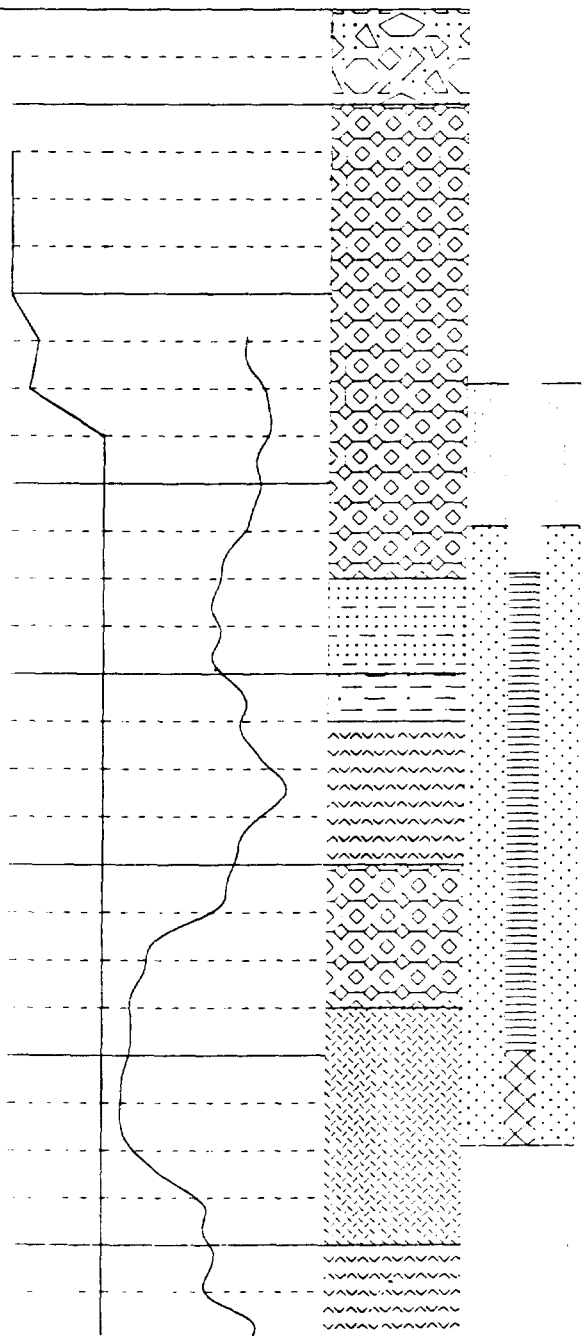
DATE STARTED: 01/14/97
DATE COMPLETED: 03/04/97
GEOLOGIST: KERNEN/ANDERSON
INSTALLED BY MAHER ENVIRONMENTAL
2-INCH ID, 316 STAINLESS STEEL

WELL ID	LOCATION	TIC ELEVATION (FT-MSL)	SCREEN INT. (FT-MSL)
PC-06S	898478.30, 634704.37	17.43 FT-MSL	6.1 to -3.9
PC-06M	898475.50, 634709.12	17.48 FT-MSL	-32.5 to -42.5
PC-06D	898471.78, 634706.36	17.52 FT-MSL	-52.7 to -62.7
PC-06B	898474.39, 634702.26	17.41 FT-MSL	-91.3 to -106.3

FEET-MSL	ASTM CLASS.	LITHOLOGIC DESCRIPTION	FID (PPM)
16	FILL	clean FILL	
14			0
			6.5
			7.5
12			1.5
			300
10			200
			1000
8			1000
			1000
6	SP-SM	brown-black oil stained fine-medium SAND with 5% silt	1000
			1000
4	GP	fine-coarse red/black GRAVEL with 30-40% coarse sand	1000
	SP	black process fill - medium to coarse SAND with 30-40% fine gravel	1000
2			1000
			1000
0	SM	gray fine-medium SAND with 10-20% silt	1000
			1000
-2			1000
	OL	dark brown PEAT with large woody roots	1000
-4			1000
			1000
-6	SP		1000
			1000
-8		gray medium-coarse SAND with 20% silt	1000
			1000

FID (PPM) 0 – 1000

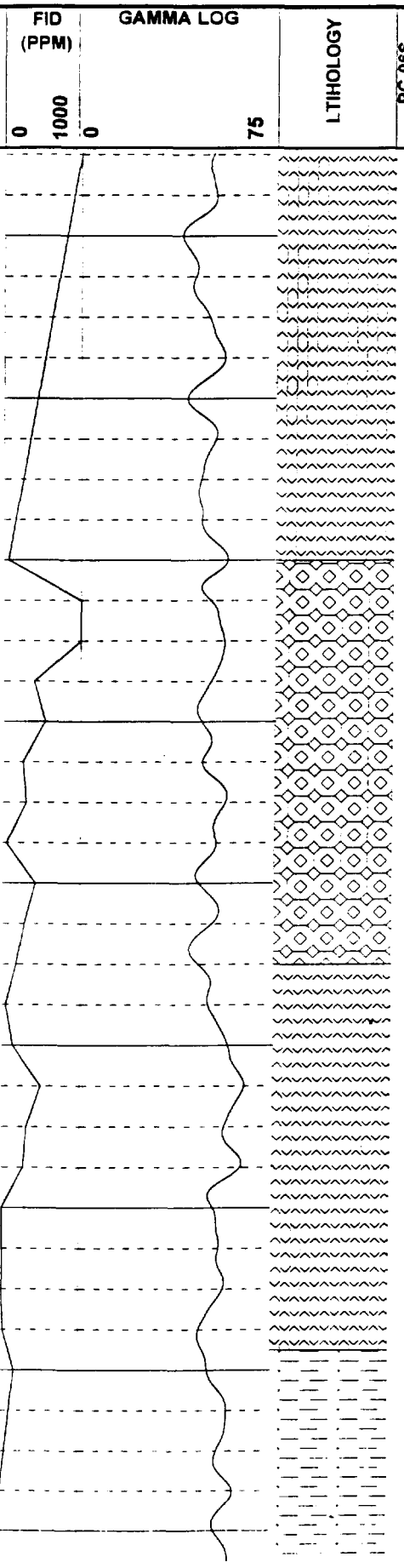
GAMMA LOG 0 – 75

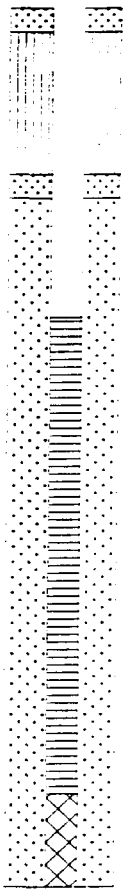


LER ENVIRONMENTAL CORPORATION
AVENUE
CHUSETTS 02210

MONITORING WELL CLUSTER: PC-06
RAYMARK INDUSTRIES FACILITY SITE - D.O. NO. 11
STRATFORD, CONNECTICUT

FEE	ASTM CL	LITHOLOGIC DESCRIPTION	FID (PPM)
-10			1000
-12			
-14			
		gray medium-coarse SAND	
-16			
-18			
-20	SM	fine brown SAND with 25-35% silt aand 5-15% fine gravel	60
			1000
-22	SM	brown fine-coarse SAND with 15-25% silt and 15-25% fine-coarse gravel	1000
			400
-24			540
			260
-26			300
			50
-28			420
			280
-30	SP	fine-medium brown-gray SAND	180
			50
-32			140
			500
-34			320
			280
-36	SP	brown medium-coarse SAND with 35-45% fine gravel	16
			20
-38			22
			40
-40	GP	fine-coarse GRAVEL with 10-20% sand and cobbles	180
-42			
			10
-44			26

