Feasibility Study/Corrective Measures Study
for
Site 7 - Fuel Depot

Naval Weapons Industrial Reserve Plant
Calverton, New York

Northern Division Naval Facilities Engineering Command
Contract Number N62472-90-D-1298
Contract Task Order 0189

April 2002

TETRA TECH NUS, INC.

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FEASIBILITY STUDY/CORRECTIVE MEASURES STUDY FOR SITE 7 - FUEL DEPOT

NAVAL WEAPONS INDUSTRIAL RESERVE PLANT CALVERTON, NEW YORK

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Engineering Field Activity Northeast
Environmental Branch Code EV2
Naval Facilities Engineering Command
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Lester, Pennsylvania 19113-2090

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ACRONYM LIST

µg/kg	micrograms per kilogram
µg/L	micrograms per liter
ARAR	Applicable or Relevant and Appropriate Requirement
atm	atmosphere
AWQC	Ambient Water Quality Criteria
BDAT	best-demonstrated available technology
BTEX	benzene, toluene, ethylbenzene and xylene
CAA	Clean Air Act
CAMU	Corrective Action Management Units and Temporary Units
CAO	Corrective Action Objective
CFM	cubic feet per minute
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
CMS	Corrective Measure Study
CRDL	Contract Required Detection Limit
CRQL	Contract Required Quantitation Limit
CTO	Contract Task Order
CWA	Clean Water Act
DOT	Department of Transportation
EBCT	empty bed contact time
ECL	Environmental Conservation Law
EO	Executive Order
EPA	Environmental Protection Agency
FS	Feasibility Study
ft/day	feet/day
GAC	granular activated carbon
GOCO	Government-Owned-Contractor-Operated
gpm	gallons per minute
GW	groundwater
HEAST	Health Effects Assessment Summary Tables
HNUS	Halliburton NUS
IAS	Initial Assessment Study
IDL	Instrument Detection Limit
IR	Installation Restoration
IRA	interim remedial action

IRIS	Integrated Risk Information System
kg	kilogram
L	liter
LDR	Land Disposal Restrictions
LOAEL	lowest observed adverse effect level
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MDL	Method Detection Limit
MF	modifying factor
mg/kg	milligrams per kilogram
MNA	monitored natural attenuation
mg/L	milligrams per liter
mol	mole
NA	Not Applicable
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NOAA	National Oceanographic and Atmospheric Administration
NOAEL	no observed adverse effect level
NPDES	National Pollution Discharge Elimination System
NSPS	New Source Performance Standards
NWIRP	Navel Weapons Industrial Reserve Plant
NYCRR	New York Code of Rules and Regulation
NYSDEC	New York State Department of Environmental Conservation
O&M	operation and maintenance
ORC	oxygen releasing compound
ORD	Office of Research and Development
OSHA	Occupational Health and Safety Act
OSWER	Office of Solid Waste and Environmental Response
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
POC	Principle Organic Contaminant
POTW	publicly owned treatment works
ppb	parts per billion
PPE	personal protective equipment
ppm	parts per million
PRG	Preliminary Remediation Goal
RBC	rotating biological contactor

RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RfD	Reference Dose
RFI	RCRA Facility Investigation
RI	Remedial Investigation
SDWA	Safe Drinking Water Act
SMCL	Secondary Maximum Contaminant Level
SPDES	State Pollutant Discharge Elimination System
SSL	Soil Screening Level
STARS	Spill Technology and Remediation Series
SVOC	Semivolatile Organic Compound
TAGM	Technical Assistance Guidance Memorandum
TBC	to be considered
TCLP	Toxicity Characteristic Leaching Procedure
TDS	total dissolved solids
THM	trihalomethane
TOC	total organic carbon
TOGS	Technical and Operational Guidance Series
TSD	Treatment, Storage, and Disposal
TtNUS	Tetra Tech NUS, Inc.
UF	uncertainty factor
UOC	Unspecific Organic Contaminant
USC	United States Code
USGS	United States Geological Survey
UST	underground storage tank
UV	ultraviolet
VOC	Volatile Organic Compound

EXECUTIVE SUMMARY

This Feasibility Study/Corrective Measures Study (FS/CMS) has been prepared for the Department of the Navy, Engineering Field Activity Northeast Naval Facilities Engineering Command by Tetra Tech NUS, Inc. (TtNUS), under Contract Order (CTO) 0189. This report summarizes the results of the FS/CMS for Site 7 – Fuel Depot at the Naval Weapons Industrial Reserve Plant (NWIRP) located in Calverton, New York. The purpose of the FS/CMS is to develop and evaluate potential corrective measures (or remedial) alternatives. Environmental data collected for the site were evaluated to determine the human health and environmental risks resulting from on-site contamination. This information was presented in the Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) (HNUS, 1995a), Phase I RFI Addendum (HNUS, 1995b), Post Closure Report (CF Braun, 1998), and Phase 2 RFI (TtNUS, 2000). This FS/CMS develops corrective measures alternatives that address the risks identified in these reports.

The facility is both a state Superfund site and a RCRA site. It has been decided that this report will encompass both state Superfund (FS) and RCRA (CMS) requirements, and the title, FS/CMS, reflects this decision. For ease of reading and clarity, this FS/CMS will be referred to as a CMS for the remainder of the document. The format of this document follows RCRA guidance; however, it also addresses elements contained in Superfund FS guidance.

SITE DESCRIPTION

Site 7 is approximately 2 acres in size, measuring 150 feet in width and 400 feet in length. The principal features of the Fuel Depot are a large concrete parking area covering the southern half of the depot, and a gravel and soil covered area where a series of underground storage tanks were located. The Fuel Depot area was used for the storage and distribution of fuel products, such as JP-4 and JP-5 jet fuel, at the facility. Fuels were stored in underground tanks (USTs). The material was then transferred to trucks for use in the flight preparation areas of NWIRP Calverton. These activities have resulted in groundwater contamination by fuels. The contamination may be occurred by tank and pipe leakage, overfilling, and spills.

To date, remedial activities consisted of the installation of free product monitoring wells, passive free product recovery, and removal of USTs. From 1989 to 1996, approximately 174 gallons of free product were collected and disposed off site. A separate free product layer has not been observed at the site since 1995. As of May 1998, all the USTs have been removed. During tank removal, excavated soils that exhibited evidence of petroleum contamination were disposed off site.

SITE RISKS

The human health risk assessment was conducted for the Phase I RFI report. The risk assessment did not identify unacceptable risks from exposure to contamination under a non-residential use scenario. Residential exposure to soil and groundwater was also evaluated. Carcinogenic risks were within the EPA target risk range. Noncarcinogenic risks were only identified for a child resident.

Although the risk assessment identified limited risks to human health at the site, the concentrations of several soil and groundwater contaminants exceeded state guidance or regulatory requirements. Soil contaminants detected at concentrations higher that state guidance include ethylbenzene, xylenes, and several polynuclear aromatic hydrocarbons (PAHs). The soil contamination was detected at the groundwater interface and is associated with the former free product layer. Groundwater contaminants detected at concentrations higher than state drinking water standards and groundwater quality standards include BTEX (benzene, toluene, ethylbenzene, and xylenes), freon, 2-methylnaphthalene, and naphthalene.

REMEDIAL ALTERNATIVES

A range of corrective measures alternatives was developed to address the media of concern (groundwater). Separate alternatives for soil were not developed or evaluated because the groundwater corrective measures will also address the soil contamination.

Alternative 1 is the no action alternative included to serve as a baseline against which other alternatives could be compared. There are no costs associated with this alternative.

Alternative 2 includes natural attenuation of groundwater and implementation of institutional controls (i.e., monitoring of natural attenuation and site development restrictions). Groundwater monitoring would be performed to measure changes in site contamination. Modeling would be conducted to estimate contaminant migration and the effectiveness natural attenuation. Site development restrictions would be implemented into the facility transfer documents. A reevaluation of the site would be performed every 5 years to determine whether any changes to the controls or remedy would be required. The estimated net present worth for Alternative 2 is $1.23 million.

Alternative 3 consists of groundwater extraction, treatment to meet state groundwater standards, and reinjection into the aquifer. Alternative 3 was developed as a remediation alternative to prevent contaminated groundwater from migrating off site and remediation on-site groundwater. Site soils would be addressed through natural degradation processes including biodegradation and flushing to groundwater. Residuals generated during groundwater treatment would be treated or disposed at a permitted off-site facility. Groundwater monitoring would be conducted to evaluate the effectiveness of the remedy. Restrictions on the use of groundwater would be imposed until clean-up standards have been attained. If after 4 years of operation, groundwater cleanup is not complete or contaminant removal has become inefficient, the remedy may become institutional controls and natural attenuation (Alternative 2). A reevaluation of the site would be performed every 5 years to determine whether any changes to the remedy would be required. The estimated net present worth for Alternative 3 is $4.9 million.

Alternative 4 was developed as an insitu treatment alternative. This alternative consists of installing an air sparging/bioventing system and groundwater monitoring. In the air sparging system, air would be injected to volatilize groundwater contaminants and supply oxygen to enhance biodegradation in the soil and groundwater. The air sparging system would be combined with a soil vapor extraction system to remove the volatilized contaminants and biodegradation products from the vadose zone. Extracted air would be treated as necessary to meet air emission limits. Any residuals generated during air treatment would be treated or disposed at a permitted off-site facility. Groundwater monitoring would be conducted to evaluate the effectiveness of the remedy. Restrictions on the use of groundwater would be imposed until clean-up standards have been attained. If after 4 years of operation, groundwater cleanup is not complete or contaminant removal has become inefficient, the remedy may become institutional controls and natural attenuation (Alternative 2). A reevaluation of the site would be performed every 5 years to determine whether any changes to the remedy would be required. The estimated net present worth for Alternative 4 is $1.57 million.

Alternative 5 was developed as an active insitu bioremediation alternative. This alternative consists of adding Oxygen Releasing Compounds (ORC) to the groundwater and groundwater monitoring. The ORC provides oxygen to the indigenous microorganisms, thereby enhancing their ability to degrade contaminants. The addition of ORC has been demonstrated to remedial fuel contaminated groundwater; however, biodegradation of freon, which is located in a portion of the site, is not expected. The freon contamination would be addressed through natural attenuation and monitoring. The ORC would be added periodically over a 4-year period. This remedy is not expected to generate any treatment residuals that would require off-site treatment or disposal. Groundwater monitoring would be conducted to evaluate the effectiveness of the remedy. Restrictions on the use of groundwater would be imposed until clean-up standards have been attained. If after 4 years of operation, groundwater cleanup is not complete or contaminant removal has become inefficient, the remedy may become institutional controls and natural attenuation (Alternative 2). A reevaluation of the site would be performed every 5 years to determine whether any changes to the remedy would be required. The estimated net present worth for Alternative 5 is $4.5 million.

RECOMMENDED CORRECTIVE MEASURE

The recommended alternative for Site 7 is Alternative 4 – Air Sparging/Bioventing. This alternative is expected to attain the corrective measures objectives at the lowest cost in a reasonable time frame. In the event that groundwater cleanup is not complete or contaminant removal has become efficient within 4 years of operation, the remediation would switch to Alternative 2 – Institutional Controls and Natural Attenuation.

1.0 INTRODUCTION

1.1 SCOPE AND OBJECTIVES

The Engineering Field Activity Northeast Naval Facilities Engineering Command has issued Contract Task Order (CTO) 0189 to Tetra Tech NUS, Inc. (TtNUS), under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract N62472-90-D-1298 to perform a Feasibility Study (FS) and Resource Conservation and Recovery Act (RCRA) Corrective Measure Study (CMS) for Site 7 - Fuel Depot at the Naval Weapons Industrial Reserve Plant (NWIRP), located in Calverton, New York.

This work is part of the Navy's Installation Restoration (IR) Program, which is designed to identify contamination of Navy and Marine Corps lands/facilities resulting from past operations and to institute corrective measures, as needed. There are typically four distinct stages. Stage 1 is the Preliminary Assessment (formerly known as the Initial Assessment Study [IAS]). Stage 2 is a RCRA Facility Assessment -Sampling Visit (RFA) (also referred to as a Site Investigation), which augments the information collected in the Preliminary Assessment. Stage 3 is the RCRA Facility Investigation/Corrective Measures Study (RFI/CMS) (also referred to as a Remedial Investigation/Feasibility Study [RI/FS]), which characterizes the contamination at a facility and develops options for remediation of the site. Stage 4 is the Remedial Action, which results in the control or cleanup of contamination at sites. This report has been prepared under Stage 3 (CMS).

This work was conducted in accordance with the requirements of the New York State RCRA Hazardous Waste Permit for the facility (NYSDEC 1-4730-00013/00001-0), dated March 25, 1992. New York State Department of Environmental Conservation (NYSDEC) is the lead oversight agency. This work was also conducted in accordance with the requirements of the United States Environmental Protection Agency (EPA) previous facility permit (EPA ID Number NYD003995198), dated May 11, 1992. The EPA supports NYSDEC in its oversight activities. The requirements of both permits appear to be the same, although the terminology and format vary. The facility is also a state Superfund site. The FS/CMS was conducted in accordance with the requirements of the NYSDEC Division of Solid & Hazardous Materials Part 373 Permit that was issued to the Navy on April 18, 2000, under the NYSDEC implementing regulations (6 NYCRR Part 621). This permit supercedes and replaces the original Part 373 Permit to Operate a Hazardous Waste Storage Facility that was issued to then Grumman Aerospace Corporation on March 25, 1992. The new permit, issued only to the Department of the Navy, deals exclusively with those Solid Waste Management Units that remain on the former NWIRP Calverton property and any corrective actions that may be required to adequately address each site. Although the Part 373 Permit is the enforceable document governing the Navy's remedial actions, the NYSDEC State Superfund group, located in the Albany office, retains primary responsibility for regulatory oversight of the Navy's actions.

As such, the Navy has agreed to a request by the NYSDEC State Superfund group to utilize terminology associated with the NYSDEC State Superfund program that is closely related to the Federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program. The CERCLA terminology parallels the RCRA terminology. The implementation phases of each program have been determined to meet the substantive requirements of both programs and will also satisfy the corrective action requirements included in Module III of the Part 373 Permit.

The objectives of the CMS are as follows.

- Identify Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBC) criteria.
- Identify risk-based action levels which are protective of human health and the environment.
- Develop Corrective Action Objectives, which identify chemicals of concern, receptor, pathway, and preliminary remediation goals. The preliminary remediation goals are based on chemical-specific ARARS, TBCs, and risk-based action levels.
- Identify and Screen Corrective Measures Technologies.
- Develop Corrective Measures Alternatives.
- Conduct a detailed analysis and comparative analysis of Corrective Measures Alternatives.

1.2 ORGANIZATION OF CORRECTIVE MEASURES STUDY

This CMS consists of five sections. Section 1.0 is the introduction section. Section 2.0 provides a description of current site conditions. Section 3.0 identifies ARARs, TBCs, and Corrective Action Objectives. The identification and screening of Corrective Measure Technologies and development of Corrective Measure Alternatives are conducted in Section 4.0. Section 5.0 presents the evaluation of Corrective Measures Alternatives.

1.3 ACTIVITY BACKGROUND INFORMATION

1.3.1 Facility Location

Site 7 - Fuel Depot is located within the confines of the NWIRP in Calverton, Suffolk County, New York, (see Figures 1-1 and 1-2). The facility is located within the municipality of Riverhead. Calverton is located on Long Island approximately 80 miles east of New York City.

The NWIRP consists of four separate parcels of land totaling approximately 358 acres. Eight Navy IR sites are included within these parcels as follows. The location of the parcels and sites are presented in Figure 1-2.

Parcel A (32 acres)

Site 2 - Fire Training Area

Parcel B1 (40 acres)

Site 6A - Fuel Calibration Area

Site 10B - Engine Test House

Parcel B2 (131) acres

Southern Area

Parcel C (10 acres)

Site 7 - Fuel Depot

Site 10A - Jet Fuel Systems Laboratory

Parcel D (145 acres)

Site 1 - Northeast Pond Disposal Area

Site 9 - ECM Area

1.3.2 Facility History

The NWIRP Calverton has been owned by the United States Navy since the early 1950's. At that time, the property was purchased from a number of private owners. The facility was expanded in 1958 through additional purchases of privately-owned land. Northrop Grumman Corporation (previously Grumman Corporation) has operated the facility since its construction (Navy, 1986).

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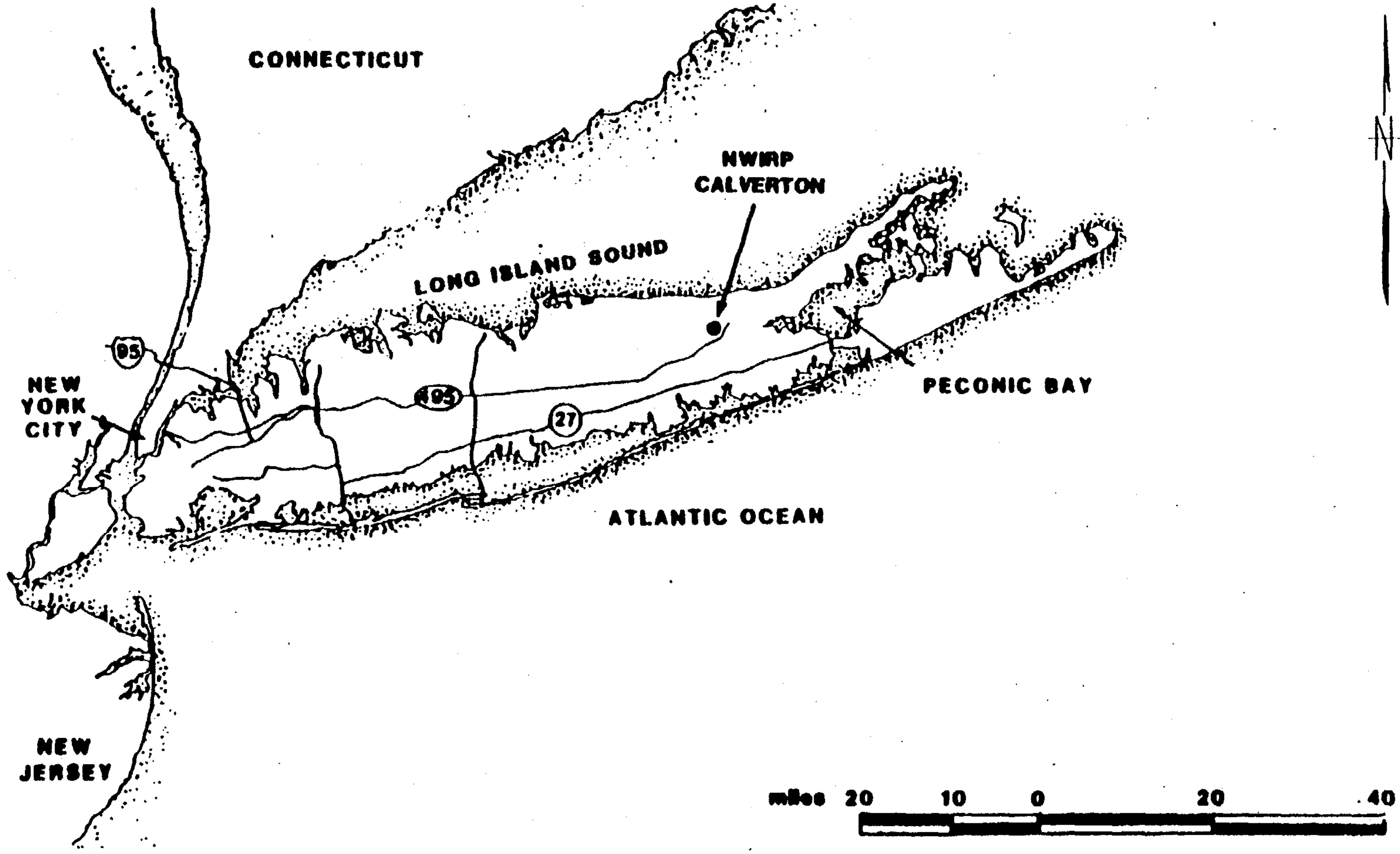

DRAWN BY HJP	DATE 8/9/99	Tetra Tech NUS, Inc.	CONTRACT NO. 4570	OWNER NO. ----
CHECKED BY	DATE	GENERAL LOCATION MAP SITE 7 CORRECTIVE MEASURES STUDY NWIRP, CALVERTON, NEW YORK	APPROVED BY	DATE
COST/SCHED-AREA			APPROVED BY	DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-1	REV. 0

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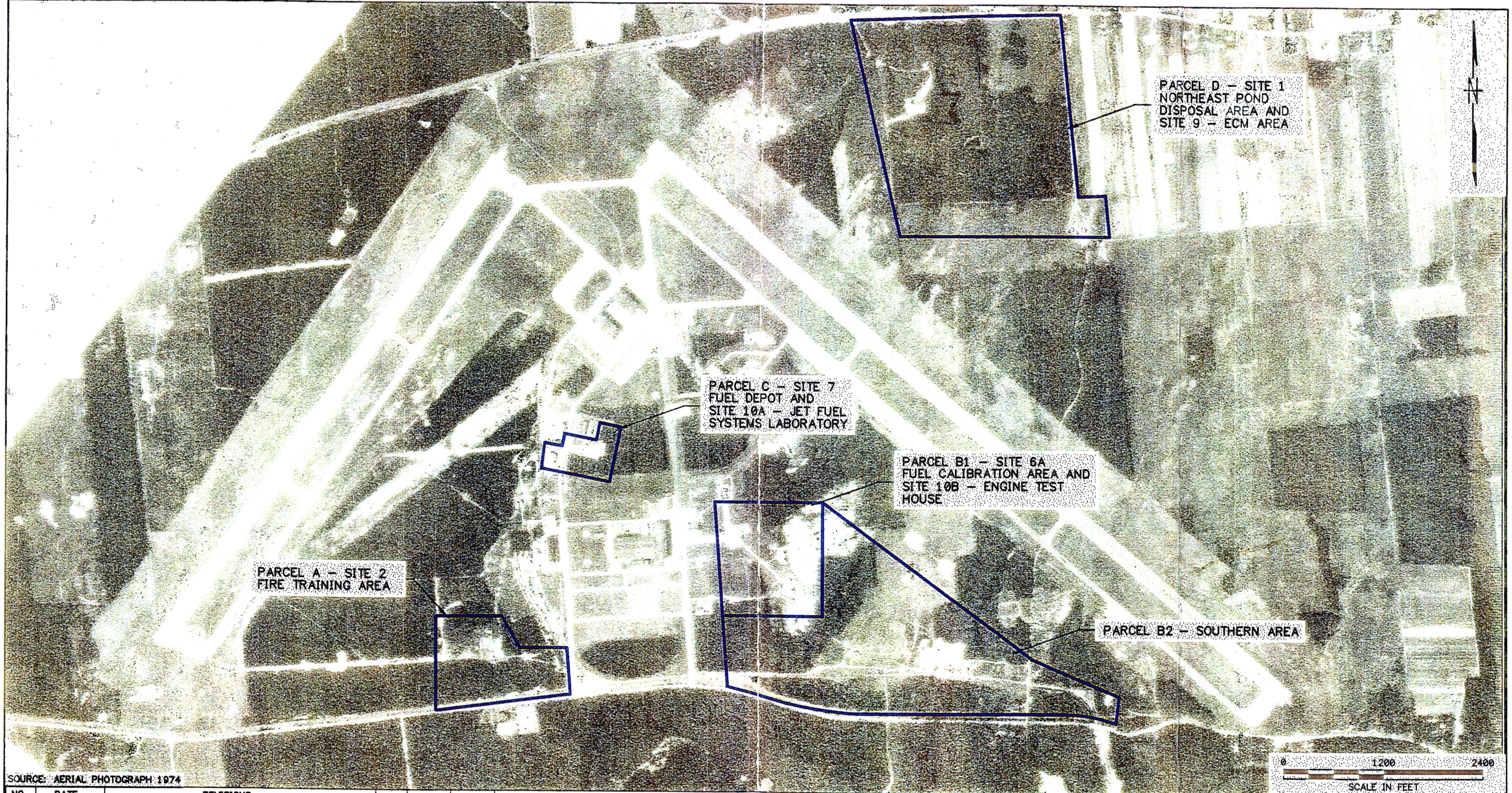

SOURCE: AERIAL PHOTOGRAPH 1974

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY HJP DATE 8/9/99

CHECKED BY DATE

COST/SCHED-AREA

SCALE AS NOTED

Tetra Tech NUS, Inc.

SITE LOCATION
SITE 7 – CORRECTIVE MEASURES STUDY
NWIRP CALVERTON, NEW YORK

CONTRACT NO. 4570

OWNER NO. ––––

APPROVED BY DATE

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DRAWING NO. FIGURE 1–2

REV. 0

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The NWIRP Calverton was constructed in the early 1950's for use in the development, assembly, testing, refitting, and retrofitting of Naval combat aircraft. Northrop Grumman was the sole operator of the facility, which was known as a Government-Owned-Contractor-Operated (GOCO) installation. Construction was completed in 1954. The facility supported aircraft design and production at the Northrop Grumman Bethpage, New York NWIRP.

The majority of industrial activities at the facility were confined to the developed area in the center and south center of the facility, between the two runways. Industrial activities at the facility were related to the manufacturing and assembly of aircraft and aircraft components. Hazardous waste generation at the facility was related to metal finishing processes, such as metal cleaning and electroplating. The painting of aircraft and components resulted in additional waste generation (Navy, 1986; HNUS, 1992).

Northrop Grumman operations at the facility ended in February 1996. In September 1998, the majority of the land within the developed section of the facility was transferred to the Town of Riverhead for redevelopment. Because of the need for additional environmental investigation and the potential need for remediation, the Navy retained four parcels of land within the developed section. The four parcels and associated Navy IR Sites are presented on Figure 1-2.

In September 1999, 2,935 acres of undeveloped land outside of the fenced areas was transferred to NYSDEC who will continue to manage the property for resource conservation and recreational uses. An additional 140 acres of the northwest buffer zone was transferred to the Department of Veterans Affairs and will be used for expansion of the Calverton National Cemetery.

1.4 PHYSICAL CHARACTERISTICS OF STUDY AREA

1.4.1 <u>Climate and Meteorology</u>

The NWIRP Calverton is located in an area classified as a humid-continental climate. Its proximity to the Atlantic Ocean and Long Island Sound add maritime influences to this classification (NOAA, 1982).

The average yearly temperature at the NOAA Riverhead Research Station, located 4.5 miles northeast of the site, is 52.2 F, with a mean maximum average monthly temperature of 73.3 F in July and a minimum average monthly mean temperature of 30.9 F in January. Annual precipitation at the Riverhead station averages 45.32 inches. The highest month average precipitation is 4.46 inches, occurring in December, and the lowest 2.90 inches, occurring in July. The average yearly evapotranspiration rate is 29 inches, resulting in a net annual precipitation rate of 16.32 inches. A 2-year, 24-hour rainfall can be expected to bring 3.4 inches of precipitation (NOAA, 1982; U.S. Department of Commerce, 1961).

1.4.2 Topography

The NWIRP Calverton is located in an area underlain by permeable glacial material and characterized by limited surface water drainage features. Normal precipitation at the facility is expected to infiltrate rapidly into the soil. The majority of the facility is located within the Peconic River drainage basin. Extensive wetland areas and glacially formed lakes and ponds are located southwest and south of the facility. NWIRP Calverton occupies a relatively flat, intermorainal area. The topographic relief at NWIRP is 54 feet; elevations range from 30 to 84 feet above mean sea level.

1.4.3 Surface Water Hydrology

The majority of the facility is located within the Peconic River drainage basin. Extensive wetland areas and glacially formed lakes and ponds are located southwest and south of the facility. The eastward-flowing Peconic River is located approximately 2000 feet south of the facility at its closest point. Based on topography, groundwater is expected to flow southward and discharge to the ponds and wetland areas, and ultimately be received by the Peconic River via overland flow. The Peconic River flows into Peconic Lake. The Peconic is tidally influenced below the dam on the Peconic Lake, located 3.2 stream miles from the site, and discharges to Peconic Bay which is 8.5 stream miles from the facility.

Major surface water features near the Calverton facility include McKay Lake, the Northeast Pond, and the North Pond. McKay Lake is a groundwater recharge basin located north of River Road, midway along the southern site border. The Northeast Pond is located at the northeast corner of the site (Northeast Pond Disposal Area), and North Pond is located near the southwest corner of the facility. Several small drainage basins exist near the Fuel Calibration Area. All of these ponds and drainage basins are land locked, with the exception of McKay Lake, which has an intermittent discharge to Swan Pond, located 1,500 feet to the south. Swan Pond, approximately 55 acres in size, discharges to the Peconic River 1.6 stream miles south of the McKay Lake via a string of cranberry bogs (USGS, 1967; Navy, 1986).

The Northeast Pond area actually consists of two ponds, a 2.3-acre pond directly east of the disposal area and an approximately 1-acre pond located less than 500 feet to the southeast of the disposal area (Shannon's Pond). Both of these ponds lie in land-locked depressions and may be of glacial origin. Observations made during RFI soil boring drilling activities in the pond disposal area indicated that the main ponds elevation is similar to the local groundwater elevation. As stated earlier, no outfalls exist from the ponds; they are expected to receive limited overland surface water flow from surrounding land in the northeast corner of the site (USGS, 1967).

The small drainage basins located near the fuel calibration area are land-locked and receive limited surface water runoff from immediately adjacent areas. Surface water runoff from the fuel calibration area is collected by drainage ditches paralleling the southern and eastern edges of the paved area. The ditches enter a southward-flowing culvert at the southeast corner of the calibration area; the culvert ends approximately 250 feet west of the engine test house, south of the road. A drainage ditch flows southward 500 feet from the outfall and enters a depression containing two small ponds. These ponds are located approximately 1,500 feet south of the fuel calibration area. Runoff from the fire training area flows to the southeast; the nearest potential receiving water is Swan Pond, located 2,000 feet to the southeast. Runoff from the fuel depot flows eastward via a very shallow slope into woodlands. No direct drainage pathway to a surface water body exists. Surface water runoff for the area at the end on the Runway 32-14 is expected to flow approximately 500 feet south to the Peconic River. The elevation of the end of the runway is approximately 20 feet above the river in this area.

1.4.4 Geology and Soils

Geologic Setting

NWIRP Calverton lies within the Atlantic Coastal Plain Physiographic Province. Generally, this region can be characterized as an area of relatively undissected, low-lying plains. The Atlantic Coastal Plain is underlain by a thick sequence of unconsolidated deposits. The surface topography has been created or modified by Pleistocene glaciation (Isbister, 1966).

Ground surface elevations on Long Island range from sea level to approximately 400 feet above mean sea level. The two most prominent topographic features in the Long Island area are the Ronkonkoma terminal moraine and the Harbor Hill end moraine. These east-west trending highlands mark the southern terminus or maximum extent of two glacial advances. The older Harbor Hill moraine lies along the northern shore of Long Island, the younger Ronkonkoma moraine basically bisects the island. NWIRP Calverton occupies a relatively flat, intermorainal area between these two features. The topographic relief at NWIRP is 54 feet; elevations range from 30 to 84 feet above mean sea level (McClymonds and Franke, 1972).

NWIRP Calverton is underlain by approximately 1,300 feet of unconsolidated sediments. The unconsolidated sediments consist of four distinct geologic units. These units, in descending order, are the Upper Glacial Formation, the Magothy Formation, the Raritan Clay Member of the Raritan Formation, and the Lloyd Sand Member of the Raritan Formation (McClymonds and Franke, 1972).

The glacial sediments beneath the NWIRP have a maximum thickness of approximately 250 feet and consist of both glacial till and outwash deposits. Till is deposited directly by the ice, while outwash deposits are laid down by meltwater-supplied glaciofluvial systems. The till in Suffolk County ranges from 0 to 150 feet in thickness and generally consists of poorly sorted to unstratified sediments. The outwash deposits consist chiefly of well-sorted and stratified sand and gravel. One important characteristic of outwash deposits is their high degree of heterogeneity. Lithologies may vary widely over relatively short vertical and horizontal distances.

The Cretaceous age Magothy Formation underlies the Upper Glacial Formation and is approximately 520 feet thick. The Magothy Formation chiefly consists of stratified, fine to coarse sand and gravel.

The Cretaceous age Raritan Clay Member of the Raritan Formation underlies the Magothy Formation and is approximately 170 feet thick. The Raritan Clay consists of clay and silty clay.

The Lloyd Sand Member of the Raritan Formation underlies the Raritan Clay and is approximately 400 feet thick. The Lloyd Sand consists chiefly of fine to coarse sand and gravel.

The unconsolidated sediments beneath the site unconformably overlie crystalline bedrock. The crystalline bedrock consist of schist, gneiss, and granite. The regional dip is to the south and southeast. All of the geologic units dip in these directions, although to varying degrees (McClymonds and Frank, 1972).

Site-Specific Geology

Based on the RFI soil boring program, the sites are predominantly underlain by fine to coarse sediments of probable glaciofluvial origin. Three distinct lithofacies were encountered. The upper lithofacies consist predominantly of silty, fine-grained sand with varying amounts of peat and clay. Fill material, where present, is always associated with the upper lithofacies. The upper lithofacies represent a mixture of soil, fill, and glacial deposits. The middle lithofacies consist of predominantly fine-grained sand with varying amounts of medium- to course-grained sand, and pebbles. The middle lithofacies probably represent undisturbed glacial deposits. The lower lithofacies consist of micaceous, silty clay and may represent the Magothy Formation.

Soils

The soils underlying the NWIRP were discussed in detail in the IAS (Navy, 1986). Each site studied as part of this investigation occurs in an area that, by the nature of the site activity, involved the disturbance of the soil. It is unlikely that the native soil exists as mapped beneath any of the sites. This is due to fill activity (Northeast Pond Disposal Area), soil removal activity (Fire Training Area), or the cut-and-fill or grading activity associated with construction at the other sites.

1.4.5 <u>Hydrogeology</u>

The unconsolidated sediments that underlie the NWIRP are generally coarse-grained with high porosities and permeabilities. These factors create aquifers with high yields and high transmissivities.

The Upper Glacial Formation, the Magothy Formation, and the Lloyd Sand are the major regional aquifers. The Upper Glacial and the Magothy aquifers are of principal importance in Suffolk County because of their proximity to the land surface. The Lloyd Sand is not widely exploited because of its depth (McClymonds and Franke, 1972).

The Upper Glacial aquifer is widely used as a source of potable water in Suffolk County. The water table beneath the NWIRP lies within this aquifer. Porosities in excess of 30 percent have been calculated for the Upper Glacial aquifer in adjoining Nassau County, Long Island. The estimated value of hydraulic conductivity is 270 feet per day (ft/day).

The Magothy aquifer is widely used as a source of potable water in Suffolk County. The most productive units are the coarser sands and gravels. The permeability of the Magothy is high; hydraulic conductivities have been calculated in excess of 70 ft/day.

The Upper Glacial and the Magothy aquifers are believed to be hydraulically interconnected and to function as a single unconfined aquifer. On-site well logs, previous hydrogeological investigations, and geologic mapping indicate that although clay lenses are present in both aquifers that may create locally confining and/or perched conditions, these lenses are not widespread and do not function as regional aquitards (McClymonds and Franke, 1972; Fetter, 1976).

The Raritan Clay has a very low permeability (approximately 3×10^{-5} ft/day) and hydrologically acts as a regional confining layer. This confining nature of this unit is believed to minimize potential contamination to the underlying Lloyd Sand aquifer (McClymonds and Franke, 1972).

The Lloyd Sand is a potential aquifer that has not been extensively developed due to its depth and the abundant water available in the overlying aquifers. Estimated hydraulic conductivities for the Lloyd Sand range from 20 to 70 ft/day.

The depth to groundwater beneath the areas of concern, as determined by the soil boring and monitoring well installation programs, ranges from approximately 5 feet in the Fuel Calibration Area (Site 6A) to approximately 43 feet in the Northeast Disposal Pond Area (Site 1). Groundwater at the Fuel Depot Area (Site 7) is approximately 15 to 17 feet below ground surface.

The NWIRP Calverton saddles a regional groundwater divide, with groundwater beneath the northern half flowing to the northeast and groundwater beneath the southern half of the NWIRP flowing to the southeast. Based on water-level measurement obtained during the RFI, the groundwater flow direction at both the Fire Training Area and the Fuel Calibration Area is to the southeast. The groundwater flow direction at the Fuel Depot Area is to the east. The groundwater flow direction at the Northeast Pond Disposal Area is to the northeast.

The facility production wells undoubtedly affect the flow pattern of the local groundwater, but to an unknown extent. These wells are between 140 and 155 feet deep. The individual well draw down and the radius of the resultant cones of depression formed by the pumping of these wells are not known (Fetter, 1976; Seaburn, 1970).

The Peconic River basin is the likely discharge point for the southern portion of the NWIRP's groundwater in the shallow aquifer zones. Long Island Sound is the likely discharge point of the northern half of the NWIRP's groundwater in the shallow aquifer zones.

1.4.6 Water Supply

Groundwater serves as the source of drinking water for the population residing within a 4-mile radius of the site. Private wells, wells on two government-owned facilities (Town of Riverhead and Brookhaven National Lab), and three municipal water systems (Riverhead Water District, Shorewood Water Company, and Suffolk Water Company) supply the drinking water needs of the study area.

1.4.7 Surrounding Land Use

The land surrounding the Calverton facility in all directions is primarily agricultural or wooded, with scattered residences and commercial establishments. Wildwood State Park and Long Island Sound are located 2.3 miles and 2.75 miles north, respectively. The town of Riverhead is located 4.25 miles to the east. A golf course, Swan Pond, and a large area of swamp, wetland, and cranberry bogs are located immediately south of the facility. The Long Island Railroad passes within 1,000 feet of the southeast corner of the facility. Brookhaven National Laboratory is located 2 miles southwest of the facility. A residential development surrounding Lake Panamoka is located 1 mile west of the facility (USGS, 1967).

1.4.8 Ecology

According to the U.S. Department of the Interior, Fish and Wildlife Service, no federally listed endangered or threatened species reside within a 4-mile radius of the study area. Transient individuals of endangered species, such as the Bald Eagle (Haliaeetus leucocephalus), may occur within the study area.

Information provided by NYSDEC and the New York Natural Heritage program indicated that several New York State endangered and threatened animal species exist within the study area. The most notable, tiger salamander (Ambystoma tigrinum), may occur on site in the ponds adjacent to the Fuel Calibration Area, and possibly the Northeast Pond Disposal Area. Other species include the northern cricket frog (Acris crepitans) and the least tern (Sterna Antillarum). While numerous additional endangered and threatened plant species occur within the Calverton facility boundary, none are believed to be present at Site 7.

According to the information supplied by NYSDEC, the wetland areas surrounding the Peconic River, including Swan Pond, are the location of significant habitat for many endangered and threatened animals and plants.

2.0 DESCRIPTION OF CURRENT CONDITIONS

This section presents a summary of the current conditions for Site 7 - Fuel Depot. The discussion is extracted from a more complete presentation in the Phase 1 RFI (HNUS, 1995a), Phase 1 RFI Addendum (HNUS, 1995b), Post Closure Report (CF Braun, 1998), and the Phase 2 RFI (TtNUS, 2000). For each site, the following situations are presented.

- Site description, including site history, remedial activities/interim actions, geology and hydrogeology.
- Nature and extent of contamination summary.
- Qualitative contaminant fate and transport.

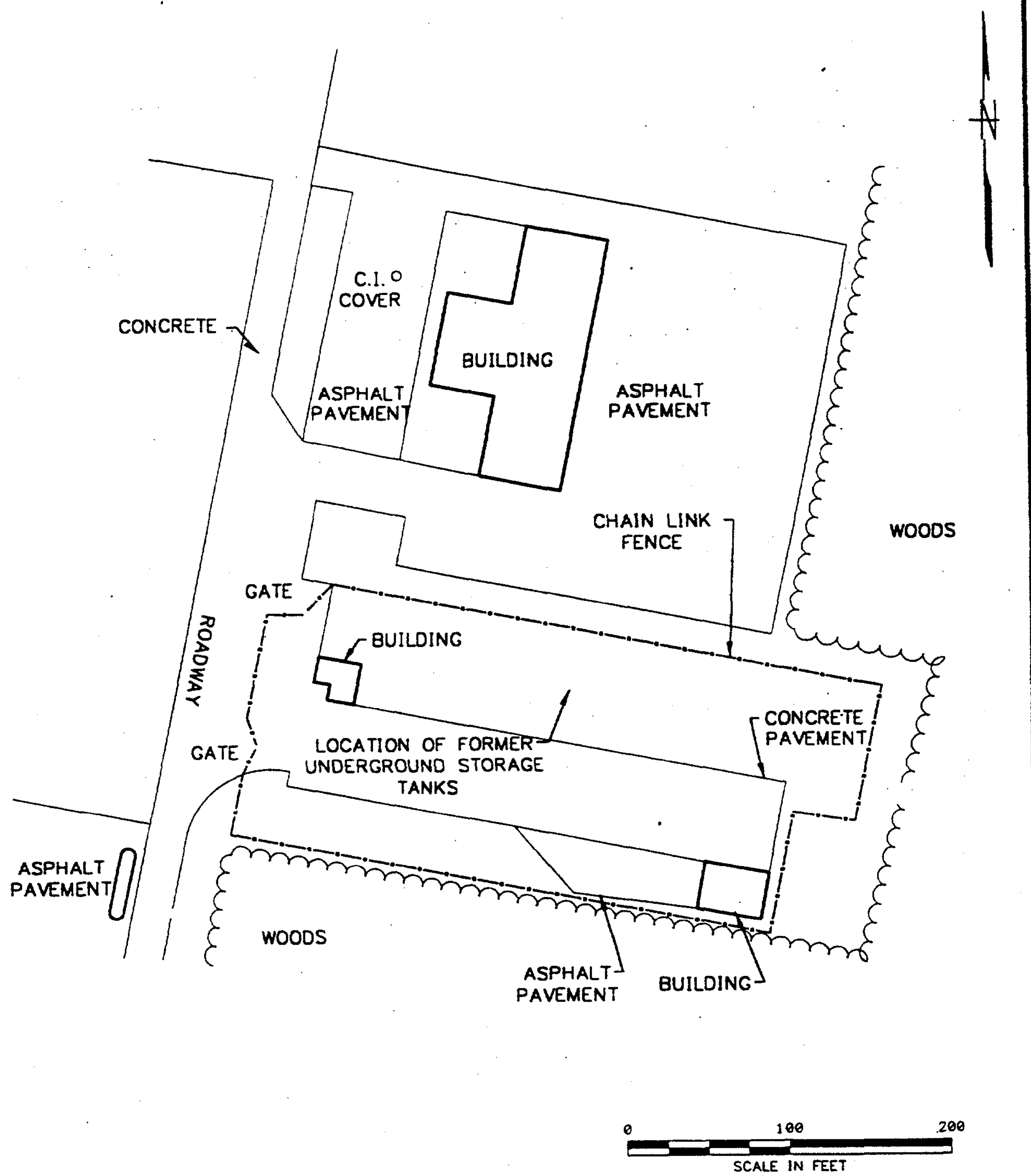
2.1 SITE DESCRIPTION

The Fuel Depot Area is located approximately 3,000 feet north of the south gate, near the geographic center of the NWIRP Calverton (Figure 1-2). It is located at the eastern side of the road leading from the south gate and is approximately 2 acres in area, measuring 150 feet in width and 400 feet in length (Figure 2-1). The principal features of the Fuel Depot are a large concrete trucking-parking area covering the southern half of the depot, and a gravel/soil area where a series of underground storage tanks were located. The last of the underground storage tanks were removed in 1998. A pump house is located at the western edge of the fuel depot.