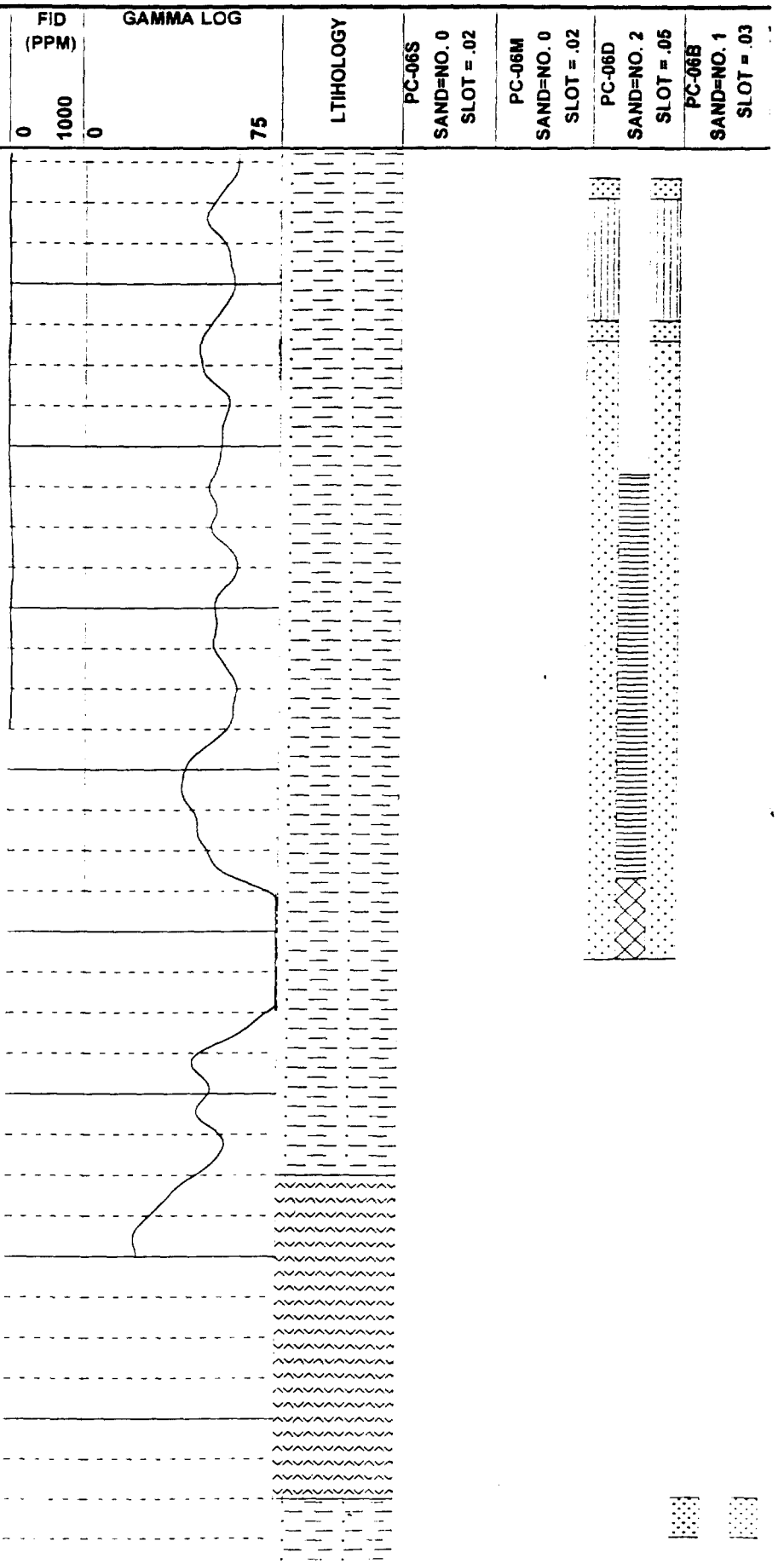




FOSTER WHEELER ENVIRONMENTAL CORPORATION
470 ATLANTIC AVENUE
BOSTON, MASSACHUSETTS 02210

MONITORING WELL CLUSTER: PC-06
RAYMARK INDUSTRIES FACILITY SITE - D.O. NO. 11
STRATFORD, CONNECTICUT

FEET-MSL	ASTM CLASS.	LITHOLOGIC DESCRIPTION	FID (PPM)
			15
-46			10
		cobles - round with 10-20% fine-coarse gravel and 5% medium coarse sand	18
-48			20
			24
-50			5
			10
-52			8
	GP	fine-coarse gravel with 35-45% fine medium sand	20
-54			40
		fine-coarse GRAVEL with 10-20% sand, occasional cobble	62
-56			28
			48
-58			50
			30
-60		boulder - gneiss-schist	
-62			
-64			
-66			
-68			
-70	SP		
-72			
-74			
		brown medium-coarse SAND with 15-25% rounded fine-coarse gravel	
-76			
-78	GP	coarse rounded GRAVEL with 10-20% sand	



FOSTER WHEELER ENVIRONMENTAL CORPORATION
470 ATLANTIC AVENUE
BOSTON, MASSACHUSETTS 02210

MONITORING WELL CLUSTER: PC-06

RAYMARK INDUSTRIES FACILITY SITE - D.O. NO. 11

STRATFORD, CONNECTICUT

FEET-MSL	ASTM CLASS.	LITHOLOGIC DESCRIPTION	FID (PPM)	FID (PPM) 0 1000	GAMMA LOG 0 75	LITHOLOGY	PC-06S SAND=NO. 0 SLOT = .02	PC-06M SAND=NO. 0 SLOT = .02	PC-06D SAND=NO. 2 SLOT = .05	PC-06B SAND=NO. 1 SLOT = .03
-80		weathered bedrock - fractured bedrock fragments with medium-coarse SAND and gravel								
-82	BR	competent bedrock								
-84										
-86										
-88										
-90										
-92										
-94										
-96										
-98										
-100										
-102										
-104										
-106										
-108										
-110										

FOSTER WHEELER ENVIRONMENTAL CORPORATION
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BOSTON, MASSACHUSETTS 02210

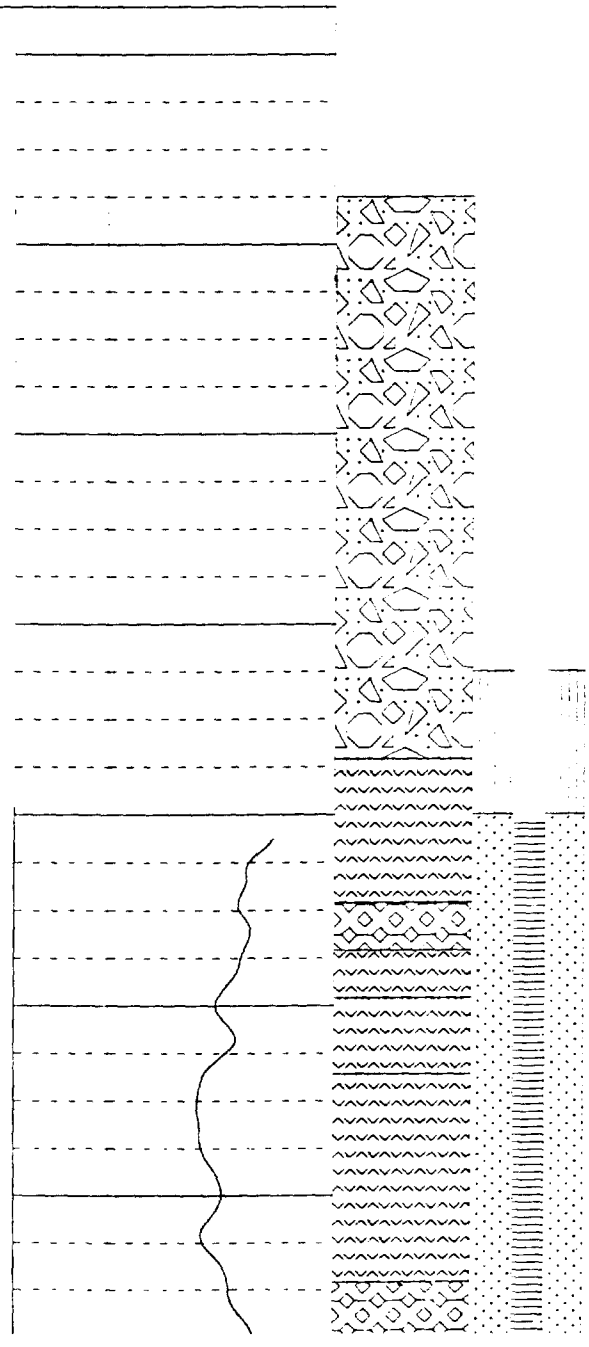
MONITORING WELL CLUSTER: PC-10
RAYMARK INDUSTRIES FACILITY SITE - D.O. NO. 11
STRATFORD, CONNECTICUT

DATE STARTED: 12/13/96
DATE COMPLETED: 01/07/97
GEOLOGIST: KERNEN/ANDERSON
INSTALLED BY MAHER ENVIRONMENTAL
2-INCH ID, 316 STAINLESS STEEL

WELL ID	LOCATION	TIC ELEVATION (FT-MSL)	SCREEN INT. (FT-MSL)
PC-10S	897888.97, 634232.13	20.72 FT-MSL	(15.75 to 0.75)
PC-10M	897885.95, 634229.0	20.71 FT-MSL	(-12.07 to -22.07)
PC-10D	897890.24, 634226.86	20.73 FT-MSL	(-41.45 to -56.45)
PC-10B	897892.24, 634230.06	20.73 FT-MSL	(-69.45 to -84.45)

FEET-MSL	ASTM CLASS.	LITHOLOGIC DESCRIPTION	FID (PPM)
24			
22			
20		clean FILL	
18			
16			
14			
12			
10			
8	SP	fine-coarse brown-black SAND with 5-15% subangular gravel	0
			0
6	SM	black process fill with string material	0
	SP	fine-medium SAND with 20-30% fine-coarse gravel	0
4	SP	fine-medium gray SAND with 15-25% fine-coarse gravel	0
		fine-medium brown SAND	0
2	SP		0
			0
0			0
			0
-2	SM	fine-medium SAND with 20-30% silt	0

FID (PPM) 0 – 1000; GAMMA LOG 20 – 160



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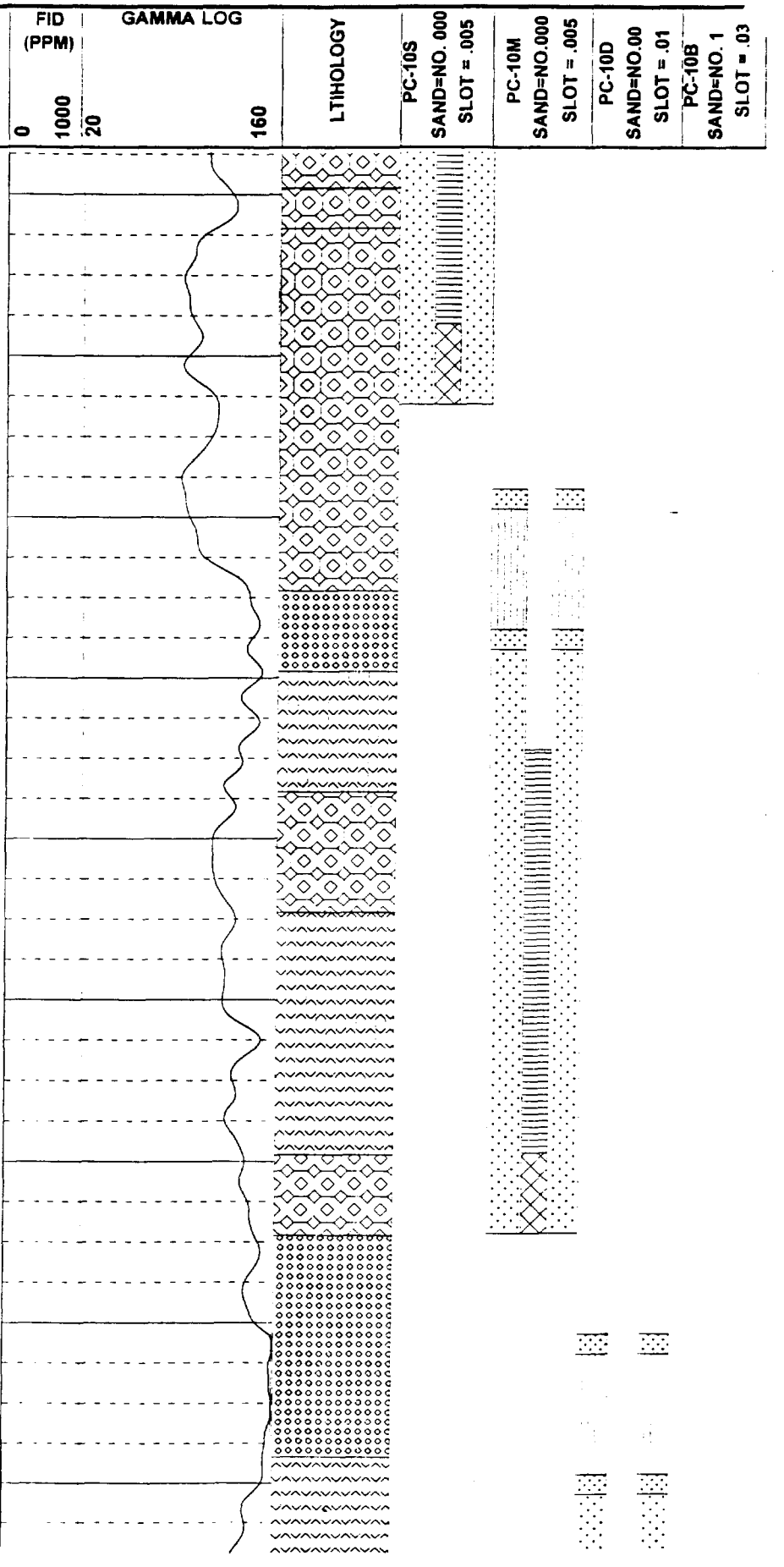
470 ATLANTIC AVENUE
BOSTON, MASSACHUSETTS 02210

MONITORING WELL CLUSTER: PC-10

RAYMARK INDUSTRIES FACILITY SITE - D.O. NO. 11

STRATFORD, CONNECTICUT

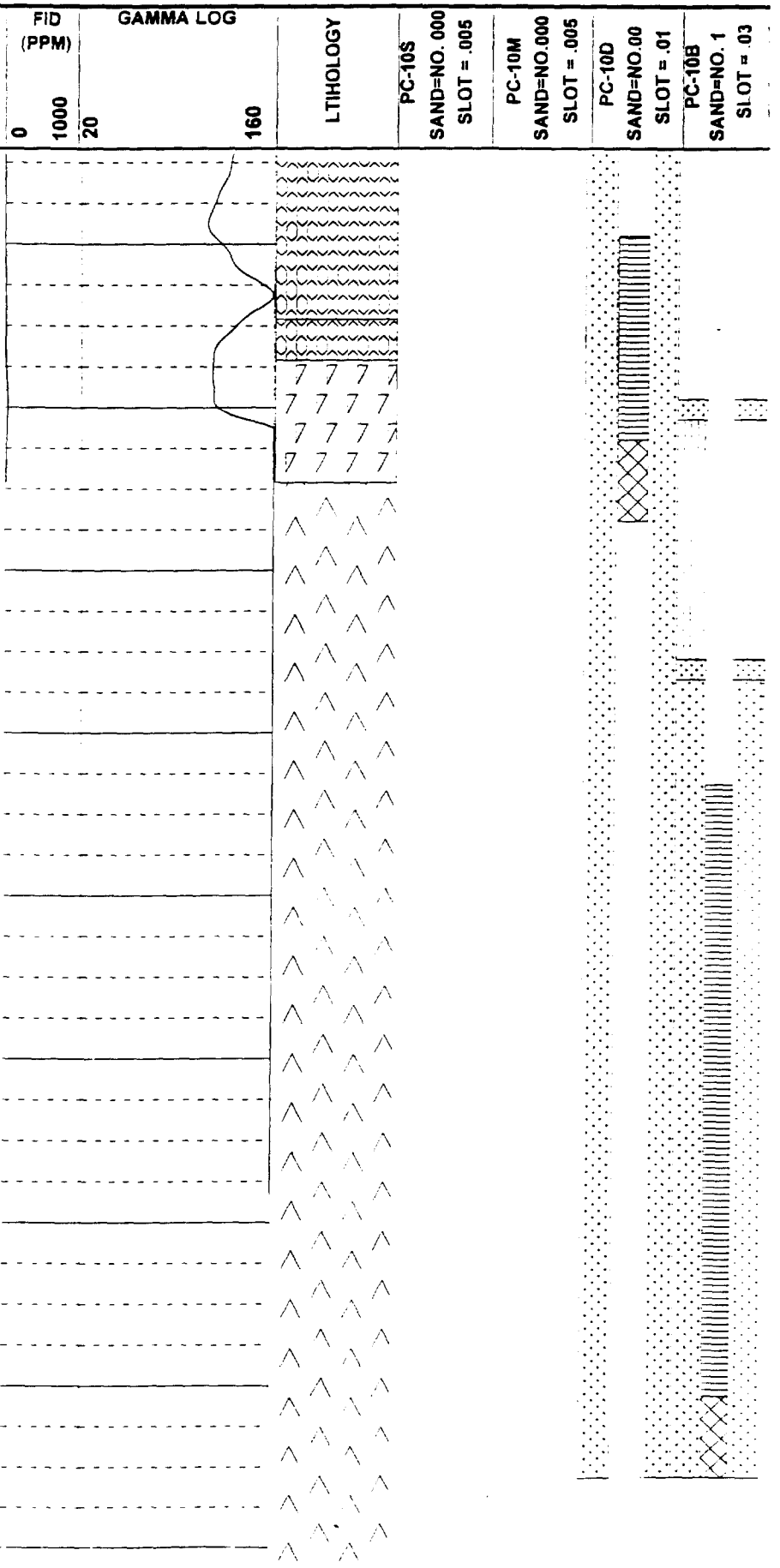
FEET-MSL	ASTM CLASS.	LITHOLOGIC DESCRIPTION	FID (PPM)
			0
-4	SM	fine brown SAND with 30-40% silt	0
	SM	brown fine-medium SAND with 15-25% silt	0
-6			0
			0
-8			0
			0
-10			0
			0
-12			0
			0
-14	ML	brown SILT with 30-40% fine sand -15.84 brown-gray fine-medium SAND	0
			3.5
-16	SP		0
			9
-18			4
	SM	fine brown SAND with 30-40% brown silt	3.5
-20			2.5
			0
-22	SP	brown medium-coarse SAND with 20-30% fine-coarse subangular gravel	0
			0
-24			1.5
			4.5
-26			1.2
			0.5
-28	SP-SM	brown fine-coarse SAND with 5-15% silt	0
			0
-30	ML	brown SILT with 15-25% fine sand	0
			0
-32			0
			0
-34			0
			4
-36	SP	gray-brown medium-coarse SAND with 30-40% fine-coarse gravel	8.5
			6.5