A garage and paved parking area for trucks and equipment used by the Northrop Grumman transportation department were located north of the Fuel Depot. Areas to the east and south are wooded. A paved roadway leading from the south gate is adjacent to the depot to the west; a storage building and the fuel system laboratory building are located west of the road. The Fuel Depot is generally level, with a very slight slope to the east.

The Fuel Depot area was used for the storage and distribution of fuel products, such as JP-4 and JP-5 jet fuel, at the facility. Fuels were stored in underground storage tanks. The material was then transferred to trucks for use in the flight preparation areas of the NWIRP Calverton. These activities have resulted in groundwater contamination by fuels, which may have occurred by tank and pipe leakage, overfilling, and spills.

To date, remedial activities at the Fuel Depot consisted of installation of free product monitoring wells, passive free product recovery, and removal of underground storage tanks. Thirty-four monitoring wells were installed by Northrop Grumman in May 1989. These wells were used to identify the extent of free product and were also used to accumulate free product prior to recovery. From 1989 to December 1996, ACAD: 4570cm10.dwg 09/10/99 HJP



DRAWN BY HJP / DATE 8/4/99	Tetra Tech NUS, Inc.	CONTRACT NO. 4570	OWNER NO. 0189
CHECKED BY / DATE	SITE LAYOUT MAP SITE 7 – FUEL DEPOT AREA NWIRP, CALVERTON, NY	APPROVED BY / DATE	
COST/SCHED-AREA		APPROVED BY / DATE	
SCALE AS NOTED		DRAWING NO. FIGURE 2–1	REV. 0

FORM CADD NO. TtNUS_AV.DWG – REV 0 – 1/22/98

174 gallons of free product were collected and disposed off site. A separate free product layer has not been observed at the Fuel Depot since 1995. As of May 1998, all the underground storage tanks have been removed from the Fuel Depot. During tank removal, excavated soils that exhibited evidence of petroleum contamination were disposed off site.

Geology

Based upon on-site soil borings and wells, the site is underlain by three distinct lithofacies, an upper (A) lithofacies, a middle (B) lithofacies, and a lower (C) lithofacies. The upper lithofacies (A) consists predominantly of orange brown, brown and light brown, silty, fine-grained sand with varying amounts of peat and pebbles. The upper lithofacies ranges from one to five feet thick and was encountered in all soil borings except FD-SB-04 and in all monitoring wells. The upper lithofacies (A) represents a mixture of soil and glacial deposits. The middle lithofacies (B) consists of light brown and tan fine-grained sand with varying amounts of medium-grained sand, pebbles, and clay. The middle lithofacies ranged form 45 to 69 feet thick and was encountered in all soil borings and monitoring wells. One of the monitoring wells, FD-MW-04-I, penetrated an additional nine feet of micaceous silt. The middle lithofacies (B) probably represents undisturbed glacial deposits. The lower lithofacies (C) consists of brownish-gray, micaceous, silty clay and was encountered in all of the intermediate wells. The lower lithofacies (C) may represent the Magothy Formation.

Hydrogeology

Groundwater in the glacial deposits occurs under unconfined conditions. The depth to groundwater, as determined by the on-site monitoring well program, ranges from 17.39 to 19.49 feet below grade. The elevation of the water tables ranges from 32.55 feet above mean sea level in FD-MW-03-I, the western-most well, to 32.20 feet above mean sea level in FD-MW-01-I, the northernmost well. The direction of groundwater flow is to the east. The hydraulic conductivity calculated for glacial deposits from slug tests ranges from 0.039 feet per minute (56 ft/day) to 0.122 feet per minute (176 ft/day) for sediments shallower than 24 feet and from 0.029 feet per minute (42 ft/day) to 0.036 feet per minute (52 ft/day) for sediments deeper than 41 feet below ground surface.

2.4.2 Nature and Extent of Contamination

The nature and extent of contamination, as presented in the RFI, is summarized as follows.

- Except at the water table in the location of the former underground storage tanks, volatile organic compounds (VOCs) were not detected in the Fuel Depot area soils. Based on the absence of VOCs being detected, the source area soils are most likely depleted of VOC contamination. Alternatively, because of the presence of underground storage tanks at this site, contaminants could have been introduced directly into the groundwater. A RCRA hazardous waste characteristic evaluation (40 CFR 261) of site soils did not find that the soils would be classifiable as a characteristic hazardous waste.

- Polynuclear aromatic hydrocarbons (PAHs) and phthalates were detected at several locations throughout the site. However, only one PAH (benzo(a)pyrene at 0.11 milligrams per kilogram [mg/kg]) at one surface location exceeded New York State soil actions levels. Higher concentrations of PAHs were found at depth near the water table and the location of a former floating free product layer (maximum concentration of 27 mg/kg).

- Lead was not found at concentrations that would be considered greater than background.

- Groundwater testing found VOCs including chloroform (1 microgram per liter [μg/L]), 1,1,1-trichloroethane (2 μg/L), benzene (17 μg/L), toluene (710 μg/L), ethylbenzene (480 μg/L), and xylenes 2,400 μg/L) at concentrations above Federal Maximum Contaminant Levels (MCLs) and/or NYSDEC groundwater quality standards (see Figure 2-2). Semivolatile organics including naphthalene (150 μg/L), and methylnaphthalene (78 μg/L) were also found at levels exceeding Federal MCLs and/or NYSDEC groundwater quality standards. Lead was found in one well at 25 μg/L, which is greater than the lead action level of 15 μg/L.

- In addition, a separate area of freon contaminated groundwater is present near the southwest corner of the Fuel Depot. The maximum freon concentration was 100 μg/L.

- Floating free product was identified at the site in 1989. The location of the free product corresponded to the location of the most contaminated groundwater. Northrop Grunman recovered floating product for several years, and the Navy followed up with recovery tests and determined that there was no recoverable product remaining. A separate floating free product layer has not been identified at the site since 1995. Any "sheen" that may remain on the water table is expected to be addressed during remediation of the site.

- The extent of groundwater contamination is adequately characterized.

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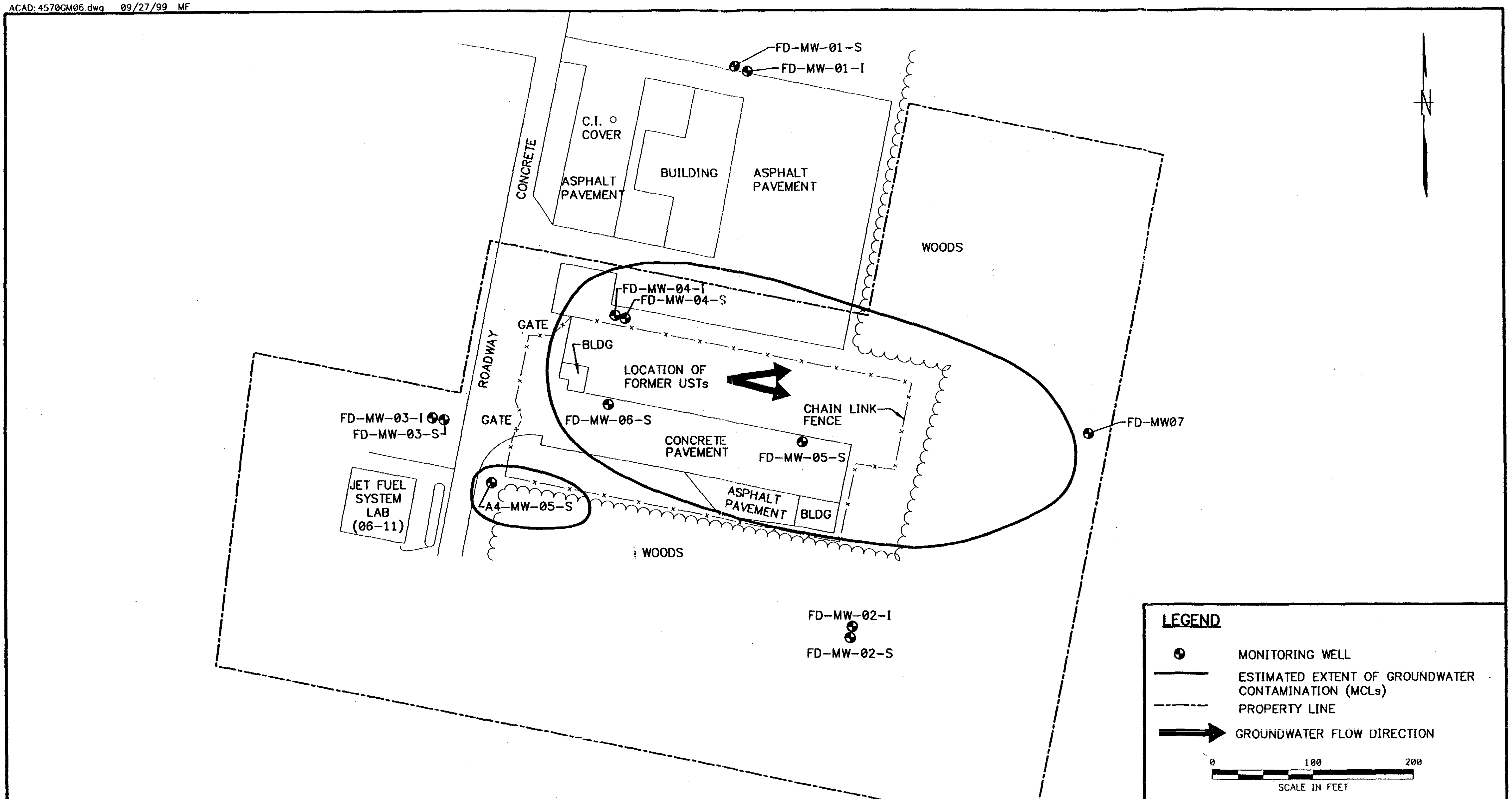

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES	DRAWN BY mf DATE 9/27/99	Tetra Tech NUS, Inc.	CONTRACT NO. 4570	OWNER NO. 0189
							CHECKED BY DATE	ESTIMATED EXTENT OF GROUNDWATER CONTAMINATION SITE 7 – FUEL DEPOT AREA PHASE 2 RFI NWIRP, CLAVERTON, NY	APPROVED BY	DATE
							COST/SCHED-AREA		APPROVED BY	DATE
							SCALE AS NOTED		DRAWING NO. FIGURE 2-2	REV. 0

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2.4.3 Contaminant Fate and Transport

This section qualitatively discusses the detected chemicals and transport potential, contaminant persistence, and observed chemical contaminant trends. Additional detail is provided in the RFI Report (HNUS, 1995a).

Detected Chemicals and Transport Potential

Analytical results for the media sampled at Site 7 indicate detectable amounts of VOCs and/or semivolatile organic compounds (SVOCs) present in the soil and groundwater. Lead was a targeted analytical parameter in the soil and groundwater investigation, concentrations which are considered greater than background were not detected in the soil. The physical transport data for the detected contaminants are presented in RFI Report.

For soil contaminants, surface dispersion transport modes, such as erosion and dust migration, typically do not provide the greatest contribution to the overall transport of chemicals in the environment. All of the detected contamination is noted at subsurface locations and cover material (concrete, asphalt, and gravel) coupled with flat topography which dominates most of the site will prevent erosion. In addition, all of the detected contaminants are PAHs and phthalate esters, which are characteristically immobile except when present at high concentrations.

The detected organic groundwater contaminants were not detected in soil samples collected above the water table. The solubility characteristics of the detected chemicals allow them to be mobile in the environment and they may have originated at source locations not identified in this investigation or from source locations which have since been depleted of these contaminants.

Contaminant Persistence

For the classes of detected chemicals, environmental persistence varies considerably. Transformation of a chemical to degradation by-product(s) can be the result of numerous processes including biotransformation and uptake, photolysis, acid- or base-catalyzed reaction, or hydrolysis. The product chemical(s) may or may not be significantly toxicologically different or be different from a physical transport perspective. If the transformational process is known or suspected, product chemicals can be predicted and the extent of transformation can be determined from chemical reaction rate data. Other transformational processes may be identified empirically from analytical data.

Observed Chemical Contaminant Trends

Soil contaminants above the water table are phthalate esters and PAHs, which are marginally soluble and have among the lowest groundwater transport potential due to solubility partitioning considerations. The detected groundwater contaminants all exhibit relatively high water solubilities which will add to their groundwater mobility.

Future trends with respect to groundwater contamination are limited to an increased extent of the observed groundwater contamination due to groundwater transport. The potential for detected soil contaminants above the water table leaching from soil is considered to be minimal.

3.0 CORRECTIVE ACTION OBJECTIVES

The following section describes the development of the proposed corrective action objectives (CAOs) for the NWIRP Calverton Site 7, Fuel Depot Area. These CAOs and media clean-up standards are based on promulgated Federal and State of New York requirements, risk-derived standards, data and information gathered during the previous investigations, interim remedial actions (IRAs), supplemental RFI/RI, and additional applicable guidance documents.

3.1 INTRODUCTION

CAOs are developed for each site as media-specific and contaminant-specific objectives that will result in the protection of human health and the environment. The development of CAOs for a site are based on human health and environmental criteria, RFI/RI gathered information, EPA guidance, and applicable Federal and state regulations. Typically, CAOs are developed based on promulgated standards [e.g., Ambient Water Quality Criteria (AWQC)], background concentrations determined from a site-specific investigation, and human health and ecological risk-based concentrations developed in accordance with the EPA risk assessment guidance. The Phase 1 and 2 RFIs presents a complete description of the nature and extent of contamination, contaminant fate and transport, baseline human health risk assessment and ecological risk assessment. In addition, conclusions are presented. The purpose of this section is to identify ARARs and develop CAOs for remediation of contaminated groundwater at Site 7. The CAOs are based on contaminant, risk assessment, and compliance with risk-based (generally guidance) and ARAR-based action levels.

3.2 ARARS AND MEDIA OF CONCERN

3.2.1 ARAR Criteria

3.2.1.1 Introduction

The ARARs, which include the requirements, criteria, or limitations promulgated under the Federal and state law that address a contaminant, action, or location at a site, are presented in this section.

The definition of ARARs is as follows:

- Any standard, requirement, criterion, or limitation under federal environmental law.
- Any promulgated standard, requirement, criterion, or limitation under a state environmental or facility-citing law that is more stringent than the associated Federal standard, requirement, criterion, or limitation.

One of the primary concerns during the development of corrective action alternatives for hazardous waste sites under RCRA is the degree of human health and environmental protection afforded by a given remedy. Consideration should be given to corrective measures that attain or exceed ARARs.

Definitions of the two types of ARARs, as well as TBC criteria, are given below:

- Applicable Requirements means those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law that directly and fully address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site.

- Relevant and Appropriate Requirements means those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law that, while not "applicable," address problems or situations sufficiently similar (relevant) to those encountered at the site that their use is well suited (appropriate) to the particular site.

- TBC Criteria are non-promulgated, non-enforceable guidelines or criteria that may be useful for developing corrective measures alternatives and for determining action levels that are protective of human health or the environment.

These requirements are included in order to provide the decision makers with a complete evaluation of potential ARARs in developing, identifying, and selecting a corrective measure alternative.

3.2.1.2 ARAR and TBC Categories

ARARs fall into three categories, based on the manner in which they are applied:

- Chemical Specific: Health/risk-based numerical values or methodologies that establish concentration or discharge limits for particular contaminants. Examples of chemical-specific ARARs include MCLs and Clean Water Act (CWA) AWQC. Chemical-specific ARARs govern the extent of site clean-up.

- Location Specific: Restrictions based on the concentration of hazardous substances or the conduct of activities in specific locations. These may restrict or preclude certain remedial actions or may apply only to certain portions of site. Examples of location-specific ARARs include RCRA location requirements and floodplain management requirements. Location-specific ARARs pertain to special site features.

- Action Specific: Technology- or activity-based controls or restrictions on activities related to management of hazardous waste. Action-specific ARARs pertain to implementing a given remedy.

Table 3-1 presents a summary of potential Federal and state ARARs and TBCs for corrective measures undertaken for Site 7 at NWIRP Calverton.

3.2.1.3 Chemical-Specific ARARs and TBCs

This section presents a summary of Federal and state chemical-specific ARAR criteria of potential concern in the case of Site 7. The ARAR criteria provide medium-specific guidance on "acceptable" or "permissible" concentrations of contaminants.

The Safe Drinking Water Act (SDWA) promulgated National Primary Drinking Water Standard MCLs (40 CFR Part 141). MCLs are enforceable standards for contaminants in public drinking water supply systems. They consider not only health factors but also the economic and technical feasibility of removing a contaminant from a water supply system. Secondary MCLs (40 CFR Part 143) are not enforceable but are intended as guidelines for contaminants that may adversely affect the aesthetic quality of drinking water, such as taste, odor, color, and appearance, and may deter public acceptance of drinking water provided by public water systems.

The SDWA also established Maximum Contaminant Level Goals (MCLGs) for several organic and inorganic compounds in drinking water. MCLGs indicate the level of contaminants in drinking water at which no known or anticipated health effects would occur, allowing for an adequate margin of safety. MCLGs are non-enforceable public health goals.

Table 3-2 provides Federal SDWA requirements that may be applicable to remedial actions involving groundwater. Drinking water standards will also be considered as discharge criteria for alternatives which include groundwater treatment.

The CWA sets EPA AWQC that are non-enforceable guidelines developed for pollutants in surface waters pursuant to Section 304(a)(1) of the CWA. Although AWQC are not legally enforceable, they should be considered as potential ARARs. AWQC are available for the protection of human health from exposure to contaminants in surface water as well as from ingestion of aquatic biota and for the protection of freshwater and saltwater aquatic life. AWQC may be considered for actions that involve groundwater treatment and/or discharge to nearby surface waters.

TABLE 3-1

SUMMARY OF ARARs AND TBC CRITERIA
SITE 7 - NWIRP, CALVERTON, NEW YORK

Requirement	Citation	Status	Synopsis	Comment
Chemical-Specific ARARs and TBCs				
Safe Drinking Water Act (SDWA) MCLs Secondary MCLs (SMCLs) MCL Goals (MCLGs)	42 USC 300f et seq. 40 CFR Parts 141 to 143	MCLs are relevant and appropriate; SMCLs and MCLGs are TBC	MCLs, SMCLs, and MCLGs established under this act are health-based limits for certain chemical substances in drinking water.	Relevant and appropriate or TBC for determining PRGs. Groundwater was identified as a concern under the RI.
CWA Ambient Water Quality Criteria (AWQC)	33 USC 1251 et seq. Section 304(a)(1)	TBC	Water-quality criteria are non-enforceable guidance and are used in conjunction with the designed use for a stream segment to establish water quality standards under CWA 303.	During remedial activities, groundwater or treatment by-products may be collected. AWQCs are TBC if this water is discharged to surface waters.
EPA Health Advisories	EPA 822-B-96-002	TBC	EPA Office of Drinking Water guidelines for chemicals that may be intermittently encountered in public water supply systems.	TBC for determining PRGs.
EPA Generic Soil Screening Levels (SSLs)	EPA 540-R-96-018 Appendix A	TBC	Federal guidance that provides screening levels for protection of human health and groundwater from soil contaminants.	TBC for determining PRGs.
Reference Doses (RfDs) from Integrated Risk Information System	NA	TBC	EPA Office of Research and Development guidelines used in the public health assessment	TBC for determining PRGs.
Carcinogenic Slope Factors	NA	TBC	EPA Environmental Criteria and Assessment Office; EPA Carcinogen Assessment Group guidelines used in the public health assessment	TBC for determining PRGs.
RBCs	EPA Region III, October 1998	TBC	RBCs are screening levels calculated for a Target Hazard Quotient of 1.0 for noncarcinogenic effects and a Target Risk of 1.0E-6 for carcinogenic effects.	TBC for determining PRGs.
Clean Air Act (CAA)	42 USC 7401 et seq.	Relevant and Appropriate	Federal legislation that addresses air pollution control.	Pertinent sections of this Act are discussed as follows.
National Ambient Air Quality Standards (NAAQS)	40 CFR Part 50	Relevant and Appropriate	Non-source specific limitations for ambient air quality.	Any air emission would require appropriate controls to meet NAAQS.
New Source Performance Standards (NSPS)	40 CFR Part 60	Relevant and Appropriate	Emission standards established for new sources of air emissions.	Relevant and appropriate to if the pollutants emitted and the technology employed (e.g., air stripping) during the clean-up action are sufficiently similar to the pollutant and source category regulated by an NSPS and are well suited to the circumstances at the site.
National Emission Standards for Hazardous Air Pollutants (NESHAPs)	40 CFR Part 61	Not Applicable	Emission standards for source types (i.e., industrial categories) that emit hazardous air pollutants.	Not likely to be applicable or relevant and appropriate because NESHAPs were developed for specific sources.
The Resource Conservation and Recovery Act (RCRA) Subtitle C – Hazardous Waste Identification and Listing Regulations	40 CFR Part 261	Applicable	These rules are used to identify a material as a hazardous waste, and thus determine applicability or relevance of RCRA Subtitle C hazardous waste management requirements.	Alternative implementation may involve excavating soils, which may exceed toxicity characteristics leaching procedure (TCLP) criteria. If so, management of these contaminated soils should be conducted in compliance with RCRA requirements.

TABLE 3-1

SUMMARY OF ARARs AND TBC CRITERIA
SITE 7 - NWIRP, CALVERTON, NEW YORK

Requirement	Citation	Status	Synopsis	Comment
New York Ambient Air Quality Standards	6 NYCRR Parts 256 and 257	Applicable	Regulations for the control and prevention of air pollutants. The NWIRP site area is classified as Level II.	Particulate and non-methane hydrocarbon standards will be applicable to the site.
New York Public Water Supply Regulations	10 NYCRR Part 5	Applicable	Drinking water quality standards for New York	Drinking water standards impact selection of groundwater remediation goals, as well as treatment goals for reinjection of treated effluent to the aquifer.
New York Water Classifications and Quality Standards	6 NYCRR Parts 609 and 700 to 705	Applicable	Regulations for the control and prevention of water pollutants. NWIRP site is in Suffolk County with groundwater classified as GA requiring reinjected groundwater to have a maximum concentration of 1,000 mg/l TDS and 10 mg/l total nitrogen.	Standards applicable for actions involving the selection of groundwater plume remediation goals as well as treatment goals for reinjection of treated effluent to the aquifer.
New York Technical and Operational Guidance Series, Division of Water	TOGS 1.1.1	TBC	Provides a compilation of ambient water quality guidance values and groundwater effluent limitations for use when there are no regulatory standards and limitations.	TBC for actions involving groundwater plume remediation.
New York Technical and Administrative Guidance Memorandum on Determination of Soil Cleanup Objectives and Cleanup Levels	TAGM 4046	TBC	Provides a basis and procedure to determine soil clean-up levels.	TBC if alternative implementation involves excavating soils.
New York Spill Technology and Remediation Series, Petroleum-Contaminated Soil Guidance	STARS Memo # 1	TBC	Provides criteria to determine whether petroleum contaminated soils require remediation and whether the soils meet beneficial use conditions.	TBC for NWIRP Site 7, which has petroleum contaminated soils.
Location Specific ARARs and TBCs				
Federal Protection of Wetlands Executive Order	Executive Order (EO) 11990	Not Applicable	Requires the action of federal agencies to minimize the destruction, loss, or degradation of wetlands and preserve and enhance the natural and beneficial values of wetland.	There are no wetlands located at or adjacent to Site 7.
The Endangered Species Act of 1978	16 USC 1531 50 CFR Part 17	Potentially Applicable	Requires federal agencies to ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the future existence or critical habitat of any endangered or threatened species.	No endangered or threatened species are known to permanently reside in the vicinity of NWIRP. However, migrating species may occasionally move through the area.
The Fish and Wildlife Coordination Act	16 USC 661.	Not Applicable	Provides for consideration of the impacts on wetlands and protected habitats.	There are no wetlands located at or adjacent to Site 7.
Federal Floodplains Management Executive Order	EO 11988	Not Applicable	Provides for consideration of floodplains during corrective actions.	Site 7 is not within a 100-year floodplain.
The Archaeological and Historic Preservation Act	16 USC 469 36 CFR 65	Potentially Applicable	Prior to site activities as well as during excavation, actions must be taken to identify, recover, and preserve artifacts.	No historic artifacts are expected to be uncovered in the vicinity of Site 7, however, artifacts may be discovered during site work.
New York Freshwater Wetlands Act and New York Freshwater Wetlands Regulations	ECL Article 24 and Title 23 of Article 71 6 NYCRR Parts 662 to 664	Potentially Applicable	Activities within or adjacent to state regulated wetlands requires a permit or letter of approval. Adjacent area is considered the area within 100 feet of the wetlands.	No wetlands are present at Site 7.

TABLE 3-1

SUMMARY OF ARARs AND TBC CRITERIA
SITE 7 - NWIRP, CALVERTON, NEW YORK
PAGE 3 OF 5

Requirement	Citation	Status	Synopsis	Comment
New York Endangered and Threatened Species of Fish and Wildlife; Species of Special Concern	6 NYCRR Part 182	Potentially Applicable	A permit or license is required to take, import, transport, possess, or sell any endangered or threatened species.	A State endangered species has been confirmed at NWIRP, although not at Site 7.
Regulation for Administration and Management of the Wild Scenic and Recreational Rivers System in New York State Excepting Adirondack Park	6 NYCRR Part 666	Not Applicable	Certain kinds of activities and developments within the defined river corridor are restricted or require a permit.	The Peconic River and some of its tributaries are classified as a Scenic River. Site 7 activities are not expected to affect the Peconic River.
Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Site Guidance	Division of Fish and Wildlife, NYSDEC July 18, 1991	TBC	Provides guidance for the evaluation of fish and wildlife concerns associated with the remediation of inactive hazardous waste sites.	Considered during the evaluation of corrective measure alternatives.
Action-Specific ARARs and TBCs				
RCRA Subtitle C	42 USC 6921 et seq.	Potentially Applicable	Establishes design and operating criteria for hazardous waste landfills.	Potentially applicable if soil is determined to be hazardous.
Identification and Listing of Hazardous Waste	40 CFR Part 261	Potentially Applicable	Regulations that govern the procedures for identifying if a material is a hazardous waste.	Specific materials at the site may be classifiable as a listed hazardous waste.
RCRA Standards Applicable to Generators of Hazardous Waste	40 CFR Part 262	Potentially Applicable	Regulations with which a generator that treats, stores, or disposes of hazardous waste on site must comply.	Applicable for removed wastes determined to be hazardous.
Standards Applicable to Transporters of Hazardous Waste	40 CFR Part 263	Potentially Applicable	Regulations for the manifest and record keeping systems and for the immediate action and cleanup of hazardous waste discharges (spills) during transportation.	Applicable for removed wastes determined to be hazardous that is transported off site.
Standards and Interim Standards for Owners and Operators of Hazardous Waste TSD Facilities	40 CFR Part 264 and 265	Potentially Applicable	Regulations that govern the treatment, storage, and disposal of hazardous waste.	These regulations would be applicable to waste removed from this site including both on-site and off-site management; however, the reuse of treated soils as backfill would not be subject to the disposal facility standard.
Land Disposal Restrictions (LDRs)	40 CFR Part 268	Potentially Applicable	Regulations that govern the treatment and disposal of certain hazardous waste.	Treatment or disposal of contaminated soils/ wastes and/or treatment residuals may be considered hazardous waste subject to land disposal restrictions.
Corrective Action Management Units and Temporary Units (CAMU), Final Rule	40 CFR Parts 260, 264,265,268,270, and 271	Potentially Applicable	CAMU designated areas qualify for certain exemptions from RCRA Subtitle C requirements. Particularly, remediation wastes can be moved between sites within the designated area and can be treated and replaced without triggering LDRs.	Site work at NWIRP may involve the use of CAMUs.
RCRA Subtitle D	40 USC 6941 et seq.	Potentially Applicable	Establishes design and operating criteria for solid waste (non-hazardous) landfills.	Potentially applicable if soil is determined to be nonhazardous.
RCRA Criteria for Classification of Solid Waste Disposal Facilities and Practices	40 CFR Part 257	Potentially Applicable	Criteria to determine which solid waste disposal facilities pose a probability of adverse health effects and therefore prohibit open dumps.	Applicable if soil is stockpiled or disposed on site.

TABLE 3-1

SUMMARY OF ARARs AND TBC CRITERIA
SITE 7 - NWIRP, CALVERTON, NEW YORK

Requirement	Citation	Status	Synopsis	Comment
Department of Transportation (DOT) Rules for Hazardous Materials Transport	49 CFR Parts 107 and 171 to 179	Potentially Applicable	Regulations for the transportation of hazardous materials. Requirements cover packaging, marking, labeling, and transportation methods.	Off-site shipments of any contaminated soil that is classified as a hazardous material from this site would have to comply with these regulations.
National Environmental Policy Act (NEPA)	42 USC 4321 40 CFR Part 6	Potentially Applicable	Requires federal agencies to evaluate the environmental impacts associated with major actions that they fund, support, permit, or implement.	Alternatives could constitute significant activities, thereby making NEPA requirements ARARs.
CWA – National Pollution Discharge Elimination System (NPDES)	40 CFR Part 122	Potentially Applicable	Regulations for discharge, dredge, or fill materials and oil or hazardous waste spills into the United States waters.	These requirements are applicable for all alternatives that include a discharge to surface water.
Control of Air Emission from Superfund Air Strippers at Superfund Sites	OSWER Directive 9355.0-28	TBC	Guidelines for control of air emissions from air strippers at Superfund groundwater remediation sites.	Site restoration at Site 7 may include air stripping and/or vapor extraction of groundwater and is in a NAAQS ozone non-attainment area.
General Pretreatment Regulations for Existing and New Sources of Pollutants	40 CFR Part 403	Potentially Applicable	Regulations for pretreatment of contaminated water prior to discharge to a POTW.	Effluent from a groundwater treatment system at Site 7 may be discharged to a local POTW.
Underground Injection Control Program	40 CFR Parts 144 and 147	Potentially Applicable	Regulations for the control and prevention of pollutants injection into groundwater.	Effluent from treatment of groundwater may be reinjected (Class IV well) into the same formation from which it was withdrawn.
Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites	OSWER Directive 9200.4-17P	TBC	Guidelines for use of monitored natural attenuation for the remediation of contaminated soil and groundwater sites.	TBC if monitored natural attenuation is one of the selected remedial options.
The Occupational Health and Safety Act (OSHA)	29 USC Sections 651 through 678	Potentially Applicable	Regulates worker health and safety during implementation of remedial actions.	Applicable for site workers during all investigations and remedial activities Site 7.
New York Air Pollution Control Regulations	6 NYCRR Parts 200 to 257	Potentially Applicable	Regulations for the control and prevention of air pollutants.	Remedial activities (air stripping, excavation, and vacuum extraction) may adversely impact air quality.
New York Waste Management Facilities Rules	6 NYCRR Part 360	Potentially Applicable	Provides standards for solid waste management facilities, including closure requirements.	Remedial activities may need to consider standards for solid waste management facilities.
New York Rules for Siting Industrial Hazardous Waste Facilities	6 NYCRR Part 361	Potentially Applicable	Provides evaluation criteria for siting new industrial hazardous waste facilities.	Remedial alternatives may need to consider criteria for industrial hazardous waste facilities.
New York Waste Transport Permit Regulations	6 NYCRR Part 364	Applicable	Regulates off-site transport of wastes.	Transport of contaminated soils/wastes and/or treatment residuals need to comply with these regulations.
New York General Hazardous Waste Management System	6 NYCRR Part 370	Potentially Applicable	Regulations that govern the management of hazardous waste.	Residuals from treatment could be considered as hazardous waste subject to these regulations.
New York Identification and Listing of Hazardous Wastes	6 NYCRR Part 371	Potentially Applicable	Regulations that govern the procedures for identifying a material as a hazardous waste.	Specific materials at the site may be classifiable as listed hazardous wastes or may test to be characteristic hazardous wastes.
New York Hazardous Waste Manifest System	6 NYCRR Part 372	Potentially Applicable	Regulations that govern the procedures for manifesting a material that is a hazardous waste.	Transport of contaminated soils/wastes and/or treatment residuals need to comply with these regulations.

TABLE 3-1

SUMMARY OF ARARs AND TBC CRITERIA
SITE 7 - NWIRP, CALVERTON, NEW YORK
PAGE 5 OF 5

Requirement	Citation	Status	Synopsis	Comment
New York Hazardous Waste Management Facilities	6 NYCRR Part 373	Potentially Applicable	Regulations that govern the treatment, storage, and disposal of hazardous waste.	Treatment and/or storage activities may take place on site. Site remediation activities must meet both administrative and the substantive technical permitting requirements.
New York Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities	6 NYCRR Part 374-1	Potentially Applicable	Regulations that govern the management of specific hazardous wastes.	Although unlikely, NWIRP site remedial alternatives may include recovery.
New York Rules for Inactive Hazardous Waste Sites	6 NYCRR Part 375	Potentially Applicable	Requires state review and concurrence of the selected remediation scheme. The hierarchy of remedial technologies is as follows: (1) destruction, (2) separation/ treatment, (3) solidification/chemical fixation, and (4) control and isolation.	Site 7 work should comply with these regulations.
New York Land Disposal Restrictions	6 NYCRR Part 376	Potentially Applicable	Regulations that govern the treatment and disposal of certain hazardous waste.	Contaminated soils and/or treatment residuals may be considered hazardous waste subject to land disposal restrictions.
New York Rules on Hazardous Waste Program Fees	6 NYCRR Parts 483	Potentially Applicable	State hazardous waste program fees related to remedial actions.	Waste transporter program fees will be required for offsite disposal of wastes or treatment residuals.
New York Water Classifications and Quality Standards	6 NYCRR Parts 609 and 700 to 706	Potentially Applicable	Regulations for the control and prevention of water pollutants. NWIRP site groundwater is classified as GA.	Standards applicable for actions involving the selection of groundwater plume remediation goals as well as treatment goals for reinjection of treated effluent to the aquifer.
New York State Pollutant Discharge Elimination System (SPDES)	6 NYCRR Parts 750 to 758	Potentially Applicable	Regulations for the control of wastewater and storm water discharges in accordance with the Clean Water Act and controls point source discharges.	Permits (SPDES or NPDES) would be required for discharges to surface water.
New York Proposed State Pollutant Discharge Elimination System (SPDES)	Proposed Subpart 750-1 and 750-2	TBC	Proposed regulation for the control of wastewater and storm water discharges in accordance with the Clean Water Act and controls point source discharges to groundwater as well as surface water. Once adopted current Parts 750 to 758 will be repealed.	TBC as a proposed regulation, which may be in place prior to implementation of alternative. Treatment goals for discharge or reinjection of treated effluent..
New York Technical Manual "Contained-in" Criteria for Environmental Media	TAGM 3028	TBC	State guidelines used in the public health assessment.	May aid in establishing soil and groundwater cleanup goals.

TABLE 3-2

OVERALL ARAR AND TBC BASED STANDARDS FOR POTENTIAL GROUNDWATER CONTAMINANTS OF CONCERN (μg/L)
NWIRP, CALVERTON, NEW YORK

Compound	MDL/ IDL	Federal Standards MCLs/MCLGs	New York State Standards			New York Guidance		
			MCLs[a]	GW Quality Standards[b]	GW Effluent Standards[b]	TOGS 1.1.1[e] Table 1 – Ambient Water Quality Standards and Guidance Values	TOGS 1.1.1[e] Table 5 – Groundwater Effluent Limitations	Contained in Policy [c]
VOLATILE ORGANICS								
Benzene	1	5 (MCL)	5	1	1	1	1	0.7
Chloroform	1	100, 80 (THM)	100 (THM)	7	7	7	7	7
1,1-Dichloroethane	2	---	5	5	---	5	5	5
Ethylbenzene	1	700 (MCL)	5	5	---	5	5	5
Toluene	1	1,000 (MCL)	5	5	---	5	5	5
1,1,1-Trichloroethane	2	200 (MCL)	5	5	---	5	5	5
Trichloroethene	2	5 (MCL)	5	5	5	5	5	5
Trichlorofluoromethane	0.5	---	5	5	---	5	5	5
1,1,2-Trichloro-1,2,2-trifluoroethane	2	---	5	5	---	5	--	--
Xylenes	0.5	10,000 (MCL)	5	5	---	5	5	5 ortho, 5 meta, 5 para
SEMIVOLATILE ORGANICS								
Bis(2-ethylhexyl)phthalate	2	6 (MCL)	6	5	5	5	5	50
Dibenzofuran	2	---	50	---	---	---	---	---
Diethylphthalate	2	---	50	---	---	50	50	4
2,4-Dimethylphenol	2	---	50	1 (tp)	---	1 (tp)	2 (tp)	---
Fluorene	2	---	50	---	---	50	50	50
2-Methylnaphthalene	1	---	50	---	---	---	---	---
2-Methylphenol	2	---	50	1 (tp)	---	1 (tp)	2 (tp)	---

TABLE 3-2

OVERALL ARAR AND TBC BASED STANDARDS FOR POTENTIAL GROUNDWATER CONTAMINANTS OF CONCERN (µg/L)
NWIRP, CALVERTON, NEW YORK

Compound	MDL/ IDL	Federal Standards MCLs/MCLGs	New York State Standards			New York Guidance		
			MCLs[a]	GW Quality Standards[b]	GW Effluent Standards[b]	TOGS 1.1.1[e] Table 1 – Ambient Water Quality Standards and Guidance Values	TOGS 1.1.1[e] Table 5 – Groundwater Effluent Limitations	Contained in Policy [c]
4-Methylphenol	1	---	50	1 (tp)	---	1 (tp)	2 (tp)	---
Naphthalene	1	---	50	---	---	10	10	10
Phenanthrene	1	---	50	---	---	50	50	50
INORGANICS								
Lead	2	15	15	25	50	25	50	---
TDS (mg/l)	---	---	---	500 mg/l	1,000 mg/l	---	1,000 mg/l	---

--- = Not available
IDL = Instrument Detection Limit
MCL = Maximum Contaminant Level
MCLG = Maximum Contaminant Level Goal
MDL = Method Detection Limit
THM = trihalomethane
tp = total phenols

a Reference: New York Public Supply Regulations, 10 NYCRR Part 5. Total Principal Organic Contaminants [POCs] (i.e., includes listed volatile organics) and Unspecified Organic Contaminants [UOCs] not to exceed 100 µg/l total.

b Reference: New York Water Classifications and Quality Standards, 6 NYCRR Part 703.

c Reference: New York Technical Manual (TAGM 3028), "Contained In" Criteria for Environmental Media. These criteria apply to listed hazardous wastes removed from their natural environment. These criteria must be met in order to preclude its management as hazardous waste. These criteria are not cleanup levels. 11/30/92

d Standard/criteria requires contaminant concentration to be not detectable by tests or analytical determinations. Method detection limits as specified in 40 CFR Part 136, Method 608 are presented.

e TOGS 1.1.1 Ambient water quality standards and guidance values, NYSDEC, Division of Water, June 1998, amended April 2000. Either standard or guidance value provided.

EPA Health Advisories are nonenforceable guidelines developed by the EPA Office of Drinking Water for chemicals that may be intermittently encountered in public water supply systems. Health advisories are available for short-term, longer-term, and lifetime exposures for a 10-kg child and a 70-kg adult.

Reference Dose (RfD), as defined in the EPA Integrated Risk Information System (IRIS), is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. RfDs are developed for chronic and/or subchronic human exposure to hazardous chemicals and are based on the assumption that thresholds exist for certain toxic effects. The RfD is usually expressed as an acceptable dose (mg) per unit body weight (kg) per unit time (day). The RfD is derived by dividing the no-observed-adverse effect level (NOAEL) or the lowest-observed-adverse effect level (LOAEL) by an uncertainty factor (UF) times a modifying factor (MF).

EPA Cancer Slope Factor, as defined in the IRIS, is an upper bound, approximating a 95 percent confidence limit, on the increased cancer risk from a lifetime exposure to a chemical. This estimate, usually expressed in units of proportion (of a population) affected per mg/kg/day, is generally reserved for use in the low-dose region of the dose-response relationship, that is, for exposures corresponding to risks less than 1 in 100.

EPA Generic Soil Screening Levels (SSLs) are guidance that provides soil concentrations for protection of human health and for migration to groundwater. SSLs are risk-based concentrations derived from equations combining exposure information assumptions with EPA toxicity data. SSLs for protection of groundwater use a simple linear equilibrium soil/water partition equation or leach test to estimate contaminant releases in soil leachate.

The Clean Air Act (CAA) (42 USC 7401) consists of three programs or requirements that may be ARARs: National Ambient Air Quality Standards (NAAQS) (40 CFR Parts 50 and 53), National Emission Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR Part 61), and New Source Performance Standards (NSPS) (40 CFR Part 60). NESHAPs, which are emission standards for source types (i.e., industrial categories) that emit hazardous air pollutants, are not likely to be applicable or relevant and appropriate for NWIRP because they were developed for a specific source. EPA requires the attainment and maintenance of primary and secondary NAAQS to protect public health and public welfare, respectively. These standards are not source specific but rather are national limitations on ambient air quality. States are responsible for assuring compliance with the NAAQS. NSPS are established for new sources of air emissions to ensure that the new stationary sources minimize emissions. These standards are for categories of stationary sources that cause or contribute to air pollution that may endanger public health or welfare. Standards are based upon the best-demonstrated available technology (BDAT).

RCRA Subtitle C Hazardous Waste Identification and Listing (40 CFR Part 261) requirements are used to identify a material that is a hazardous waste and thus determine applicability or relevance of RCRA Subtitle C hazardous waste rules.

New York Ambient Air Quality Standards (6 NYCRR Parts 256 and 257) provides four general classifications of social and economic development and resulting pollution potential upon which standards are based. In addition air quality standards are established to provide protection from adverse health effects of air contamination and to protect and conserve natural resources and the environment. Part 256 provides the air quality classification standards. The NWIRP is probably classified as Level II (predominantly single and two family residences, small farms, and limited commercial services and industrial development). Part 257 provides air quality standards for regulated contaminants, which includes sulfur dioxide, particulates, carbon monoxide, photochemical oxidants, non-methane hydrocarbons, nitrogen dioxide, fluorides, beryllium, and hydrogen sulfide.

New York Public Water Supply Regulations (10 NYCRR Part 5) provide requirements for state public water supplies. Refer to Table 3-2 for standards applying to NWIRP site compounds.

New York Water Classifications and Quality Standards (6 NYCRR Parts 609 and 700 to 705) regulates reclassification of water based on use and value, including protection and propagation of fish, shellfish and wildlife, recreation in and on the water, public water supplies, and agricultural, industrial and other purposes including navigation. Additionally, regulates the discharge of sewage, industrial waste or other wastes so as not to cause impairment of the best usages of the receiving water as specified by the water classifications at the location of discharge that may be affected by such discharge. Both quantitative standards as well as narrative water quality standards (turbidity, solids, oil, etc.) are provided. (See Action Specific ARARs for Groundwater Effluent Standards which would be applicable for alternatives including reinjection to the aquifer).

Part 701 provides the classification of surface water and groundwater. Groundwater beneath the NWIRP would be classified as Class GA. Groundwater quality standards (Class GA) for Site 7 are provided in Table 3-2. Also for GA groundwater, pH shall be between 6.5 and 8.5 and TDS shall not exceed 500 mg/l.

New York Technical and Operational Guidance, Division of Water (TOGS 1.1.1) provides a compilation of ambient water quality guidance values and groundwater effluent limitations for use where there are no regulatory ambient water quality standards (in 6 NYCRR 703.5) or effluent limitations (in 6 NYCRR 703.6). For the convenience of the user, the standards in 703.5 and the limitations in 703.6 are included in this document. The guidance values are appropriate for actions involving groundwater plume remediation and reinjection of treated groundwater into the aquifer.

New York Technical and Administrative Guidance Memorandum on Determination of Soil Clean-up Objectives and Cleanup Levels (TAGM 4046) provides a basis and procedure to determine soil clean-up levels. Soil clean-up objectives based on human health based levels that correspond to excess lifetime cancer risks, human health based levels for systemic toxicants calculated from RfDs, environmental concentrations which are protective of groundwater/drinking water quality based on promulgated or proposed New York State Standards, background values for contaminants, or detection limits. Clean-up objectives should be above the method detection limit (MDL) and preferably above the contract required quantification limit (CRQL). Table 3-3 provides soil clean-up objectives. For the protection of groundwater quality, concentrations are based on a total organic content of 1 percent. Soil clean-up objectives are limited to the following maximum values: total VOCs less than or equal to 10 ppm, total SVOCs less than or equal to 500 ppm, individual SVOCs less than or equal to 50 ppm, and total pesticides less than or equal to 10 ppm. In addition, soil can not exhibit a discernible odor nuisance.

New York Spill Technology and Remediation Series, Petroleum-Contaminated Soil Guidance (STARS Memo #1) is intended as a guidance in determining whether petroleum-contaminated soils have been contaminated to levels which require investigation and remediation. In addition, if the petroleum-contaminated soil contaminant concentrations meet the criteria provided, the soil can be reused or disposed of as directed in this guidance (beneficial use). Soils which meet beneficial use conditions are no longer a solid waste as regulated by 6 NYCRR Part 360. This guidance applies to petroleum-contaminated soils which are not considered a characteristic hazardous wastes as regulated by 6 NYCRR Part 371 [i.e., Toxicity Characteristic Leaching Procedure (TCLP) results less than or equal to the TCLP Extraction Guidance Values or contaminant concentrations in the soil less than TCLP Alternative Guidance Values]. Guidelines for protection of groundwater (TCLP Extraction Guidance Values and Alternative Guidance Values), protection of human health (Human Heath Guidance Values), and protection against objectionable nuisance characteristics are provided. Guidance Values are provided for primary gasoline and fuel oil components of concern. If the soil does not exhibit petroleum-type odors and does not contain any individual contaminant at greater than 10,000 parts per billion (ppb), then the soil is considered acceptable for nuisance characteristics. Guidance is also provided for management of excavated (exsitu) and non-excavated (insitu) contaminated soil. TCLP Alternative Guidance Values and Human Health Guidance Values are presented in Table 3-3. As per discussions with NYSDEC, the TAGM 4046 guidance values are to be used. However, the STARS Memo #1 values are provided for informational purposes.

3.2.1.2 Location-Specific ARARs and TBCs

This section presents a summary of federal and state location-specific ARAR criteria of potential concern for Site 7. These potential ARARs and TBCs are as follows:

TABLE 3-3

OVERALL ARAR AND TBC BASED STANDARDS FOR POTENTIAL SOIL CONTAMINANTS OF CONCERN (mg/kg)
NWIRP, CALVERTON, NEW YORK
PAGE 1 OF 2

Compound	CRQL/ CRDL	New York State Guidance (TAGM 4046)		New York Guidance (STARS Memo #1)		Soil Contained In Policy(e)
		Protection of Groundwater (a)(b)	USEPA Health Based (a)(c)	TCLP Alternative Value(d)	Human Health Guidance(d)	
VOLATILE ORGANICS						
Benzene	0.01	0.06	24 (C)	0.014	24	24
Ethylbenzene	0.01	5.5	8,000 (S)	0.1	8,000	8,000
4-Methyl-2-pentanone	0.01	1.0	---	---	---	4,000
Toluene	0.01	1.5	20,000 (S)	0.1	20,000	20,000
Xylenes	0.01	1.2	200,000 (S)	0.1	200,000	200,000
SEMI-VOLATILE ORGANICS						
Anthracene	0.33	700	20,000 (S)	1	20,000	20,000
Benzo(a)anthracene	0.33	3.0	0.224 (C)	0.00004	0.22	0.22
Benzo(a)pyrene	0.33	11	0.061 (C)	0.00004	0.061	0.061
Benzo(b)fluoranthene	0.33	1.1	---	0.00004	0.22	0.220
Benzo(g,h,i)perylene	0.33	800	---	0.00004	---	---
Benzo(k)fluoranthene	0.33	1.1	---	0.00004	0.22	0.22
Carbazole	0.33	---	---	--	---	3.2
Chrysene	0.33	0.4	---	0.00004	---	---
Dibenzo(a,h)anthracene	0.33	165,000	0.0143 (C)	1	0.014	0.014
Di-n-butylphthalate	0.33	8.1	8,000 (S)	---	---	8,000
Di-n-octylphthalate	0.33	120	2,000 (S)	---	---	2,000
Fluoranthene	0.33	1,900	3,000 (S)	1	3,000	3,000
Fluorene	0.33	350	3,000 (S)	1	3,000	3,000
Indeno(1,2,3-cd)pyrene	0.33	3.2	---	0.00004	---	---

TABLE 3-3

OVERALL ARAR AND TBC BASED STANDARDS FOR POTENTIAL SOIL CONTAMINANTS OF CONCERN (mg/kg)
NWIRP, CALVERTON, NEW YORK

Compound	CRQL/ CRDL	New York State Guidance (TAGM 4046)		New York Guidance (STARS Memo #1)		Soil Contained In Policy[e]
		Protection of Groundwater (a)(b)	USEPA Health Based (a)(c)	TCLP Alternative Value[d]	Human Health Guidance[d]	
Phenanthrene	0.33	220	---	1	---	---
Pyrene	0.33	665	2,000 (S)	1	2,000	2,000

--- = Not available
CRDL = Contract Required Detection Limit
CRQL = Contract Required Quantitation Limit
C = Carcinogens
S = Systemic Toxicants
a Reference: Technical and Administrative Guidance Memorandum on Determination of Soil Cleanup Objectives and Cleanup Levels (TAGM 4046), NYSDEC, January 1994. Total VOC concentration must be less than or equal to 10 ppm; Total SVOC concentration must be less than or equal to 500 ppm; Individual SVOC concentration can not exceed 50 ppm. In addition although contaminant concentrations may be under the cleanup level; soil must not exhibit a discernible oder nuisance.
b *Soil clean-up objectives to protect groundwater quality. Soil clean-up levels are developed for soil organic carbon content of 1 percent and should be* adjusted for actual soil organic carbon content if it is known.
c USEPA Health based cleanup objectives, provided for carionogens (C) and Systemic (S) toxicants.
d Reference: New York Petroleum Contaminated Soil Guidance, STARS 1. TCLP Alternative Values are for the protection of groundwater. For protection against objectionable nuisance, soil can not have a petroleum-type odor and no individual contaminant with concentration greater than 10 ppm. Standards provided are for fuel-oil contaminated soil. For contaminants with high detection limits in comparison to TCLP Alternative Value, TCLP Extraction Method must be used to demonstrate groundwater quality protection for these contaminants.
e Reference: New York Technical Manual "Contained In" Criteria for Environmental Media (TAGM 3028). Criteria applies to listed hazardous waste removed from its natural environment. These criteria must be met in order to preclude its management as a hazardous waste. These criteria are not clean-up levels and only consider protection of public health through direct ingestion.

Federal Protection of Wetlands Executive Order (E.O. 11990) requires federal agencies, in carrying out their responsibilities, to take action to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands (unless there is no practical alternative to that construction), minimize the harm to wetlands (if the only no practical alternative requires construction in the wetlands), and provide early and adequate opportunities for public review of plans involving new construction in wetlands. Corrective measures at Site 7 should not impact regulated wetland areas. There are no wetlands located at or adjacent to Site 7.

The Endangered Species Act of 1978 (16 USC 1531) (50 CFR Part 17) provides for consideration of the impacts on endangered and threatened species and their critical habitats. Corrective measure actions, if required, would need to be conducted in a manner such that the continued existence of any endangered or threatened species is not jeopardized or its critical habitat is not adversely affected. Consultation with the United States Fish and Wildlife Service is also required. There are no endangered or threatened species known to reside at or near Site 7. However, migrating species may move through the area.

The Fish and Wildlife Coordination Act (16 USC 661) provides for consideration of the impacts on wetlands and protected habitats. The act requires that federal agencies, before issuing a permit or undertaking federal action for the modification of any body of water, consult with the appropriate state agency exercising jurisdiction over wildlife resources to conserve those resources. Consultation with the United States Fish and Wildlife Service is also required.

Federal Floodplains Management Executive Order (E.O. 11988) provides for consideration of floodplains during corrective actions. This Executive Order requires that activities be conducted to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupation or modification of floodplains. Floodplain development should be avoided whenever there are practicable alternatives and should minimize potential harm to floodplains when there are no practical alternatives. Site 7 is not within a 100-year floodplain.

The Archaeological and Historic Preservation Act (16 USC Section 469) (36 CFR Part 65) establishes requirements relating to potential loss or destruction of significant scientific, historical, or archaeological data as a result of any proposed remedy. The Secretary of the Interior must be notified if a federal agency finds that its activities, in connection with any federal construction project, might cause loss or destruction of such data. No historic artifacts are expected to be uncovered at Site 7.

New York Freshwater Wetlands Act (ECL Article 24 and Title 23 of Article 71 of the New York Environmental Conservation Law) regulates activities within wetlands. New York Freshwater Wetlands Regulations (6 NYCRR Parts 662 to 664) provide regulations to preserve, protect and conserve freshwater wetlands and regulate use and development of the wetlands. Activities within or adjacent to a wetland with an area of at least 12.4 acres or, if smaller, unusual local importance as determined by the state, require a permit or letter of approval. The adjacent area is considered the area within 100 feet of the wetland. Wetlands are classified according to the benefit of the wetlands, with Class I wetlands being the most beneficial to Class IV being the least beneficial. No wetlands are present at or adjacent to Site 7.

New York Endangered and Threatened Species of Fish and Wildlife; Species of Special Concern (6 NYCRR Part 182) provides a list of regulated species. A state endangered species (*Ambystoma tigrinum*, tiger salamander) has been confirmed at the NWIRP, Calverton but not at Site 7. This species is a state-regulated species but is not federally regulated, (Natural Resources Management Plan, 1989). A permit or license is required to take, import, transport, possess, or sell any endangered or threatened species.

New York Regulation for Administration and Management of the Wild, Scenic, and Recreational Rivers System in New York State Excepting the Adirondack Park (6 NYCRR Part 666) is authorized under the New York Wild, Scenic, and Recreational Rivers System Act (Title 27 of Article 15 of the New York Environmental Conservation Law) and provides regulations for the management, protection, enhancement, and control of land use and development in river areas on all designated wild, scenic, and recreational rivers (except within the Adirondack Park). The Peconic River and some of its tributaries are classified as a scenic river. Certain kinds of activities and developments within the defined river corridor are restricted or require a permit. Any new direct discharge of any substance into a scenic river must meet water quality standards, (6 NYCRR Parts 701 and 702). Site 7 activities are not expected to affect the Peconic River.

Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites Guidance (Division of Fish and Wildlife, NYSDEC, July 18, 1991) provides guidance for the evaluation of fish and wildlife concerns associated with the remediation of inactive hazardous waste sites. This guidance provides the required elements for a complete impact analysis including site description, contaminant-specific impact analysis, ecological effects of remedial alternatives, implementation of selected alternatives in design, and monitoring program.

3.2.1.5 Action-Specific ARARs and TBCs

This section presents a summary of federal and state action-specific ARAR criteria of potential concern in the case of Site 7. These potential ARARs and TBCs are as follows:

RCRA Subtitle C regulates the treatment, storage, and disposal of hazardous waste from its generation until its ultimate disposal. In general, RCRA Subtitle C requirements for the treatment, storage, or disposal of hazardous waste will be applicable if:

- The waste is a listed or characteristic waste under RCRA.

- The waste was treated, stored, or disposed (as defined in 40 CFR 260.10) after the effective date of the RCRA requirements under consideration.

- The activity at the site constitutes current treatment, storage, or disposal as defined by RCRA.

RCRA Subtitle C requirements may be relevant and appropriate when the waste is sufficiently similar to a hazardous waste and/or the on-site corrective action constitutes treatment, storage, or disposal and the particular RCRA requirement is well suited to the circumstances of the contaminant release and site. RCRA Subtitle C requirements may also be applicable when the corrective action constitutes generation of a hazardous waste.

The following requirements included in the RCRA Subtitle C regulations may pertain to the NWIRP Calverton:

- Hazardous waste identification and listing regulations (40 CFR Part 261).
- Hazardous waste generator requirements (40 CFR Part 262).
- Transportation requirements (40 CFR Part 263).
- Standards for owners and operators of hazardous waste treatment, storage, and disposal (TSD) facilities (40 CFR Part 264).
- Interim status standards for owners and operators of hazardous waste TSD facilities (40 CFR Part 265).
- Land disposal restrictions (LDRs) (40 CFR Part 268).

Hazardous Waste Identification and Listing Regulations (40 CFR Part 261) define those solid wastes that are subject to regulation as hazardous waste under 40 CFR Parts 262 to 265 and Parts 124, 270, and 271.

A generator that treats, stores, or disposes of hazardous waste on site must comply with RCRA Standards Applicable to Generators of Hazardous Waste (40 CFR Part 262). These standards include manifest, pre-transport (i.e., packaging, labeling, and placarding), record keeping, and reporting requirements. The standards are applicable if actions taken at Site 7 constitute generation of a hazardous waste (e.g., generation of water treatment residues or excavation of contaminated soils and/or sediments that may be hazardous).

Standards Applicable to Transporters of Hazardous Waste (40 CFR Part 263) are applicable to off-site transportation of hazardous waste. These regulations include requirements for compliance with the manifest and record keeping systems and requirements for immediate action and cleanup of hazardous waste discharges (spills) during transportation. The standards are potentially applicable if corrective actions involve off-site transportation of hazardous waste from Site 7.

Standards and Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities (40 CFR Parts 264 and 265) are applicable to corrective actions that may be taken at Site 7 and to off-site facilities that receive hazardous waste from the site for treatment and/or disposal. Standards for TSD facilities include requirements for preparedness and prevention, corrective action requirements, closure and post-closure care, use and management of containers, and design and operating standards for tank systems, surface impoundments, waste piles, landfills, and incinerators. These standards are potentially applicable if corrective actions involve the on-site treatment or disposal of hazardous waste at Site 7.

RCRA Land Disposal Restriction (LDR) Requirements (40 CFR Part 268) restrict certain wastes from being placed or disposed on the land unless they meet specific best demonstrated available technology (BDAT) treatment standards (expressed as concentrations, total or in the TCLP extract, or as specified technologies). Removal and treatment of a RCRA hazardous waste or movement of the waste outside of a Corrective Action Management Unit (CAMU), thereby constituting "placement" would trigger the LDR requirements.

Placement of hazardous waste into underground injection wells constitutes "land disposal" under the LDRs. Furthermore, RCRA Section 3020(a) bans hazardous waste disposal by underground injection into or above an underground source of drinking water. RCRA Section 3020(b), however, exempts from the ban all reinjection of treated contaminated groundwater into such formations undertaken as part of a RCRA corrective action. The contaminated groundwater must be treated to substantially reduce hazardous constituents before such injection, and the corrective action must be sufficient to protect human health and the environment upon completion. LDRs would be potentially applicable if corrective actions at Site 7 include off-site disposal of wastes in a landfill or reinjection of treated groundwater.

RCRA Corrective Action Management Units and Temporary Units, Final Rule (40 CFR Parts 260, 264, 265, 268, 270, and 271) addresses two new units, corrective action management units (CAMUs) and temporary units (TUs), under RCRA corrective action authorities. These special provisions were proposed as part of a more comprehensive rulemaking on July 27, 1990. The final regulations became effective on April 19, 1993 and were amended on November 30, 1998 to include staging piles.

When a site, or portion of a site, receives a CAMU designation, the designated area qualifies for certain exemptions from RCRA Subtitle C requirements. LDRs are not triggered when hazardous remediation waste is placed in a CAMU, when remediation wastes generated at a facility outside a CAMU are consolidated into a CAMU, or when remediation wastes are moved between two or more CAMUs. In addition, remediation wastes can be excavated from a CAMU, treated in a separate unit, and redeposited in the CAMU without triggering LDRs. TUs are containers and tanks used on a temporary basis. TUs and staging piles may be subject to reduced minimum technology standards and closure requirements. This rule may be applicable or relevant and appropriate for on-site handling and disposal of soil.

RCRA Subtitle D includes guidelines for regional solid waste plans, design and operating criteria for solid (non-hazardous) waste landfills, and upgrading of open dumps.

RCRA Criteria for Classification of Solid Waste Disposal Facilities and Practices (40 CFR Part 257) establish criteria for use in determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health and thereby constitute prohibited open dumps.

Department of Transportation (DOT) Rules for Hazardous Materials Transport (49 CFR Parts 107 and 171 to 179) regulate the transport of hazardous materials, including packaging, shipping equipment, and placarding. These rules are considered applicable to wastes shipped off site for laboratory analysis, treatment, or disposal.

National Environmental Policy Act (NEPA) (42 USC 4321 et seq) and implementing regulations (40 CFR Part 6) require federal agencies to evaluate the environmental impacts associated with major actions that they fund, support, permit, or implement.

The CWA, as amended, governs point-source discharges through the National Pollutant Discharge Elimination System (NPDES), discharge of dredge or fill material, and oil and hazardous waste spills to United States waters. NPDES requirements (40 CFR Part 122) will be applicable if the direct discharge of pollutants into surface waters is part of the corrective action (i.e., discharge of effluent from a groundwater treatment system). These regulations contain discharge limitations, monitoring requirements, and best management practices.

Control of Air Emissions from Superfund Air Strippers at Superfund Groundwater Sites (Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-28) is a TBC that guides the control of air emissions from air strippers. For sites located in areas that are not attaining NAAQS for ozone, add-on emission controls are required for an air stripper with an actual emission rate in excess of 3 pounds per hour, an actual emission rate in excess of 15 pounds per day, or a potential (i.e., calculated) emission rate of 10 tons per year of total VOCs. Generally, the guidelines are suitable for VOC air emissions from other vented extraction techniques (e.g., soil vapor extraction) but not from area sources (e.g., soil excavation). NWIRP Calverton is in a nonattainment area for ozone.

General Pretreatment Regulations for Existing and New Sources of Pollutants (40 CFR Part 403) controls the indirect discharge of pollutants to publicly owned treatment works (POTWs). The goal of the pretreatment program is to protect municipal wastewater treatment plants and the environment from damage that may occur when hazardous, toxic, or other non-domestic wastes are discharged in a sewer system. The regulations include general and specific prohibitions on discharges to POTWs. The regulations are potentially applicable if treated or untreated groundwater is discharged to a local POTW.

Underground Injection Control Program (40 CFR Parts 144 and 147) contains provisions for the control and prevention of pollutant injection into groundwater. Class IV wells are used to inject hazardous waste into or above a formation that, within 1/4 mile of the well, contains an underground drinking water source. Operation or construction of Class IV wells is prohibited and allowed only for the reinjection of treated wastes as part of a CERCLA or RCRA cleanup. The regulations are potentially applicable if groundwater is removed, treated, and reinjected into the formation from which it was withdrawn.

Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites (OSWER Directive 9200.4-17P) contains guidelines for the use of monitored natural attenuation for the remediation of contaminated soil and groundwater. This guidance is a TBC criterion if monitored natural attenuation is a component of the corrective action at Site 7.

The Occupational Health and Safety Act (29 USC Sections 651 through 678) regulates worker health and safety during implementation of remedial actions.

New York Environmental Conservation Law (ECL) (New York Consolidated Laws, Chapter 43-B) concerns the conservation, improvement, and protection of state natural resources and environment and controls water, land, and air pollution.

The following requirements included in the ECL in particular may pertain to remedial activities at the NWIRP sites:

- Article 17-Water Pollution Control provides policy to require use of all known available and reasonable methods to prevent and control the pollution of state waters consistent with public health and use, propagation and protection of fish and wildlife, and the industrial development of the state.

- Article 19-Air Pollution Control Act provides policy to maintain the quality of the air resources of the state. Regulations for implementing this act are provided in 6 NYCRR Parts 200 to 257. This act also provides trial burn requirements for burning of hazardous waste.

- Article 27- New York Solid and Hazardous Waste Management Laws addresses solid and hazardous waste management, including waste transport permits, solid waste management and resource recovery facilities, industrial hazardous waste management, siting of hazardous waste facilities, and inactive hazardous waste disposal sites. A preferred state-wide hazardous management practices hierarchy is also provided (1) reduce or eliminate to the maximum extent practical the generation of hazardous waste, (2) recover, reuse, or recycle to the maximum extent practical generated hazardous waste, (3) utilize detoxification, treatment, or destruction technology for hazardous waste which cannot be reduced, recovered, reused or recycled, and (4) land disposal of industrial hazardous waste, except treated residuals posing no significant threat to the public health or environment. Special provisions for land burial and disposal in Nassau and Suffolk Counties are provided. No new landfills (or expansions to existing landfills) are allowed in a deep flow recharge area. For new landfills outside a deep flow recharge area, hazardous waste is prohibited and the landfill can only accept material which is a product or resource recovery, incineration or composting. Regulations to implement these laws are included in 6 NYCRR Parts 360 to 483.

- Article 70-Uniform Procedures establishes uniform review procedures for major regulatory programs of the NYSDEC and establishes time periods for NYSDEC action on permits under such programs. Procedures are provided for coordinating permitting for a project requiring one or more NYSDEC permit.

New York Air Pollution Control Regulations (6 NYCRR Parts 200 to 257) regulate emissions from specific sources. Part 212, General Process Emission Sources, provides general requirements. NWIRP is located in Suffolk County, which is considered part of the New York City Metropolitan Area. The degree of air cleaning required for the different contaminants ratings are as follows. For the most stringent rated contaminants (Rating A), for emission rate potentials greater than 1 lb/hr, 99 percent or more removal or best available control technology if required. For emission rate potentials less than 1 lb/hr, the degree of air cleaning required shall be specified by the state. For Ratings of B, C, or D and for emission rate potentials of 3.5 lb/hr or less, the degree of air cleaning required shall be specified by the state (Ratings B or C) or no cleaning is required (Rating D). For emission rate potentials greater than 3.5 lb/hr, reasonably available control technology shall be used. Part 231 regulates new source review for air contamination source projects in non-attainment areas. To be applicable, annual emissions (within a nonattainment area) from the source must exceed the de minimus emission limits. The de minimus emission limit is 40 tons per year for volatile organics and 25 tons per year for particulates.

New York Waste Management Facilities Rules (6 NYCRR Part 360) regulate solid waste management facilities (other than hazardous waste management facilities subject to Parts 373 and 374). Siting requirements for solid waste management facilities include that the facility must not be constructed or operated in such a manner that may have an adverse affect on any endangered or threatened species or their critical habitat and the facility cannot be located within the boundary of a regulated wetland. A permit is required to construct, operate, modify, or expand a solid waste management facility. However, temporary storage, treatment, incineration, and process facilities (including temporary mobile processing facilities) may be exempt from permitting requirements if the facility is located at an industrial or commercial establishment and is used exclusively for solid wastes generated at that location or at a location under the same ownership within a single region of the NYSDEC. The rules specify that excavated petroleum contaminated soils cannot be stored on site greater than 60 days unless otherwise approved by the NYSDEC. Nonhazardous petroleum contaminated soil which has been decontaminated and is being used in an acceptable manner is considered beneficial use (this includes incorporation into asphalt pavement by an authorized facility). These rules may be applicable if contaminated soil is stored or landfilled on site.

New York Rules for Siting Industrial Hazardous Waste Facilities (6 NYCRR Part 361) regulate the siting of new industrial hazardous waste facilities located wholly or partially within the state. Evaluation criteria for siting include consideration of population density, transportation route, contamination of groundwater and surface water, air quality, and preservation of endangered, threatened, and indigenous species.

New York Waste Transport Permit Regulations (6 NYCRR Part 364) governs the collection, transport, and delivery of regulated waste originating or terminating at a location within the state. These regulations are potentially applicable if contaminated soils or groundwater treatment residuals are hauled off site for treatment or disposal.

New York General Hazardous Waste Management System Regulations (6 NYCRR Part 370) provide general definitions and set forth state procedures for making information available to the public, confidentiality, petitioning equivalent testing methods, and petitioning for exclusion of a waste from a particular facility. These regulations are potentially applicable if excavated soil or treatment residuals would be classified as a hazardous waste.

New York Identification and Listing of Hazardous Wastes Regulations (6 NYCRR Part 371) establish procedures for identifying solid wastes subject to regulation as hazardous wastes. These regulations would be used to determine whether contaminated soil or treatment residuals meet the definition of a hazardous waste.

New York Hazardous Waste Manifest System Regulations (6 NYCRR Part 372) establishes standards for hazardous waste generators, transporters, and TSD facilities associated with the use of the manifest system and its record keeping requirements. These regulations are potentially applicable if corrective actions involve off-site transportation of hazardous waste.

New York Hazardous Waste Treatment, Storage, and Disposal Facility Permitting Requirements (6 NYCRR Subpart 373-1) regulate hazardous waste management facilities located within the state. These regulations are potentially applicable if corrective actions involve on-site treatment, storage, or disposal of hazardous waste.

New York Final Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities (6 NYCRR Subpart 373-2) establish minimum state standards which define the acceptable management of hazardous waste. These standards are potentially applicable if corrective actions involve on-site treatment or disposal of hazardous waste at Site 7.

New York Interim Status Standards for Owners and Operators of Hazardous Waste Facilities (6 NYCRR Subpart 373-3) establish minimum state standards which define the acceptable management of hazardous waste during the period of interim status and until certification of closure. These standards are potentially applicable if corrective actions involve on-site treatment or disposal of hazardous waste.

New York Standards for the Management of Specific Hazardous Wastes and Hazardous Waste Management Facilities (6 NYCRR Part 374-1) contain requirements for generators and transporters of hazardous waste and for owners and operators of facilities managing hazardous wastes. The regulation specifically addresses recyclable materials, hazardous waste or used oil burned for energy recovery, and reclaimed lead-acid batteries. These standards would be potentially applicable in the unlikely event that recyclable hazardous waste materials are used in a manner constituting disposal.

New York Rules for Inactive Hazardous Waste Disposal Sites (6 NYCRR Part 375) apply to the development and implementation of programs to address inactive hazardous waste disposal sites. The goal for a specific site is to restore it to pre-disposal conditions, to the extent feasible and authorized by law. At a minimum, the remedy selected shall eliminate or mitigate significant threats to the public health and the environment. State review and concurrence with the selected remediation scheme is required. The hierarchy of remedial technologies is as follows: destruction, separation/treatment, solidification/chemical fixation, and control and isolation.

New York Land Disposal Restrictions Regulations (6 NYCRR Part 376) identify hazardous wastes that are restricted from land disposal and define limited circumstances under which an otherwise prohibited waste may be land disposed. LDRs would be potentially applicable if corrective actions at Site 7 include land disposal of hazardous waste.

New York Rules on Hazardous Waste Program Fees (6 NYCRR Parts 483) address generator fees, TSD facility fees, and waste transporter fees.

New York Water Classifications and Quality Standards (6 NYCRR Parts 609 and 700 to 706) Parts 700 to 706 provide regulations for the discharge of sewage, industrial waste, or other wastes so as not to cause impairment of the best usages of the receiving water as specified by the water classifications at the location of discharge that may be affected by such discharge. Part 703.6 provides groundwater effluent limitations. Treated groundwater may be reinjected to groundwater and would need to comply with groundwater effluent limitations (see Table 3-2). The NWIRP site is in Suffolk County and will additionally have to comply with a maximum concentration of 1,000 mg/L total dissolved solids (TDS) and 10 mg/L total nitrogen (as N).

New York Regulations on State Pollutant Discharge Elimination System (6 NYCRR Parts 750 to 758) prescribe procedures and substantive rules concerning discharges to state waters. A State Pollutant Discharge Elimination System (SPDES) permit or NPDES permit is required to discharge to surface water. Amendments to these regulations will be proposed to repeal the current portions of Pants 750 through 758 that have been suspended by other law and regulation and renumber the remaining sections to develop a new comprehensive Part 750.

New York Technical and Administrative Guidance Memorandum on "Contained-In" Criteria for Environmental Media (TAGM 3028) is a guidance document applicable to soil, sediment, and groundwater contaminated by listed hazardous waste which has been removed from its natural environment. These criteria do not apply to listed or characteristic wastes as initially generated or residuals derived from treating these listed hazardous wastes. This TAGM sets minimum criteria for an environmental medium contaminated by listed hazardous waste, which must be met in order to preclude its management as hazardous waste. These criteria are not clean-up levels for contaminated environmental media. Criteria are provided in Table 3-2.

3.3 CORRECTIVE ACTION OBJECTIVES

Corrective Action Objectives are developed in this section to address contaminated soils and groundwater. Corrective Action Objectives generally identify chemicals of concern, receptor, pathway, and action levels (Preliminary Remediation Goals [PRGs]). Media-specific Corrective Action Objectives and corresponding PRGs are presented in the following sections.

For the NWIRP Calverton Site 7, the Corrective Action Objectives address the identified environmental risks at the facility. Contaminated soils and groundwater represent a potential threat to human health at the site through ingestion, dermal contact, and inhalation of contaminated media.

3.3.1 Corrective Action Objectives for Soil

The Corrective Action Objectives for contaminated soils are as follows.

- Prevent human exposure (ingestion, dermal contact, dust inhalation) to contaminated soils in concentrations greater than the PRGs.

- Prevent leaching of contaminants at resultant groundwater concentrations in excess of groundwater PRGs.

- Comply with chemical-specific, location-specific, and action-specific ARARs and guidance.

PRGs for contaminated soils are provided in Table 3-4. Also presented in this table is the maximum concentration detected for each chemical at Site 7. It should be noted that there are no specific Federal or state standards for soil remediation. However, the recommended soil clean-up objectives in TAGM 4046 were used to develop PRGs for soil. In general, the lower of the clean-up objective to protect groundwater quality or to protect human health was used as the PRG. For many of the SVOCs, the detection limit is lower than the recommended clean-up objective. In these cases, the detection limit was selected as the PRG. For other SVOCs, the PRGs are based on the maximum value recommended in TAGM 4046 for any individual SVOC (50 mg/kg). In these cases, the clean-up objectives for both protection of groundwater and protection of human health in TAGM 4046 are greater than 50 mg/kg.

The following VOCs were detected at concentrations greater than the PRGs: ethylbenzene and xylenes. PRGs for the VOCs are based on protection of groundwater. The following SVOCs were detected at concentrations greater than the PRGs: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene. It should be noted that all the PRGs for the SVOCs are the detection limit.

As per TAGM 4046, the soil clean-up objectives developed per this guidance should be used in selecting alternatives in the FS. Based on the proposed selected remedial technology (outcome of the FS), final site-specific soil clean-up levels are established in the Record of Decision (or other decision document). TAGM 4046 also notes that even after final soil clean-up levels are established, these levels may prove to be unattainable, and institutional controls may be necessary.

3.3.2 Corrective Action Objectives for Groundwater

The Corrective Action Objectives for contaminated groundwater are as follows.

- Prevent human exposure (through ingestion, inhalation, dermal contact) to groundwater having contaminants in concentrations greater than the PRGs.
- Restore contaminated groundwater quality to the PRGs to the maximum extent that is technically feasible.
- Comply with contaminant-specific, location-specific, and action-specific ARARs and guidance.

TABLE 3-4

SOIL PRELIMINARY REMEDIATION GOALS AND MAXIMUM SITE DETECTIONS (MG/KG) SITE 7 - NWIRP CALVERTON, NEW YORK

Compound	Site Maximum Detection[1]	PRG
VOLATILE ORGANICS		
Ethylbenzene	0.59	0.55[2]
Methylene chloride	0.0055	0.1[2]
Toluene	0.004	0.15[2]
Xylenes	2.6	0.12[2]
SEMI-VOLATILE ORGANICS		
2-Methylnaphthalene	2.6	36.4[2]
Acenaphthene	0.087	50[3]
Anthracene	1.2	0.50[3]
Benzo(a)anthracene	3.3	0.33[4]
Benzo(a)pyrene	2.2	0.33[4]
Benzo(b)fluoranthene	1.7	0.33[4]
Benzo(g,h,i)perylene	1.1	0.33[4]
Benzo(k)fluoranthene	1.7	0.33[4]
Carbazole	0.12	---
Chrysene	3.1	0.33[4]
Dibenzo(a,h)anthracene	0.24	0.33[4]
Di-n-butylphthalate	0.026	8.1[2]
Di-n-octylphthalate	0.03	50[3]
Fluoranthene	7.4	50[3]
Fluorene	0.55	50[3]
Indeno(1,2,3-cd)pyrene	1.4	0.33[4]
Phenanthrene	1.5	50[3]
Pyrene	10.0	50[3]

--- Not available
1 Maximum detections in soil were all observed in soils near the water table and associated with a former floating product layer.
2 TAGM 4046 based on protection of groundwater adjusted for TOC = 0.1%.
3 As per TAGM 4046, 50 mg/kg (maximum) for individual SVOCs.
4 PRG is the detection limit. TAGM 4046 recommended soil clean-up objective is less than the detection limit.

If groundwater PRGs cannot be achieved or the aquifer cannot be restored, then at a minimum, the following objectives should be met:

- Reduce human exposure (ingestion, inhalation, dermal contact) to groundwater having contaminants in concentrations greater than the PRGs.
- Prevent further migration of contaminants.

PRGs for contaminated groundwater are provided in Table 3-5. Also presented in this table is the maximum concentration detected for each chemical. To develop the groundwater PRGs, the most stringent promulgated standard has been utilized, including Federal MCLs/MCLGs, New York State MCLs, and New York State Groundwater Quality Standards, for the contaminants of concern. Proposed Federal standards or New York State guidance were only considered if no other criteria was available. If proposed standards were less than the detection limit, then the detection limit was selected for the PRG.

TABLE 3-5

GROUNDWATER PRELIMINARY REMEDIATION GOALS AND MAXIMUM SITE DETECTIONS (UG/L)
SITE 7 - NWIRP CALVERTON, NEW YORK

Compound	Site Maximum Detection	PRG
VOLATILE ORGANICS		
Benzene	17	1
Toluene	710	5
Ethylbenzene	480	5
Xylenes	2,400	5
Freon	100	5
SEMIVOLATILE ORGANICS		
Naphthalene	150	10
2-Methylnaphthalene	78	50
INORGANICS (TOTAL)		
Lead[1]	25	15/25

1 The 15 µg/l lead criteria is an action level in potable water supplies. The NYSDEC groundwater quality standard is 25 µg/l.

4.0 IDENTIFICATION AND SCREENING OF CORRECTIVE MEASURES TECHNOLOGIES

4.1 IDENTIFICATION AND PRELIMINARY SCREENING OF CORRECTIVE MEASURES TECHNOLOGIES

Section 4.1 provides an initial identification and preliminary screening of Corrective Measures Technologies for groundwater (Section 4.1.1). The preliminary screening of technologies is conducted to eliminate those technologies, which clearly would not apply to this site. Section 4.2 presents a more detailed identification and screening of technologies passing the preliminary screening.

The preliminary screening of technologies is based on their overall applicability (technical implementability) to the media (soils, groundwater), primary contaminants (volatile organics, other organics), and conditions present at the NWIRP facility (high yield aquifer and sandy soils). The purpose of this screening effort is to investigate all available technologies and process options and to eliminate those obviously not applicable for the site, based on the established Corrective Measures Objectives and a comparison of the contaminants detected at each site and PRGs.

Initial screening of groundwater technologies is presented in Table 4-1. Screening comments are provided in this table. The groundwater technologies retained from this preliminary screening are then summarized in Table 4-2.

Based on the following factors, the separate identification and screening of technologies for soil is not recommended:

- The soil contaminants were detected at the groundwater interface, and the source was the former floating product layer.
- The contaminated soil was detected at depths greater than 14 feet. This depth effectively eliminates direct contact with the contaminants.
- The VOCs detected at concentrations above PRGs would be effectively addressed by active groundwater remediation technologies or would be expected to biodegrade naturally.
- The SVOCs detected in soil at concentrations above PRGs were not detected in groundwater at concentrations above groundwater PRGs. None of the SVOCs was detected in soil at a concentration higher than that recommended for protection of groundwater.