FOSTER WHEELER ENVIRONMENTAL CORPORATION
470 ATLANTIC AVENUE
BOSTON, MASSACHUSETTS 02210

MONITORING WELL CLUSTER: PC-10
RAYMARK INDUSTRIES FACILITY SITE - D.O. NO. 11
STRATFORD, CONNECTICUT

FEET-MSL	ASTM CLASS.	LITHOLOGIC DESCRIPTION	FID (PPM)
-38			0
			2
-40			0
			9
-42	SP	red-brown fine-medium SAND	10
	MH	blue-gray clay with fragments of weathered bedrock	15
-44			38
			22
-46	BR	competent bedrock	14
-48			
-50			
-52			
-54			
-56			
-58			
-60			
-62			
-64			
-66			
-68			
-70			
-72			



FOSTER WHEELER ENVIRONMENTAL CORPORATION
470 ATLANTIC AVENUE
BOSTON, MASSACHUSETTS 02210

MONITORING WELL CLUSTER: PC-10
RAYMARK INDUSTRIES FACILITY SITE - D.O. NO. 11
STRATFORD, CONNECTICUT

FEET-MSL	ASTM CLASS.	LITHOLOGIC DESCRIPTION	FID (PPM)	FID (PPM) 0 1000	GAMMA LOG 20 160	LTIHOLOGY	PC-10S SAND=NO. 000 SLOT = .005	PC-10M SAND=NO.000 SLOT = .005	PC-10D SAND=NO.00 SLOT = .01	PC-10B SAND=NO. 1 SLOT = .03
-74										

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 1

Project Number: N0003.0320

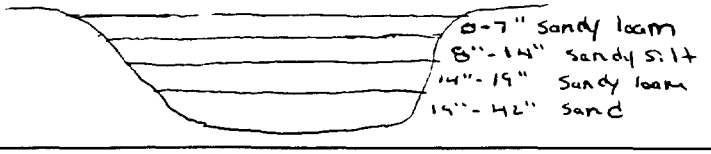
Date: 12/8/98

Location: Behind ballfield Scoreboard in Parking area

Field Geologist: B. Irwin K. O'neill

DEPTH (~~feet~~) inches	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-7"		Sandy Loam		
8"-14"		Sand/Silt		
14"-19"		Sandy Loam		
19"-42"		Sand		

Test Pit Cross Section and/or Plan View



REMARKS: Trench depth = 3.5', Trench Width = 2', Trench Length = 10'

PHOTO LOG:

TEST PIT: 1

PAGE 1 OF 1

Tt NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

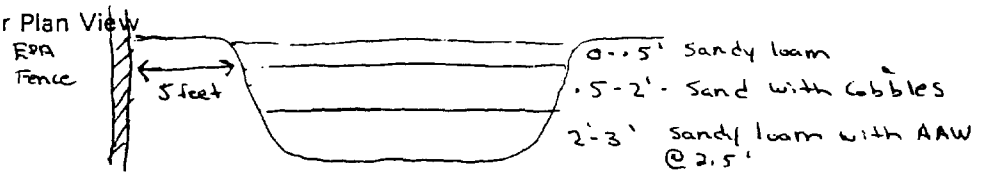
Site Name: RAYMARK OU4 Test Pit No.: 2

Project Number: N0003.0320 Date: 12/8/98

Location: 3rd light pole behind ballfield fence Field Geologist: B. Irwin K. O'Neill

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-.5		Sandy Loam		
.5-2		Sand		
2-3		Sandy Loam		AAW @ 2.5 feet below surface

Test Pit Cross Section and/or Plan View



REMARKS: Trench depth = 3', Trench Width = 2', Trench Length = 30'
Apparent Asbestos Waste ends 5 feet from EPA fence line, Fill consisted of cobbles, Apparent Asbestos Waste (AAW) located at 2.5-3 feet below surface

PHOTO LOG:

TEST PIT: 2

PAGE 1 OF 1

Tt NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 3

Project Number: N0003.0320

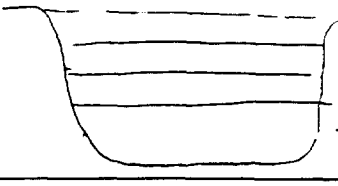
Date: 12/8/98

Location: 4th lightpole behind ballfield fence

Field Geologist: B. Irwin K. O'Neill

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-1'		Sandy Loam		
1'-2'		Silty Sand with some trace gravel		
2'-3'		Silty sand w/trace gravel and roots		At 2.5 feet there is AAW of 5 inches thick
3+		Sandy gravel		

Test Pit Cross Section and/or Plan View



0-1' Sandy Loam
1'-2' Silty Sand w/traces gravel @ 2.5'
2'-3' Silty Sand w/trace gravel and roots @ 2.5' AAW 5 inches thick
3+ Sandy gravel

REMARKS: Trench depth = 3.5', Trench width = 2.5', Trench Length = 17'

Hit 8" Corrugated steel drain pipe @ 2.5' depth and 6.5' off EPA fence line (Pipe is protected by 3/4' stone bed. Apparent Asbestos Waste (AAW) ends 7 feet from EPA fence line

PHOTO LOG:

TEST PIT: 3

PAGE 1 OF 1

Tt NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 4

Project Number: N0003.0320

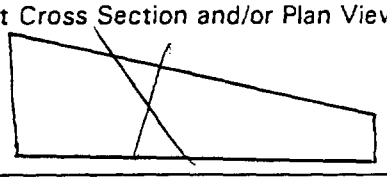
Date: 12/8/98

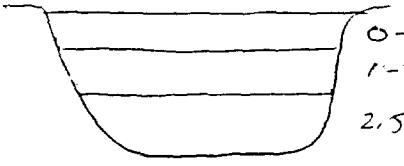
Location: Treeline behind Residential area Sloped

Field Geologist: B. Irwin K. O'Neill

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-1		Sandy Loam		
1-2.5		silty Sand with trace gravel		
2.5-3.5		Sandy gravel		At 2.5' there is 6 inches of AAW

Test Pit Cross Section and/or Plan View





0-1' Sandy Loam
1-2.5' silty Sand
2.5-3.5 Sandy gravel @ 2.5' AAW is 6 inches deep.

REMARKS: Total depth = 3.5', Total width = 2.5', Total Length = 17'-8", Apparent Asbestos Waste (AAW) located at 2.5 feet below surface and follows slope and gets shallower and is located at 2 feet

PHOTO LOG:

TEST PIT: 4

PAGE 1 OF 1

Tt NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 5

Project Number: N0003.0320

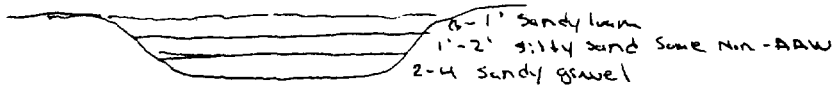
Date: 12/8/98

Location: Old Access Road behind treeline

Field Geologist: B. Irwin K O'Neill

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-1		Sandy Loam		
1-2		Silty Sand trace gravel mixed with household trash (bags, bottles)		located Non-AAW at 1.5 feet below Surface
2-4		Sandy gravel		

Test Pit Cross Section and/or Plan View



REMARKS: Total depth = 4', Total width = 3', Total Length = 23'

Located Non-Apparent Asbestos Waste (household trash - bottles, bags, wood, leaves) at 1.5 feet below Surface

PHOTO LOG:

TEST PIT: 5

PAGE 1 OF 1

Tt NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 6

Project Number: N0003.0320

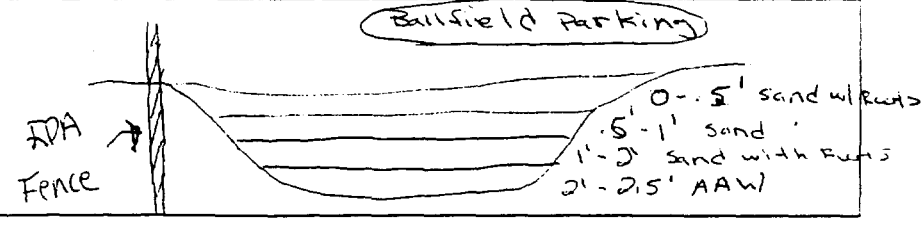
Date: 12/9/98

Location: South West Corner

Field Geologist: B. Irwin T. Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-6"		Sandy loam with roots		
6"-1'		Sand		
1'-2'		Sand with roots		
2'-2.5'		fill - brake pads, clutch pads gray - charcol ~~ash~~ 30 white fibers		AAW Located @ 2 feet below surface up to the fence line
		contained brake pads, clutch pads, brake diaphrams		

Test Pit Cross Section and/or Plan View



REMARKS: fill against fence pit long 2.5' wide, 2.5' deep

Trench depth = 2.5', Trench Width = 2.5', Trench length = 9',

Located Apparent Asbestos Waste 2' below surface and continued up to fence line

PHOTO LOG:

TEST PIT: 6

PAGE 1 OF 1

Tt NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 7

Project Number: N0003.0320

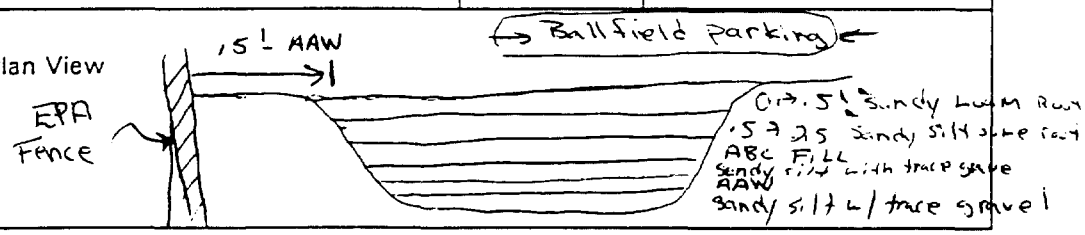
Date: 12/9/93

Location: South West Corner

Field Geologist: B. Irwin, T. Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-0.5'		Loam		
0.5'-2.5'		Sandy silt		
2.5'-3.5'		Asphalt with concrete fill		
3.5-4.0'		Sandy w/gravel silt		
4'-4.5'		apparent asbestos waste wavy charcoal green with white fibers		AAW Located at 4 feet below surface, continued for 1 foot 3 inches
4'-5.3'		asbestos waste		then came into sandy silt with trace gravel
5.3'-5.5'		Sandy silt with trace gravel		

Test Pit Cross Section and/or Plan View



REMARKS: Total depth 5.5 feet, Total width 2.5 feet, Total Length 25 feet Located Asphalt, Concrete and brick fill 7 feet off fence line 2.5 feet below Surface. Located Apparent Asbestos Waste 15 feet off fence line at a depth of 4 feet, AAW continued to the depth of 5.3 feet

PHOTO LOG:

TEST PIT: 7

PAGE 1 OF 1

Tt NUS FORM 0011 * AAW = Apparent Asbestos Waste

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 8

Project Number: N0003.0320

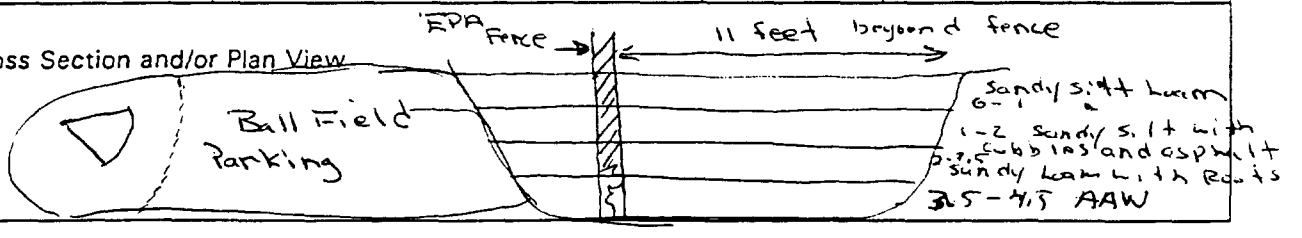
Date: 12/9/98

Location: South east Corner

Field Geologist: B. Irwin K. ONEILL T. ARMSTRONG

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-1		Sandy silt Loam		
1-2		sandy silt Layer lots of cobbles with some asphalt		
2-3.5		Sandy silt loam with Roots organic		Traces of peat
3.5-4.5		Apparent Asbestos waste		AAW Located at 3.5 feet below surface

Test Pit Cross Section and/or Plan View



REMARKS: Total Depth 4.5 feet, Total width 3 feet, Total Length 25 feet At 1-2 feet Located Asphalt mixed with cobbles, continued down and at 3.5 feet located Apparent Asbestos waste (AAW). AAW was heavy at the fence line, Operator proceeded over fence line and the AAW was still ~~PHOTO LOG~~: at 3.5 - 4 feet below surface but in very small spotted quantities

TEST PIT: 8

PAGE 1 OF 1

TT NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

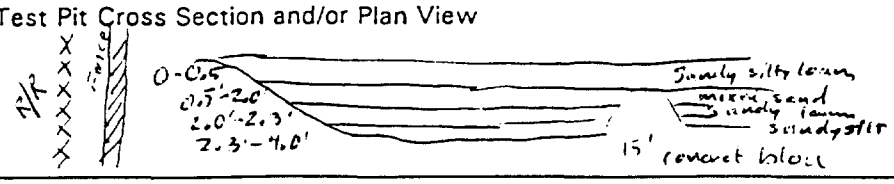
Site Name: RAYMARK OU4 Test Pit No.: 9A

Project Number: N0003.0320 Date: 12/9/98

Location: Southeast / adjacent to R/R Field Geologist: B. Irwin T. Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0'-0.5'		Sandy loam, dark red brown high root content		
0.5'-2.0'		mixed sand with some gravel grey brown low root content		
2.0'-2.3'		Sandy loam, brown grey high root content		
2.3'-4.0'		Sandy silt, light red brown with dead wood roots		

Test Pit Cross Section and/or Plan View



cont on 9B

REMARKS: Profile 14' from fence, pit continues to remainder 9 series

Trench length 14', Trench depth 4.0', trench width 3'. 14 feet from fence line soil material had different characteristics and broke test Pit log into different sections (ABC.....)

PHOTO LOG:

TEST PIT: 9A

PAGE 1 OF

Tt NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 9 B

Project Number: N0003.0320

Date: 12/9/98

Location: Southeast, next to RR

Field Geologist: B. [illegible], T. Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0 – 0.6'		Sandy silty loam, red brown color root content		
0.6' – 1.6'		Gravely sand, grey brown color no roots		
1.6' – 2.1'		Gravely sand, brown black color few roots		suspected fill layer (AAW)
2.1' – 4.0'		Gravely sand, light brown color no roots		

Test Pit Cross Section and/or Plan View

from 9 A

0 – 0.6' Sandy silty loam
0.6' – 1.6' gravely sand
1.6' – 2.1' gravely sand
2.1' – 4.0' gravely sand

con't 9 C

REMARKS: 2nd log for pit 9, 30' from fence. Spots of AAW found in black brown gravely sand, 1.6' to 2.1' down. Trench width 3', Trench depth 4', trench length 16'.

PHOTO LOG:

TEST PIT: 9 B

PAGE 2 OF

Tt NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 9c

Project Number: N0003.0320

Date: 12/9/98

Location: Southeast, next to RR

Field Geologist: B. Jones, T. Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-0.5'		Sandy silty loam, red brown roots		
0.5'-1.5'		~~gravely~~ mixed sand, grey brown no roots		
1.5'-2.3'		gravely sand, black brown,		suspected fill (AAW)
2.3'-3.5'		gravely sand, light brown lots of gravels		

Test Pit Cross Section and/or Plan View

from 9B

0-0.5' ~~Sandy~~ silty loam
0.5'-1.5' ~~gravely sand~~ mixed sand
1.5'-2.3' gravely sand
2.3'-3.5' gravely sand (lots of gravels

REMARKS: 3rd log of pit 9. 49' from fence. Spots of AAW found in black brown gravely sand 1.5' to 2.3' down. Continued excavation to verify the extent of AAW fill.