TABLE 4-1

SCREENING OF TECHNOLOGIES/PROCESS OPTIONS FOR GROUNDWATER
SITE 7 - NWIRP, CALVERTON, NEW YORK

General Action	Technology	Process Options	Description	General Screening[1]	
No Action	No Action	No Action	No activities conducted at site to address contamination.	No action will be considered for sites that have not experienced any releases of hazardous substances or certain sites that have been determined to have minimal short-term or long-term effect on soils, air, groundwater, or surface water quality.	*
Institutional Controls	Institutional Controls	Deed Restrictions	Administrative action used to restrict groundwater use and future site activities.	Deed restrictions are viable, in combination with other technologies, since contaminated groundwater/material may remain in place. Deed restrictions would consist of banning well installation and use of existing wells.	*
		Groundwater Monitoring	Sampling and analysis to evaluate the migration of contaminants within or the potential contamination of groundwater.	Groundwater monitoring is viable for assessing the effectiveness of containment or treatment measures, during and following remediation.	*
		Alternative Water Supply	Replacement of contaminated groundwater source with alternative water supply for end user.	Deleted based on lack of another potable water source.	x
		Natural Attenuation	Use and monitoring of natural processes that affect the rate of migration and the concentration of contaminants.	Many of the groundwater contaminants, especially BTEX compounds and petroleum – related contaminants are ameanable to natural attenuation processes.	*
Containment	Capping	Capping	Use of impermeable or semi-permeable materials (e.g., soil, clay, synthetic membrane, asphalt) to prevent exposure to contamination and/or reduce the vertical migration of contaminants to groundwater.	Capping will not address groundwater contamination. Majority of contaminants are already present at the water table.	x

TABLE 4-1

SCREENING OF TECHNOLOGIES/PROCESS OPTIONS FOR GROUNDWATER
SITE 7 - NWIRP, CALVERTON, NEW YORK

General Action	Technology	Process Options	Description	General Screening(1)	
Containment (Continued)	Cut-off Barriers	Slurry Wall	Clay wall used to restrict horizontal migration of contaminants.	Area lacks confining units to tie barriers into.	x
		Sheet Piling	Sheet made of wood, pre-cast concrete, or steel used as a retaining wall to restrict horizontal migration of contaminants.	Area lacks confining units to tie barriers into.	x
		Bank Revetment	Riprap, piling, etc. used to protect and stabilize slopes of river bank.	Slopes requiring stabilization are not present at the site.	x
	Horizontal Barriers	Jet Grouting Curtain	Use of pressure-injected cement to restrict vertical migration of contaminants to groundwater.	Area lacks confining units to tie barriers into.	x
Removal	Extraction	Extraction Wells	Discrete pumping wells strategically placed to remove contaminants from the entire plume.	Contaminated groundwater in or near source areas would be extracted via pumping wells and treated prior to discharge.	
		Collection Trench	A permeable trench used to intercept and collect groundwater.	Aquifer is too deep to implement an effective permeable trench.	x
		Product Removal	Discrete extraction wells designed to recover either floating product or sinking product.	Recoverable free product is no longer present at the site.	x
	Enhanced Removal	Enhanced Removal	Blasting or hydrofracturing of bedrock to promote access to groundwater in bedrock fractures.	Enhanced removal is not necessary based on site geology. The aquifer is sufficiently permeable to extract groundwater via conventional means.	x
Disposal	Beneficial Reuse	Beneficial Re-use as Process Water/Potable Water	On-site re-use of groundwater in which the contaminants have been removed.	Beneficial re-use of treated effluent as process water/potable water is not warranted since there is no need for process water/potable water services at this time.	x

TABLE 4-1

SCREENING OF TECHNOLOGIES/PROCESS OPTIONS FOR GROUNDWATER
SITE 7 - NWIRP, CALVERTON, NEW YORK
PAGE 3 OF 7

General Action	Technology	Process Options	Description	General Screening(1)	
Disposal (Continued)	Surface Discharge	Direct Discharge (NPDES)	Discharge of collected/treated water to local surface water.	Direct discharge (NPDES) of effluent is not a viable option. Flowing surface water bodies are not available in the area.	x
		Indirect Discharge (POTW)	Discharge of collected/treated water to a publicly owned treatment works.	Indirect discharge (POTW) of effluent is not a viable option. A POTW is not available in the area.	x
		Off-site Treatment Facility	Treatment and disposal of hazardous or nonhazardous materials at permitted off-site facilities.	Off-site treatment facility is not feasible since the volume of contaminated groundwater is too large to effectively transport and treat off site.	x
	Subsurface Discharge	Reinjection	Use of reinjection, spray irrigation, or infiltration to discharge collected/treated groundwater to underground.	Reinjection of untreated effluent is not a viable option. Reinjection of treated effluent may be appropriate to discharge treated water and enhance contaminant removal. Spray irrigation requires relatively large areas, which are not presented at the site. Also, spray irrigation cannot be operated during the winter because of freezing problems.	*
Exsitu Treatment	Physical	Solvent Extraction	Separation of contaminants from a solution by contact with an immiscible liquid with a higher affinity for the contaminants of concern.	Solvent extraction is typically utilized for high concentration wastewater streams and is rarely utilized for groundwater remediation.	x
		Dewatering	Mechanical removal of free water from wastes using equipment such as a filter press or a vacuum filter.	Dewatering of sludges resulting from precipitation processes for metals removal may be required.	**
		Detonation	Detoxification of explosive waste by setting off a charge.	Detonation is not applicable since no wastes are explosive.	x

TABLE 4-1

SCREENING OF TECHNOLOGIES/PROCESS OPTIONS FOR GROUNDWATER
SITE 7 - NWIRP, CALVERTON, NEW YORK

General Action	Technology	Process Options	Description	General Screening[1]	
Exsitu Treatment (Continued)	Physical (Continued)	Equalization	Dampening of flow and/or contaminant concentration variation in a large vessel to promote constant discharge rate and water quality.	Equalization is feasible at the front end of a groundwater treatment system for equalizing flow and contaminant concentrations.	**
		Filtration	Separation of materials from water via entrapment in a bed or membrane separation.	Filtration may be required for suspended solids and particulate metals removal.	**
		Flotation	Separation of oils and suspended solids less dense than water by flotation methods.	Floating product is no longer present at the site.	x
		Reverse Osmosis/ Ultrafiltration	Use of high pressure and membranes to separate dissolved materials, including organics and inorganics from water.	Reverse Osmosis/Ultrafiltration is effective for removal of dissolved contaminants. This technology is considered only when other feasible options are not available.	x
		Volatilization	Contact of contaminated water with air to remove volatile compounds. Air stripping method is typically employed.	Air stripping would be effective for removal of volatile contaminants from the groundwater.	*
		Gravity Settling/ Clarification	Flow of water through a quiescent tank to a low gravity settling of solids.	If sufficient suspended solids are present in the groundwater, then this technology will be considered as a secondary technology.	**
		Aeration	Bubbling of air through water to volatilize organics and oxidize some metals.	Iron and manganese, if present, will be addressed through other options/components.	x
		Adsorption	Adsorption of contaminants onto activated carbon, resins, or activated alumina.	Adsorption may be considered for removal of VOCs and SVOCs from the groundwater.	*

TABLE 4-1

SCREENING OF TECHNOLOGIES/PROCESS OPTIONS FOR GROUNDWATER
SITE 7 - NWIRP, CALVERTON, NEW YORK

General Action	Technology	Process Options	Description	General Screening(1)	
Exsitu Treatment (Continued)	Physical (Continued)	Evaporation	Change from the liquid to the gaseous state at a temperature below the boiling point.	Evaporation is typically utilized for high concentration wastewater streams and is rarely utilized for groundwater remediation.	x
		Electrodialysis	Recovery of anions or cations using special membranes under the influence of an electrical current.	Electrodialysis is typically utilized for high concentration wastewater streams. This technology is considered only when other feasible options are not available.	x
	Biological	Aerobic Biodegradation	Suspended growth or fixed film process employing aeration and biomass recycle to decompose biodegradable organic components.	Applicable for biodegradable organic contaminants of concern, including hydrocarbons. It is not generally viable for chlorinated aliphatics.	*
		Anaerobic Biodegradation	Suspended growth or fixed film process employing anaerobic biomass to decompose organic contaminants.	Anaerobic biodegradation may not be effective for the primary site contaminants. Additionally for the anaerobic biodegradation process, vinyl chloride, which is more toxic than the parent compound, is the apparent end product of chlorinated VOC biodegradation.	x
	Chemical	Ion Exchange	Process in which ions, held by electrostatic forces to charged functional groups on the ion exchange resin surface, are exchanged for ions of similar charge in a water stream.	Ion exchange is a well established technology for removal of heavy metals and hazardous anions from dilute solutions. The reliability of ion exchange is affected by the presence of suspended solids, organics, and oxidants. This technology is considered only when other feasible options are not available.	x
		Electrolytic Recovery	Passage of an electric current through a solution with resultant ion recovery on positive and negative electrodes.	Electrolytic recovery is typically utilized for high concentration wastewater streams and is rarely utilized for groundwater remediation.	x

TABLE 4-1

SCREENING OF TECHNOLOGIES/PROCESS OPTIONS FOR GROUNDWATER
SITE 7 - NWIRP, CALVERTON, NEW YORK

General Action	Technology	Process Options	Description	General Screening[1]	
Exsitu Treatment (Continued)	Chemical (Continued)	Enhanced Oxidation	Use of strong oxidizers such as ultraviolet light, ozone, peroxide, chlorine, or permanganate to chemically oxidize materials. Oxidation may also be accomplished through the use of high temperatures, pressures, and air.	Enhanced oxidation would be effective for the destruction of volatile organics in the groundwater, although less effective removal efficiencies are anticipated for other site organics.	*
		Reduction	Use of strong reducers such as sulfur dioxide, sulfite, or ferrous iron to chemically reduce the oxidation state of materials.	Reduction would not effect site contaminants.	x
		Neutralization	Use of acids or bases to counteract excessive pHs or to adjust pH to optimum for a given technology.	Neutralization may be required in conjunction with pretreatment requirements for a given technology.	**
		Dechlorination	Use of chemicals to remove chlorine from chlorinated compounds.	Dechlorination is typically utilized for high concentration wastewater streams and is rarely utilized for groundwater remediation.	x
		Flocculation/ Coagulation	Use of chemicals to neutralize surface charges and promote attraction of colloidal particles to facilitate settling.	Flocculation/coagulation may be warranted to improve suspended solids removal.	**
		Precipitation	Use of reagents to convert soluble materials into insoluble materials.	Precipitation may be warranted for dissolved metals removal.	**

TABLE 4-1

SCREENING OF TECHNOLOGIES/PROCESS OPTIONS FOR GROUNDWATER
SITE 7 - NWIRP, CALVERTON, NEW YORK

General Action	Technology	Process Options	Description	General Screening[1]	
In-Situ Treatment	Chemical/ Physical	Air Sparging	Flushing of contaminants using an injection / extraction well system and above-ground treatment system.	Removal of contaminants from groundwater is achieved by air stripping/ bioventing of contaminants. Contaminants must be amenable to volatilization or biodegradation. The effective depth is usually limited to 20 feet below the water table. Treatment to greater depths is potentially viable.	*
	Biological	Aerobic Biodegradation (Bioventing)	Enhancement of in-place biodegradation by addition of nutrients and control of environment.	Removal of contaminants from groundwater is achieved by air stripping/bioventing of contaminants. Contaminants must be able amenable to volatilization or biodegradation.	*

* Potentially applicable as a primary technology.

** Potentially applicable as a secondary technology (i.e., handling of treatment residuals resulting from a primary technology). Discussed as appropriate under applicable alternatives.

x Not applicable as a primary technology.

TABLE 4-2

SUMMARY OF RETAINED PRIMARY GROUNDWATER TECHNOLOGIES AND PROCESS OPTIONS SITE 7 - NWIRP, CALVERTON, NEW YORK

General Action	Technology	Process Option
No Action	No Action	No Action
Institutional Controls	Institutional Controls	Deed Restrictions
		Groundwater Monitoring
		Natural Attenuation
Removal	Extraction	Extraction Wells
Disposal	Subsurface Discharge	Reinjection
Exsitu Treatment	Physical	Air Stripping
		Adsorption
	Biological	Aerobic Biodegradation
	Chemical	Enhanced Oxidation
Insitu Treatment	Chemical/Physical	Air Sparging
	Biological	Aerobic Biodegradation (Bioventing)

- The concentrations of PAHs in soil are expected to biodegrade naturally, although slowly. Half-lives for the PAHs detected in soil at concentrations higher than PRGs range from 1.45 years for benzo(a)pyrene to 5.86 years for benzo(k)fluoranthene (Howard, 1991).

- The groundwater corrective measures will also address existing soil contamination.

4.2 SCREENING OF CORRECTIVE MEASURES TECHNOLOGIES

The technologies retained in the initial screening are broadly evaluated in this section. Technologies, which are retained for a site, will be evaluated in the detailed analysis sections of the respective sites.

The evaluation of technologies utilizes three criteria; effectiveness, implementability, and relative cost. The criteria are defined as follows:

- Effectiveness - This criterion focuses on the potential effectiveness of process options in protecting human health and the environment, and in meeting the corrective measures objectives. This criterion considers potential impacts to human health and the environment during construction and implementation, and how proven and reliable the process is with respect to the contaminants and conditions at the site.

- Implementability - Implementability is a measure of both the technical and administrative feasibility of implementing a technology. It provides a means of evaluating the ability of a technology to be adapted to site-specific conditions. Technical feasibility includes consideration of construction and operational issues, demonstrated performance, and adaptability to site conditions. Administrative feasibility considerations include the ability to obtain any necessary permits or easements or adherence to applicable nonenvironmental laws and concerns of other regulatory agencies. General availability of necessary equipment and resources is also evaluated.

- Cost - Cost evaluations allow a relative comparison between similar technologies. Cost plays a limited role in technology screening. The cost analysis is based on engineering judgement, and each technology is evaluated as to whether costs are high, low, or medium relative to the other options in the same technology type. If there is only one process option, costs are compared to other candidate technologies.

One representative process option is selected, if possible, for each technology type, to simplify the subsequent development and evaluation of alternatives without limiting flexibility during remedial design.

4.2.1 <u>Corrective Measures Technologies for Groundwater</u>

The following general actions for groundwater are discussed below:

- No action
- Institutional controls
- Removal
- Disposal
- Exsitu treatment
- Insitu treatment

4.2.1.1 No Action

No action consists of allowing the groundwater to remain status quo. Under this condition, the contamination in the water will remain at original concentrations, and any reduction will be due to natural attenuating factors such as dilution, dispersion, biodegradation, adsorption, infiltration, etc.

Effectiveness The no-action scenario would not achieve remediation goals for Site 7. Groundwater with contaminants concentrations above the PRGs would remain at the site.

Implementability Since there would be no activity, there are no implementability considerations associated with the no action scenario.

Cost. Because no action would be taken, there would be no costs associated with this option.

Conclusion No action is retained to provide a baseline for comparison with other alternatives.

4.2.1.2 Institutional Controls/Monitoring/Natural Attenuation

Institutional controls for groundwater include deed restrictions, groundwater monitoring, and natural attenuation. Deed restrictions are institutional controls that are placed on property deeds. These restrictions may limit future activities, such as placement of new wells or construction. Groundwater monitoring would be used to determine if the groundwater contamination is increasing or migrating off site. Monitoring can also be used to monitor the progress of groundwater remediation and natural attenuation process. Natural attenuation refers to inherent processes that affect the rate of migration and the concentrations of contaminants. The most important processes are biodegradation, advection, hydrodynamic dispersion, dilution from recharge, sorption, and volatilization.

Effectiveness Institutional controls would allow any contamination present in groundwater to remain at the facilities. Deed restrictions could ensure that no new wells would be installed in the contaminated plume, thereby reducing the potential risk to human health associated with ingestion/inhalation of contaminated groundwater. However, these restrictions, over the long term, may not be reliable and are difficult to enforce especially when the site is no longer under government control. Groundwater monitoring would not provide any additional protection of the environment, since contaminated groundwater would continue to spread into uncontaminated or lesser-contaminated areas. Groundwater monitoring would be used to evaluate whether contaminant concentrations are increasing. Monitoring would also be helpful in measuring and evaluating the effectiveness of groundwater remediation and natural attenuation processes. Natural attenuation is effective if the rate of biodegradation, aided by sorption and dilution, is rapid enough to prevent significant migration by advection and dispersion. Monitoring is a key component in confirming effectiveness.

Implementability Institutional controls are readily implementable for contaminated groundwater since only administrative action and limited remedial activities would be required. Deed restrictions could be implemented by the Navy. Limited equipment and personnel would be required for groundwater monitoring. Local and state permits may be required for monitoring well installation. Monitoring of natural attenuation would be readily implementable.

Cost Costs of implementing institutional controls are low.

Conclusion Institutional controls, groundwater monitoring, and natural attenuation may be used alone and in combination with other process options at the site. Groundwater contamination was detected at Site 7. Institutional controls would not prevent continued migration of contaminated groundwater at this site. However, the site contaminants are relatively biodegradable, and monitoring would determine whether contaminants are migrating off site.

4.2.1.3 Groundwater Extraction

The extraction option uses a series of pumping wells completed in overburden deposits, which can be used to capture contaminated groundwater for treatment. The wells used in the capture system are designed and located to provide optimum efficiency in capturing contaminated groundwater while minimizing the collection of uncontaminated groundwater. The extraction system can be designed to contain the contaminated groundwater plume from migrating off site or to remediate the contaminated groundwater plume.

Pumping contaminant involves the active manipulation and management of groundwater to contain or remove a plume. The selection of the appropriate well system depends upon the depth of contamination and the hydrologic and geologic characteristics of the aquifer. Well systems are very versatile and can be used to contain, remove, divert, or prevent development of plumes under a variety of site conditions.

Effectiveness The effectiveness of an extraction well system depends largely on the type and extent of contamination and the geology and hydrogeology. For this facility, extraction wells should effectively control the migration of contaminants and remove the contaminated groundwater for subsequent treatment and/or disposal. More mobile chemicals are more readily removed than less mobile chemicals. The use of wells to extract groundwater should attain the remediation goals. The technology is reliable and minimal effects on human health and the environment are expected.

Implementability Groundwater extraction through a pumping well system can be readily implemented. The technology uses readily available equipment and techniques and has proven to be effective in similar situations. Implementation of this technology would require long-term operation and maintenance. Maintenance may require periodic replacement of mechanical components and well flushing to remove fine-grained material that may clog the wells. Local and state permits may be required for installation of extraction wells. Extracted groundwater would require treatment prior to disposal.

Cost Costs are low.

Conclusion Groundwater extraction is retained for Site 7.

4.2.1.4 Disposal

Reinjection of groundwater consists of disposing of treated water into an aquifer using injection wells. Reinjection may be used to increase contaminant removal by directing groundwater toward extraction wells. Reinjection wells can be coupled with extraction wells to create a closed system in which pumping and injection rates balance one another.

Effectiveness Reinjection is an effective means of disposing of the volumes of water generated by the groundwater pumping/treatment system. Injection wells offer the advantage of decreasing groundwater remediation time by increasing the groundwater flow through the aquifer. The effectiveness of reinjection depends upon the hydraulic conductivity, aquifer thickness, and the hydraulic gradient/aquifer recharge rate. Often, these methods of disposal require treatment of the water to meet very stringent standards (e.g., drinking water standards).

Implementability Installation of a well system for underground injection is implementable. Reinjected water that is not captured by the extraction wells could potentially force contaminated groundwater into lesser-contaminated areas. A system should be implementable that would adequately capture contaminated groundwater. Periodic groundwater monitoring would help to assess whether or not this condition is occurring. Subsurface discharge would require that groundwater be treated to either action or background levels prior to reinjection. Reinjection of water may require a state permit. The permit would set limitations on contaminant concentrations, and possible flow rates, of treated water. This permit should be obtainable provided that drinking water and groundwater standards are achieved prior to reinjection.

Cost Costs would be moderate.

Conclusion Reinjection is the only disposal option available and will be retained for the site.

4.2.1.5 Exsitu Treatment

Exsitu treatment consists of the use of technologies for the treatment of groundwater after extraction. The processes applicable for treatment of site-specific groundwater contamination will be assembled into a treatment system in the detailed analysis. These technologies may also be appropriate for treatment of water removed during dewatering.

<u>Air/Steam Stripping</u>

Air Stripping:

Air stripping is a mass transfer process in which volatile contaminants (compounds with Henry's Law constant greater than 3.0 L atm/mol) in water or soil are transferred to gas. There are five basic equipment configurations used to airstrip liquids: packed columns, cross-flow towers, coke tray aerators, diffused air basins, and mixing jets.

Air stripping is frequently accomplished in a packed tower equipped with an air blower. The packed tower works on the principle of countercurrent flow. The water stream flows down through the packing while the air flows upward, and is exhausted through the top. Volatile, soluble components have an affinity for the gas phase and tend to leave the aqueous stream for the gas phase. In the cross-flow tower, water flows down through the packing as in the countercurrent packed column; however, the air is pulled across the water flow path by a fan. The coke tray aerator is a simple, low-maintenance process requiring no blower. The water being treated is allowed to trickle through several layers of trays. This produces a large surface area for gas transfer. Diffused aeration stripping and induced draft stripping use aeration basins similar to wastewater treatment aeration basins. Water flows through the basin from top to bottom or from one side to another with the air dispersed through diffuses at the bottom of the basin. The air-to-water ratio is significantly lower than in either the packed column or the cross-flow tower. Mixing jet systems involve high intensity mixing of pressurized air and water. The air-to-water flow ratio, temperature of the water, and height of packing may be adjusted to achieve adequate removal of VOCs to meet discharge standards. Typically, pretreatment for removal of suspended solids, organic-free product, and scaling constituents would be required for air stripping.

Steam Stripping:

Steam stripping is a unit process that uses steam to extract organic contaminants from a liquid or slurry. Steam stripping by direct injection of steam can be used to treat aqueous and mixed wastes containing organic contaminants at higher concentrations and/or having lower volatility than those streams, which can be stripped by air. Direct injection of steam and multiple pass heat exchangers are the two most prevalent methods of steam stripping. It is an energy-intensive process and the steam may account for a major portion of the operating costs. This process is similar to steam distillation except that reflux of the stripped and recovered material does not usually occur.

Effectiveness Air stripping is a well proven and reliable technology that would be effective for removing VOCs from groundwater. Removal efficiencies greater than 99 percent can theoretically be achieved for the volatile contaminants present at Site 7. Since air stripping only removes the contaminants from the water and concentrates them in the offgas, the offgas may have to be treated by other means such as granular activated carbon adsorption, catalytic oxidation, or thermal destruction. The need and type of offgas treatment depends on the specific contaminants and their concentrations. Each of the noted offgas treatment technologies should be effective for contaminants in site groundwater. Steam stripping is not expected to provide any advantages in effectiveness beyond air stripping.

Implementability Air stripping would be readily implementable at the site. Steam stripping would require disposal of condensed organics. Vendors that provide air-stripping technology are readily available. In order to meet state Ambient Air Quality Standards, control of offgas emissions and an air permit may be required. Construction permits may also be required. These permits should be obtainable.

A maintenance problem associated with air stripping is the channeling of flow resulting from clogging in packing material. Common causes of clogging include high concentrations of oils, suspended solids, iron, and slightly soluble salts such as calcium carbonate. Pretreatment of contaminated groundwater would be required prior to air stripping to remove such materials.

Cost Costs are low to moderate and will depend on influent contaminant concentrations, the degree of removal required, and the type of offgas treatment required.

Conclusion Air stripping is retained for treatment of VOCs at Site 7.

Activated Carbon Adsorption

A large variety of organic contaminants and some inorganic ionic species that are commonly found in groundwater are amenable to removal by adsorption onto activated carbon. Contaminants adsorb to the internal pore surfaces of activated carbon particles as the contaminated water passes through a column of the activated carbon. When the available surface area of the activated carbon particles is occupied, the column must be replaced by fresh activated carbon. The exhausted carbon must then be either regenerated or disposed of according to Federal or state regulations. Removal efficiency exceeding 99 percent is possible depending on the type of organic solute and system operating parameters such as retention time and carbon replacement frequency.

Among organic contaminants, long-chain, low solubility, less polar compounds have a greater affinity for adsorption than others. The adsorption of organic acids is favored by low pH conditions in the water, whereas that of organic bases is favored by high pH conditions.

The presence of high levels of suspended solids can clog the flow of water through the column. The presence of organic free product can hinder the adsorption of target dissolved contaminants by coating the surfaces and exhausting the column quickly. Because of the nonselective nature of this technology, the presence of naturally occurring organic substances can significantly increase the consumption rate of activated carbon.

Typical activated carbon adsorption treatment systems include gravity flow or pressure flow columns in series and/or parallel configuration some with backwashing capability. Granular activated carbon (GAC) is generally used in these systems. Common flow rates range from 0.5 to 5.0 gpm/ft^2. Factors such as pH and temperature of the influent, empty bed contact time (EBCT), surface area/volume ratio of the activated carbon, and solubility of the organic compound will affect the carbon adsorption process.

Effectiveness Carbon adsorption is a well proven, reliable technology that would be effective in removing most organic contamination at Site 7. For Site 7 with high VOC concentrations in the source area (greater than 50 to 100 µg/L), carbon adsorption may not be as effective as other technologies, such as air stripping, for removal of VOCs. Generally, the most effective application of carbon adsorption would be for dilute concentrations of organics that result in relatively low carbon consumption. Removal efficiencies exceeding 99 percent, with nondetected organics in effluents, are commonly achievable. Spent carbon containing the removed organic contaminants would have to be regenerated or disposed in a hazardous waste landfill.

Implementability Carbon adsorption would be readily implementable. There are a sufficient number of vendors that provide carbon adsorption units. Construction permits may also be required. These permits should be obtainable.

Pretreatment may be required if the influent has a suspended solids concentration greater than 15 mg/L, oil and grease concentrations greater than 10 mg/L, or calcium or magnesium concentrations greater than 500 mg/L to prevent clogging and high pressure drops.

Implementation factors include planning for disposal or regeneration of the spent carbon. Thermal, steam, and solvent treatments are the most common types of regeneration technologies, which are typically conducted off site.

Cost. Costs are low to moderate, depending on the carbon usage rate that is a function of influent contaminant concentration.

Conclusion. Carbon adsorption is a viable technology for treating most site organics and in particular non-volatile organics. It is retained for further consideration for Site 7.

<u>Biological Treatment</u>

Biological treatment of contaminated groundwater utilizes processes that have operated successfully at publicly owned treatment works (POTWs) and industrial wastewater treatment plants. Microorganisms, either suspended in the contaminated groundwater or attached to a medium, feed off the organic material, converting the more complex organics to energy for growth and cell reproduction, releasing final waste products such as carbon dioxide and water. Oxygen and nutrients such as nitrogen and phosphorus must be added to the system to maintain microbial growth. After a predetermined residence time has been reached, a high percentage of the biodegradable organics will have been metabolized. The microorganisms are then separated, and supernatant may either be released to receiving surface waters, pumped back into the ground, or pumped to another process for additional treatment. The volume of microorganisms and other solids will continue to accumulate, with wasting of a certain amount required periodically. The waste microorganisms and solids constituting sludge will be treated by microbial digestion under oxygen-deficient conditions to form mineralized sludge prior to disposal.

Biological processes can be either aerobic or anaerobic. Aerobic operations are more common due to the fact that the aerobic microorganisms are less vulnerable to shock than anaerobic microorganisms caused by high organic loadings or toxic inorganics. For either situation, a period of time prior to full-scale operation needs to be set aside to acclimate the microbes to the particular organics and inorganics and at the given concentrations present in the groundwater. Similarly, the pH, nutrient balance, temperature, and total residence time in the reactor will need to be adjusted in order to reach an optimal balance among these parameters.

Several chemical characteristics of the groundwater are important in assessing the effectiveness of biological treatment. Some of the most important of these chemical characteristics are the following: nature of organic contaminants; biodegradability (measured by oxygen demand for oxidation); presence of nutrients (nitrogen, phosphorus) and micronutrient (trace metals, salts, sulfur); concentration of total and suspended heavy metals; and the speciation of metals.

In general, under aerobic conditions, hydrocarbons, light petroleum distillates, and aromatic hydrocarbons (including benzene, toluene, xylene, ethylbenzene, and naphthalene) are degradable. The rate of degradation decreases with increasing molecular weight (i.e., long-chain, cyclic, and polyaromatic hydrocarbons) and decreasing solubility. Chlorinated hydrocarbons (such as freon) are not readily degraded aerobically. The degradation of these chemicals is more difficult with the degree of chlorine substitution. In addition, high removal efficiencies of many volatile materials, which are known to be biodegradable, may be a result of volatilization instead of biodegradation. Under anaerobic conditions, chlorinated hydrocarbon compounds can be dechlorinated, but this process may create toxic byproducts such as vinyl chloride.

Metals such as arsenic, chromium, and lead can be toxic to the microorganisms, blocking enzyme reactions needed in order to metabolize the organics for energy. Inorganic particulates can be insolubilized in the water if the environment is slightly basic to neutral. Particulates are removed by sedimentation, either by attaching to the surface of a settling floc or by primary treatment prior to biological treatment.

The most common designs for biological treatment include activated sludge reactors, trickling filters, and rotating biological contactors (RBCs).

In general, most exsitu groundwater treatment technologies are affected by the following parameters: presence of organic free product; extreme pH and temperature; high levels of total suspended solids; and scale-forming agents: total dissolved solids, alkalinity, hardness, iron and manganese.

Effectiveness Biological treatment would be moderately effective for treating several of the organics present at the site, and in particular several of the SVOCs and the BTEX compounds. Significant risks to human health or the environment during implementation would not be expected. For several of the organics the process is proven and reliable; however, the process is not proven or reliable for most of the organics identified. Also, the process may need the addition of supplemental organics to maintain the biological population.

Implementability The process should be readily implemented. Only common construction-type permits would be required. Equipment and resources are readily available.

Cost The costs associated with biological treatment are high.

Conclusion Biological treatment is only partially effective, and the costs are high. As a result, it will not be retained for further consideration.

Enhanced Oxidation

Enhanced oxidation processes use a controlled combination of ozone or hydrogen peroxide and ultraviolet light to induce photochemical oxidation of organic compounds. Ozone has been used extensively in Europe for purification, disinfection, and odor control of drinking water. Ozone alone has the ability to break down some organics but has generally proved to be an ineffective oxidant of halogenated organics under conditions normally used for drinking water treatment or for disinfecting wastewaters (i.e., 1 to 10 mg/L concentration levels and 5- to 10-minute contact times) (Brenton et al., 1986; Arienti et al., 1986). Oxidation of organic species to carbon dioxide, water, etc., however, is possible if the ozone dosage and contact times are sufficiently high (EPA, 1987). Hydrogen peroxide can be used as an alternative to ozone for water treatment.

Ultraviolet (UV) light is electromagnetic energy whose wavelengths fall between those of visible light and X-ray radiation on the electromagnetic spectrum. UV energy is capable of breaking down or re-arranging a molecular structure, depending on the dissociation energies of the chemical bonds within the structure. The combination of ultraviolet radiation with ozone treatment results in the oxidation of organic contaminants at a rate many times faster than that obtained from applying UV light or ozone alone.

Ultraviolet light photolyzes hydrogen peroxide into highly reactive radicals. In addition, UV light also either directly oxidizes, or splits organic molecules into more reactive species, thereby enhancing the oxidation reaction.

A typical continuous-flow enhanced oxidation system consists of an oxygen or air source, an ozone generator or hydrogen peroxide feed system, a UV/oxidation reactor, and an off-gas ozone decomposer. Flow patterns and configurations are designed to maximize exposure of the oxidant-bearing wastewater to the UV light, which is supplied by an arrangement of UV lamps. Typical reactor designs range from mechanically agitated reactors to spray, packed, and tray-type towers. Reactor gases are passed through a catalytic decomposer, which converts remaining ozone to oxygen and destroys any residual volatiles. The gases are then discharged to the atmosphere or recycled. Hydrogen peroxide is gaining importance as a supplement or replacement for ozone.

Pretreatment for the removal of suspended solids, iron, manganese, organic-free product, and scale-forming constituents is important.

Effectiveness The hydrogen peroxide/ozone/UV technology should be effective for most chlorinated VOCs and benzene, toluene, ethylbenzene, and xylenes (BTEX). Effectiveness varies greatly depending on the contaminant of concern. This process does not effectively degrade ketones and alcohols. In addition, alcohols and ketones may be formed in the process from the degradation of other organics. The presence of these compounds may prevent the discharge of the treated water without additional complicated treatment.

This process is considered an innovative technology; only a few commercial systems have been installed and tested. Bench- and pilot-scale treatability studies would therefore need to be conducted to determine the actual effectiveness and cost of applying this process to the contaminants of concern.

Implementability Hydrogen peroxide/ozone/UV technology should be implementable. Only a few vendors, however, currently offer this technology. Construction permits and a TSD permit may also be required and should be obtainable.

Recent improvements have been made by hydrogen peroxide/UV vendors to minimize energy usage and reduce UV lamp fouling problems. With this treatment, no toxics are emitted to the atmosphere or adsorbed onto media that require further treatment or disposal. Hydrogen peroxide is a strong oxidizing agent; therefore, dicing and other engineering controls are required to minimize potential risks associated with peroxide releases.

Cost Costs are moderate to high. Costs may vary depending on flow rate, and contaminant type and concentration. Enhanced oxidation requires high-energy usage, which can result in prohibitive costs.

Conclusion Even though enhanced oxidation may be effective and implementable, costs are expected to be significantly higher than other equally (or more) effective and implementable technologies (such as air stripping and activated carbon adsorption). In addition, the process may generate alcohols and ketones, which may prevent potential discharge standards from being achieved. As a result, enhanced oxidation will not be retained for further consideration.

4.2.1.6 Insitu Treatment

Insitu treatment involves the remediation of the groundwater within the formation in which it is present with a limited extent of extraction and injection. The two main technologies considered here are insitu air sparging and insitu biological treatment.

Air Sparging

Insitu air sparging consists of injection of contaminant-free air into the saturated zone within the contaminated plume. The injected air bubbles disperse within the saturated zone and contact the contaminants. In this process, the VOCs adsorbed on the soil particles and dissolved in the water are volatilized, like an insitu air stripping process. The VOCs are then carried into the vadose zone by the air phase, within the radius of influence of an operating vapor extraction system.

Air sparging is often used in combination with soil vapor extraction and bioventing. In this technology, the removal of the contaminants is achieved by air stripping/biodegradation of VOCs and biodegradation of the SVOCs. Most petroleum hydrocarbon contaminants are amenable to removal from the saturated zone using this technology. Air stripping and biodegradation of contaminants can occur simultaneously in the groundwater as well as in the saturated zone soils.

Effectiveness. Air sparging should be relatively effective for the VOCs and some of the SVOCs. Removal of the chlorinated VOCs (freon) from the aquifer would be by volatilization, whereas removal of the non-chlorinated organics would be by volatilization and/or biodegradation. The process is only somewhat proven, and treatability work would be required. In combination with vapor extraction, it should be very reliable and there should not be any significant risks to human health and the environment.

Implementability. Air sparging would be implementable. Permits should not be required for the air sparging component. However, air discharge permits may be required for the associated vapor extraction system. Vendors are available to perform this work.

Cost. The costs associated with air sparging are relatively low.

Conclusion. Air sparging will be retained for further consideration at Site 7, but only in combination with soil vapor extraction.

Insitu Biological Treatment

Insitu bioremediation is a process by which microorganisms biologically degrade organic compounds to less harmful degradation products, such as carbon dioxide, methane, and water. This process is conducted in the subsurface by providing the indigenous microorganisms optimum conditions for growth, such as controlled pH and nutrient feed. Biodegradation can be conducted under aerobic conditions by supplying a sufficient source of oxygen or under anaerobic conditions by removing the oxygen from the subsurface. The conditions chosen (i.e., aerobic or anaerobic) are dependent on the chemical compounds to be remediated and ease of implementation. Historically, petroleum compounds are known to be more susceptible to aerobic biodegradation than to anaerobic biodegradation. Moreover, anaerobic biodegradation of chlorinated aliphatic compounds is incomplete and can lead to the formation of more toxic compounds (vinyl chloride). Therefore, only aerobic bioremediation will be discussed here.

Aerobic bioremediation involves stimulation of the indigenous aerobic microflora in the subsurface to enhance the biodegradation of contaminants by providing a supply of oxygen and nutrients. In some cases, a cometabolite or an additional carbon source is necessary to achieve biodegradation.

Oxygen may be provided in the form of air, pure oxygen, hydrogen peroxide, or oxygen releasing compounds (ORC). The oxygen may either be added to the extracted groundwater prior to reinjection, directly bubbled in through spargers (air sparging), or supplied by in-line injection of pure oxygen. The use of hydrogen peroxide leads to certain advantages such as a greater supply of oxygen and control of biofouling of the well.

Nutrients such as nitrogen and phosphate are essential for microorganisms and may be present in limited concentrations in the subsurface. The forms of nitrogen and phosphorus are not critical. However, the decision to add salts as nutrients must be based not only on laboratory tests for microbes, but also on potential interaction with the site geochemistry. Certain nutrients such as phosphates could result in the precipitation of calcium phosphate, which may clog pores and reduce the permeability of the subsurface. If the contamination is relatively low, it may be necessary to add an additional carbon source to support sufficient bacterial growth. The selection of this additional carbon source is critical. The compound that is selected must not be preferentially biodegraded over the contaminants of concern. In addition, the compound should be innocuous so that it will not adversely affect the groundwater. Other microbial nutrients such as potassium, magnesium, calcium, sulfur, sodium, manganese, iron, and trace metals may be already present in the groundwater.

Under aerobic conditions, petroleum hydrocarbons are more readily biodegradable than chlorinated organics (freon).

Ideally, insitu biological degradation (in the aqueous phase) would be used in combination with an extraction system and would likely reduce the total time of remediation. However, the actual extent of bioremediation achievable would be difficult to predict unless the hydraulic conductivity of the subsurface is found to be conducive to achieve adequate dispersion of nutrients and oxygen, which are vital factors for bioremediation.

The following parameters can aid in evaluating the effectiveness and implementability of insitu treatment:

- Hydrology/aquifer characteristics.
- Nature of contaminants.
- Presence of biodegradable compounds (measured by oxygen demand for oxidation), nutrients (nitrogen, phosphorus), micronutrient (trace metals, salts, sulfur), calcium and TDS.

Effectiveness Bioremediation should be effective for the removal of most VOCs and SVOCs in Site 7 groundwater. The process is not well proven, and extensive treatability work could be required. In addition, the reliability of the system is questionable, since organics and nutrients would have to be introduced into the aquifer. Once introduced, these chemicals may be difficult to capture and remove.

Implementability Bioremediation may be implementable. Permits would be required for the injection of organics and nutrients into the aquifer. Because the aquifer is a sole-source aquifer, the permit may be difficult to obtain. There are only a limited number of vendors available to perform this work, although not critically.

Cost The costs associated with bioremediation are relatively low.

Conclusion Bioremediation will be retained for further consideration at Site 7.

4.3 DEVELOPMENT OF CORRECTIVE MEASURES ALTERNATIVES

The following sections provide the development of corrective measures alternatives to address the contaminated material at Site 7.

Groundwater and very limited soil contamination were detected at Site 7. Semivolatile organic compounds (SVOCs) were greater than soil PRGs in only soil samples collected at a depth of 14 to 16 feet below ground surface, at the groundwater interface. This contamination is likely associated with residual groundwater/free product contamination. Pesticides, polychlorinated biphenyls (PCBs), and metals other than lead were not analyzed. Based on site history, these chemicals would not be expected to be present. Toxicity Leaching Characteristic Procedure (TCLP) results indicate that none of the soils tested would be classifiable as a characteristic hazardous waste. The extent of soil contamination is limited to deep soils in the area of the former underground storage tanks (see Figure 2-1).

Groundwater contaminants detected at concentrations greater than PRGs include benzene, ethylbenzene, toluene, xylene, freon, naphthalene, and 2-methylnaphthalene. Figure 2-2 shows the estimated areal extent of groundwater contamination. Based on estimates provided in Appendix A, there is approximately 18 pounds of organics in the Site 7 groundwater.

Extent and volume of contamination calculations are provided in Appendix A.

4.3.1.1 Alternative 1: No Action

The No Action alternative maintains the site at status quo. This alternative is retained to provide a baseline for comparison to other alternatives; therefore, it does not address the contamination in the soils and groundwater. There would be no reduction in toxicity, mobility, or volume of the contaminants from treatment at Site 7 other than that which would result from natural dispersion, dilution, biodegradation, or other attenuating factors. Existing remedial activities, monitoring programs, and institutional controls would be discontinued, and the property would be available for unrestricted use.

4.3.1.2 Alternative 2: Institutional Controls and Natural Attenuation

This alternative consists of natural attenuation and institutional controls (i.e., monitoring of natural attenuation and site development restrictions). This alternative would monitor the natural attenuation of groundwater contaminants. Approximately four new monitoring wells would be installed. Groundwater sampling, quarterly for the first year and annually for the next 30 years, would be conducted. This sampling would be performed based on state and Federal regulations and would measure changes in site contamination. Modeling would be conducted to estimate contaminant migration and natural attenuation. Site development restrictions would be implemented into the facility transfer documents. A reevaluation of the site would be performed every 5 years to determine if any changes to the controls or remedy would be required.

The viability of natural attenuation was evaluated using the BIOSCREEN model. BIOSCREEN was developed as a simple screening tool to evaluate the natural attenuation of dissolved hydrocarbons at spill sites involving petroleum hydrocarbons. Model runs were performed for the BTEX compounds. Additional details on the model, input parameters, and results are provided in Appendix D. The model runs are based on a spill of JP-4 that was assumed to have occurred in 1975. The model predicts that benzene concentrations would be near the PRG after 25 years, and benzene would be completed degraded after 50 years. At time equals 50 years, the highest predicted concentration of toluene is 0.009 mg/L at the source. At time equals 50 years, the highest predicted concentration of ethylbenzene is 0.659 mg/L at the source. The amount of time predicted by the model for ethylbenzene to degrade to the PRG is approximately 150 years. At time equals 50 years, the highest predicted concentration of xylene is 0.051 mg/L at the source. The amount of time predicted by the model for xylene to degrade to the PRG is approximately 75 years.

4.3.1.3 Alternative 3: Groundwater Extraction, Treatment, and Discharge

Alternative 3 consists of groundwater extraction wells, suspended solid treatment as required, air stripping, and reinjection. Alternative 3 was developed as a remediation alternative to prevent contaminated groundwater from migrating off site and remediating on-site groundwater. Site soils would be addressed through natural degradation processes including biodegradation and flushing to groundwater. This alternative consists of installing groundwater extraction wells, treating and reinjecting extracted groundwater, and long-term groundwater monitoring.

Generally, alternative development would consider options for source area treatment, downgradient plume containment, and a combination of both. This approach results from many sites having a relatively small area of higher-level contamination (source area) and a relatively large area of lower-level contamination (downgradient area). However, at Site 7 the downgradient area is small relative to the source area. Consequently, this alternative includes only one option consisting of groundwater extraction in the source area and an additional downgradient extraction well to prevent the contaminant plume from migrating off site. Options for only source area treatment and only downgradient plume containment are not considered viable for this site.

Based on preliminary calculations, one extraction well placed toward the eastern edge of the contaminated groundwater plume would capture contaminated groundwater before it flows off site (see Figure 4-1). Three wells would be placed in the area of the most contaminated groundwater, and one well would be placed in the area of the freon contaminated groundwater in the southwest portion of the site. The wells would be constructed to capture groundwater from 15 feet below ground surface (at the groundwater table) to 30 feet below ground surface. The wells would extract a total of approximately 40 gpm of contaminated groundwater. The location and pumping rate of the wells are based on preventing off-site migration of contaminated groundwater. Calculations are provided in Appendix B.

Extracted groundwater would be treated to meet PRGs prior to reinjection. The treatment system is shown in Figure 4-2 and consists of the following unit operations/processes: equalization/chemical precipitation, clarification, filtration, and air stripping. The extracted groundwater would be transferred to an equalization tank to dampen flow and contaminant surges. The equalization tank would receive a total

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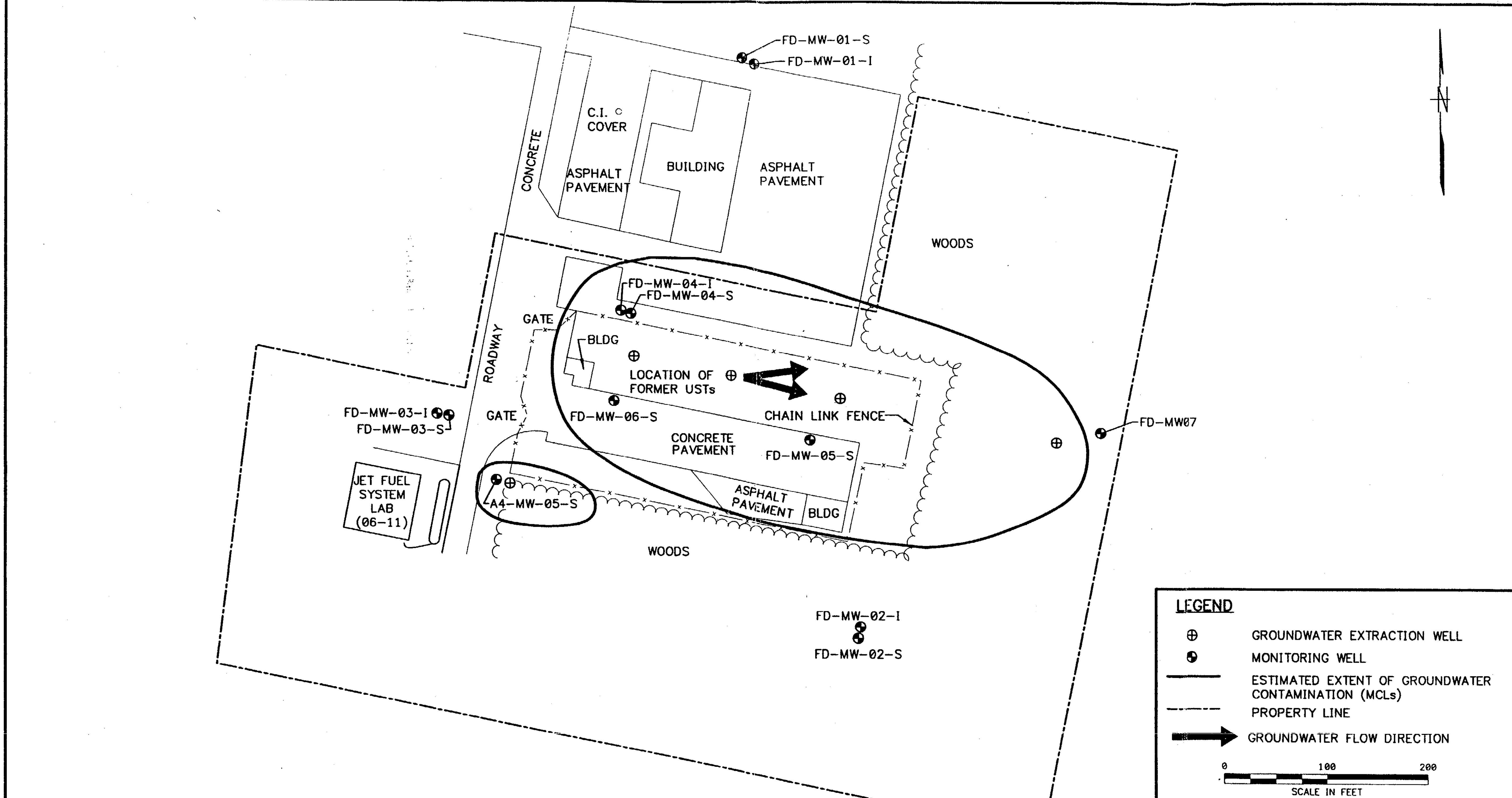

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Tetra Tech NUS, Inc.

ALTERNATIVE 3: GROUNDWATER EXTRACTION, EXTENT, AND DISCHARGE SYSTEM
SITE 7 – FUEL DEPOT AREA
CMS
NWIRP, CLAVERTON, NY

CONTRACT NO. 4570
OWNER NO. 0189
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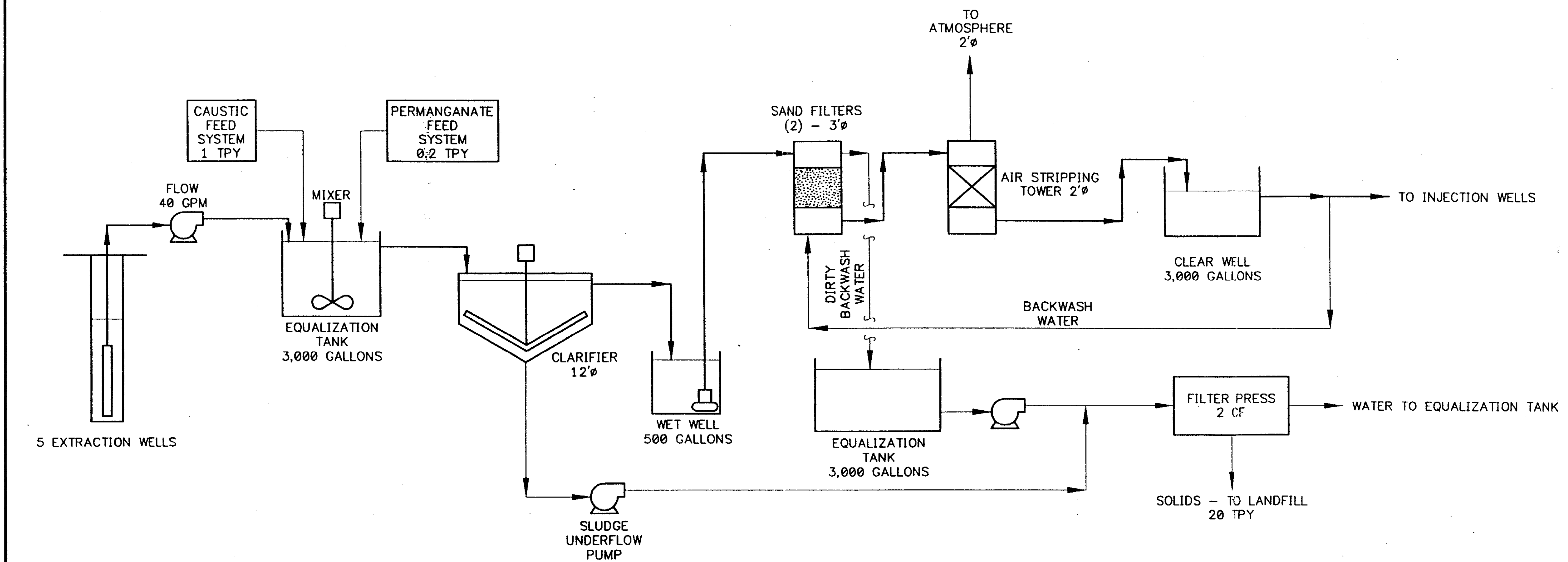

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CHECKED BY DATE	GROUNDWATER ALTERNATIVE 3 GROUNDWATER EXTRACTION, TREATMENT, AND DISCHARGE SYSTEM SITE 7 - FUEL DEPOT AREA NWIRP, CALVERTON, NY	APPROVED BY DATE	
COST/SCHED-AREA		APPROVED BY DATE	
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FORM CADD NO. TtNUS_BH.DGN - REV 0 - 1/20/98 of 40 gpm of contaminated groundwater. Caustic would be added for pH control, and permanganate would be added for iron and manganese oxidation. Precipitated metals would be removed in the clarifier. The precipitate would then be disposed off site. The clarified water would be pumped to a sand filter for suspended solids removal and then to an air stripper. An air stripping countercurrent packed tower would be used for VOC removal. Alternately, liquid phase granular activated carbon could be used. Based on the low volume of treated groundwater and low VOC concentrations, off gas treatment may not be required. After treatment, the effluent would be reinjected via an injection well placed side-gradient/down-gradient of the extraction well. System design calculations are provided in Appendix B.

Groundwater monitoring would be conducted quarterly for the first year and then annually thereafter. Groundwater analytical data would be reviewed periodically to evaluate the effectiveness of the groundwater containment system. If after 4 years of operation, groundwater clean-up is not complete or contaminant removal has become inefficient then the remedy may become institutional controls and natural attenuation (Alternative 2). The BIOSCREEN model (Appendix D) predicted that PRGs for BTEX compounds could be attained in 10 years or less by natural attenuation if the contaminant mass was reduced by 90 percent at the source.

4.3.1.4 Alternative 4: Air Sparging/Bioventing

Alternative 4 was developed as an insitu treatment alternative. This alternative consists of installing an air sparging/bioventing system and conducting short-term groundwater monitoring. A schematic of the air sparing/soil vapor extraction and treatment system is present in Figure 4-3. The air would be injected in the areas of the contaminated groundwater, see Figure 4-4.

Generally, alternatives development would consider options for source area treatment, downgradient plume containment, and a combination of both. This approach results from many sites having a relatively small area of higher-level contamination (source area) and a relatively large area of lower-level contamination (downgradient area). However, at Site 7 the downgradient area is small relative to the source area. Consequently, this alternative includes only one option consisting of groundwater treatment in the source area and downgradient area. Options for only source area treatment or only downgradient plume containment are not considered viable for this site.

In the air sparging system, approximately 340 cubic feet per minute (cfm) of air would be injected into the saturated zone. Approximately 56 air injection wells would be installed to a depth of 10 to 20 feet below the water table. Air injection causes volatilization of the VOCs in the groundwater and also supplies oxygen to enhance the biodegradation in the groundwater and capillary zone. Air sparging/bioventing are usually used in combination with soil vapor extraction. Vapor extraction in the vadose zone removes the VOCs released from the groundwater and the contaminated soils in the vadose zone, as well as

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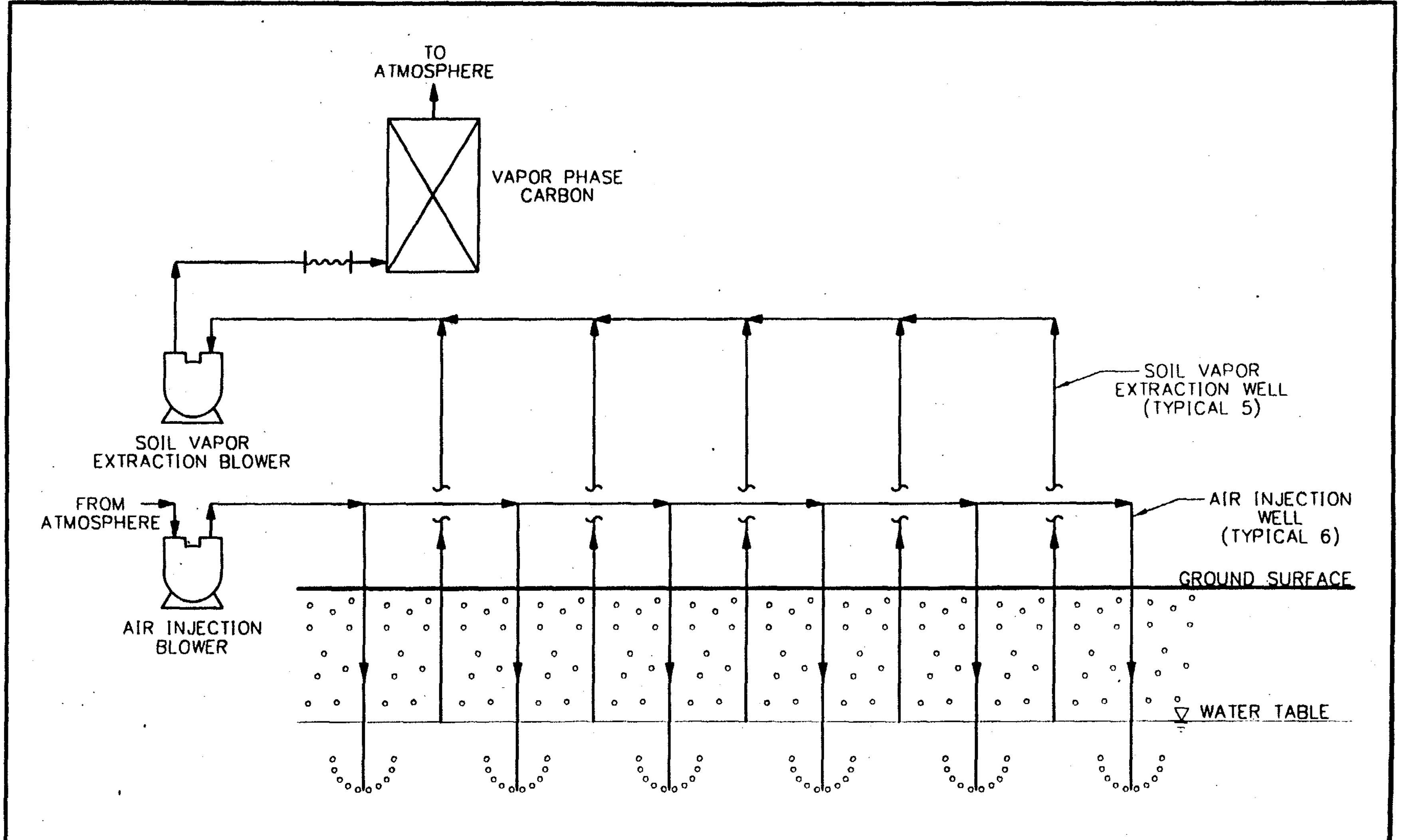

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CHECKED BY / DATE	ALTERNATIVE 4 – AIR STRIPPING/BIOVENTING SCHEMATIC SITE 7 – FUEL DEPOT AREA CMS NWIRP, CALVERTON, NY	APPROVED BY	DATE
COST/SCHED-AREA		APPROVED BY	DATE
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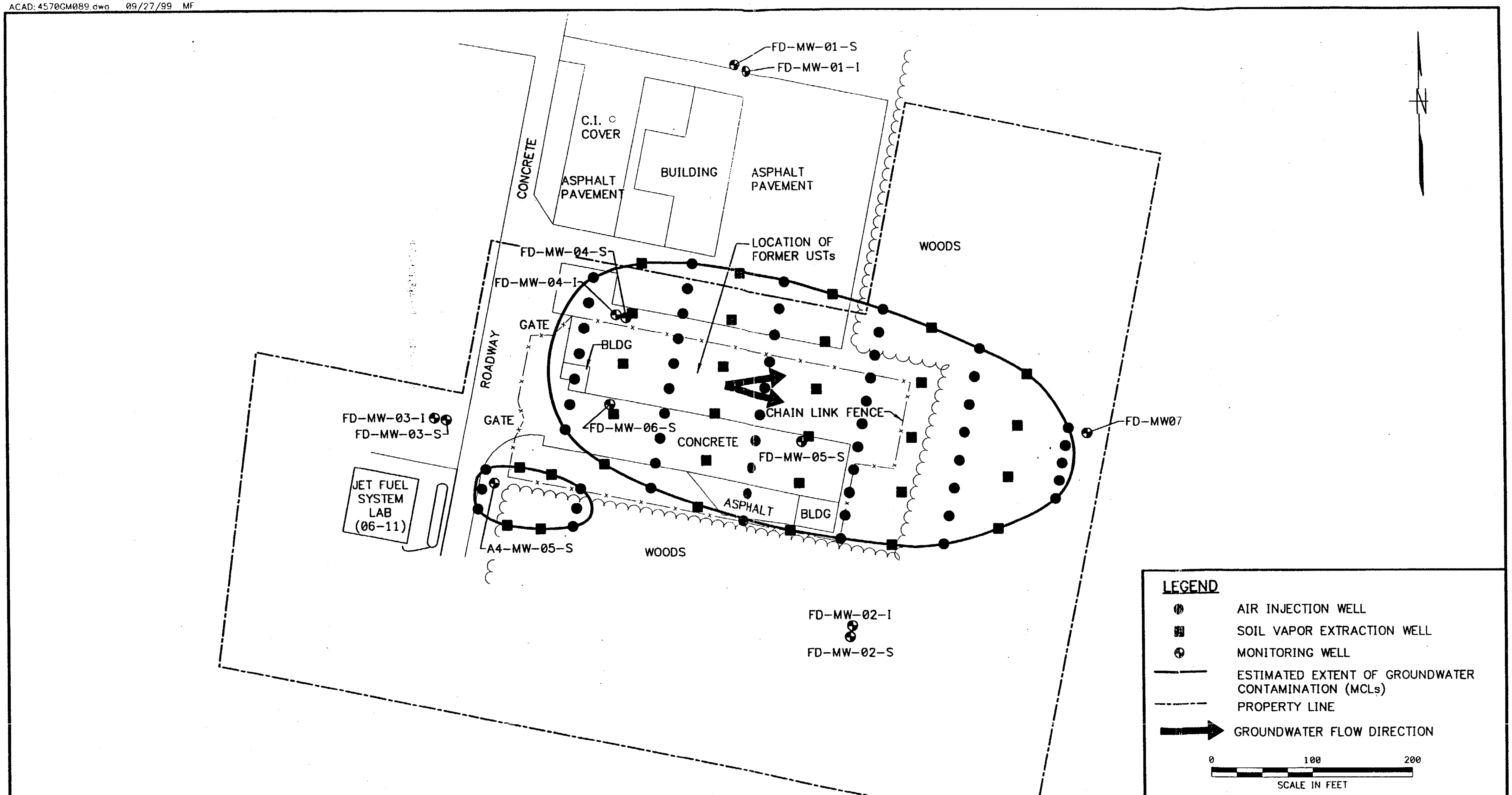

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Tetra Tech NUS, Inc.

ALTERNATIVE 4: AIR STRIPPING/BIOVENTING LAYOUT
SITE 7 – FUEL DEPOT AREA
CMS
NWIRP, CLAVERTON, NY

CONTRACT NO. 4570
OWNER NO. 0189
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 4-4
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biodegradation products (mainly carbon dioxide and water). Approximately 30 soil vapor extraction wells would be used. Horizontal spacing between wells would be designed to ensure that there are no contaminated areas left untreated while at the same time, preventing too much overlap of zones of influence of individual wells. If after 4 years of operation, groundwater cleanup is not complete or contaminant removal has become inefficient, then the remedy may become institutional controls and natural attenuation (Alternative 2). The BIOSCREEN model (Appendix D) predicted that PRGs for BTEX compounds could be attained in 10 years or less by natural attenuation if the contaminant mass was reduced at the source by 90 percent.

Approximately four new monitoring wells would be installed to monitor groundwater cleanup. Groundwater monitoring would be conducted quarterly for one year and annually thereafter. Groundwater analytical data would be reviewed to evaluate the effectiveness of the treatment system.

This alternative includes installation of a soil vapor extraction system and an air treatment system for extracted contaminants. An insitu vapor extraction system would be installed to treat soils and groundwater within an area of 120,000 square feet (2.8 acres), at a depth of approximately 15 feet below grade. The area to be addressed corresponds to the extent of contamination shown in Figure 4-4 (for groundwater). Vapor extraction utilizes an induced vacuum to pull air through the soil. The soil vapor extraction rate would be 1.1 to 1.5 times the air injection rate. The vacuum transports volatile organic contaminants out of the soil to a vapor collection system. Upon withdrawal, the contaminated air stream would be treated with a technique appropriate for the specific compounds. Treatment technologies for the effluent air stream may consist of granular activated carbon adsorption, combustion, or catalytic destruction. Gas phase granular activated carbon adsorption has been selected as the representative process option, based on anticipated air stream contaminant concentrations. Spent carbon would be regenerated off site. Calculations are presented in Appendix B.

Air monitoring, as necessary for the protection of human health and the environment, would be conducted during remedial activities on site. Air discharge permits would be obtained, as necessary.

4.3.1.5 Alternative 5: Bioremediation with Oxygen Releasing Compounds

Alternative 5 was developed as an active insitu bioremediation alternative. This alternative consists of adding Oxygen Releasing Compounds (ORC) to the groundwater and groundwater monitoring. The ORC would be installed to treat groundwater within an area of 120,000 square feet (2.8 acres). The area to be addressed corresponds to the extent of contamination shown in Figure 4-5.

Generally, alternative development would consider options for source area treatment, downgradient plume containment, and a combination of both. This approach results from many sites having a relatively

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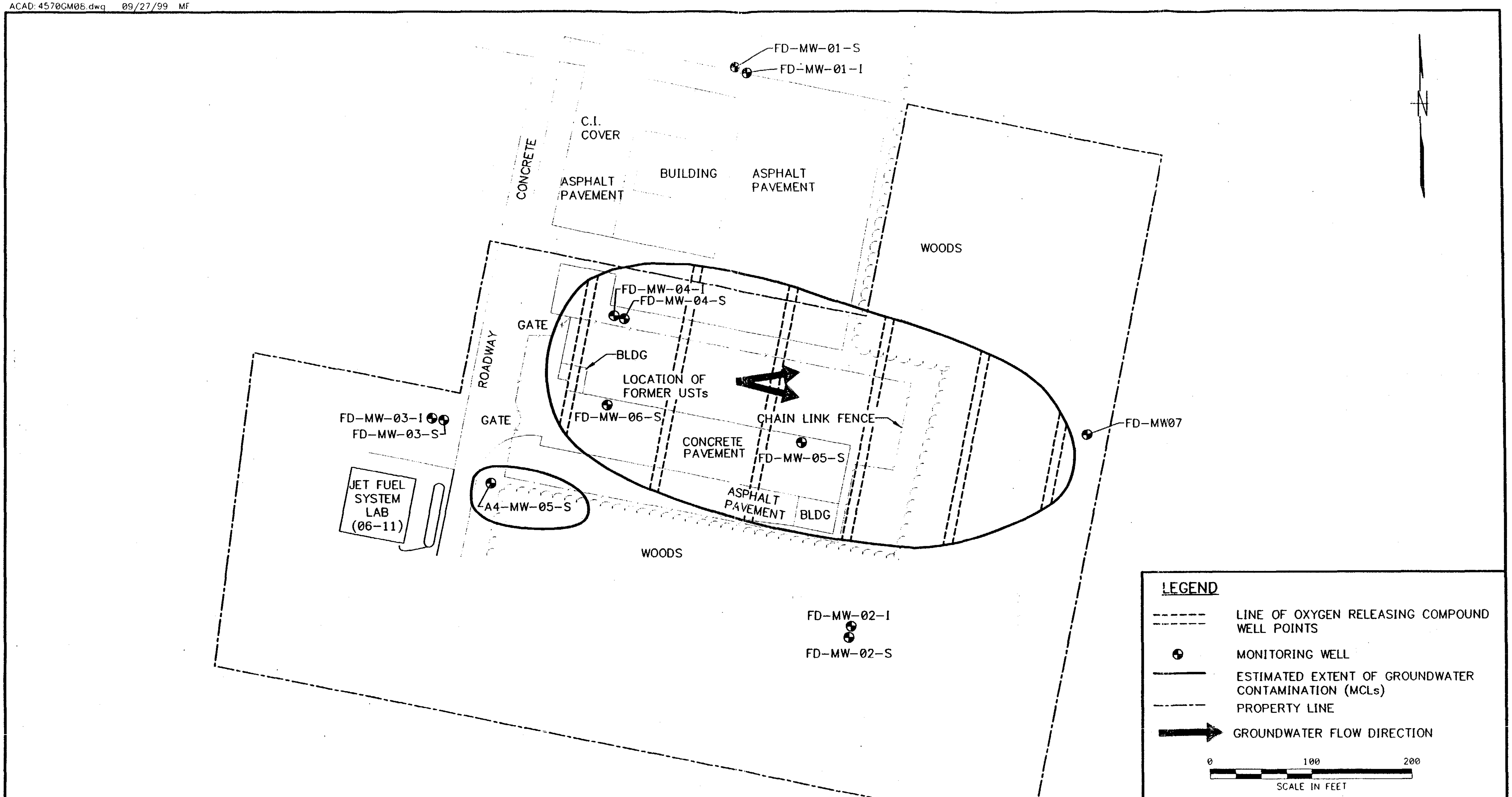

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Tetra Tech NUS, Inc.

ALTERNATIVE 5: BIOREMEDIATIN WITH OXYGEN RELEASING COMPOUNDS
SITE 7 – FUEL DEPOT AREA
CMS
NWIRP, CLAVERTON, NY

CONTRACT NO. 4570
OWNER NO. 0189
APPROVED BY DATE
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small area of higher-level contamination (source area) and a relatively large area of lower-level contamination (downgradient area). However, at Site 7 the downgradient area is small relative to the source area. Consequently, this alternative includes only one option consisting of groundwater treatment in the source area and downgradient area. Options for only source area treatment or only downgradient plume containment are not considered viable for this site.

The ORC provides oxygen to the indigenous microorganisms enhancing their ability to degrade contaminants. The addition of ORC has been demonstrated to remediate fuel contaminated groundwater. However, biodegradation of freon is not expected. The area of freon contaminated groundwater would be addressed through natural attenuation and monitoring. The ORC can be added in through drive point injection, placement of ORC socks or briquettes into existing wells, or installing new borings or trenches to place ORC into contact with the groundwater. The ORC would be added using wells installed on 5-foot centers along the lines illustrated in Figure 4-5. The ORC would be added periodically over a four year period. If after 4 years of operation, groundwater cleanup is not complete or contaminant removal has become inefficient, then the remedy may become institutional controls and natural attenuation (Alternative 2). The BIOSCREEN model (Appendix D) predicted that PRGs for BTEX compounds could be attained in 10 years or less by natural attenuation if the contaminant mass was reduced at the source by 90 percent.

Approximately four new monitoring wells would be installed. Groundwater sampling (quarterly for the first year and annually for the next 4 years) would be conducted. This sampling would be performed based on state and Federal regulations and would monitor the effectiveness of the ORC in enhancing the natural biodegradation of the petroleum contamination. Site development restrictions would be implemented into the facilities transfer documents. A reevaluation of the site would be performed every 5 years to determine if any changes to the controls would be required. Calculations are presented in Appendix B.

5.0 EVALUATION OF THE CORRECTIVE MEASURES ALTERNATIVES

5.1 EVALUATION OF CORRECTIVE MEASURES ALTERNATIVES

The corrective measures alternatives described in Section 4.3 are evaluated in this section. The alternatives are evaluated against technical, environmental, human health, and institutional criteria. Costs estimates are also provided. The format of the evaluation follows RCRA guidance; however, all of the CERCLA criteria used to evaluate remedial alternatives, except support agency and community acceptance, are addressed. Support agency and community acceptance are usually addressed after the preferred alternative has been identified.

5.2.1 Alternative 1: No Action

5.2.1.1 Protection of Human Health and the Environment

Alternative 1 is considered primarily for comparison to the other corrective measures. This alternative is somewhat protective of human health. Although contaminants would remain in the groundwater for extended periods of time, they would slowly biodegrade and attenuate. Since there are no current users of groundwater and the existing soil contamination is at a depth of 12 to 16 feet below ground surface, there are no current environmental risks to human health. Under future potential scenarios, the people could be directly exposed to the deep contaminated soils and groundwater wells could be installed and the groundwater used for potable purposes. Under these scenarios, Alternative 1 would not be protective of human health.

Based on the type of contamination (fuels and trace solvents), depth of contamination (12 to 16 feet below ground surface), the distance from this site to a surface water body (Peconic River), and natural attenuation factors, contamination from this site would not be expected to pose a significant potential risk to ecological receptors.

5.2.1.2 Media Clean-up Standards

Alternative 1 would not comply with groundwater- and drinking water-based criteria at the site. Groundwater leaving the site is currently in compliance with these requirements. However, future migration off site would not be known.

5.2.1.3 Source Control

Alternative 1 involves no additional source control as no action would be performed at Site 7. The source of the contamination, underground storage tanks and fuel transfer activities at the site, has been eliminated.

5.2.1.4 Waste Management Standards

There are no actions to be implemented for Alternative 1 and, therefore, no waste would be generated.

5.2.1.5 Other Factors

Long-term Reliability and Effectiveness

The future potential threat to human health would remain since there would be no access controls or removal or treatment of the contaminants. Except any decrease through natural attenuation, organic contaminants would remain in the groundwater at Site 7 at levels greater than the media clean-up standards and may migrate off site. Since monitoring would not be conducted, the long-term reliability and effectiveness of this alternative would not be known.

Reduction in Toxicity, Mobility, and Volume

Alternative 1 involves no reduction in toxicity, mobility, or volume of the contaminants at Site 7 other than that which would result from natural dispersion, dilution, or other attenuating factors. There are no treatment processes employed; therefore, no materials are treated or destroyed.

Short-term Effectiveness

Alternative 1 involves no action and, therefore, would not pose any risks to on-site workers during implementation. No environmental impacts would be expected. This alternative would not achieve any of the CAOs.

Implementability

Since no actions would occur, this alternative is readily implementable. The technical feasibility criteria, including constructability, operability, and reliability, are not applicable.

Cost Analysis

There are no costs associated with the No Action alternative.

5.2.2 Alternative 2 - Institutional Controls and Natural Attenuation

5.2.2.1 Protection of Human Health and the Environment

Alternative 2 would be protective of human health by limiting site access and land use within and around Site 7. Also, contaminant concentrations at the site and potential for migration would be monitored. Existing contaminants at Site 7 do not pose current or potential future risks to ecological receptors.

This alternative involves limiting site access and use. Since the surface soils at the site do not represent an environmental risk, fencing is not required to limit non-intrusive activities. Restrictions would be placed to inform future workers of the contaminants in the deep soils and groundwater and to prohibit the use of site groundwater for potable water.

Sampling of groundwater is included to monitor potential groundwater contamination migration and determine the effectiveness of natural attenuation. Periodic review of the site would be necessary to ensure that contaminant concentrations were not increasing or migrating off site and to determine whether additional measures would be necessary to protect human health and the environment.

5.2.2.2 Media Clean-up Standards

In the short term, Alternative 2 would not comply with the media clean-up standards for groundwater (drinking water criteria). Since the contaminants present are biodegradable and/or subject to other natural attenuation processes, groundwater would ultimately achieve the media clean-up standards. However, the length of time required and the potential for contamination to spread to new area is uncertain. The BIOSCREEN modeling predicts that it could take over 100 years to attain PRGs for some BTEX compounds. Institutional controls would be used to prevent exposure to media with contaminant concentrations above clean-up standards.

5.2.2.3 Source Control

Alternative 2 does not involve additional source control, as only institutional controls would be implemented. The source of the contamination, underground storage tanks and fuel transfer activities at the site, has been eliminated.

5.2.2.4 Waste Management Standards

Alternative 2 involves no removal of contaminated groundwater; therefore, this alternative would not generate any wastes.

5.2.2.5 Other Factors

Long-term Reliability and Effectiveness

Although no removal would occur in Alternative 2, the potential threats to human health would be minimized. This limited action alternative would use institutional controls such as the NWIRP Calverton transfer documents to limit future use of the site.

Institutional controls have uncertain long-term effectiveness. The protection of the potential future construction worker would depend on effective administration and management of the transfer documents. A reevaluation of the site would be performed every 5 years to determine whether any changes to the controls would be required.

Also, since there is the possibility that contaminated groundwater would migrate faster than it is attenuating, new areas could be impacted. Monitoring would be used to address this concern and to evaluate the effectiveness of natural attenuation. In the event that contaminant concentrations are increasing in the downgradient areas and moving off site than additional actions may be required.

Reduction in Toxicity, Mobility, and Volume

Alternative 2 would not result in reduction in toxicity, mobility, or volume through treatment of the hazardous substances at Site 7 other than that which would result from natural dispersion, dilution, or other attenuating factors.

Short-term Effectiveness

Alternative 2 would involve groundwater monitoring, administration of institutional controls, and potential restriction of residential land use. The short-term risks associated with these limited remedial activities would be minimal. Sampling personnel would wear the required personal protective equipment (PPE) and receive the appropriate health and safety training. There would be no potential risk to the community or environmental impacts upon the implementation of institutional controls.

Implementability

Alternative 2 is expected to be readily implementable since Site 7 is located within a controlled facility, where rules and local ordinances can be strictly enforced. Restrictions for future property use would involve legal assistance and regulatory approval. Provisions in the NWIRP Calverton transfer documents would be defined and enforced relatively easily because the site is located within a Federal facility. Sampling and analysis are also readily implemented.

Cost Analysis

The following costs are estimated for Alternative 2.

Capital Costs:	\$70,300
O&M Costs:	\$0
Monitoring Costs:	\$220,000/yr (Year 1)
	\$79,400/yr (Year 2 through 30)
30 Year Present-Worth:	\$1,230,000

Detailed cost estimates are included in Appendix C.

5.2.3 Alternative 3: Groundwater Extraction, Treatment, and Discharge

Plume remediation would be used to accelerate the cleanup of groundwater and ensure that contaminated groundwater is not migrating off site. In general, five extraction wells would be used. One groundwater extraction well located near the downgradient edge of the plume would be used to contain contaminated groundwater from migrating off site. Three extraction wells at the hot spot areas would extract the highly contaminated groundwater. One extraction well would be placed in the area contaminated only with freon. Extracted groundwater would be treated prior to reinjection. In the treatment system, metals (as needed) and organic contaminants would be removed from groundwater. Concentrated contaminants would be transported off site for disposal. If required, spent granular activated carbon would be regenerated off site. Groundwater reinjection wells would be placed to enhance contaminant removal. Restrictions on groundwater use would be necessary to ensure that contaminated groundwater would not be used for drinking during the remediation phase.

Groundwater monitoring would be conducted to determine the effectiveness of the containment system and to determine whether contaminant concentrations were decreasing. Groundwater extraction and treatment would be conducted as long as groundwater has contaminant concentrations above PRGs. Only limited soil contamination has been detected at the groundwater interface. Natural flushing of contaminants into the groundwater, coupling with biodegradation of the contaminants in the soils, would ultimately address the contaminants in the soils. However, since flushing of contaminants from the soils is a slow process, even low levels of contaminants in the soils could significantly extend the time required to achieve the groundwater PRGs.

Groundwater extraction and treatment would be readily implemented. Equipment for groundwater extraction and injection well construction would be readily available and installed. Permits may be required for general construction as well as for water and air discharges. The components of the groundwater treatment system are common and would not require special equipment.

O&M requirements for this system would be extensive and consist of the following:

- Extraction/injection wells
- Oxidation/precipitation facilities
- Filtration units
- Air stripping facilities and/or carbon adsorption units

This alternative would take 1 to 3 years to implement. Groundwater extraction and monitoring would be conducted for 30 plus years.

5.2.3.1 Protection of Human Health and the Environment

Alternative 3 would be protective of human health and the environment by containing and treating contaminated groundwater at Site 7. During implementation, site contaminants would also be treated in situ via natural biodegradation and other attenuation factors. The extracted groundwater would be treated using air stripping prior to reinjection. Long-term groundwater monitoring would be conducted to determine the effectiveness of this alternative. Restrictions on groundwater use would be implemented to prevent exposure to contaminated groundwater during the remediation process.

After the VOC portion of the remediation is complete, some SVOC contaminants would remain in the soils near the water table. These SVOCs are primarily PAHs, which are naturally biodegradable, but over relatively long periods of time. The PAHs are at depth near the water table and only represent potential risk to human receptors under a long-term direct contact scenario.

5.2.3.2 Media Clean-up Standards

In the short term, Alternative 3 would not comply with the media clean-up standards for groundwater. Contaminated groundwater would be extracted to prevent off-site migration of contaminated groundwater and treated prior to reinjection. Through groundwater extraction and treatment and natural biodegradation, groundwater would ultimately achieve the media clean-up standards. However, the length of time required is uncertain. Institutional controls would be used to prevent exposure to media with contaminant concentrations above clean-up standards.

Some SVOC contaminants would remain in the soils near the water table. These SVOCs are primarily PAHs, which are naturally biodegradable, but over relatively long periods of time. The PAHs are at depth near the water table and only represent potential risk to human receptors under a long term direct contact scenario.

5.2.3.3 Source Control

The source of the contamination, underground storage tanks and fuel transfer activities at the site, has been eliminated. This alternative would extract and treat contaminated groundwater and reduce the potential for further spread of contaminated groundwater.

5.2.3.4 Waste Management Standards

Treatment residues generated during the process include metal sludges and drilling related soils. The off gas from the air stripper would be treated if required. Sludges and/or possibly granular activated carbon residuals would be loaded into suitable containers and transferred to appropriate off site treatment/disposal facilities.

Equipment used on site may come in contact with potentially hazardous chemicals (contaminated groundwater). The equipment would be decontaminated prior to leaving site. Decontamination water would be collected, sampled, and if required, properly treated and disposed.

5.2.3.5 Other Factors

Long-term Reliability and Effectiveness

Alternative 3 would provide for good long-term effectiveness since groundwater extraction can be very effective at containing contaminated groundwater. Long-term groundwater monitoring would be conducted to determine the effectiveness of this alternative.

Groundwater extraction alternatives can result in residual contaminant concentrations in groundwater leveling off at relatively low concentrations but that are still greater than the PRGs. If this occurs, Alternative 3 includes a provision for shutting down and switching to monitored natural attenuation (Alternative 2).

The effectiveness of this alternative would be monitored through confirmation sampling. The effectiveness of the treatment residuals treatment would be confirmed by sampling and testing before the material is shipped off site for treatment/disposal. During installation and monitoring, PPE would be used and monitoring conducted to ensure that exposure of the workers to potentially contaminated material is minimized.

Reduction in Toxicity, Mobility, and Volume

Alternative 3 would utilize treatment of the contaminated groundwater to reduce the toxicity, mobility, and volume of the waste. The toxicity of the VOCs would be eliminated through photochemical degradation in the atmosphere, thermal destruction during regeneration of activated carbon, if required, and/or natural insitu biodegradation. The treatment residuals would be transported off site to a permitted treatment/disposal facility.

Short-term Effectiveness

Based on the relatively low concentration of contaminants at Site 7, the short-term effectiveness for Alternative 3 would be moderate. Site workers would receive the appropriate health and safety training and would wear the required PPE during implementation. If air stripping is used to treat the groundwater, the off gas would be treated as required to comply with state requirements. One potential risk to the community would be during transport of the contaminated materials off site for treatment and disposal. Since the residues to be collected are not anticipated to be hazardous, this risk is anticipated to be minimal.

Implementability

Alternative 3 is considered to be implementable. Drilling contractors and equipment are readily available for extraction well installation. The remedial technologies are well proven and established in the remediation and construction industries. Additional extraction wells, if indicated by confirmation sampling, would require supplemental drilling. Treatment/disposal facilities are available. Sampling and analysis are also readily implementable.

Cost Analysis

The following costs are estimated for Alternative 3.

Capital Costs:	$2,240,000
O&M Costs:	$150,000 (30 year)
Monitoring Costs:	$116,000/yr (Year 1)
	$55,900/yr (Year 2 through 30)
30 Year Present-Worth:	$4,900,000

Detailed cost estimates are provided in Appendix C.

5.2.4 Alternative 4: Air Sparging/Bioventing

Air sparging would be used in combination with soil vapor extraction to remove volatile contaminants from the groundwater. Soil vapor extraction would then remove the volatilized contaminants as they move through the unsaturated soil. The addition of air also enhances biological activity in groundwater and soil.

Short-term groundwater monitoring would be conducted to determine the effectiveness of the treatment system and to determine whether contaminant concentrations had decreased to below PRGs. Additional action for groundwater and in particular SVOC contaminated groundwater may be necessary if contaminant concentrations remain above PRGs. In combination with soil vapor extraction, air sparging/bioventing may address most of the volatile and biodegradable contaminants.

Air sparging/bioventing could only be implemented in combination with soil vapor extraction. Air sparging/bioventing along with vapor extraction would be readily implementable. The equipment used to construct and operate this technology are relatively common. Air sparging/bioventing would be operated for the same length of time the vapor extraction system would be operated (approximately 2 to 4 years).

5.2.4.1 Protection of Human Health and the Environment

Alternative 4 would be protective of human health and the environment by treating the organic contamination in place. Sparging/bioventing would volatilize/degrade the majority of contaminants in the groundwater. The volatilized contaminants would be collected by the vapor extraction system and vapor phase granular activated carbon would be used as needed to comply with air discharge quality standards.