PHOTO LOG:

TEST PIT: 9C

PAGE 3 OF

Tt NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 9D

Project Number: N0003.0320

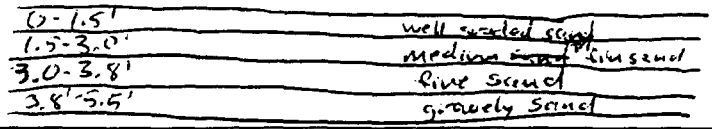
Date: 12/9/93

Location: Southwest corner

Field Geologist: B. Irwin, T Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-1.5'		well graded sand, red brown color		
1.5'-3.0'		medium sand, light brown color		spotty AAW
3.0'-3.8'	medium	fine sand, grey color		spotty AAW
3.8'-5.5'		gravely sand, light red brown color		

Test Pit Cross Section and/or Plan View



from 9C

REMARKS: 4th log for pit 9, 69' from fence. Spotty AAW seen between layers 1.5'-3.0' and 3.0'-3.8', also other fill material. Continued excavation per order K. O'neill to verify extent of AAW.

PHOTO LOG:

TEST PIT: 9D

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TT-NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 9E

Project Number: N0003.0320

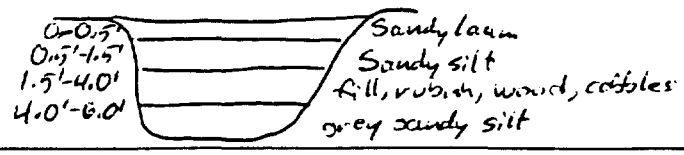
Date: 12/9/98

Location: Southeast corner, next to RR

Field Geologist: B Irwin, T Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0 - 0.5'		Sandy loam		
0.5' - 1.5'		Sandy silt		
1.5' - 4.0'		fill, rubish, wood, cobbles		
4.0' - 6.0'		grey sandy silt		

Test Pit Cross Section and/or Plan View



REMARKS: 5th log for pit 9, 78' from fence. Excavation removed cobbles rubbish and wood debris from approximately 2' - 4' deep. Excavated below 4' and encountered gray sandy silt and ceased excavation further back.

PHOTO LOG:

TEST PIT: 9E

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Tt NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Project Number: N0003.0320

Location: Southeast corner

Test Pit No.: 9F

Date: 12/9/98

Field Geologist: B. Irwin T. Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-0.6'		Sandy loam		
0.6'-1.5'		Sandy silt		
1.5'-5.0'		Boulders, trash, vinyl pieces, wood		spots of AAW small quantities

Test Pit Cross Section and/or Plan View

REMARKS: small spots of AAW in 1.5'-5.0', continued excavation further back to verify spotted areas of AAW (see test pit 9G-log)

PHOTO LOG:

TEST PIT: 9F

PAGE 6 OF

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 96

Project Number: N0003.0320

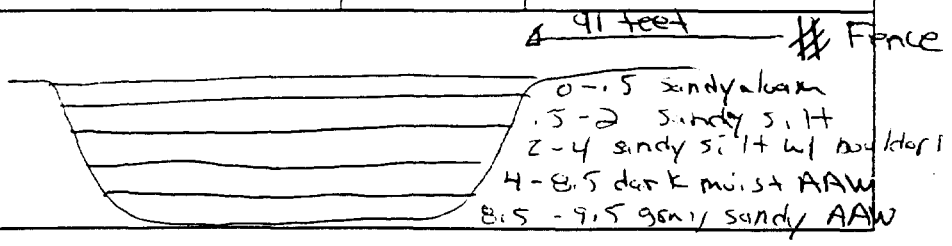
Date: 12/9/98

Location: South east Corner

Field Geologist: B. Irwin T. Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-.5		sandy loam with roots		
.5-2		sandy silt		
2-4		sandy silt with cobbles and large boulders.		
↓		material contained trash tires, steel, vynles.		
4-8.5		dark apparent Asbestos waste. (moist		AAW located 4 feet below surface
8.5-9.5		grayish sandy fill that contained some AAW		Sample collected starting
				at 7-8' interval B.J. 3-15-99
				Sample I.D. collected at 1635 1219 OU4-SO-TP096-0708 3.9 3-15-99

Test Pit Cross Section and/or Plan View



REMARKS: found heavy quantities of Apparent Asbestos Waste 91 feet from fence line continued below ~~beyond~~ boulders and found more moist AAW at 4-8.5 feet below surface (collected sample from 7 foot to 8 foot depth in trench)

~~PHOTO LOG~~:

TEST PIT: 96

PAGE 1 OF 1

TtNUS FORM 0011

Brown & Root Environmental

TEST PIT LOG

Site Name: Raymark OU4

Test Pit No.: 10A

Project Number: N0003 0320

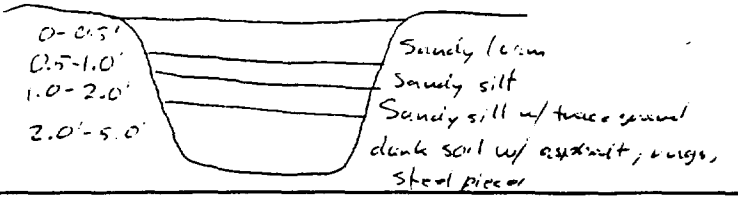
Date: 12/10/98

Location: South edge of Drill field 50' ~~east~~ from brush line stream

Field Geologist: B. Irwin, T. Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0 - 0.5		Sandy loam		
0.5'-1.0'		Sandy silt		
1.0'-2.0'		Sandy silt w/ trace gravel		
2.0'-5.0'		dark soil, w/ asphalt, roots, steel pieces, spotted ~~AAW~~ (brake pads)		FID reading 0.0-17.4

Test Pit Cross Section and/or Plan View



REMARKS: Dark soil (2.0-5.0') had FID readings from 0.0 - 17.4 PPM, PID from 0.0 to 1.0 PPM. This layer contained asphalt, roots and steel pieces and brake pads. Separate pit from 10 B, C, D

PHOTO LOG:

TEST PIT: 10A

PAGE 1 OF 1

B&R FORM 0010

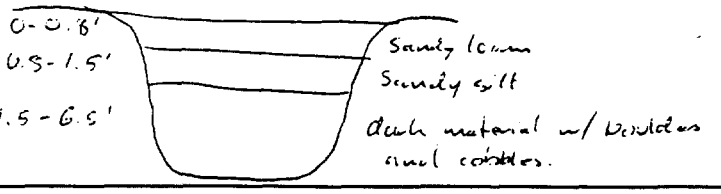
Brown & Root Environmental

TEST PIT LOG

Site Name: Raymark OU4
Test Pit No.: 10B
Project Number: N0003.0320
Date: 12/10/98
Location: South edge of field
Field Geologist: B. Irwin, T. Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0 - 0.3'		Sandy loam		
0.3 - 1.5'		Sandy silt		
1.5 - 6.5		Back fill material, boulders, cobbles, dark material		FID readings 5.4 PPM

Test Pit Cross Section and/or Plan View



REMARKS: Pit was 11' long, 6.5' deep by 2.5' wide. The 1.5-6.5' layer was dark material (suspect back fill) with cobbles and boulders, had FID readings up to 5.4 PPM. Seperate pit from 10A, C, D

PHOTO LOG:

TEST PIT: 10B

PAGE 1 OF 1

B&R FORM 0010

Brown & Root Environmental

TEST PIT LOG

Site Name: Rayonier OU4
Test Pit No.: 10 C
Project Number: N0003.320
Date: 12/10/93
Location: south, edge of brushline
Field Geologist: B. Irwin, T. Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-0.8'	~~Sand~~ PI	Sandy loam		
0.8-1.5'		Silty sand		
1.5-1.8		Sand silt		
1.8-4.0'		fine sand, sparse gravel		
4.0-6.0'		medium-fine sand, with cobbles and gravel		
6.0-10.0'		dark silty sand. AAW		AAW found. PID 193.9
				Collected @ 1050 OU4-SO-TP10C-0809
				and DUP01 @ 1055

Test Pit Cross Section and/or Plan View

REMARKS: The pit was 15' long, 9' deep, 2.5' wide. AAW found in 6.0-10.0' layer. PID reading of 193.9 directly off bucket. Separate pit from 10.AB.D

PHOTO LOG:

TEST PIT: 10 C

PAGE 1 OF 1

B&R FORM 0010

Brown & Root Environmental

TEST PIT LOG

Site Name: Raymark OU4

Test Pit No.: 10D

Project Number: N0005.~~02~~ 0320

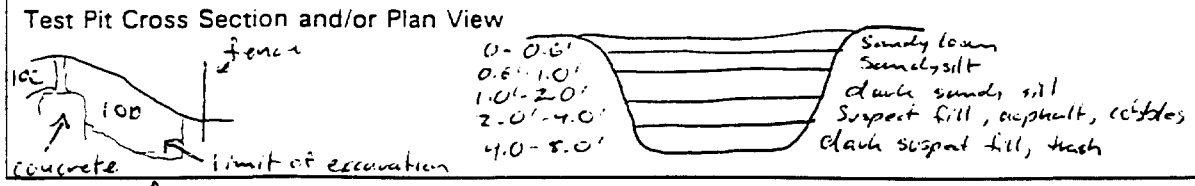
Date: 12/10/98

Location: edge of fence, back line, south of field

Field Geologist: B. Irwin, T. Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-0.6'		Sandy loam		
0.6-1.0'		Sandy silt		
1.0-2.0'		dark sandy silt		
2.0'-4.0'		Suspected fill, gravel, asphalt and cobbles		Spots of RAW located throughout trench
4.0-8.0'		dark fill, debris, trash		

Test Pit Cross Section and/or Plan View



REMARKS: Back line at its limit due to slope, concrete, and fence. Separate pit from 10 A,B,C

PHOTO LOG:

TEST PIT: 10D

PAGE 1 OF 1

B&R FORM 0010

Brown & Root Environmental

TEST PIT LOG

Site Name: Raymark OU4

Test Pit No.: 11 A

Project Number: N0005.0320

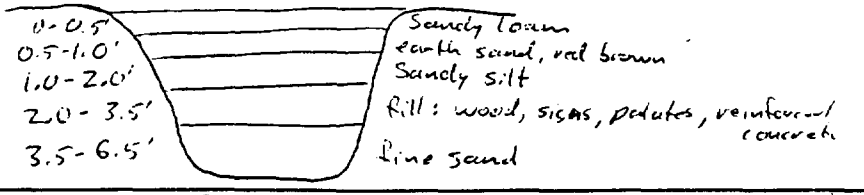
Date: 12/10/98

Location: Southeast corner of chain link fence diagonally out

Field Geologist: B. Irwin, T. Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0 - 0.5'		Sandy loam		
0.5 - 1.0'		earth sand. red brown, terra cotta color		
1.0 - 2.0'		Sandy silt		
2.0 - 3.5'		fill, wiet of wood debris, signs, potatos, reinforced concrete blocks		~~(will go thru cross A~~
3.5 - 6.5'		fine sand.		* Potential back-fill material over pipeline

Test Pit Cross Section and/or Plan View



REMARKS: 3.5' - 6.5' fine sand suspected as possible back-fill over a pipeline. → clean sand for pipe protection (3.0) moved excavation away. Profile at begining of trench (6' from fence corner). Fine Sand appeared to have no AAW

PHOTO LOG:

TEST PIT: 11

PAGE 1 OF 1

B&R FORM 0010

Brown & Root Environmental

TEST PIT LOG

Site Name: Raymark OU4

Test Pit No.: 11 B

Project Number: N0005.0320

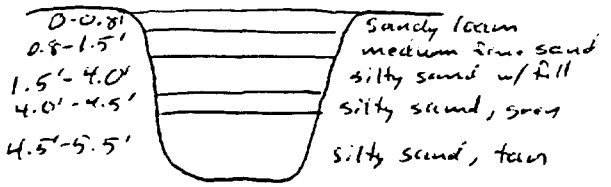
Date: 12/10/98

Location: Southeast fence corner 28' out

Field Geologist: B Irwin, T Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-0.8'		Sandy loam		
0.8-1.5'		medium fine sand		
1.5'-4.0'		silty Sand, fill material, rebar, wood, other refuse		OU4-SO-TP11-0203 collected @ 1440
4.0-4.5'		Silty sand, grey color		
4.5'-5.5'		Silty Sand, tan color		

Test Pit Cross Section and/or Plan View



REMARKS: sampled from 02-03' to determine nature of waste. Profile approximately 32' from beginning of trench.

PHOTO LOG:

TEST PIT: 11

PAGE 1 OF 1

B&R FORM 0010

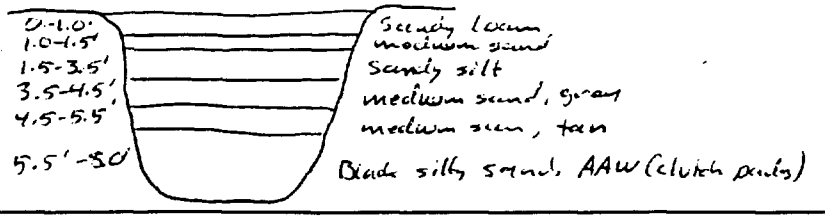
Brown & Root Environmental

TEST PIT LOG

Site Name: Raymark OU4
Test Pit No.: ~~11A~~ 11C
Project Number: N0003.0320
Date: 12/10/98
Location: South
Field Geologist: B. Irwin, T. Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-1.0		Sandy loam, red brown color		
1.0'-1.5'		medium sand		
1.5-3.5		Sandy silt, fill w/ plastic, wood, other refuse		
3.5-4.5		medium sand, gray color		
4.5-5.5		medium sand, tan color		
5.5-8.0'		Black silty sand, AAW, clutch beads		AAW OU4-SO-TP11-0708
				collected @ 1530

Test Pit Cross Section and/or Plan View



REMARKS: found AAW at 5.5-8.0', 55' from start of trench

PHOTO LOG:

TEST PIT: ~~11A~~ 11

PAGE 1 OF 1

B&R FORM 0010

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 12A (17)

Project Number: N0003.0320

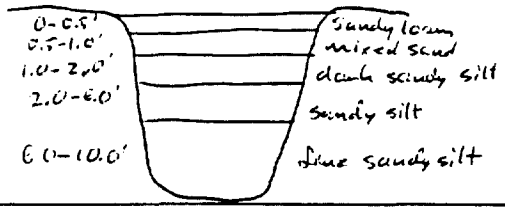
Date: 12/11/98

Location: 49' behind scoreboard 600E, 300N

Field Geologist: B Irwin, T Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-0.5'		Sandy loam		
0.5'-1.0'		mixed sand		
1.0'-2.0'		dark sandy silt		
2.0'-6.0'		~~fine~~ sandy silt		
6.0'-10.0'		fine sandy silt		bottom 2-4' moist

Test Pit Cross Section and/or Plan View



REMARKS: from 2.0' to 10.0 appears undisturbed, sidewalls of excavation where firm and well packed

PHOTO LOG:

TEST PIT: 12

PAGE 1 OF 1

Tt NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 13

Project Number: N0003.0320

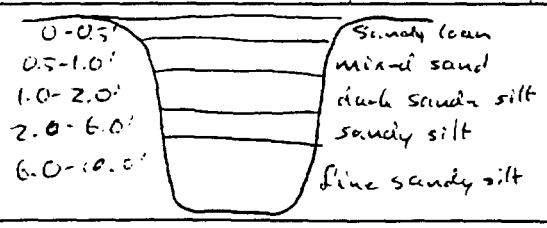
Date: 12/11/93

Location: 65' south of TP12A

Field Geologist: B. Irwin, T. Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-0.5'		sandy loam		
0.5-1.0'		mixed sand		
1.0-2.0'		dark sandy silt		
2.0-6.0'		sandy silt		
6.0'-10'		fine sandy silt		

Test Pit Cross Section and/or Plan View



REMARKS: same profile as 12A

PHOTO LOG:

TEST PIT: 13

PAGE 1 OF 1

Tt NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 14 A

Project Number: N0003.0320

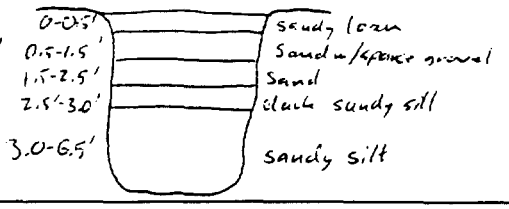
Date: 12/4/93

Location: 3.5 from N end of trench

Field Geologist: B. Irwin, T. Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-0.5'		Sandy loam		
0.5-1.5'		Sand w/ few gravel		
1.5'-2.5'		Sand		
2.5-3.0'		dark sandy silt		
3.0-6.5		sandy silt		

Test Pit Cross Section and/or Plan View



REMARKS: stopped because no AAW.