Some SVOC contaminants would remain in the soils near the water table. These SVOCs are primarily PAHs, which are naturally biodegradable, but over relatively long periods of time. The PAHs are at depth near the water table and only represent potential risk to human receptors under a long term direct contact scenario.

Short-term groundwater monitoring would be conducted to determine the effectiveness of the alternative and whether additional action for groundwater would be necessary. Restrictions would be necessary until groundwater concentrations were below PRGs to ensure contaminated groundwater would not be used for drinking.

5.2.4.2 Media Clean-up Standards

Alternative 4 would comply with the media clean-up standards for groundwater. Air sparging/bioventing would volatilize/degrade the majority of contaminants in the upper portion of groundwater. The volatilized contaminants would be collected and treated by the vapor extraction system. It would include long-term monitoring to determine whether contaminant concentrations were decreasing. Institutional controls would be used to prevent exposure to media with contaminant concentrations above clean-up standards.

5.2.4.3 Source Control

The source of the contamination, underground storage tanks and fuel transfer activities at the site, has been eliminated. This alternative would use air sparging/bioventing of the groundwater that is in excess of PRGs. The volatilized contaminants would be collected and treated by the vapor extraction system. This action would reduce the potential for further spread of contaminated groundwater that could pose a threat to human health.

5.2.4.4 Waste Management Standards

During implementation of Alternative 4, waste management practices would be used to avoid spreading contamination. Contaminated groundwater would be air sparged, and the air with volatilized contaminants would be collected and treated as needed prior to release to the atmosphere. The treatment residuals would be loaded into suitable containers for transportation to an off-site treatment/disposal facility. If treatment were required, the treatment residuals would be transported to an appropriate off-site facility to convert the hazardous contaminants to nonhazardous or less toxic compounds.

Equipment used on site may come in contact with potentially hazardous chemicals (contaminated groundwater). The equipment would be decontaminated prior to leaving site. Decontamination water would be collected, sampled, and if required, properly treated and disposed.

5.2.4.5 Other Factors

Long-term Reliability and Effectiveness

Alternative 4 would provide good long-term effectiveness since air sparging/bioventing can be very effective at treating VOC and SVOC contaminated groundwater. Long-term groundwater monitoring would be conducted to determine the effectiveness of this alternative.

Insitu groundwater treatment alternatives can result in residual contaminant concentrations in groundwater leveling off at relatively low concentrations, but that are still greater than PRGs. If this occurs, this alternative includes a provision for shutting down the air injection and vapor extraction wells and switching to monitored natural attenuation (Alternative 2).

The effectiveness of this alternative would be monitored through the groundwater monitoring.

Reduction in Toxicity, Mobility, and Volume

Alternative 4 would utilize treatment of the contaminated air and in-situ bioremediation to reduce the toxicity, mobility, and volume of contamination. The treatment residuals would be transported off-site to a permitted TSD facility. The treatment process would convert hazardous contaminants to nonhazardous or less toxic compounds that are more stable, less mobile, and/or inert.

Short-term Effectiveness

Based on the relatively low concentration of contaminants, the short-term effectiveness for Alternative 4 would be moderate. Site workers would receive the appropriate health and safety training and would wear the required PPE during implementation. The only potential risk to the community would be during transport of the contaminated materials off site for treatment and disposal. There are no potential environmental impacts from the implementation of this alternative. The potential human exposure to contaminated groundwater would be reduced through implementation of this alternative.

Implementability

Alternative 4 is considered to be implementable. Drilling contractors and equipment are readily available for injection and extraction well installation. The remedial technologies are well proven and established in the remediation and construction industries. Additional extraction wells, if indicated by confirmation sampling, would require supplemental drilling. TSD facilities are available for treatment of treatment residuals contaminated with organics. Sampling and analysis are also readily implementable.

Cost Analysis

The following costs are estimated for Alternative 4.

Capital Costs:	$700,000
O&M Costs:	$59,400 (4 years)
Monitoring Costs:	$78/000/yr (Year 1)
	$42,280/yr (Years 2 through 30)
30 Year Present-Worth:	$1,570,000

Detailed cost estimates are provided in Appendix C.

5.2.5 Alternative 5: Bioremediation with Oxygen Releasing Compounds

Alternative 5 was developed as an active in-situ bioremediation alternative to avoid extracting contaminated groundwater or air. This alternative consists of adding Oxygen Releasing Compounds (ORC) to the groundwater and groundwater monitoring. The ORC would be installed to treat groundwater within an area of 120,000 square feet (2.8 acres).

The ORC provides oxygen to the indigenous microorganisms enhancing their ability to degrade contaminants. The addition of ORC to petroleum contaminated ground water has been demonstrated to fully remediate groundwater contamination. The ORC can be added in several ways, through drive point injection, placement of ORC socks or briquettes into existing wells, and installing new borings or trenches to place ORC into contact with the groundwater. For costing purposes, new wells are budgeted. Also, the quantity of ORC is based on the total estimated petroleum hydrocarbons at the site, and the ORC cost is considered as a capital cost element.

Groundwater analytical data would be reviewed to evaluate the effectiveness of the treatment system. This alternative would monitor the assisted natural attenuation of groundwater contaminants. Groundwater sampling (quarterly for the first year and annually for the next four years) would be conducted. This sampling would be performed based on state and Federal regulations and would monitor the effectiveness of the ORC in enhancing the natural biodegradation of the petroleum contamination. Site development restrictions would be implemented into the facility transfer document. Deed restrictions on groundwater use would be necessary until groundwater was remediated to below PRGs. An evaluation of the site would be performed after 5 years to determine if the controls would be required.

Implementation of this alternative would not pose any safety risk to nearby communities, the environment, or on-site workers. Remedial activities would not cause fire or explosion. On-site workers would be protected from exposure to hazardous substances through appropriate use of PPE. OSHA standards would be followed during all remedial activities.

5.2.5.1 Protection of Human Health and the Environment

Alternative 5 would be protective of human health and the environment by treating the groundwater at Site 7. ORC assisted bioremediation would degrade the majority of contaminants in the upper portion of groundwater. Short-term groundwater monitoring would be conducted to determine the effectiveness of the alternative and whether additional action for groundwater would be necessary. Restrictions would be necessary until groundwater concentrations were below PRGs to ensure contaminated groundwater would not be used for drinking.

5.2.5.2 Media Clean-up Standards

Alternative 5 would eventually comply with most of the media clean-up standards for groundwater. Freon would not be addressed by ORC directly. Freon was detected in a separate plume in the southwestern portion of the site, and in the main plume that contains mainly BTEX compounds. Other attenuation factors would ultimately reduce the freon to meet the criteria. ORC assisted bioremediation would degrade the majority of contaminants in the upper portion of groundwater. It would include monitoring to determine whether contaminant concentrations were decreasing. Institutional controls would be used to prevent exposure to media with contaminant concentrations above clean-up standards.

5.2.5.3 Source Control

The source of the contamination, underground storage tanks and fuel transfer activities at the site, has been eliminated. This alternative would use ORC assisted bioremediation of the groundwater that is contaminated in excess of PRGs. This action would reduce the potential for further spread of contaminated groundwater that could pose a threat to human health.

5.2.5.4 Waste Management Standards

During implementation of Alternative 5, waste management practices would be used to avoid spreading contamination. Contaminated groundwater would be treated with ORC assisted bioremediation, which should reduce contaminant concentrations to below PRGs prior to completion. There should be no treatment residues associated with this alternative.

Equipment used on site may come in contact with potentially hazardous chemicals (contaminated groundwater). The equipment would be decontaminated prior to leaving site. Decontamination water would be collected, sampled, and if required, properly treated and disposed.

5.3.5.5 Other Factors

Long-term Reliability and Effectiveness

Alternative 5 would provide good long-term effectiveness since ORC assisted bioremediation can be very effective at treating VOC contaminated groundwater. Long-term groundwater monitoring would be conducted to determine the effectiveness of this alternative.

Insitu groundwater treatment alternatives can result in residual contaminant concentrations in groundwater leveling off at relatively low concentrations but that are still greater than PRGs. If this occurs, Alternative 5 includes a provision for switching to monitored natural attenuation (Alternative 2).

The effectiveness of this alternative would be monitored through groundwater monitoring. During installation and monitoring, PPE would be used and monitoring conducted to ensure that exposure of the workers to potentially contaminated material is minimized.

Reduction in Toxicity, Mobility, and Volume

Alternative 5 would utilize treatment of the contaminated groundwater by insitu bioremediation to reduce the toxicity, mobility, and volume of the waste. The treatment process would convert hazardous contaminants to nonhazardous or less toxic compounds that are more stable, less mobile, and/or inert.

Short-term Effectiveness

Based on the relatively low concentration of contaminants, the short-term effectiveness for Alternative 5 would be moderate. Site workers would receive the appropriate health and safety training and would wear the required PPE during implementation. There are no potential environmental impacts from the implementation of this alternative. The potential human exposure to contaminated groundwater would be reduced through implementation of this alternative.

Implementability

Alternative 5 is considered to be implementable. It involves using an innovative technology, the ORC. Contractors and equipment are available for injection/installation of the ORC and additional well installation. The remedial technology has been the subject of studies that have established it as a viable remediation for petroleum contaminated groundwater. Sampling and analysis are also readily implementable.

Cost Analysis

The following costs are estimated for Alternative 5

Capital Costs:	$3,800,000
O&M Costs:	$0/yr
Monitoring Costs:	$80,160/yr (Year 1)
	$55,000/yr (Years 2 through 30)
30 year Present-Worth:	$4,500,000

Detailed cost estimates are provided in Appendix C.

5.3 JUSTIFICATION

5.3.1 Technical

Alternatives 1 and 2 would require long-term maintenance and restrictions in the transfer documents. Alternatives 3, 4, and 5 may require long-term action; however, because treatment would be used to address the majority of the contamination, restrictions would be less. Alternatives 3, 4, and 5 would actively treat contaminants in the groundwater. Alternative 4 would remove the majority of the contaminants in the quickest time frame (approximately 2 to 5 years). However, SVOC contamination may not be addressed in this time period. Alternative 5 should be able to remediate the site in 3 to 10 years. Alternative 3 should capture all of the groundwater contamination. However, cleanup may last greater than 30 years. All the alternatives but Alternative 1 include operation and maintenance (O&M) and/or sampling requirements; however, Alternative 4 may be for the shortest period of time. All five alternatives are implementable.

5.3.2 Human Health

Alternatives 3, 4, and 5 would provide treatment of groundwater. Alternative 3 would prevent migration of contaminated groundwater off site. If contaminants above PRGs remain in groundwater under Alternatives 1, 2, 4, and 5 then contaminated groundwater could migrate off site. The potential for off-site migration is greater under Alternatives 1 and 2 than under Alternatives 4 and 5.

5.3.3 Environmental

None of the alternatives would adversely affect the environment. Alternative 3 would prevent migration of contaminated groundwater off site. If contaminants above PRGs remain in groundwater under Alternatives 1, 2, 4, and 5 then contaminated groundwater could migrate off site. The potential for off-site migration is greater under Alternatives 1 and 2 than under Alternatives 4 and 5.

5.3.4 Cost Estimates

The estimated capital, O&M, and net present worth costs are presented in Table 5-1.

5.4 RECOMMENDED CORRECTIVE MEASURE

The recommended alternative for this site is Alternative 4 - Air Sparging/Bioventing. In the event that the air sparging/bioventing treatment efficiency levels off (2 to 5 years), then the remediation would switch to Alternative 2 - Institutional Controls and Natural Attenuation.

TABLE 5-1

SUMMARY OF CAPITAL, O&M, AND MONITORING COSTS ESTIMATES
SITE 7 - NWIRP CALVERTON, NEW YORK

Alternative	Capital ($)	O&M ($/yr)	Monitoring Year 1 ($)	Monitoring Years 2 to 30 ($/Yr)	30-Year Net Present Worth ($)
1 - No Action	0	0	0	0	0
2 - Institutional Control and Natural Attenuation	70,300	0	220,000	79,400	1,230,000
3 - Groundwater Extraction, Treatment, and Discharge	2,240,000	150,000 for 30 years	116,000	55,900	4,900,000
4 - Air Sparging/Bioventing	700,000	59,000 for 4 years	78,400	42,280	1,570,000
5 - ORC	3,800,000	0	80,000	55,000	4,500,000

5 year review costs of approximately $20,000 each are not included.

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APPENDIX A

SOIL AND GROUNDWATER VOLUME CALCULATIONS

Appendix A - Soil and Groundwater Volume Calculations

A-1 Estimate areal extent and volume of contaminated soils.

The PRGs for soils are the NYS TAGM (4046). Positive detections and TAGMs are discussed below.

The only chemicals detected at concentrations greater than TAGM 4046 are PAHs and xylene.

Samples were collected at depth of greater than 14 feet bgs. During tank removal operations, most petroleum contaminated soils were observed at the water. Some petroleum contamination was noted near some of the tank fill tubes and was excavated and disposed off site during tank removal.

The soil TAGMs for PAHs are based on direct human contact/injestion of soils. The presence of 14 feet of clean soil above the contaminated soils would effectively preclude extensive human contact.

The TAGM for xylene is based on groundwater contamination.

Based on the data and observations of free product, the estimated maximum areal extent of the contaminated soils is		20,000 SF
	or	0.46 acres

The estimated thickness of the contamination is 3 feet (14 to 17 feet bgs) which corresponds to the smear zone of floating product on the water table. The corresponding volume is		2222 CY
	Say	2200 CY

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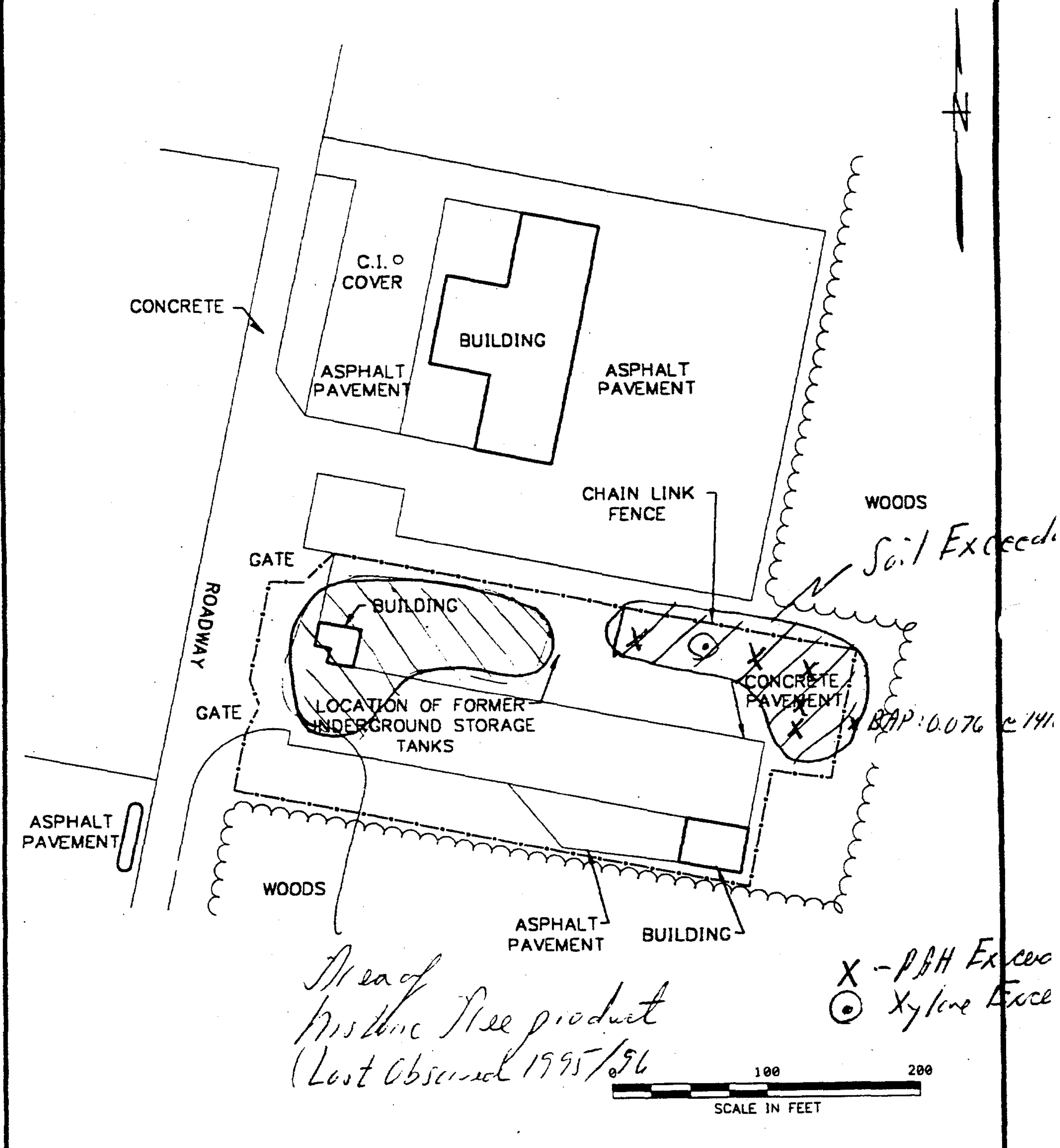

DRAWN BY HJP DATE 8/4/99	Tetra Tech NUS, Inc.	CONTRACT NO. 4570	OWNER NO. 0189
CHECKED BY DATE	SITE LAYOUT MAP SITE 7 - FUEL DEPOT AREA NWIRP, CALVERTON, NY	APPROVED BY	DATE
COST/SCHED-AREA		APPROVED BY	DATE
SCALE AS NOTED		DRAWING NO. FIGURE A2-1	REV. 0

FORM CADD NO. TtNUS_AV.DWG - REV 0 - 1/22/98

TABLE 7-12

DATA EVALUATION - SOIL SAMPLES
SITE 7 - FUEL DEPOT AREA
NWIRP CALVERTON, NEW YORK

Chemical	Frequency of Detection	Range of Positive Results (mg/Kg)	Data Distribution Characteristic	Representative Concentrations (mg/Kg)	TAG [illegible]
Di-n-butylphthalate	4/9	0.026	Lognormal	0.276	50
Fluoranthene	2/9	0.220 - 0.310	Undefined	0.265	50
Pyrene	2/9	0.260 - 0.340	Undefined	0.300	50
Benzo(a)anthracene	2/9	0.094 - 0.130	Undefined	0.112	0.224
Chrysene	2/9	0.082 - 0.110	Undefined	0.096	0.4
Di-n-octylphthalate	1/9	0.030	Undefined	0.030	50
Benzo(b)fluoranthene	2/9	0.081 - 0.089	Undefined	0.085	1.1
Benzo(k)fluoranthene	2/9	0.057 - 0.084	Undefined	0.071	1.1
Benzo(a)pyrene	2/9	0.057 - 0.076	Undefined	0.067	0.061
Indeno(1,2,3-cd)pyrene	1/9	0.036	Undefined	0.036	3.2

Phase 1 - RFI - 1995

Parameter	NYSDEC TAGM 4046 (1% TOC) Criteria (mg/kg)	Tank 06-12-13 Soil Result (mg/kg)		
		Sample 1	Sample 2	Sample 3
Methylene chloride	0.1			0.0055
Acenaphthene	50	0.087J		
Benzo (a) anthracene	0.224	0.45		
Benzo (a) pryrene	0.061	0.45		
Benzo (b) fluoranthene	1.1	0.53		
Benzo (g,h,i) perylene	50	0.33J		
Benzo (k) fluoranthene	1.1	0.23J		
Chrysene	0.4	0.53		
Fluoranthene	50	1.0		
Indeno(1,2,3-CD) pyrene	3.2	0.31J		
Phenanthrene	50	0.32J		
Pyrene	50	0.88		

Parameter	NYSDEC TAGM 4046 (1% TOC) Criteria (mg/kg)	Tank 06-12-14 Soil Result (mg/kg)		
		Sample 1	Sample 2	Sample 3
Toluene	1.5	0.013		
Xylene	1.2	0.0083J		

Parameter	NYSDEC TAGM 4046 (1% TOC) Criteria (mg/kg)	Tank 06-12-15 Soil Result (mg/kg)		
		Sample 1	Sample 2	Sample 3
Toluene	1.5	0.11		
Ethylbenzene	5.5	0.59		
Xylene	1.2	2.6E		
2-methylnaphthalene	36.4	2.6		

E - Encore samplers were used to collect media. Xylene result exceeded equipment calibration range. As a result, results may be biased low.

NA - Not available

Post Closure Report, 1998

TABLE 4-3

SUBSURFACE SOIL ANALYTICAL RESULTS
50,000 GALLON FUEL TANKS
SITE 7 - FUEL DEPOT AREA
PHASE 2 RFI
NWIRP CALVERTON, NEW YORK

Chemical	TAGM 4046	Analytical Result (ug/kg)							
		FDT1SB01	FDT1SB02	T1-DUP-7	FDT1SB03	FDT2SB01	FDT2SB02	FDT2SB03	FDT2SB04
Toluene	1500					4J			
Anthracene	50000		610J	1200J	310J				
Benzo(a)anthracene	224	3,300	1,500	2,300	2,000	100J			
Benzo(b)fluoranthene	1100	1,700	760	1,100	1,200J	430			
Benzo(k)fluoranthene	1100	1,700	700J	1,200J	920J	250J			
Benzo(ghi)perylene	50000	1,100J	560J	830J	720J	190J			360
Benzo(a)pyrene	61	2,200	990	1,500J	1,400J	500			
Chrysene	400	3,100	1,600	2,600	2,100	410			
Dibenz(a,h)anthracene	14			240J					
Fluorene	50000		180J	550J					
Fluoranthene	50000	7,400	4,200	6,900	4,600	130J			
Indeno(1,2,3-cd)pyrene	3200	1,400J	650J	980J	860J	250J			380
Phenanthrene	50000		870J	2,100J	250J				
Pyrene	50000	10,000	3,400	5,300	4,900	120J			
Carbazole	-		120J						
Tentatively Identified Compounds		Yes	Yes	Yes	Yes	Yes			Yes

TABLE 4-3 (Continued) - Page 2
SUBSURFACE SOIL ANALYTICAL RESULTS
50,000 GALLON FUEL TANKS
SITE 7 - FUEL DEPOT AREA
PHASE 2 RFI
NWIRP CALVERTON, NEW YORK

Chemical	STARS Memo #1	Analytical Result (ug/kg)					
		FDT2SB05	FDT3SB01	FDT3SB02	FDT3SB03	FDT3SB04	FDT3SB05
Toluene	1500						
Anthracene	50000						
Benzo(a)anthracene	224						
Benzo(b)fluoranthene	1100				82J		50J
Benzo(k)fluoranthene	1100						
Benzo(ghi)perylene	50000				390		280J
Benzo(a)pyrene	61				36J		170J
Chrysene	400						
Fluorene	14						
Fluoranthene	50000						
Indeno(1,2,3-cd)pyrene	50000				480		340
Phenanthrene	3200						
Pyrene	50000						
Carbazole	50000						
Tentatively Identified Compounds	-				Yes		Yes

Samples were collected at the bottom of each tank excavation, which is approximately 15 to 17 feet below ground surface.

VOC: volatile organic compounds.
SVOC: semi-volatile organic compounds.

A-2 Estimate the areal extent and volume of contaminated groundwater.

The PRGs for groundwater are Federal and NYS MCLs. Positive detections are presented below.

The chemicals detected at concentrations greater than MCLs are presented on the attached sheets.

The chemicals consist primarily of diesel -type volatile organics and semivolatile organics.

Calculate the volume of contaminated groundwater and mass of soluble contaminants.

Fuel plume	Width:	220	feet
	Length:	520	feet
	Area:	114,400	SF
	Area:	2.63	acres
	Thickness:	20	feet
	Volume:	4,278,560	gallons (0.25 porosity)
Approximate mass of soluble constituents.		17.84	pounds (500 ug/l TEX)
Freon Plum	Width:	60	feet
	Length:	120	feet
	Area:	7,200	SF
	Area:	0.17	acres
	Thickness	40	feet
	Volume:	538,560	gallons (0.25 porosity)
Approximate mass of soluble constituents.		0.22	pounds (50 ug/l)

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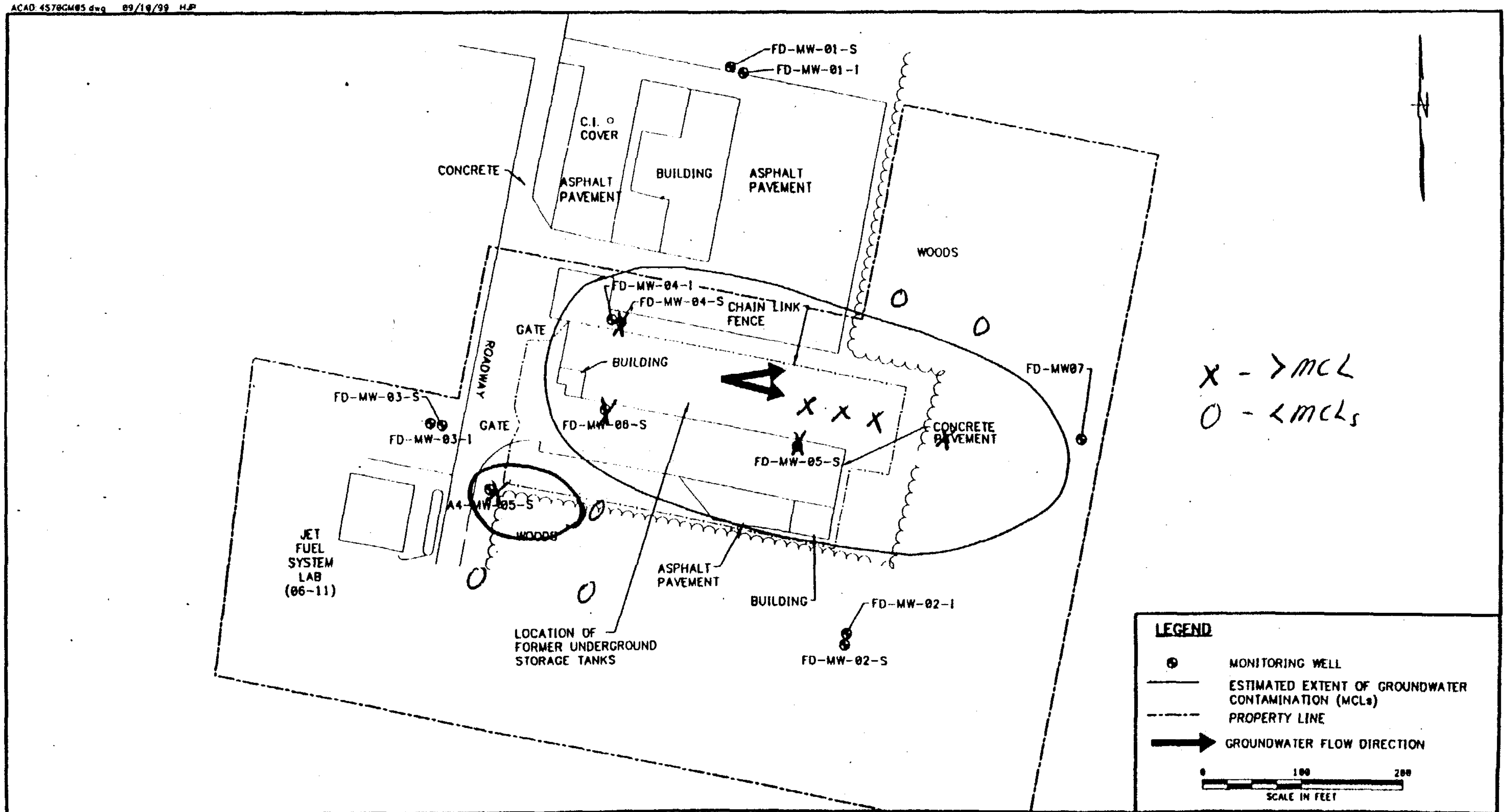

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY HJP DATE 9/10/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE RESULTS EXCEEDING CRITERIA
SITE 7 - FUEL DEPOT AREA
PHASE 2 RFI
NWIRP, CLAVERTON, NY

CONTRACT NO. 4570
OWNER NO. 0189
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE
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TABLE 4-1

TEMPORARY MONITORING WELL ANALYTICAL RESULTS
SITE 7 - FUEL DEPOT AREA
PHASE 2 RFI
NWIRP CALVERTON, NEW YORK

QUICK TURN AROUND VOC RESULTS (VOLUMETRIC) - DOWNGRADIENT INVESTIGATION

Sample Location	Depth BWT (ft)	Analytical Result (ug/l)						
		Benzene	Chloro-benzene	Ethyl benzene	Toluene	Xylene	1,1,2-TCA	1,1-DCA
FDGW0117	5							
FDGW0136	20							
FDGW0219	5							
FDGW0234	20						3	
FDGW0319	5	17	11	15	26	10		
FDGW0334	20	12	8	10	17	6		
FDGW0419	5				0.6			
FDGW0434	20				0.6			
FDGW0454	40							1

1,1,2-TCA: 1,1,2-trichloroethane
1,1-DCA: 1,1-dichloroethane

A-9

TABLE 4-1 (Continued) - Page 2
TEMPORARY MONITORING WELL ANALYTICAL RESULTS
SITE 7 - FUEL DEPOT AREA
PHASE 2 RFI
NWIRP CALVERTON, NEW YORK

FIXED BASE VOC AND SVOC RESULTS (QUANTERRA) - SOURCE AREA

Chemical	Analytical Result (ug/l)		
	FDGW05	FDGW06	FDGW07
Benzene		12	11
Ethylbenzene	480	170	67
Toluene	710	7J	12
Xylene	1,900	540	320
Diethylphthalate		3J	
2,4-dimethylphenol	2J		
Fluorene	1J		1J
2-methylnaphthalene	54	69	62
2-methylphenol		2J	2J
4-methylphenol	3J		
Naphthalene	80	110	79
Phenanthrene	1J		
Carbazole			10
Tentatively Identified Compounds	Yes	Yes	Yes

VOC: volatile organic compounds.
SVOC: semi-volatile organic compounds.

Sample to location correlation is groundwater (GW) equals temporary well (TW), e.g. Sample FDGW01, was collected from temporary monitoring well TW01.

D-01-95-13
Addendum

DRAFT

TABLE 4

COMPARISON OF GROUNDWATER RESULTS - RDS. 1 & 2
SITE 7 - FUEL DEPOT
NWIRP CALVERTON, NEW YORK

CHEMICAL	MDL/IDL (ug/L)	FD-GW01-S		FD-GW01-I		FD-GW02-S		FD-GW02-I		FD-GW03-S	
		AUG '94	MAR '95	AUG '94	MAR '95	AUG '94	MAR '95	AUG '94	MAR '95	AUG '94	MAR '95
TCL VOLATILES											
1,1-DICHLOROETHANE	2			3 J	3 J			3 J	2 J		
CHLOROFORM	2			1 J	0.5 J				0.3 J		
1,2-DICHLOROETHANE	2				0.6 J		0.6 J		0.6 J		
1,1,1-TRICHLOROETHANE	2			2 J	1 J			2 J	0.7 J		
TCL SEMIVOLATILES											
DIETHYL PHTHALATE	2								0.3 J		
TAL METALS											
LEAD	3/2	10 R	9.0			10 R	14.0 J	4 R		5 R	3.0 J

Phase 1 - RFI - 1995/1996

TABLE 4 (CONTINUED)
COMPARISON OF GROUNDWATER RESULTS - RDS. 1 & 2
SITE 7 - FUEL DEPOT
NWIRP CALVERTON, NEW YORK

DRAFT

D-01-95-13

CHEMICAL	MDL/IDL (ug/L)	FD-GW03-I		FD-GW04-S			FD-GW04-I		FC-GW05-S	
		AUG '94	MAR '95	AUG '94	AUG '94^{D}	MAR '95	AUG '94	MAR '95	AUG '94	MAR '95
TCL VOLATILES										
1,1-DICHLOROETHANE	2		2 J				3 J	2 J		
1,2-DICHLOROETHANE	2					0.5 J		0.6 J		
1,1,1-TRICHLOROETHANE	2			1 J	2 J	1 J		1 J		
TOLUENE	2			34	31	45				
ETHYLBENZENE	1			170	190	200			26	
TOTAL XYLENES	0.5			1500	1600	1600			29	
TCL SEMIVOLATILES										
2,4-DIMETHYLPHENOL	1			11 J	5 J	0.9 J				
NAPHTHALENE	1		0.1 J	8 J	3 J	15			8 J	
2-METHYLNAPHTHALENE	1			2 J	1 J	5 J			13	
BIS(2-ETHYLHEXYL) PHTHALATE	2								2 J	
TAL METALS										
LEAD	2	3 R		13 R	32 R	14.0	14 R		10 R	6.0

TABLE 4 (CONTINUED)
COMPARISON OF GROUNDWATER RESULTS - RDS. 1 & 2
SITE 7 - FUEL DEPOT
NWIRP CALVERTON, NEW YORK

DRAFT

D-01-95-13
Addendum

CHEMICAL	MDL/IDL (ug/L)	FC-GW06-S		
		AUG '94	MAR '95	MAR '95[D]
TCL VOLATILES				
TOLUENE	1	160	25	20 J
ETHYLBENZENE	1	290	170	120 J
TOTAL XYLENES	0.5	2400	850	860
TCL SEMIVOLATILES				
4-METHYLPHENOL	1	15		
NAPHTHALENE	1	150	41	37
2-METHYLNAPHTHALENE	1	78	22	19
DIBENZOFURAN	2	2 J		
DIETHYL PHTHALATE	2	1 J		
FLUORENE	2	2 J		
PHENANTHRENE	1	1 J		
BIS(2-ETHYLHEXYL) PHTHALATE	2	3 J	0.5 J	0.3 J
TAL METALS				
LEAD	2	18 R	25.0	20.0

A-13

D - Duplicate
J - Estimated
R - Rejected (low matrix spike recovery)

APPENDIX B

ALTERNATIVE SPECIFIC CALCULATIONS

APPENDIX B - ALTERNATIVE SPECIFIC CALCULATIONS

B-1 ALTERNATIVE 3 - GROUNDWATER EXTRACTION, TREATMENT AND DISPOSAL

Groundwater rate extraction calculations are based on the calculations presented on pages

Assumptions

K	100 ft/day
b	40 feet
Width	50 feet source area
	160 feet maximum

Add one well for freon contaminated groundwater area, do not increase flow rate since areas interact.

See Figure 4-1 for well locations

Combined flow rate is estimated to be 40 gpm

Treatment Plant design is as follows.

Equalization Tank Use for blending, neutralization, and iron/manganese oxidition.
Provide 60 minutes Volume is 2400 gallons

Increase to provide free board: 3000 gallons

Caustic requirement is assumed to be 12 mg/l

Caustic requirement is then 1 tpy

Permanganate feed is estimated to be 2 mg/l

0.2 tpy

Quantities of caustic and permanganate are very low and in expensive. Higher quantities may be required.

Clarifier Used for settling and storage of particulates (may not be required)

Provide for 0.4 gpm/ft

Size would be: 12 feet diameter

Provide sand filtration

Provide for 5 gpm/sf

Size would be 2 units 3 feet in diameter

Provide a clear well and equalization tanks for backwash water. Each tank would be 3000 gallons

Filter press (may not be required.)

Potential volume of dewatered sludge would be

TSS estimate:	80 mg/l
Use a 35% moisture content	

Estimated wet sludge volume is (maximum)	20 TPY

Air stripping tower

Provide for	13 gpm/sf
Size would be	2 feet in diameter

CALCULATION WORKSHEET Order No. 19116 (01-81) PAGE OF

CLIENT Navy	JOB NUMBER 4570
SUBJECT Calverton CMS	
BASED ON	DRAWING NUMBER

BY JPO	CHECKED BY CAR 3/1/95	APPROVED BY	DATE

Site 7

Remediation of "hot spot" zone (area of free product)

Assume free product zone ~ 60' wide x 110' long

Technical approach - Install 3 product/recovery wells along axis of free product area. Pump water/product @ rate sufficient to create inward gradient to WT all along edges of the free product area (perimeter length ~ 340'). Assume gradient of 5 x natural gradient sufficient to contain free product (nat. grad. = .0008, 5x = .004). Recovery trenches were considered but rejected due to depth to gw (>14').

Required pumping rate $Q = Kb\,i\,A$

$= (100\,ft/day)(40\,ft)(.004)(340')$

$= 5440\ ft^3/day$

$= 28$ gpm, say 10 gpm/well

Drawdown/well -

$$s = \frac{2.3Q}{4\pi T} \log \frac{2.25\,Tt}{r^2 S}$$

$T = 4000\ ft^2/day$

$Q = 1925\ ft^3/day$

$= (.09)(7.64)$

$= .7$ ft dd ✓

Screen wells over upper 12 ft of sat zone & lower 3 ft of vadose zone to allow for free product recovery under changing WL conditions. Actual DD's will be higher than predicted due to well efficiency & partial penetration effects.

System - 3 wells pumping @ 10 gpm each, aligned along centerline of plume. Reinject water along upgradient & sidegradient edges of hot spot area.

CALCULATION WORKSHEET Order No. 19118 (01-81)

PAGE ___ OF ___

CLIENT Navy		JOB NUMBER 4570	
SUBJECT Calverton CMS			
BASED ON		DRAWING NUMBER	
BY JFO	CHECKED BY CAR 3/1/95	APPROVED BY	DATE

Site 7

Extraction well system for plume containment
- Install well(s) near downgradient edge of plume.

Required Pumping Rate - Near leading edge of plume, plume width ~ 180' - 180' also is max plume width.

Capture zone width @ location of extraction well, $w = Q/2Ti$

$Q = 2Tiw$

$= 2(4000)(.0008)(180')$

$= 1152 \text{ ft}^3/\text{day}$

$= 6 \text{ gpm}$

Install 1 well, pumping @ 6 gpm, near leading edge of plume to contain plume.

Reinject gw @ pt close enough to achieve ~ 20% recirculation, eliminate stagnation zone downgradient of pumping well.

$$\frac{Q_{wr}}{Q} = \frac{2}{\pi}\left\{\tan^{-1}\sqrt{\frac{Q_w}{\pi d T i}-1} - \left(\frac{\pi d T i}{Q_w}\right)\left(\sqrt{\frac{Q_w}{\pi d T i}-1}\right)\right\}$$

Assuming 20% recirc. Q_w must be increased 20% to maintain plume capture - 6 gpm × 1.2 = 7.2 gpm say 8 gpm (1540 ft³/day)

For d = 72' (represents well spacing of 144'),

$$\frac{Q_{wr}}{Q} = \frac{2}{\pi}(.82 - (.47)(1.06))$$

$= .20$ ✓

Place injection well near (but outside of) leading edge of plume (say 40'), place extraction well ~ 100' inside plume edge.