PHOTO LOG: 1 photo

TEST PIT: 14

PAGE 1 OF 1

Tt NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 14B

Project Number: N0003.0320

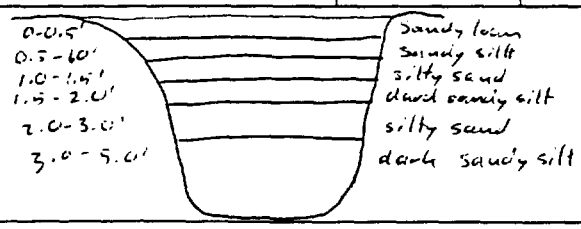
Date: 12/11/98

Location: middle of eastern portion of field 11.5' from N end of Trench

Field Geologist: B. Irwin, T. Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-0.5'		Sandy loam		
0.5-1.0'		Sandy silt, dark brown		
1.0-1.5'		silty sand		
1.5-2.0'		Sandy silt, dark		
2.0-3.0		silty sand.		
3.0-5.0		dark sandy silt, AAW, asbestos fiber		2-3' thick lens
				Collected sample @ 0935 G04-S0-TP14B-0305
				B.I 3-15-99

Test Pit Cross Section and/or Plan View



REMARKS: dark sandy silt, AAW (asbestos fibers) in lens 2-3' thick

PHOTO LOG: 2 photos

TEST PIT: 14

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Tt NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 15

Project Number: N0003.0320

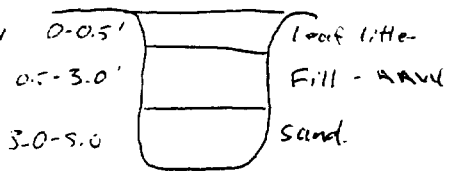
Date: 12/11/98

Location: near TP 6, through West fence

Field Geologist: B. Irwin T Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-0.5'		leaf litter		
0.5-3.0'		Fill, brake pads, clutch pads, asbestos fibers.		OU4-SO-TP15-0103 Bucket overflowing with brake and clutch pads
3.0-5.0'		Sandy		collected @ 1625 B.I 3-15-99

Test Pit Cross Section and/or Plan View



REMARKS: Bucket coming up full of brake and clutch pads. Sampled a Spliced EPA Fence and excavated beyond. Encountered AAW under top soil / leaf layer approximately .5' below surface. AAW was about 3' thick mostly clutch & brake pads Excavated 14' into contract Plating area - stopped excavation to no access through trees and brush.

PHOTO LOG: 1 photo

TEST PIT: 15

PAGE 1 OF 1

Tt NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: L6

Project Number: N0003.0320

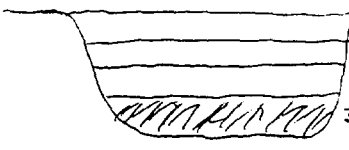
Date: 12/11/98

Location: NW Corner @ berm on small path.

Field Geologist: B. Irwin T. Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-1		Silty sand		
1-3		Silty sand trace gravel.		
3-3.5		grey silty sand		
3.5		suspected ledge		

Test Pit Cross Section and/or Plan View



0-1' silty sand
1-3' silty sand trace gravel
3-3.5' greyish silty sand
3.5 suspected ledge (backhoe refusal)

REMARKS: At 3.5' encountered ledge moved backhoe away berm to determine length of ledge. Continued to encounter suspected ledge. K. oneil discontinued test pit. Trench was approximately 40' in length

PHOTO LOG:

TEST PIT: 16

PAGE 1 OF 1

Tt NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 17

Project Number: N0003.0320

Date: 12/11/98

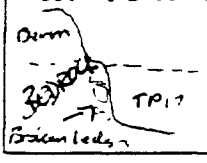
Location: NW edge, at berm

Field Geologist: B Irwin, T Armstrong, K. ONeill

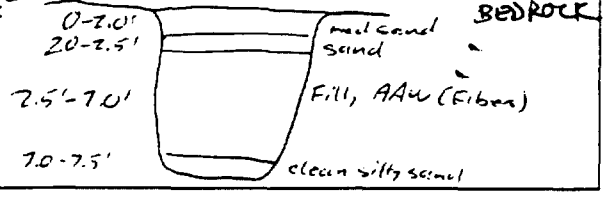
DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-2.0'		red sand		
2.0'-~~3.0'~~ 2.5'		Sand		
2.5' ~~3.0'~~ - 7.0'		Fill, AAW (fibers) sandy silt (dark)		OU4-SO-TP17-0405 fibers were tightly packed
2.0 - 7.5'		Clean, ~~sandy~~ silty sand.		Collected sample @ 1130 B.J 3-15-99

BEDROCK ENCOUNTERED APPROX. 1 FOOT BGS AT WEST END OF EXC. TD. 5/21/99

Test Pit Cross Section and/or Plan View



X-SECTION OF TEST PIT. ALONG EDGE OF BEDROCK



REMARKS: Beginning edge against berm (rocks and boulders), ledge and BEDROCK TD 5-10-99 ~~dead end~~ clean edge in TP. AAW was encountered at approximately 2.5' below grade and continued to 7' below grade. ENCOUNTERED BEDROCK @ WEST END OF TEST PIT, EXCAVATED EASTWARD AWAY FROM LEDGE INTO OVERBURDEN. TD 5/21

PHOTO LOG:

TEST PIT: 17

PAGE ____ OF ____

TT NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 18

Project Number: N0003.0320

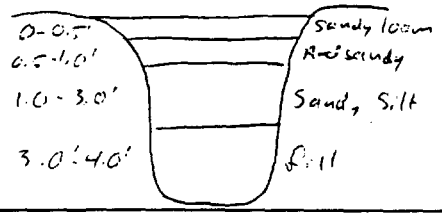
Date: 12/11/98

Location: N of W fence

Field Geologist: B. Irwin, T Armstrong, R O'Neill

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-0.5'		Sandy loam		
0.5-1.0'		Red sand		
1.0-3.0'		Sandy silt		
~~1.0-3.0~~				
3.0-4.0'		fill, ARW (fibers, sand)		Collected sample @ 1205 004-SO-TP18-0304
				B.I 12-15-98

Test Pit Cross Section and/or Plan View



REMARKS:

PHOTO LOG:

TEST PIT: 18

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Tt NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 19

Project Number: N0003.0320

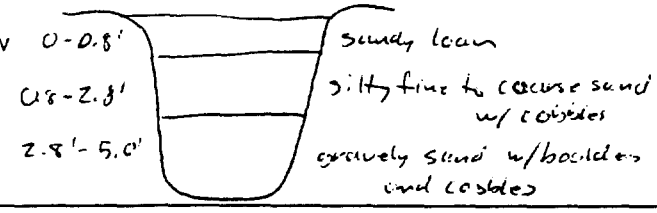
Date: 12/11/98

Location: N of W fence

Field Geologist: T Dorgan, T Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-.8'		loam, sandy		
0.8'-2.8'		Silty fine to course sand w/ cobbles brown	SM	
2.8'-5'		~~fine~~ gravely sand w/boulders and cobbles light tan	SW	

Test Pit Cross Section and/or Plan View



REMARKS: 5', roots down 2.5', No AAW found

PHOTO LOG:

TEST PIT: 19

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TtNUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 20

Project Number: N0003.0320

Date: 12/11/92

Location: Ball field - Center field

Field Geologist: B. Irwin / T. Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-1		Silty sand		
1-2.5		Coarse sand trace gravel.		Some cobbles
2.5		Encountered rock. suspected ledge.		K. O'neill. Stopped excavation due to ledge

Test Pit Cross Section and/or Plan View

REMARKS: Excavated 2.5' deep hit suspected ledge; continued to excavate trench to 12' in length and still encountered ledge. K. O'neil determined to stop.

PHOTO LOG:

TEST PIT:

PAGE 1 OF

T+ NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 21

Project Number: N0003.0320

Date: 12/11/98

Location: Ballfield - Right field

Field Geologist: B. Irwin T. Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-1		Silty sand		
1-2		Silty sand		spots of AAW found at 2' below surface
				exposed electrical line @ 2'

Test Pit Cross Section and/or Plan View

REMARKS: At 2' exposed unmarked electrical line. K. O'neil determined to stop excavation.

PHOTO LOG:

TEST PIT: 21

PAGE 1 OF

TT NUS FORM 0011

TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: RAYMARK OU4

Test Pit No.: 22

Project Number: N0003.0320

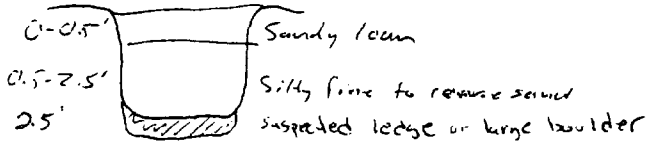
Date: 12/11/98

Location: Right field, ball field

Field Geologist: B. Irwin, T. Armstrong

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS
0-0.5'		Sandy loam		
0.5-2.5'		Silty fine to coarse sand with gravel and cobbles.		
2.5'		Encountered Rock. Backhoe could not move. suspected ledge		Found spots of AAW at 2.5' below surface

Test Pit Cross Section and/or Plan View



REMARKS:

PHOTO LOG:

TEST PIT: 22

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TT-NUS FORM 0011