******* A N A L Y S I S OF S T R I P P I N G T O W E R *******

PROJECT : Calverton Site 7 - Remediation — DATE : 2/18/1995

ENGINEER : DJC — PAGE : 1/2

PHYSICAL CONSTANTS

Design temperature	:	45.0 degrees F.
Density of water	:	62.4 lb/ft^3
Density of air	:	0.0786 lb/ft^3
Viscosity of water	:	9.56E-04 lb/ft.s
Viscosity of air	:	1.15E-05 lb/ft.s
Surface tension of water	:	75 dyne/cm
Atmospheric pressure	:	1.00 atm

CONTAMINANT PROPERTIES

Name	:	Toluene
Molecular weight	:	92.2 g/mol
Boiling point	:	232 degrees F.
Molal volume at boiling point	:	0.1182 L/mol
Henry's Constant	:	0.19000
Temperature constant	:	3517 deg K
Molecular diffusivity in air	:	8.22E-05 ft^2/s
Molecular diffusivity in water	:	5.72E-09 ft^2/s

PACKING PROPERTIES

Name	:	Jaeger Tripacks
Packing Material	:	Plastic
Nominal Size	:	2.00 inch
Specific Area	:	47.9 ft^2/ft^3
Critical surface tension	:	33 dyne/cm
Packing depth	:	35.0 ft
Air friction factor	:	15

******* ANALYSIS OF STRIPPING TOWER *******

PROJECT : Calverton Site 7 - Remediation	DATE : 2/18/1995
ENGINEER : DJC	PAGE : 2/2

LOADING RATES

Water mass loading rate	:	1.8 lb/ft^2.s	*
Air mass loading rate	:	0.068 lb/ft^2.s	*
Water volumetric loading rate	:	12.99 gpm/ft^2	*
Air volumetric loading rate	:	390 gpm/ft^2	*
Air pressure gradient	:	<.06 " H2O/ft	#
Volumetric air/water ratio	:	30.0	
Stripping factor	:	1.7	

MASS TRANSFER PARAMETERS

Percentage of packing area wetted	:	44.1 %	
Wetted packing area	:	21.1 ft^2/ft^3	*
Transfer rate constant in water	:	0.000358 ft/s	
Transfer rate constant in air	:	0.016382 ft/s	
Overall transfer rate constant	:	0.000258 ft/s	
Overall mass transfer coefficient	:	0.0054 1/s	
NTU	:	5.8563	
HTU	:	5.9764 ft	

CONTAMINANT REMOVAL

Influent concentration	:	48.0 ug/L	
Effluent concentration	:	1.9 ug/L	
Fraction removed	:	96.1 %	
Mass of contaminant removed	:	0.00720 lb/ft^2.day	*
Concentration in airstream	:	0.00404 mg/ft^2.ft^3	

* Expressed per unit of stripping tower cross-sectional area
\# Expressed per unit of tower length

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***** NUS Corporation, Pittsburgh PA. *****

******* A N A L Y S I S   OF   S T R I P P I N G   T O W E R *******

PROJECT : Calverton Site 7 - Remediation   DATE : 2/18/1995

ENGINEER : DJC   PAGE : 1/2

PHYSICAL CONSTANTS

Design temperature	:	45.0 degrees F.
Density of water	:	62.4 lb/ft^3
Density of air	:	0.0786 lb/ft^3
Viscosity of water	:	9.56E-04 lb/ft.s
Viscosity of air	:	1.15E-05 lb/ft.s
Surface tension of water	:	75 dyne/cm
Atmospheric pressure	:	1.00 atm

CONTAMINANT PROPERTIES

Name	:	Ethylbenzene
Molecular weight	:	106.2 g/mol
Boiling point	:	277 degrees F.
Molal volume at boiling point	:	0.1404 L/mol
Henry's Constant	:	0.27000
Temperature constant	:	1904 deg K
Molecular diffusivity in air	:	7.44E-05 ft^2/s
Molecular diffusivity in water	:	5.16E-09 ft^2/s

PACKING PROPERTIES

Name	:	Jaeger Tripacks
Packing Material	:	Plastic
Nominal Size	:	2.00 inch
Specific Area	:	47.9 ft^2/ft^3
Critical surface tension	:	33 dyne/cm
Packing depth	:	35.0 ft
Air friction factor	:	15

******* A N A L Y S I S   O F   S T R I P P I N G   T O W E R *******

PROJECT : Calverton Site 7 - Remediation   DATE : 2/18/1995

ENGINEER : DJC   PAGE : 2/2

LOADING RATES

Water mass loading rate	:	1.8 lb/ft^2.s	*
Air mass loading rate	:	0.068 lb/ft^2.s	*
Water volumetric loading rate	:	12.99 gpm/ft^2	*
Air volumetric loading rate	:	390 gpm/ft^2	*
Air pressure gradient	:	<.06 " H2O/ft	#
Volumetric air/water ratio	:	30.0	
Stripping factor	:	4.3	

MASS TRANSFER PARAMETERS

Percentage of packing area wetted	:	44.1 %	
Wetted packing area	:	21.1 ft^2/ft^3	*
Transfer rate constant in water	:	0.000340 ft/s	
Transfer rate constant in air	:	0.015336 ft/s	
Overall transfer rate constant	:	0.000294 ft/s	
Overall mass transfer coefficient	:	0.0062 1/s	
NTU	:	7.0905	
HTU	:	4.9362 ft	

CONTAMINANT REMOVAL

Influent concentration	:	123.0 ug/L	
Effluent concentration	:	0.4 ug/L	
Fraction removed	:	99.7 %	
Mass of contaminant removed	:	0.01912 lb/ft^2.day	*
Concentration in airstream	:	0.01075 mg/ft^2.ft^3	

* Expressed per unit of stripping tower cross-sectional area
# Expressed per unit of tower length

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******* A N A L Y S I S   O F   S T R I P P I N G   T O W E R *******

PROJECT : Calverton Site 7 - Remediation   DATE : 2/18/1995

ENGINEER : DJC   PAGE : 1/2

PHYSICAL CONSTANTS

Design temperature	:	45.0 degrees F.
Density of water	:	62.4 lb/ft^3
Density of air	:	0.0786 lb/ft^3
Viscosity of water	:	9.56E-04 lb/ft.s
Viscosity of air	:	1.15E-05 lb/ft.s
Surface tension of water	:	75 dyne/cm
Atmospheric pressure	:	1.00 atm

CONTAMINANT PROPERTIES

Name	:	p-Xylene
Molecular weight	:	106.2 g/mol
Boiling point	:	280 degrees F.
Molal volume at boiling point	:	0.1404 L/mol
Henry's Constant	:	0.29000
Temperature constant	:	1904 deg K
Molecular diffusivity in air	:	7.43E-05 ft^2/s
Molecular diffusivity in water	:	5.16E-09 ft^2/s

PACKING PROPERTIES

Name	:	Jaeger Tripacks
Packing Material	:	Plastic
Nominal Size	:	2.00 inch
Specific Area	:	47.9 ft^2/ft^3
Critical surface tension	:	33 dyne/cm
Packing depth	:	35.0 ft
Air friction factor	:	15

******* A N A L Y S I S   O F   S T R I P P I N G   T O W E R *******

PROJECT : Calverton Site 7 - Remediation   DATE : 2/18/1995

ENGINEER : DJC   PAGE : 2/2

LOADING RATES

Water mass loading rate	:	1.8 lb/ft^2.s	*
Air mass loading rate	:	0.068 lb/ft^2.s	*
Water volumetric loading rate	:	12.99 gpm/ft^2	*
Air volumetric loading rate	:	390 gpm/ft^2	*
Air pressure gradient	:	<.06 " H2O/ft	#
Volumetric air/water ratio	:	30.0	
Stripping factor	:	4.6	

MASS TRANSFER PARAMETERS

Percentage of packing area wetted	:	44.1 %	
Wetted packing area	:	21.1 ft^2/ft^3	*
Transfer rate constant in water	:	0.000340 ft/s	
Transfer rate constant in air	:	0.015326 ft/s	
Overall transfer rate constant	:	0.000297 ft/s	
Overall mass transfer coefficient	:	0.0063 1/s	
NTU	:	7.1866	
HTU	:	4.8702 ft	

CONTAMINANT REMOVAL

Influent concentration	:	980.0 ug/L	
Effluent concentration	:	2.8 ug/L	
Fraction removed	:	99.7 %	
Mass of contaminant removed	:	0.15245 lb/ft^2.day	*
Concentration in airstream	:	0.08567 mg/ft^2.ft^3	

*   Expressed per unit of stripping tower cross-sectional area
\#   Expressed per unit of tower length

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B-2 ALTERNATIVE 4 - AIR SPARGING/SOIL VAPOR EXTRACTION

Basis - Assumptions
Treat Areas of Groundwater Contamination (MCLs).
Establish a series of injection and extraction wells perpendicular to groundwater flow.
Set lateral lines on 50 foot centers (100 feet between injection laterals)
To establish a line of aeration, set injection wells on 25 foot centers on each lateral.
Set SVE collection wells on 50 foot centers on each lateral.
Figure 4-4 presents approximate layout.

Set injection wells at a depth of 15 foot below water table, total depth equals	32 ft
Set extraction wells 5 feet into the water table, total depth equals	22 ft
Collect split spoon samples in injection wells below water table to	
confirm flow paths, number of split spoons per injection well:	8
confirm geology around SVE wells, number of split spoons per SVE well	5
Number off injection wells:	53
Footage of injection wells	1696
Number of SVE wells	23
Footable of SVE wells	506
Number of split spoon samples	539

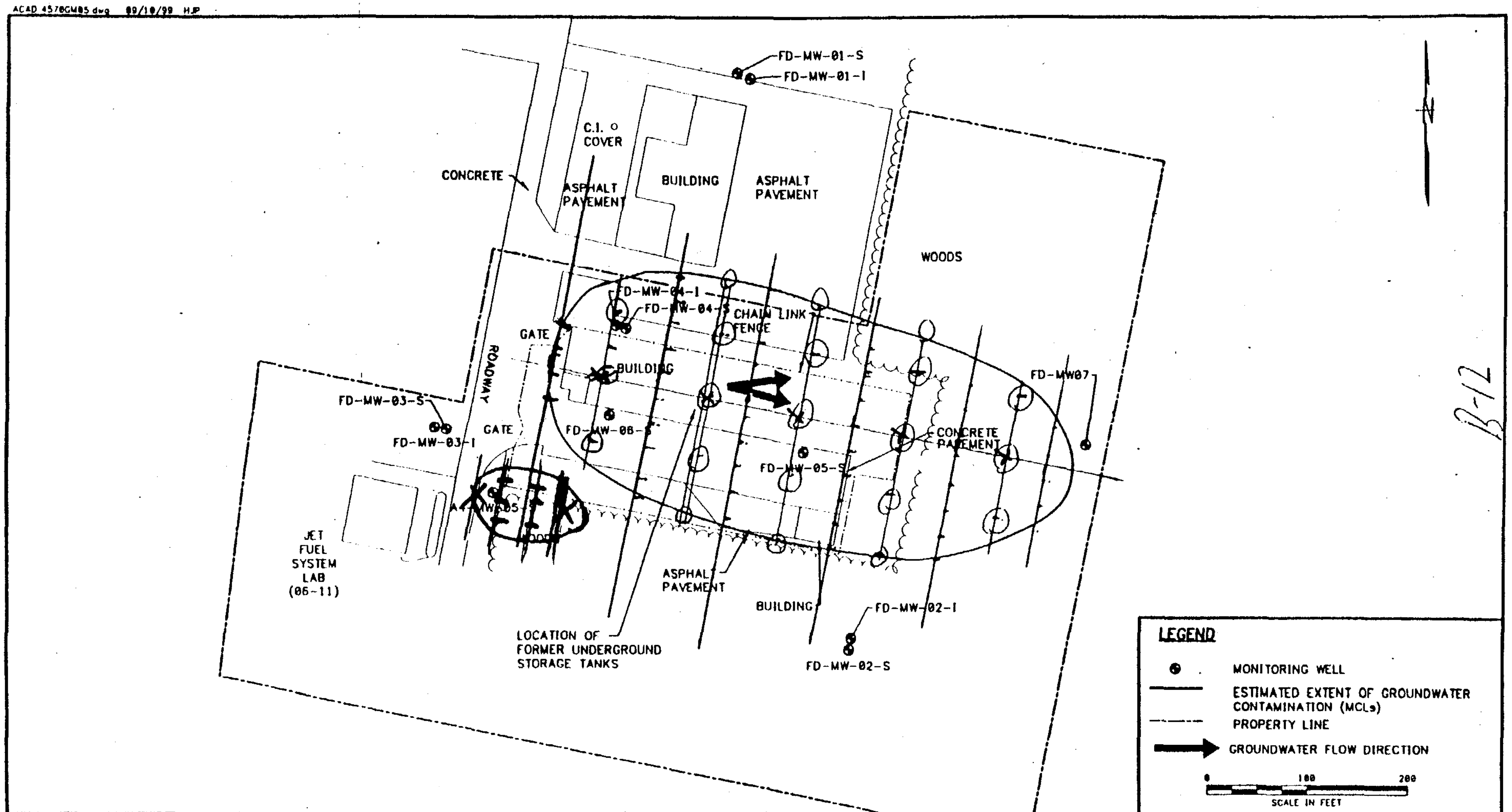
Estimate quantity of petroleum present.

Assumptions:	Soluble organic content			80 mg/l
	Volume of contaminated groundwater			
		Fuel:		4,278,560 gallons
		Freon		538,560 gallons
			Total	4,817,120 gallons
		Mass of soluble organics		3,214 lbs
	Volume of contaminated soils			2,200 CY
	TPH content of soils			2,000 ppm
		Mass of insoluble organics		13,068 lbs
Total lbs of organics				16,282 lb C

Check to see if adequate oxygen is being added for biodegradation.	
Total oxygen requirement	43,419 lb O2
Required operation of AS system for biodegradation (320 scm, 3% efficieny)	301,518 min
	7 months

This calculation assumes that biomass is present to degrade.
Actual time is expected to be limited by degradation rates.
(biomass & nutrients)

ACAD 4570GM05.dwg 09/10/99 HJP



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY HJP DATE 9/10/99

CHECKED BY DATE

COST/SCHED-AREA

SCALE AS NOTED

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE RESULTS EXCEEDING CRITERIA
SITE 7 – FUEL DEPOT AREA
PHASE 2 RFI
NWIRP, CLAVERTON, NY

CONTRACT NO. 4570

OWNER NO. 0189

APPROVED BY DATE

APPROVED BY DATE

DRAWING NO. FIGURE 2-2

REV. 0

FORM CADD NO. TNUS_BH.DGN – REV 0 – 1/20/98

B-3 Alternative 5 - ORC

Basis - Assumptions
Treat Areas of Groundwater Contamination (MCLs).
Establish a series of injection points perpendicular to groundwater flow.
Set lateral lines on 100 foot centers
To establish a line of aeration, set injection points on 5 foot centers on each lateral.
Figure 4-5 presents approximate layout.

Set injection points at an average depth of 20 foot below water table, total depth equ			37 ft
	Number of injection points		216
	Footage of injection points		7992

Estimate quantity of petroleum present.

Assumptions:	Soluble organic content		100 mg/l
	Volume of contaminated groundwater		
	Fuel:		4,278,560 gallons
	Freon		538,560 gallons
		Total	4,817,120 gallons
	Mass of soluble organics		3,214 lbs
	Volume of contaminated soils		2,200 CY
	TPH content of soils		2,000 ppm
	Mass of insoluble organics		13,068 lbs
Total lbs of organics			16,282 lb C

Calculate O2 requirement
Total oxygen requirement (biodegradation) 43,419 lb O2

Ignore other O2 requirements, assume natural O2 sources, (precipitation) balances other O2 consumption (iron).

MgO2 requirement
$C + 2MgO_2 \Rightarrow CO_2 + MgO$

Weight ratio of MgO2 to C is based on molecular weights

MgO2:	56	
C:	12	
Ratio is		9.3

Mass of MgO2 required is 405,240 lbs

Since, biodegradation will continue anaerobically as well as oxygen will be introduced through other means (diffusion), use of value of 40%. 162,096

Say 160000 lbs of ORC.

APPENDIX C

COST ESTIMATES

C-1

Site 7 - Fuel Depot Area
Naval Weapons Industrial Reserve Plant
Calverton, New York
Option 2 - Limited Action (Monitoring and Education)
****Note** This estimate based on 5/95 costs updated to current 99 costs by the RS Means Historical Cost Index (Means 99). This equates to a 1.082 multiplier.**

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal	Comments
1 PROJECT PLANNING												
1.1 Prepare Remedial Action Plan	200	hr		$0.00	$40.00	$0.00	$0	$0	$8,000	$0	$8,000	
2 MONITORING WELL INSTALLATION												
2 1 Mob/Demob Drill Rig	1	ea	$2,500.00	$0.00	$0.00	$0.00	$5,000	$0	$0	$0	$5,000	
2 2 Well Drilling (4 wells)	200	lf		$0.00	$5.36	$10.75	$0	$0	$1,072	$2,150	$3,222	
2 3 Split Spoon Samples (on 5' centers)	40	ea		$0.00	$70.01	$111.54	$0	$0	$2,800	$4,462	$7,262	
2 4 2" PVC Schedule 40 Casing	200	lf		$0.98	$1.95	$3.92	$0	$196	$390	$784	$1,370	
2 5 2" PVC Schedule 40 Screen	50	lf		$2.27	$2.52	$5.06	$0	$114	$126	$253	$493	
2.6 2" Screen Gravel Pack	50	lf		$2.55	$1.68	$2.33	$0	$128	$83	$117	$327	
2 7 2" Annular Seal (grouted)	150	lf		$2.41	$9.68	$19.40	$0	$362	$1,452	$2,910	$4,724	
2.8 3000 psi, 8" Thick Surface Pad	4	ea		$67.50	$135.40	$9.66	$0	$270	$542	$39	$851	
2 9 Guard Posts (5' Cast Iron Concrete Filled)	16	ea		$21.52	$26.02	$0.05	$0	$344	$416	$1	$761	
2.10 Locking 2" Well Caps	4	ea		$10.11	$18.32	$36.75	$0	$40	$73	$147	$261	
3 INSTITUTIONAL CONTROLS												
3 1 Prepare Deed Restrictions	50	hr		$0.00	$40.00	$0.00	$0	$0	$2,000	$0	$2,000	
3 2 Modify Existing Master Plan	50	hr		$0.00	$40.00	$0.00	$0	$0	$2,000	$0	$2,000	
Subtotal Direct Costs less Subcontract								$1,453	$18,956	$10,862	$31,270	
Local Area Adjustments								99.8%	105.0%	102.3%		
Subtotal								$1,450	$19,902	$11,112	$32,465	
Overhead on Labor Cost @ 0.3									$5,971		$5,971	
G & A on Labor Cost @ 0.1									$1,990		$1,990	
G & A on Material Cost @ 0.1								$145			$145	
Total Direct Cost								$1,595	$27,863	$11,112	$40,571	
Indirects on Total Direct Labor Cost @ 0.25									$6,966		$6,966	
Profit on Total Direct Cost @ 0.1											$4,057	
Subtotal											$51,594	
Health and Safety Monitoring @ 0.005											$257.97	
Total Field Cost											$51,852	
Subtotal Subcontractor Cost							$5,000				$5,000.00	
G & A on Subcontractor Cost @ 0.01							$50				$50	
Profit on Subcontractor 0.05							$250				$250	
Subcontractor Cost											$5,300	
Subtotal											$57,152	
Contingency on total Field and Subcontractor Costs @ 0.15											$8,573	
Engineering on Total Field Cost @ 0.08											$4,572.14	
Total Cost											$70,297	

Site 7 - Fuel Depot Area
Naval Weapons Industrial Reserve Plant
Calverton, New York
Option 2 - Limited Action (Monitoring and Education)
Annual Operating and Maintenance Costs

	Item	Qty	Unit	Unit Cost	Subtotal Cost	Notes
1	Energy - Electric	0	Kw-hr	$0.09	$0	Treatment Plant
2	Maintenance	0	ea	$0.00	$0	3 % of Capitol Cost
	Total Annual Cost				$0	

Note: Annual Cost - 24 hr/ day - 365 days/ year

C-2

Site 7 - Fuel Depot Area
Naval Weapons Industrial Reserve Plant
Calverton, New York
Option 2 - Limited Action (Monitoring and Education)
Annual Cost

Item	Item Cost Annually	Item Cost per 5 Years	Notes
YEAR 1			
Sampling	$22,500.00		GW samples quarterly plus travel, living, and shipping costs
Analysis	$51,200.00		GW analysis (VOCs, SVOCs, NA parameters including blanks and
Modeling	$75,000.00		
Reporting	$72,000.00		
Site Review		$20,000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTALS	$220,700.00	$20,000.00	Post remedial monitoring will be performed annually for years 1 through 30
YEARS 2-30			
Sampling	$5,600.00		GW samples quarterly plus travel, living, and shipping costs
Analysis	$12,800.00		GW analysis (VOCs, SVOCs, NA parameters including blanks and
Modeling	$25,000.00		
Reporting	$36,000.00		
Site Review		$20,000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTALS	$79,400.00	$20,000.00	Post remedial monitoring will be performed annually for years 1 through 30

Site 7 - Fuel Depot Area
Naval Weapons Industrial Reserve Plant
Calverton, New York
Option 2 - Limited Action (Monitoring and Education)
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$70,296.58		$70,296.58	1.000	$70,297
1		$220,700.00	$220,700.00	0.935	$206,355
2		$79,400.00	$79,400.00	0.873	$69,316
3		$79,400.00	$79,400.00	0.816	$64,790
4		$79,400.00	$79,400.00	0.763	$60,582
5		$99,400.00	$99,400.00	0.713	$70,872
6		$79,400.00	$79,400.00	0.666	$52,880
7		$79,400.00	$79,400.00	0.623	$49,466
8		$79,400.00	$79,400.00	0.582	$46,211
9		$79,400.00	$79,400.00	0.544	$43,194
10		$99,400.00	$99,400.00	0.508	$50,495
11		$79,400.00	$79,400.00	0.475	$37,715
12		$79,400.00	$79,400.00	0.444	$35,254
13		$79,400.00	$79,400.00	0.415	$32,951
14		$79,400.00	$79,400.00	0.388	$30,807
15		$99,400.00	$99,400.00	0.362	$35,983
16		$79,400.00	$79,400.00	0.339	$26,917
17		$79,400.00	$79,400.00	0.317	$25,170
18		$79,400.00	$79,400.00	0.296	$23,502
19		$79,400.00	$79,400.00	0.277	$21,994
20		$99,400.00	$99,400.00	0.258	$25,645
21		$79,400.00	$79,400.00	0.242	$19,215
22		$79,400.00	$79,400.00	0.226	$17,944
23		$79,400.00	$79,400.00	0.211	$16,753
24		$79,400.00	$79,400.00	0.197	$15,642
25		$99,400.00	$99,400.00	0.184	$18,290
26		$79,400.00	$79,400.00	0.172	$13,657
27		$79,400.00	$79,400.00	0.161	$12,783
28		$79,400.00	$79,400.00	0.150	$11,910
29		$79,400.00	$79,400.00	0.141	$11,195
30		$99,400.00	$99,400.00	0.131	$13,021
				TOTAL PRESENT WORTH	**$1,230,807**

Site 7 - Fuel Depot Area
Naval Weapons Industrial Reserve Plant
Calverton, New York
Option 3 - Groundwater Remediation
****Note** This estimate based on 5/95 costs updated to current 99 costs by the RS Means Historical Cost Index (Means 99). This equates to a 1.082 multiplier.**

				Unit Cost			Extended Cost					
Item	Quantity	Unit	Subcontract	Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	Subtotal	Comments
1 MOBILIZATION/DEMOBILIZATION												
1.1 Construction Survey Services	1	ls	$9,000.00	$0.00	$0.00	$0.00	$9,000	$0	$0	$0	$9,000	
1.2 Equipment Mobilization/Demobilization	1	ls		$0.00	$9,000.00	$13,000.00	$0	$0	$9,000	$13,000	$22,000	
1.3 Site Utilities	18	mo	$1,000.00	$0.00	$0.00	$0.00	$18,000	$0	$0	$0	$18,000	including temporary set-up/tear-down
2 DECONTAMINATION												
2.1 Decontamination Water	5,000	gal		$0.25	$0.00	$0.00	$0	$1,250	$0	$0	$1,250	
2.2 Decon Water Storage Tank (8,000 gallon)	6	mo	$577.50	$0.00	$0.00	$0.00	$3,465	$0	$0	$0	$3,465	
2.3 Clean Water Storage Tank (4,000 gallon)	6	mo	$472.50	$0.00	$0.00	$0.00	$2,835	$0	$0	$0	$2,835	
3 EARTHWORK / CLEARING												
3.1 Clearing and Grubbing	1	ac		$0.00	$1,260.00	$1,991.00	$0	$0	$1,260	$1,991	$3,251	
3.2 Grading	1600	cy		$0.00	$0.26	$0.85	$0	$0	$416	$1,360	$1,776	
4 STURCTURAL												
4.1 Building Foundation	75	cy		$185.00	$340.00	$17.00	$0	$13,875	$25,500	$1,275	$40,650	
4.2 Equipment Foundation	30	cy		$145.00	$270.00	$17.00	$0	$4,350	$8,100	$510	$12,960	
4.3 Treatment Building	2,000	sf	$30.00				$60,000	$0	$0	$0	$60,000	
5 EQUIPMENT												
5.1 Groundwater Injection Wells	286	lf	$215.00				$61,490	$0	$0	$0	$61,490	
5.2 Extraction Well Pump	5	ea		$2,700.00	$650.00		$0	$13,500	$3,250	$0	$16,750	
5.3 Equalization Tank	1	ea		$5,625.00	$650.00		$0	$5,625	$650	$0	$6,275	
5.4 Equlization Tank Mixer	1	ea		$3,030.00	$650.00		$0	$3,030	$650	$0	$3,680	
5.5 Clarifier	1	ea		$52,000.00	$8,655.00	$8,655.00	$0	$52,000	$8,655	$8,655	$69,310	
5.6 Clarifier Underflow Pump	2	ea		$1,625.00	$325.00		$0	$3,250	$650	$0	$3,900	
5.7 Wet Well	1	ea		$1,190.00	$325.00		$0	$1,190	$325	$0	$1,515	
5.8 Filter Supply Pump	2	ea		$3,030.00	$435.00		$0	$6,060	$870	$0	$6,930	
5.9 Sand Filter	2	ea		$48,750.00	$4,875.00	$2,435.00	$0	$97,500	$9,750	$4,870	$112,120	
5.10 Air Stripping System incl. Tower, Packing, and Blower	1	ea		$27,050.00	$2,700.00	$2,700.00	$0	$27,050	$2,700	$2,700	$32,450	
5.11 Activated Carbon Unit	2	ea		$54,100.00	$5,410.00	$5,410.00	$0	$108,200	$10,820	$10,820	$129,840	
5.12 Clearwell	1	ea		$6,500.00	$865.00	$0.00	$0	$6,500	$865	$0	$7,365	
5.13 Backwash Equilization Tank	1	ea		$6,500.00	$865.00	$0.00	$0	$6,500	$865	$0	$7,365	
5.14 Backwash Equilization Tank Mixer	1	ea		$3,030.00	$650.00	$0.00	$0	$3,030	$650	$0	$3,680	
5.15 Filter Press Feed Pump	2	ea		$3,245.00	$650.00	$0.00	$0	$6,490	$1,300	$0	$7,790	
5.16 Filter Press	1	ea		$37,875.00	$7,575.00	$0.00	$0	$37,875	$7,575	$0	$45,450	
5.17 Filtrate Recycle Tank	1	ea		$1,085.00	$435.00	$0.00	$0	$1,085	$435	$0	$1,520	
5.18 Filtrate Recycle Pump	2	ea		$1,625.00	$435.00	$0.00	$0	$3,250	$870	$0	$4,120	
5.19 Reinjection Pump	2	ea		$3,250.00	$350.00	$0.00	$0	$6,500	$700	$0	$7,200	
5.20 Reinjection Wells	120	lf	$215.00	$0.00	$0.00	$0.00	$25,800	$0	$0	$0	$25,800	
5.21 Caustic Feed System	1	ea		$8,655.00	$2,165.00	$0.00	$0	$8,655	$2,165	$0	$10,820	
5.22 Potassium Permanganate Feed System	1	ea		$1,085.00	$2,165.00	$0.00	$0	$1,085	$2,165	$0	$3,250	
5.23 Air Compressor	1	ea		$6,500.00	$865.00	$0.00	$0	$6,500	$865	$0	$7,365	
5.24 Sump Pump	2	ea		$2,165.00	$435.00	$0.00	$0	$4,330	$870	$0	$5,200	
5.25 Oil / Water Seperator	1	ea		$815.00	$865.00	$0.00	$0	$815	$865	$0	$1,680	
5.26 Equipment and Piping Coating /Painting	1	ea	$4,325.00	$0.00	$0.00	$0.00	$4,325	$0	$0	$0	$4,325	
							$0	$0	$0	$0	$0	
6 PIPING AND INSTRUMENTATION												
6.1 Extraction Wells to Equalizer Tank												
a) Well Piping - 4" polyethylene	140	lf		$1.62	$2.33	$0.63	$0	$227	$326	$88	$641	
b) Well Piping - 4" Corrosion Resistant Ductile Iron	140	lf		$46.50	$9.05	$0.00	$0	$6,510	$1,267	$0	$7,777	
c) Collection Piping - 2" polyethylene	600	lf		$1.26	$2.05	$0.61	$0	$756	$1,230	$366	$2,352	
d) Collection Piping - 2" Corrosion Resistant Ductile Iron	600	lf		$28.00	$7.10	$0.00	$0	$16,800	$4,260	$0	$19,860	
e) Excavation, Backfill, and Compaction	1,200	lf		$0.00	$4.75	$2.85	$0	$0	$5,700	$3,420	$9,120	
f) Pipe Bedding	1,200	lf		$0.00	$1.62	$2.26	$0	$0	$1,944	$2,712	$4,656	
g) Revegetation	7	msf		$55.00	$12.00	$9.75	$0	$385	$84	$68	$537	
6.2 System Interconnecting Pipe												
a) 1/2"	200	lf		$3.75	$1.65	$0.00	$0	$750	$330	$0	$1,080	
b) 1 1/2"	400	lf		$14.00	$7.55	$0.00	$0	$5,600	$3,020	$0	$8,620	
c) 2"	50	lf		$21.00	$11.35	$0.00	$0	$1,050	$568	$0	$1,618	
d) 3"	100	lf		$29.25	$14.00	$0.00	$0	$2,925	$1,400	$0	$4,325	
6.3 Air Piping	200	lf		$10.55	$5.65	$0.00	$0	$2,110	$1,130	$0	$3,240	
6.4 Reinjection Piping							$0	$0	$0	$0	$0	
a) Reinjection Piping - 1 1/2" Ductile Iron	350	lf		$8.65	$4.35	$0.00	$0	$3,028	$1,523	$0	$4,550	
b) Reinjection Piping - 1 1/2" Polyethylene	350	lf		$1.26	$2.05	$0.61	$0	$441	$718	$214	$1,372	
b) Excavation, Backfill, Compaction	700	lf		$0.00	$4.75	$2.85	$0	$0	$3,325	$1,995	$5,320	
c) Pipe Bedding	700	lf		$0.00	$1.61	$2.26	$0	$0	$1,127	$1,582	$2,709	
d) Revegetation	7	msf		$54.10	$11.90	$9.75	$0	$379	$83	$68	$530	
6.5 Valves												
1/2"	40	ea		$73.35	$16.25	$0.00	$0	$2,934	$650	$0	$3,584	
1"	10	ea		$110.00	$27.00	$0.00	$0	$1,100	$270	$0	$1,370	
1 1/2"	20	ea		$238.00	$65.00	$0.00	$0	$4,760	$1,300	$0	$6,060	
2"	10	ea		$325.00	$97.35	$0.00	$0	$3,250	$974	$0	$4,224	
6.6 Pressure Gauges	22	ea		$190.00	$54.00	$0.00	$0	$4,180	$1,188	$0	$5,368	
6.7 Level Control System	7	ea		$865.00	$433.00	$0.00	$0	$6,055	$3,031	$0	$9,086	
7 ELECTRICAL												
7.1 Power Supply	1	ea	$5,400.00	$0.00	$0.00	$0.00	$5,400	$0	$0	$0	$5,400	
7.2 Well Pump Feeder Cable	700	lf		$3.25	$5.00	$0.00	$0	$2,275	$3,500	$0	$5,775	
7.3 Starter # 1	23	ea		$1,460.00	$595.00	$0.00	$0	$33,580	$13,685	$0	$47,265	
[illegible]	23	ea		$165.00	$55.00	$0.00	$0	$3,795	$1,265	$0	$5,060	
[illegible]				[illegible]	[illegible]	$0.00	$0	$16,330	$18,285	$0	$34,615	
[illegible]										[illegible]	[illegible]	

Naval Weapons Industrial Reserve Plant
Calverton, New York
Option 3 - Groundwater Remediation
Note This estimate based on 5/95 costs updated to current 99 costs by the RS Means Historical Cost Index (Means 99). This equates to a 1.082 multiplier.

			Unit Cost				Extended Cost					
Item	Quantity	Unit	Subcontract	Material	Labor	Equipment	Subcontract	Material	Labor	Equipmen	Subtotal	Comments
7.8 Grounding	.1	ea		$4,975.00	$4,975.00	$0.00	$0	$4,975	$4,975	$0	$9,950	
7.9 Misc. Wiring	1	ea		$12,445.00	$12,445.00	$0.00	$0	$12,445	$12,445	$0	$24,890	
7.10 Outdoor Lighting	1	ea		$2,700.00	$1,625.00	$0.00	$0	$2,700	$1,625	$0	$4,325	
8 PAVEMENT							$0	$0	$0	$0	$0	
8.1 Loading / Unloading Area (3" compacted gravel)	4000	sf	$0.00	$3.07	$0.31	$0.63	$0	$12,280	$1,240	$2,520	$16,040	
8.2 Parking Area (6" compacted gravel)	600	sf	$0.00	$6.15	$0.32	$0.65	$0	$3,690	$192	$390	$4,272	
9 OFFICE SUPPORT/FIELD SUPPORT							$0	$0	$0	$0	$0	
9.1 Field Oversight Personnel (1 person - full time)	1400	hours		$0.00	$25.00	$0.00	$0	$0	$35,000	$0	$35,000	
9.2 Office Oversight Personnel (2 people - 1/4 time)	700	hours		$0.00	$30.00	$0.00	$0	$0	$21,000	$0	$21,000	
10 PROJECT DOCUMENTATION												
10.1 Pre- and Post-Construction Submittals	1000	hours		$0.00	$30.00	$0.00	$0	$0	$30,000	$0	$30,000	
10.2 Permitting/Planning Documents	300	hours		$0.00	$50.00	$0.00	$0	$0	$15,000	$0	$15,000	
11 INSTITUTIONAL CONTROLS												
11.1 Prepare Deed Restrictions	50	hours		$0.00	$35.00	$0.00	$0	$0	$1,750	$0	$1,750	
11.2 Modify Existing Master Plan	50	hours		$0.00	$35.00	$0.00	$0	$0	$1,750	$0	$1,750	
Subtotal Direct Costs less Subcontract								$590,634	$304,430	$58,604	$953,668	
Local Area Adjustments								99.8%	105.0%	102.3%		
Subtotal								$589,453	$319,651	$59,952	$969,056	
Overhead on Labor Cost @ 0.3									$95,895		$95,895	
G & A on Labor Cost @ 0.1									$31,965		$31,965	
G & A on Material Cost @ 0.1								$58,945			$58,945	
Total Direct Cost								$648,398	$447,511	$59,952	$1,155,861	
Indirects on Total Direct Labor Cost @ 0.75									$335,634		$335,634	
Profit on Total Direct Cost @ 0.1											$115,586	
Subtotal											$1,607,081	
Health & Safety Monitoring @ 0.005											$8,035	
Total Field Cost											$1,615,117	
Subtotal Subcontractor Cost							$190,315				$190,315	
G & A on Subcontract Cost @ 0.1							$19,032				$19,032	
Profit on Subcontractor Cost @ 0.05											$9,516	
Subcontractor Cost											$218,862	
Subtotal											$1,833,979	
Contingency on Total Field and Subcontractor Costs @ 0.15											$275,097	
Engineering on Total Field Cost @ 0.08											$129,209	
TOTAL COST											$2,238,285	

Site 7 - Fuel Depot Area
Naval Weapons Industrial Reserve Plant
Calverton, New York
Option 3 - Groundwater Remediation
Annual Operating and Maintenance Costs

	Item	Qty	Unit	Unit Cost	Subtotal Cost	Notes
1	Energy - Electric	189438	Kw-hr	$0.09	$17,428	Treatment Plant
2	Maintenance	1	ea	$62,144.67	$62,145	3 % of Capitol Cost
3	Operator	1	ea	$43,250.00	$43,250	1 opterator / day, 5 days / week
4	Chemical (Caustic Soda)	4	ton	$435.00	$1,740	
5	Chemical (Potassium Permanganate)	1800	lb	$1.65	$2,970	
6	Activiated Carbon (Liquid)	7000	lb	$2.15	$15,050	
7	Sludge Hauling	2	ld	$2,435.00	$4,870	
8	Sludge Disposal	20	ton	$162.00	$3,240	
	Total Annual Cost				**$150,693**	

Note: Annual Cost - 24 hr/ day - 365 days/ year
System running for 30 years

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Site 7 - Fuel Depot Area
Naval Weapons Industrial Reserve Plant
Calverton, New York
Option 3 - Groundwater Remediation
Annual Cost

Item	Item Cost Annually	Item Cost per 5 Years	Notes
YEAR 1 :			
Sampling	$11,200.00		GW samples quarterly plus travel, living, and shipping costs
	$2,800.00		Monthly Injection Sampling
Analysis	$12,000.00		Groundwater for VOCS, Discharged Water for VOCS including field blanks and dups
Reporting	$90,000.00		320 manhours per report plus other direct costs
Site Review		$20,000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTALS	$116,000.00	$20,000.00	Post remedial monitoring will be performed annually for years 1 through 30
YEARS 2-30			
Sampling	$2,800.00		GW samples annually plus travel, living, and shipping costs
	$2,800.00		Monthly Injection Sampling
Analysis	$5,300.00		Groundwater for VOCS, Discharged Water for VOCS including field blanks and dups
Reporting	$45,000.00		320 manhours per report plus other direct costs
Site Review		$20,000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTALS	$55,900.00	$20,000.00	Post remedial monitoring will be performed annually for years 1 through

Site 7 - Fuel Depot Area
Naval Weapons Industrial Reserve Plant
Calverton, New York
Option 3 - Groundwater Remediation
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$2,238,285	$0	$2,238,285	1.000	$2,238,285
1		$266,693	$266,693	0.935	$249,358
2		$206,593	$206,593	0.873	$180,356
3		$206,593	$206,593	0.816	$168,580
4		$206,593	$206,593	0.763	$157,630
5		$226,593	$226,593	0.713	$161,561
6		$206,593	$206,593	0.666	$137,591
7		$206,593	$206,593	0.623	$128,707
8		$206,593	$206,593	0.582	$120,237
9		$206,593	$206,593	0.544	$112,387
10		$226,593	$226,593	0.508	$115,109
11		$206,593	$206,593	0.475	$98,132
12		$206,593	$206,593	0.444	$91,727
13		$206,593	$206,593	0.415	$85,736
14		$206,593	$206,593	0.388	$80,158
15		$226,593	$226,593	0.362	$82,027
16		$206,593	$206,593	0.339	$70,035
17		$206,593	$206,593	0.317	$65,490
18		$206,593	$206,593	0.296	$61,152
19		$206,593	$206,593	0.277	$57,226
20		$226,593	$226,593	0.258	$58,461
21		$206,593	$206,593	0.242	$49,996
22		$206,593	$206,593	0.226	$46,690
23		$206,593	$206,593	0.211	$43,591
24		$206,593	$206,593	0.197	$40,699
25		$226,593	$226,593	0.184	$41,693
26		$206,593	$206,593	0.172	$35,534
27		$206,593	$206,593	0.161	$33,261
28		$206,593	$206,593	0.150	$30,989
29		$206,593	$206,593	0.141	$29,130
30		$226,593	$226,593	0.131	$29,684
				TOTAL PRESENT WORTH	**$4,901,211**

Site 7 - Fuel Depot Area
Naval Weapons Industrial Reserve Plant
Calverton, New York
Option 4 - AS/SVE

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipmen	Subtotal	Comments
1 PROJECT PLANNING												
1.1 Prepare Remedial Action	300	hr		$0.00	$40.00	$0.00	$0	$0	$12,000	$0	$12,000	
1 MOBILIZATION/DEMOBILIZATIOI												
1.1 Office Trailer	3	mo	$195.00	$0.00	$0.00	$0.00	$585	$0	$0	$0	$585	
1.2 Storage Trialer	3	mo	$85.00	$0.00	$0.00	$0.00	$255	$0	$0	$0	$255	
1.3 Construction Survey Services	1	ls	$9,000.00	$0.00	$0.00	$0.00	$9,000	$0	$0	$0	$9,000	
1.4 Equipment Mobilization/Demobilizatio	1	ls		$0.00	$9,000.00	$13,000.00	$0	$0	$9,000	$13,000	$22,000	
1.5 Site Utilities	18	mo	$1,000.00	$0.00	$0.00	$0.00	$18,000	$0	$0	$0	$18,000	including temporary set-up/tear-down
2 DECONTAMINATION												
2.1 Decontamination Water	500	gal		$0.25	$0.00	$0.00	$0	$125	$0	$0	$125	
2.2 Decon Water Storage Tank (6,000 gallon)		mo	$577.50	$0.00	$0.00	$0.00	$0	$0	$0	$0	$0	
2.3 Clean Water Storage Tank (4,000 gallon)		mo	$472.50	$0.00	$0.00	$0.00	$0	$0	$0	$0	$0	
2.4 Decon Trailer		mo	$2,200.00	$0.00	$0.00	$0.00	$0	$0	$0	$0	$0	
2.5 Temporary Decon Pad (installation and removal)	1	ea		$500.00	$900.00	$150.00	$0	$500	$900	$150	$1,550	
2.6 PPE (5 people per day)	90	day	$150.00	$0.00	$0.00	$0.00	$13,500	$0	$0	$0	$13,500	$30 per person, 5 people perday = 150/day
2.7 Disposal of Decon Waste	1000	gal	$0.20	$0.00	$0.00	$0.00	$200	$0	$0	$0	$200	
3 EARTHWORK / CLEARING												
3.1 Clearing and Grubbing	1	ac		$0.00	$1,260.00	$1,991.00	$0	$0	$1,260	$1,991	$3,251	
3.2 Grading	1600	cy		$0.00	$0.26	$0.85	$0	$0	$416	$1,360	$1,776	
4 MONITORING WELL INSTALLATION												
4.1 Install Monitoring Wells (four wells)	120	lf	$23.75	$0.00	$0.00	$0.00	$2,850	$0	$0	$0	$2,850	
4.2 Well Development (four wells)	6	hr	$35.00	$0.00	$0.00	$0.00	$210	$0	$0	$0	$210	
4.3 Collect / Containerize IDW	2	drums	$50.00	$0.00	$0.00	$0.00	$100	$0	$0	$0	$100	
4.4 Transport / Dispose of IDW	2	drums	$150.00	$0.00	$0.00	$0.00	$300	$0	$0	$0	$300	
4.5 Stick-up Pads with posts	4	ea	$500.00	$0.00	$0.00	$0.00	$2,000	$0	$0	$0	$2,000	
4.6 Survey Well Locations	1	ea	$6,000.00	$0.00	$0.00	$0.00	$6,000	$0	$0	$0	$6,000	
5 AS/SVE WELL INSTALLATION												
5.1 Install Vapor Extraction Wells (23 wells ave. depth 22')	510	lf	$23.00	$0.00	$0.00	$0.00	$11,730	$0	$0	$0	$11,730	2" PVC wells, 6" bore
5.2 Install Air Sparge Wells (53 wells ave. depth 32')	1,020	lf	$23.00	$0.00	$0.00	$0.00	$23,460	$0	$0	$0	$23,460	2" PVC wells, 6" bore
5.3 Well Development 76 wells, 1 1/2 hrs per well)	102	hrs	$35.00	$0.00	$0.00	$0.00	$3,570	$0	$0	$0	$3,570	
5.4 Split Spoon Samples	316	ea	$15.00	$0.00	$0.00	$0.00	$4,770	$0	$0	$0	$4,770	
5.5 6" PVC Pipe	600	ft		$50.50	$3.25	$0.00	$0	$30,300	$1,950	$0	$32,250	
5.6 4" PVC Pipe	800	ft		$2.95	$2.92	$0.00	$0	$2,360	$2,336	$0	$4,696	
5.7 2" PVC Pipe	700	ft		$1.35	$1.95	$0.00	$0	$945	$1,365	$0	$2,310	
5.8 Valves	80	ea	$60.00	$0.00	$0.00	$0.00	$4,800	$0	$0	$0	$4,800	
5.9 Fittings	1	ls	$2,500.00	$0.00	$0.00	$0.00	$2,500	$0	$0	$0	$2,500	
5.10 Pipe Supports / misc.	1	ls		$1,500.00	$1,125.00	$0.00	$0	$1,500	$1,125	$0	$2,625	approx. 1500 lf pf pipe support - labor $0.75/
5.11 Collect / Containerize IDW	25	drums	$50.00	$0.00	$0.00	$0.00	$1,250	$0	$0	$0	$1,250	average cuttings from 3 wells per drum
5.12 Transport / Dispose of IDW (offsite)	25	drums	$150.00	$0.00	$0.00	$0.00	$3,750	$0	$0	$0	$3,750	
6 AS/SVE SYSTEM INSTALLATION												
6.1 Concrete Foundation	2,000	sf		$2.74	$3.50	$0.67	$0	$5,480	$7,000	$1,340	$13,820	
6.2 System Control Building	2,000	sf		$4.36	$0.93	$0.56	$0	$8,720	$1,860	$1,120	$11,700	
6.3 Compressor (320 cfm, 20 HP) Installed Package	1	ea	$12,000.00	$0.00	$0.00	$0.00	$12,000	$0	$0	$0	$12,000	
6.4 Receiver Tank (250 gallon)	3	ea	$325.00	$0.00	$0.00	$0.00	$975	$0	$0	$0	$975	
6.5 Vaccum Pump (700 cfm, 20 hp) Installed Package	1	ea	$12,000.00	$0.00	$0.00	$0.00	$12,000	$0	$0	$0	$12,000	
6.6 Moisture Saperator - Installed	1	ea	$3,000.00	$0.00	$0.00	$0.00	$3,000	$0	$0	$0	$3,000	
6.7 2000 lb. GAC Canister	4	ea		$5,554.00	$989.00	$165.00	$0	$22,216	$3,956	$660	$26,832	
6.8 System Start-up and Testing	1	event		$7,000.00	$2,900.00	$0.00	$0	$7,000	$2,900	$0	$9,900	
7 ELECTRICAL / MECHANICAL												
7.1 Power Supply	1	ea	$5,400.00	$0.00	$0.00	$0.00	$5,400	$0	$0	$0	$5,400	
7.2 Plumb / Electrify System	1	ea		$20,000.00	$15,000.00	$0.00	$0	$20,000	$15,000	$0	$35,000	
7.3 Outdoor Lighting	1	ea		$2,700.00	$1,625.00	$0.00	$0	$2,700	$1,625	$0	$4,325	
8 PAVEMENT												
8.1 Loading / Unloading Area	4000	sf	$1.25	$0.00	$0.00	$0.00	$5,000	$0	$0	$0	$5,000	
8.2 Parking Area	600	sf	$3.25	$0.00	$0.00	$0.00	$1,950	$0	$0	$0	$1,950	
9 OFFICE SUPPORT/FIELD SUPPORT												
9.1 Field Oversight Personnel (1 person - full time)	700	hours		$0.00	$25.00	$0.00	$0	$0	$17,500	$0	$17,500	
9.2 Office Oversight Personnel (2 people - 1/4 time)	350	hours		$0.00	$30.00	$0.00	$0	$0	$10,500	$0	$10,500	
10 PROJECT DOCUMENTATION												
10.1 Pre- and Post-Construction Submittals	400	hours		$0.00	$30.00	$0.00	$0	$0	$12,000	$0	$12,000	
10.2 Permitting/Planning Documents	100	hours		$0.00	$50.00	$0.00	$0	$0	$5,000	$0	$5,000	
11 INSTITUTIONAL CONTROLS												
11.1 Transer Documents	200	hours		$0.00	$35.00	$0.00	$0	$0	$7,000	$0	$7,000	
11.2 Modify Master Plan	50	hours		0.00	35.00	0.00	$0	$0	$1,750	$0	$1,750	
Subtotal Direct Costs less Subcontract								$101,846	$95,693	$19,621	$217,160	
Local Area Adjustments								99.8%	105.0%	102.3%		
Subtotal								$101,642	$100,476	$20,072	$222,192	
Overhead on Labor Cost @ 0.3									$30,143		$30,143	
G & A on Labor Cost @ 0.1									$10,048		$10,048	
G & A on Material Cost @ 0.1								$10,164			$10,164	
l Direct Cost								$111,807	$140,669	$20,072	$272,548	
[illegible] @ 0.35									$105,502		$105,502	

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Naval Weapons Industrial Reserve Plant
Calverton, New York
Option 4 - AS/SVE

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal	Comments
Subtotal											$405,304	
Health & Safety Monitoring @ 0.005											$2,027	
Total Field Cost											$407,330	
Subtotal Subcontractor Cost							$148,315				$148,315	
G & A on Subcontract Cost @ 0.1							$14,832				$14,832	
Profit on Subcontractor Cost @ 0.05											$7,416	
Subcontractor Cost											$170,562	
Subtotal											$577,893	
Contingency on Total Field and Subcontractor Costs @ 0.15											$86,684	
Engineering on Total Field Cost @ 0.08											$32,586	
TOTAL COST											$697,163	

Site 7 - Fuel Depot Area
Naval Weapons Industrial Reserve Plant
Calverton, New York
Option 4 - AS/SVE
Annual Operating and Maintenance Costs

	Item	Qty	Unit	Unit Cost	Subtotal Cost	Notes
1	Energy - Electric	160000	Kw-hr	$0.09	$14,720	Treatment Plant
2	Maintenance	1	ea	$20,914.89	$20,915	3 % of Capitol Cost
3	Operator	416	hrs	$25.00	$10,400	8 hours/week for 4 years
4	Activiated Carbon (Vapor)	4000	lb	$3.30	$13,200	
	Total Annual Cost				**$59,235**	

Note: Annual Cost - 24 hr/ day - 365 days/ year
For the first 4 years only

Site 7 - Fuel Depot Area
Naval Weapons Industrial Reserve Plant
Calverton, New York
Option 4 - AS/SVE
Annual Cost

Item	Item Cost Annually	Item Cost per 5 Years	Notes
YEAR 1			
Sampling	$11,200.00 $1,450.00		GW samples per quarter annually plus travel, living, and shipping costs Monthly Air Samples
Analysis	$20,750.00		Complete analysis for water and air samples collected including field blanks and
Reporting	$45,000.00		
Site Review		$20,000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTALS	$78,400.00	$20,000.00	Post remedial monitoring will be performed annually for years 1 through 30
YEARS 2-30			
Sampling	$2,800.00 $480.00		GW samples annually plus travel, living, and shipping costs Quarterly Air Samples
Analysis	$9,000.00		Complete analysis for water and air samples collected including field blanks and
Reporting	$30,000.00		20 manhours per report plus other direct costs
Site Review		$20,000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTALS	$42,280.00	$20,000.00	Post remedial monitoring will be performed annually for years 1 through 30

Site 7 - Fuel Depot Area
Naval Weapons Industrial Reserve Plant
Calverton, New York
Option 4 - AS/SVE
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$697,163		$697,162.90	1.000	$697,163
1		$137,635	$137,634.89	0.935	$128,689
2		$188,000.00	$188,000.00	0.873	$164,124
3		$101,514.89	$101,514.89	0.816	$82,836
4		$101,514.89	$101,514.89	0.763	$77,456
5		$62,280.00	$62,280.00	0.713	$44,406
6		$42,280.00	$42,280.00	0.666	$28,158
7		$42,280.00	$42,280.00	0.623	$26,340
8		$42,280.00	$42,280.00	0.582	$24,607
9		$42,280.00	$42,280.00	0.544	$23,000
10		$62,280.00	$62,280.00	0.508	$31,638
11		$42,280.00	$42,280.00	0.475	$20,083
12		$42,280.00	$42,280.00	0.444	$18,772
13		$42,280.00	$42,280.00	0.415	$17,546
14		$42,280.00	$42,280.00	0.388	$16,405
15		$62,280.00	$62,280.00	0.362	$22,545
16		$42,280.00	$42,280.00	0.339	$14,333
17		$42,280.00	$42,280.00	0.317	$13,403
18		$42,280.00	$42,280.00	0.296	$12,515
19		$42,280.00	$42,280.00	0.277	$11,712
20		$62,280.00	$62,280.00	0.258	$16,068
21		$42,280.00	$42,280.00	0.242	$10,232
22		$42,280.00	$42,280.00	0.226	$9,555
23		$42,280.00	$42,280.00	0.211	$8,921
24		$42,280.00	$42,280.00	0.197	$8,329
25		$62,280.00	$62,280.00	0.184	$11,460
26		$42,280.00	$42,280.00	0.172	$7,272
27		$42,280.00	$42,280.00	0.161	$6,807
28		$42,280.00	$42,280.00	0.150	$6,342
29		$42,280.00	$42,280.00	0.141	$5,961
30		$62,280.00	$62,280.00	0.131	$8,159

TOTAL PRESENT WORTH $1,574,838

Site 7 - Fuel Depot Area
Naval Weapons Industrial Reserve Plant
Calverton, New York
Option 5 - ORC

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal	Comments
1 PROJECT PLANNING												
1.1 Prepare Remedial Action	300	hr		$0.00	$40.00	$0.00	$0	$0	$12,000	$0	$12,000	
1 MOBILIZATION/DEMOBILIZATIOI												
1.1 Office Trailer	3	mo	$195.00	$0.00	$0.00	$0.00	$585	$0	$0	$0	$585	
1.2 Storage Trialer	3	mo	$85.00	$0.00	$0.00	$0.00	$255	$0	$0	$0	$255	
1.3 Construction Survey Services	1	ls	$9,000.00	$0.00	$0.00	$0.00	$9,000	$0	$0	$0	$9,000	
1.4 Equipment Mobilization/Demobilizatio	1	ls		$0.00	$9,000.00	$13,000.00	$0	$0	$9,000	$13,000	$22,000	
1.5 Site Utilities	1	mo	$1,000.00	$0.00	$0.00	$0.00	$1,000	$0	$0	$0	$1,000	Including temporary set-up/tear-down
2 DECONTAMINATION												
2.1 Decontamination Water	500	gal		$0.25	$0.00	$0.00	$0	$125	$0	$0	$125	
2.2 Decon Water Storage Tank (6,000 gallon)	6	mo	$577.50	$0.00	$0.00	$0.00	$3,465	$0	$0	$0	$3,465	
2.3 Clean Water Storage Tank (4,000 gallon)	2	mo	$472.50	$0.00	$0.00	$0.00	$945	$0	$0	$0	$945	
2.4 Decon Trailer	2	mo	$2,200.00	$0.00	$0.00	$0.00	$4,400	$0	$0	$0	$4,400	
2.5 Temporary Decon Pad (installation and removal)	1	ea		$500.00	$900.00	$150.00	$0	$500	$900	$150	$1,550	
2.6 PPE (1 person per day)	90	day		$30.00	$0.00	$0.00	$0	$2,700	$0	$0	$2,700	
2.7 Disposal of Decon Waste	1000	gal	$0.25	$0.00	$0.00	$0.00	$250	$0	$0	$0	$250	
3 EARTHWORK / CLEARING												
3.1 Clearing and Grubbing	1	ac		$0.00	$1,260.00	$1,991.00	$0	$0	$1,260	$1,991	$3,251	
3.2 Grading	1600	cy		$0.00	$0.26	$0.85	$0	$0	$416	$1,360	$1,776	
4 MONITORING WELL INSTALLATION												
4.1 Install Monitoring Wells (four wells)	120	lf	$23.75	$0.00	$0.00	$0.00	$2,850	$0	$0	$0	$2,850	
4.2 Well Development (four wells)	6	hr	$35.00	$0.00	$0.00	$0.00	$210	$0	$0	$0	$210	
4.3 Collect / Containerize IDW	2	drums	$50.00	$0.00	$0.00	$0.00	$100	$0	$0	$0	$100	
4.4 Transport / Dispose of IDW	2	drums	$150.00	$0.00	$0.00	$0.00	$300	$0	$0	$0	$300	
4.5 Stick-up Pads with posts	4	ea	$500.00	$0.00	$0.00	$0.00	$2,000	$0	$0	$0	$2,000	
4.6 Survey Well Locations	1	ea	$800.00	$0.00	$0.00	$0.00	$800	$0	$0	$0	$800	
5 ORC Direct Push Installation												
5.1 Direct Push (mob / demob 2 rigs)	2	events	$5,000.00									
5.2 Well Point Installation (direct push)	216	ea	$600.00	$0.00	$0.00	$0.00	$129,600	$0	$0	$0	$129,600	
5.3 ORC	160,000	lb	$15.00	$0.00	$0.00	$0.00	$2,400,000	$0	$0	$0	$2,400,000	
5.4 Standby	10	hrs	$100.00	$0.00	$0.00	$0.00	$1,000	$0	$0	$0	$1,000	
5.5 Collect / Containerize IDW	2	drums	$50.00	$0.00	$0.00	$0.00	$100	$0	$0	$0	$100	
5.6 Transport / Dispose of IDW (offsite)	2	drums	$150.00	$0.00	$0.00	$0.00	$300	$0	$0	$0	$300	
8 PAVEMENT							$0	$0	$0	$0	$0	
8.1 Loading / Unloading Area	4000	sf	$1.25	$0.00	$0.00	$0.00	$5,000	$0	$0	$0	$5,000	
8.2 Parking Area	600	sf	$3.25	$0.00	$0.00	$0.00	$1,950	$0	$0	$0	$1,950	
9 OFFICE SUPPORT/FIELD SUPPORT							$0	$0	$0	$0	$0	
9.1 Field Oversight Personnel (1 person - full time)	700	hours		$0.00	$25.00	$0.00	$0	$0	$17,500	$0	$17,500	
9.2 Office Oversight Personnel (2 people - 1/4 time)	350	hours		$0.00	$30.00	$0.00	$0	$0	$10,500	$0	$10,500	
10 PROJECT DOCUMENTATION												
10.1 Pre- and Post-Construction Submittals	1000	hours		$0.00	$30.00	$0.00	$0	$0	$30,000	$0	$30,000	
10.2 Permitting/Planning Documents	800	hours		$0.00	$50.00	$0.00	$0	$0	$40,000	$0	$40,000	
11 INSTITUTIONAL CONTROLS												
11.1 Transfer Documents	100	hours		$0.00	$0.00	$0.00	$0	$0	$0	$0	$0	
11.2 Modify Existing Master Plan	50	hours		$0.00	$0.00	$0.00	$0	$0	$0	$0	$0	
Subtotal Direct Costs less Subcontract								$3,325	$121,576	$16,501	$141,402	
Local Area Adjustments								99.8%	105.0%	102.3%		
Subtotal								$3,318	$127,655	$16,881	$147,854	
Overhead on Labor Cost @ 0.3									$38,296		$38,296	
G & A on Labor Cost @ 0.1									$12,765		$12,765	
G & A on Material Cost @ 0.1								$332			$332	
Total Direct Cost								$3,650	$178,717	$16,881	$199,247	
Indirects on Total Direct Labor Cost @ 0.75									$134,038		$134,038	
Profit on Total Direct Cost @ 0.1											$19,925	
Subtotal											$353,210	
Health & Safety Monitoring @ 0.005											$1,766	
Total Field Cost											$354,976	
Subtotal Subcontractor Cost							$2,563,270				$2,563,270	
G & A on Subcontract Cost @ 0.1							$256,327				$256,327	
Profit on Subcontractor Cost @ 0.05											$128,164	
Subcontractor Cost											$2,947,761	
Subtotal											$3,302,736	
Contingency on Total Field and Subcontractor Costs @ 0.15											$495,410	
Engineering on Total Field Cost @ 0.08											$28,398	
											$3,826,545	

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Site 7 - Fuel Depot Area
Naval Weapons Industrial Reserve Plant
Calverton, New York
Option 5 - ORC
Annual Operating and Maintenance Costs

	Item	Qty	Unit	Unit Cost	Subtotal Cost	Notes
1	Energy - Electric		Kw-hr	$0.09	$0	
2	Maintenance		ea	$114,796.34	$0	
3	Operator		ea	$22,000.00	$0	
	Total Annual Cost				$0	

Note: Annual Cost - 24 hr/ day - 365 days/ year

Site 7 - Fuel Depot Area
Naval Weapons Industrial Reserve Plant
Calverton, New York
Option 5 - ORC
Annual Cost

Item	Item Cost Annually	Item Cost per 5 Years	Notes
YEAR 1			
Sampling	$11,200.00		GW samples quarterly plus travel, living, and shipping costs
Analysis	$8,960.00		Groundwater analysis only for quarterly samples
Reporting	$60,000.00		
Site Review		$20,000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTALS	$80,160.00	$20,000.00	Post remedial monitoring will be performed annually for years 1 through 30
YEARS 2-30			
Sampling	$2,800.00		GW samples quarterly plus travel, living, and shipping costs
Analysis	$2,240.00		Groundwater analysis only for quarterly samples
Reporting	$50,000.00		
Site Review		$20,000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTALS	$55,040.00	$20,000.00	Post remedial monitoring will be performed annually for years 1 through 30

Site 7 - Fuel Depot Area
Naval Weapons Industrial Reserve Plant
Calverton, New York
Option 5 - ORC
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$3,826,545		$3,826,544.76	1.000	$3,826,545
1		$80,160.00	$80,160.00	0.935	$74,950
2		$55,040.00	$55,040.00	0.873	$48,050
3		$50,040.00	$50,040.00	0.816	$40,833
4		$50,040.00	$50,040.00	0.763	$38,181
5		$75,040.00	$75,040.00	0.713	$53,504
6		$50,040.00	$50,040.00	0.666	$33,327
7		$50,040.00	$50,040.00	0.623	$31,175
8		$50,040.00	$50,040.00	0.582	$29,123
9		$50,040.00	$50,040.00	0.544	$27,222
10		$75,040.00	$75,040.00	0.508	$38,120
11		$50,040.00	$50,040.00	0.475	$23,769
12		$50,040.00	$50,040.00	0.444	$22,218
13		$50,040.00	$50,040.00	0.415	$20,767
14		$50,040.00	$50,040.00	0.388	$19,416
15		$75,040.00	$75,040.00	0.362	$27,164
16		$50,040.00	$50,040.00	0.339	$16,964
17		$50,040.00	$50,040.00	0.317	$15,863
18		$50,040.00	$50,040.00	0.296	$14,812
19		$50,040.00	$50,040.00	0.277	$13,861
20		$75,040.00	$75,040.00	0.258	$19,360
21		$50,040.00	$50,040.00	0.242	$12,110
22		$50,040.00	$50,040.00	0.226	$11,309
23		$50,040.00	$50,040.00	0.211	$10,558
24		$50,040.00	$50,040.00	0.197	$9,858
25		$75,040.00	$75,040.00	0.184	$13,807
26		$50,040.00	$50,040.00	0.172	$8,607
27		$50,040.00	$50,040.00	0.161	$8,056
28		$50,040.00	$50,040.00	0.150	$7,506
29		$50,040.00	$50,040.00	0.141	$7,056
30		$75,040.00	$75,040.00	0.131	$9,830
				TOTAL PRESENT WORTH	**$4,533,918**

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APPENDIX D

TECHNICAL MEMORANDUM – MONITORED NATURAL ATTENUATION

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLES

FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

µg/L	microgram per liter
BGS	below ground surface
BOD	biochemical oxygen demand
BTEX	benzene, toluene, ethylbenzene, xylenes
CLEAN	Comprehensive Long-term Environmental Action Navy
CMS	Corrective Measures Study
COD	chemical oxygen demand
CTO	Contract Task Order
DRO	diesel range organics
EPA	U.S. Environmental Protection Agency
GRO	gasoline range organics
HDPE	high density polyethylene
HNUS	Halliburton NUS Corporation
ID	inside diameter
IDW	investigation derived waste
MCL	maximum contaminant level
mg/L	milligram per liter
MNA	monitored natural attenuation
NAVFAC	Naval Facilities Engineering Command
NWIRP	Naval Weapons Industrial Reserve Plant
OD	outside diameter
ORP	oxidation reduction potential
PID	photoionization detection
PVC	polyvinyl chloride
QA	quality assurance
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
TPH	Total Petroleum Hydrocarbons
TtNUS	Tetra Tech NUS, Inc.
VOCs	volatile organic compounds

1.0 INTRODUCTION

This technical memorandum presents a monitored natural attenuation evaluation of fuel contaminated groundwater at Site 7-Fuel Depot at the Naval Weapons Industrial Reserve Plant (NWIRP) in Calverton, New York. In addition, data was collected to better define the current extent of groundwater contamination. This memorandum was prepared under Contract Task Order (CTO) 0189 by Tetra Tech NUS, Inc. (TtNUS), under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Number N62472-90-D and was conducted to support a Corrective Measures Study (CMS) for the site.

1.1 PURPOSE

The purpose of this monitored natural attenuation (MNA) study was to document the current extent of groundwater contamination and to determine if monitored natural attenuation is a potentially viable technology either as a stand alone technology or in combination with other remedial options. The MNA evaluation considers the presence of biodegradation compounds, plume stability over time, and the use of a model (BIOSCREEN) to predict plume migration and biodegradation rates.

1.2 REPORT FORMAT

Section 1.0 of this technical memorandum presents this introduction. Section 2.0 describes groundwater sampling and analytical results obtained in 2000. Section 3.0 presents the BIOSCREEN modeling evaluation. Conclusions are presented in Section 4.0.

2.0 GROUNDWATER SAMPLING AND RESULTS (2000)

In 2000, two rounds of field investigation were conducted at Site 7. The first round (Step 1) was conducted in late February/early March 2000 and consisted of sampling 12 existing shallow monitoring wells at the site. These samples were collected to evaluate current conditions of site contamination. The second round (Step 2) of investigation was conducted between June and July 2000 and consisted of the installation of four new groundwater monitoring wells and the sampling of six groundwater wells for monitored natural attenuation parameters. The investigation is based on the Monitored Natural Attenuation Work Plan for Site 7 (TtNUS, 2000a), and the results are detailed below.

2.1 STEP 1 TASKS (CURRENT CONDITIONS)

2.1.1 Sampling Procedures

Groundwater sampling was conducted at Site 7 from February 28 through March 2, 2000. Twelve existing monitoring wells were sampled during this phase. Sample locations, numbers, and analysis are provided on Figure 2-1 and in Table 2-1. These wells were selected based on the estimated extent of groundwater contamination as presented in the Phase 2 Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) report for this site (TtNUS, 2000b) and were selected to represent a three by four grid pattern.

During a pre-sample survey of the site, wells 5 and 15 could not be located and since the area is primarily concrete/asphalt were assumed to have been removed during tank excavations and sump installation. The areas surrounding these wells were field checked, and nearby wells could not be located. Instead, wells BR/D and FD-MW-05-S were added to the program to replace these wells.

Prior to groundwater sampling, a round of water level readings was collected from the twelve wells (see Attachment A). The wells were then purged prior to sampling using a peristaltic pump and high-density polyethylene (HDPE) tubing. The tubing intake was placed at approximately the center of the saturated well screen for purge/sampling. Pump flow rates were less than 1.0 gallons per minute on all wells sampled. Note that this method of groundwater sampling has been an approved sampling technique at the facility since the early 1990s. The U.S. Environmental Protection Agency (EPA) recently established another sampling technique for sampling groundwater that includes the use of a submersible pump. The revised EPA approach was used during the second round of the investigation.

Water quality parameter readings were collected during purge/sampling and included pH, specific conductivity, temperature, dissolved oxygen, turbidity, salinity, and eH/oxidation-reduction potential

(ORP). Water level measurements and field parameters were collected at approximate 5-minute intervals during purging. A minimum of three well volumes was removed from each well prior to sampling. Field parameters for pH, specific conductivity, and turbidity were monitored to obtain three consecutive stabilized reading within 10 percent. All purge water was containerized, transported, and transferred to the existing tank for storage of investigation derived waste (IDW) located at the Fuel Calibration area of the site.

With the exception of the volatile organic compounds (VOCs) and total petroleum hydrocarbon-gasoline range organics (TPH-GRO), all sample containers were filled directly from the discharge of the HDPE tubing. Sample containers for VOCs and TPH-GRO were filled using the "soda straw" method. The peristaltic pump was shut off following purging of the well, the tubing was crimped, the tubing was then withdrawn from the well, and the sample containers were filled from the intake end of the tubing while uncrimping the opposite end of the tubing. The process was repeated to acquire sufficient volume to fill all required sample containers. All purge and sampling information was recorded on groundwater purge data sheets and groundwater sample log sheets, respectively. These sheets as well as chain of custody forms can be found in Attachment B.

2.1.2 Analytical Results

In February/March 2000, twelve existing monitoring wells were sampled for VOCs and TPH to characterize existing groundwater contamination at the site. The following monitoring wells were analyzed: FD-MW-01-S, FD-MW-03-S, FD-MW-04-S, FD-MW-05-S, FD-MW-06-S, FD-MW-07-S, 4, 16, 24, BK/19, BN/11, and BR/D (see Figure 2-1).

The results of the initial sample event can be found in Table 2-2 and Attachment I. During this sample event, detected VOCs consisted on benzene, toluene, ethylbenzene, and xylenes (BTEX). In addition, freon 113 was detected at 13 µg/L in well 16. Freon 113 has been used in the area and in particular in the jet fuel systems lab located hydraulically upgradient of this site. Previous sampling was conducted throughout this area, and a source of freon-contaminated groundwater was found in one location, near the jet fuel systems laboratory. Chemicals not detected in the sample are not presented in the table. Figures 2-2, 2-3, 2-4, and 2-5 present the current estimated extent of benzene, toluene, ethylbenzene, and xylene plumes, respectively. Note that these figures include data collected for the newly installed permanent monitoring wells discussed in Section 2.2.

Figure 2-6 illustrates the concentration of BTEX compounds across the site, beginning with well FD-MW-03-S that is considered to be hydraulically upgradient of the site, and continuing to those wells down-gradient of the flow. As seen from the figure, the highest BTEX concentration occurs at monitoring well BN/11, which is located just down-gradient of the location of the former underground storage tanks.

During previous testing, samples collected in the area of the former underground storage tanks were measured to contain up to 1,900 ug/L of xylenes (TtNUS, 2000b).

2.2 STEP 2 TASKS (MNA TESTING)

Step 2 tasks consisting of the installation of four new permanent monitoring wells, sampling and analysis of these wells, and sampling and analysis of six monitoring wells for MNA parameters. The new wells were installed in anticipation of potential future sampling needs for the site as well as to provide permanent down gradient monitoring wells to evaluate near site groundwater contaminant concentrations. Each of these tasks is detailed below.

2.2.1 Monitoring well Installation and Development

Three shallow permanent monitoring wells (FD-MW-08-S through FD-MW-10-S) and one intermediate permanent monitoring well (FD-MW-07-I) were installed in June 2000 for the site. Well locations are illustrated on Figure 2-1. Well locations are approximate, pending final survey results. The locations of the wells were based on groundwater flow patterns for the area and were confirmed based on analytical results obtained during the Step 1 groundwater sampling activities. The borings were drilled with a Failing F-10 drilling rig using hollow-stem-auger drilling techniques and 6.25 inch I.D. augers. The three shallow boring were drilled to 22 feet below ground surface (BGS) and the intermediate boring was completed to 44 feet BGS. Water was encountered in all borings at approximately 12 feet BGS during drilling. The three shallow borings were drilled to approximately 8 feet below the water table and completed as cased wells, screened across the water table. The intermediate boring was drilled to approximately 30 feet below the water table and was also completed as a cased well. Monitoring well characteristics are summarized in Table 2-3.

Subsurface soil samples were collected within each boring at 5-foot intervals by driving a 2-inch O.D. by 24-inch length split-barrel with repeated blows using a 140-pound hammer falling a distance of 30 inches. The samples were screened with a photoionization detector (PID) and visually inspected for evidence of contamination (such as staining) and for lithologic description.

Approximately 1 foot of dark brown to brown, fine-grained silty sand was encountered just below the ground surface within each of the monitoring well borings. The remaining lithology of each boring was characterized by tan-white, slightly pebbly, fine-to-medium grained sand. The lithologies seen in each of the borings are consistent with that of previous site investigations and represent unconsolidated sediments of the Upper Glacial Formation which underlies the subject site. Soil boring logsheets were completed for each boring to document the subsurface lithologies and are included in Attachment C.

The wells were constructed with 4-inch diameter, flush-jointed and threaded, schedule 40 polyvinyl chloride (PVC) well casing and 4-inch diameter, schedule 40, 0.020-inch slotted PVC well screen fitted with a PVC bottom cap. Ten-foot screens were installed in all the wells. The annular space between the well screen and the borehole was packed with Morie No. 1 sand to a height of approximately 2 feet above the top of the screen. A minimum 2-foot annular seal, consisting of hydrated bentonite pellets, was placed on top of the filter pack. The remainder of the well annulus was backfilled with a cement/bentonite grout to a height of approximately 0.5 foot BGS. The wells were completed with 6-inch diameter protective steel casings which were installed at approximately 2.5 feet above the ground surface. A 2-feet by 2-feet square concrete apron was also placed around each well. Monitoring well construction sheets are included in Attachment D.

The wells were developed a minimum of 24 hours after installation with a submersible pump. The pump flow-rate, water level, and groundwater pH, specific conductance, dissolved oxygen, turbidity, and ORP were monitored on a regular basis during development. All wells were developed to a water turbidity of 10 NTU or less. Approximately 420 total gallons of water was removed from the wells. This water was containerized and transported to the temporary storage tanks located at the site staging area. Monitoring well development log sheets were completed for each well and are included in Attachment E.

2.2.2 Water Level and Free Product Thickness Measurements

Prior to the groundwater sampling for Step 2, on July 14, 2000, one round of free-product and static water level measurements was collected from the on-site wells. No free product was detected within any of the wells surveyed. Free product measurements and static water levels were collected using a Keck electronic Interface probe. All measurements were made from the top of the inner PVC riser pipe (TIC) and readings were recorded to the nearest 0.01 foot. Depth to water table ranged from 14.64 feet to 18.95 feet TIC. A groundwater level measurement log sheet was completed and is included in Attachment F.

2.2.3 Monitoring well Purging and Sampling

The four new wells plus four of the existing wells at Site 7 were sampled between July 11 and July 19, 2000. Sample numbers and analysis are provided in Table 2-4. Sample locations are indicated on Figure 2-1.

All wells, with the exception of BN/11, were sampled using EPA quality assurance (QA) directives for low flow purging and sampling of groundwater monitoring wells (EPA Region III QA Directives, Bulletin QAD023, August 8, 1994). Because of a low water level in BN/11, this well was sampled using the peristaltic pump technique discussed in Step 1. An adjustable rate, Redi-flow pump and Teflon lined

HDPE tubing was utilized for purging and sampling of the wells. The pump was placed at approximately the center of the saturated well screen prior to beginning purge activities. All wells, with the exception of FD-MW-07-I (in which three well screen volumes purged) were purged a minimum of three well volumes and until monitored water quality parameters of three consecutive purge-water reading fell within 10 percent of one another. Water quality field measurements were collected every 5-minutes and included pH, specific conductivity, temperature, dissolved oxygen, turbidity, and Eh/ORP. All water quality parameters were measured with a device utilizing a flow-through cell. In addition, wells FD-MW-07-S, FD-MW-07-I, FD-MW-10-S, BN/11, FD-MW-03-S, and FD-MW-04-S were also monitored for natural attenuation parameters of carbon dioxide, dissolved oxygen, ferrous iron, and hydrogen sulfide using field test kits. The water level in each well and the flow rate of the pump were also monitored to assure that the wells were not purged at a higher rate than the natural yield of the formation. Except for VOCs in well FD-BN/11, all well samples were collected by filling the appropriate sample jars directly from the pump discharge tubing. Because there was inadequate water in Well FD-BN/11 (2 feet), this well was sampled using a peristaltic pump and HDPE tubing and VOC samples were collected using the soda straw method. All water quality parameters and data collection times were the same as obtained from all other wells sampled at Site 7. Samples were collected as noted in section 2.1.1 above. Groundwater sample log sheets, low flow purge data sheets, and natural attenuation parameter log sheets were completed for each well and can be found in Attachment G along with chain of custody forms.

2.2.4 Hydraulic Conductivity Testing

In-situ hydraulic conductivity tests (slug tests) were performed in seven of the permanent monitoring wells in the Fuel Depot Area on October 3, 2000. Testing included six shallow wells and one intermediate well. Nearly instantaneous water level changes were induced in the wells by quickly withdrawing or inserting a PVC slug of known dimensions for the rising head and falling head tests, respectively. The subsequent water level changes during recovery were measured using a pressure transducer and automatic data logger. All down-hole slug testing equipment was decontaminated before and after use in each well.

Rising head tests only were performed in the six shallow wells where the static water level is below the top of the screened interval. Both rising head and falling head tests were recorded in intermediate well FD-MW-07-I where the static water level is above the top of the screened interval and gravel pack. Each test was performed twice and recorded separately to confirm the results.

The slug test water level data were plotted as the change in head versus elapsed time and were analyzed using the Bouwer and Rice technique (the second falling head test recorded in FD-MW-07-I was not analyzed due to poor data quality). An assumed aquifer thickness of 55 feet was used in the calculations. The aquifer thickness estimate is based on an average depth to local aquiclude deposits of about 70 feet below the ground surface and an approximate depth of 15 feet below the ground surface to the top of the water table aquifer. All other parameters were obtained from well construction logs and field measurements of static water level and well total depth.

The results of the slug test analysis are presented in Table 2-5. Slug test raw data, plots, and calculations are included in Attachment H.

2.2.5 Analytical Results

The analytical results for the six permanent monitoring wells tested for MNA parameters are presented in Table 2-6 and Attachment I. Also included in this table are the analytical results for the newly installed monitoring wells FD-MW-08-S and FD-MW-09-S, which were sampled for VOCs and TPH analysis only. Well locations are presented in Figure 2-1.

During the monitored natural attenuation sample event mentioned above, detected VOCs consisted of benzene, toluene, ethylbenzene, and xylenes. Freon 113 was also detected in monitoring well FD-MW-07-I at a maximum concentration of 17 µg/L. Freon has been detected in two other wells in the area and will be specifically addressed in the Corrective Measures Study.

In addition, groundwater from six monitoring wells sampled was analyzed for biodegradation indicators. Each of these MNA parameters is discussed as follows. During the biodegradation of organics, biochemical oxygen demand (BOD) represents both biological and chemical reactions in groundwater that can occur over a 5 day period and consume elemental oxygen. For most applications, the BOD is a measure of biodegradable organics, dissolved iron, and to a lesser extent dissolved manganese. Chemical oxygen demand measures these same constituents plus more complex organics that are not amenable to biodegradation over a 5 day period.

Dissolved oxygen levels greater than 1.0 mg/L are indicative of an aerobic environment. Under aerobic conditions, natural bacteria present in the aquifer use oxygen and petroleum hydrocarbons for energy and cell growth and produce carbon dioxide as a waste product. Therefore, the absence of dissolved oxygen and the presence of elevated carbon dioxide concentrations in groundwater, relative to the upgradient monitoring well, are generally direct evidence of biodegradation. Biodegradation rates for most petroleum compounds are more rapid under aerobic conditions. The dissolved oxygen concentration in the upgradient monitoring well FD-MW-03-S is 7.17 mg/L indicating that the groundwater entering the site is aerobic. Similarly, the dissolved oxygen concentration in an in-plume well near the upgradient edge of the site had a dissolved oxygen reading greater than 1.0 mg/L. However, instrument error is suspected with this reading, because the ORP reading was negative in this well. The balance of the in-plume wells (FD-MW-07-I, FD-MW-10-S, and BN/11) had depressed dissolved oxygen concentrations and depressed ORP readings indicating that the residual oxygen in the aquifer has been consumed. In the downgradient shallow wells, dissolved oxygen concentrations greater than 1.0 mg/L and positive ORP readings were noted, indicating that aerobic conditions were again present.

Once the available free oxygen is consumed, bacteria will use other natural compounds in the aquifer such as sulfates, nitrates, iron, and manganese to react with the petroleum compounds to form energy and cell growth (anaerobic biodegradation). Carbon dioxide is also formed in these reactions, however, methane, chloride (if chlorinated compounds are present), nitrite, sulfide, dissolved iron (ferrous iron), and dissolved manganese (divalent manganese) are also formed. The presence of these other compounds suggests that anaerobic biodegradation of the petroleum hydrocarbons is also occurring.

Figure 2-7 illustrates MNA BTEX contamination following the path of groundwater, from up-gradient to down-gradient monitoring wells. Figure 2-8 illustrates methane concentration along the site, while BOD and chemical oxygen demand (COD) are illustrated on Figure 2-9.

Overall, the analytical results from this investigation provide direct evidence that biodegradation of the site petroleum hydrocarbons is occurring.

2.2.6 Historical Contaminant Migration Trends

The second element of the MNA evaluation is to evaluate plume stability over time. Ideally, long term data from within the groundwater plume and downgradient areas are used to track the stability of the plume. Representative samples are collected at regular intervals from permanent monitoring wells and evaluated to ensure that plume contaminants are not migrating adversely. Currently for this site, only limited long term data is available. Some data is available from Grumman studies in the late 1980s. The Navy's Site Investigation in 1991, and the RFI investigations in 1994, 1995, and 2000 present more detail. This data is summarized in Table 2-7 and represents site wells in which there is at least 5 years of history.

Wells FD-MW-04-S, FD-MW-05-S, FD-MW-06-S, and 24 represent groundwater in or near the likely source area at Site 7 (namely the former underground storage tank area). Based on a review of this data over a 5 to 10 year period in the source area, there is no obvious trend with the results either increasing or decreasing. Fluctuations of a factor of three to four in chemical concentrations are apparent but may result from seasonal, dissolution, equilibrium, and/or biodegradation rate variables.

Data from two downgradient or near downgradient wells (wells 16 and 19), are also presented. In well 16, BTEX concentrations increased from nondetect values to as high as 24 ug/L for ethylbenzene. In well 19, BTEX concentrations decreased from a high of 800 ug/L to a nondetect value (5 ug/L).

TABLE 2-1

SUMMARY OF STEP 1 SAMPLES (CURRENT CONDITIONS)
SITE 7 – FUEL DEPOT AREA
NWIRP CALVERTON, NEW YORK

WELL NUMBER	SAMPLE IDENTIFICATION	SAMPLE ANALYSIS
FD-MW-01-S	FD-GW01S-00	VOCs, TPH (GRO & DRO)
FD-MW-03-2	FD-GW03S-00	VOCs, TPH (GRO & DRO)
FD-MW-04-S	FD-GW04S-00	VOCs, TPH (GRO & DRO)
FD-MW-06-S	FD-GW06S-00	VOCs, TPH (GRO & DRO)
FD-MW-07-S	FD-GW07S-00 and GWFD-030200 (duplicate)	VOCs, TPH (GRO & DRO)
FD-MW-05-S	FD-GW05S-00	VOCs, TPH (GRO & DRO)
BR/D	FD-GWGRD-00	VOCs, TPH (GRO & DRO)
BN/11	FD-GWGR11-00	VOCs, TPH (GRO & DRO)
BK/19	FD-GWGR19-00	VOCs, TPH (GRO & DRO)
4	FD-GWGR4-00	VOCs, TPH (GRO & DRO)
16	FD-GWGR16-00	VOCs, TPH (GRO & DRO)
24	FD-GWGR24-00	VOCs, TPH (GRO & DRO)

Notes:

VOCs = volatile organic compounds

TPH (GRO & DRO) = Total petroleum hydrocarbons (gasoline range organics & diesel range organics)

TABLE 2-2

INITIAL GROUNDWATER ANALYTICAL RESULTS FOR DELINEATING GROUNDWATER PLUME
SITE 7 - FUEL DEPOT
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
CALVERTON, NEW YORK

CHEMICAL	FD-MW-01-S (Side-gradient)	FD-MW-03-S (Up-gradient)	FD-MW-04-S (Source Area-North)	FD-MW-05-S (Down-gradient-South)	FD-MW-06-S (Source Area)	FD-MW-07-S (Down-gradient-Center)
Volatile Organic Compounds (µg/L)						
BENZENE	ND	ND	ND	ND	ND	ND
TOLUENE	ND	ND	5.2 J	ND	ND	ND
ETHYLBENZENE	ND	ND	120	110	28	ND
XYLENES, TOTAL	ND	2.2 J	1100	460	170	ND
FREON 113	ND	ND	ND	ND	ND	ND
Total Petroleum Hydrocarbons (mg/L)						
DIESEL RANGE ORGANICS	0.15	0.47	0.85	1.0	3.0	0.56
GASOLINE RANGE ORGANICS	ND	ND	2.8	1.7	4.0	ND

Notes:
ND = Not Detected
Other VOCs not detected
The directions in parentheses below the monitoring well names indicate location of well in reference to plume (see Figure 2-1)

TABLE 2-2

INITIAL GROUNDWATER ANALYTICAL RESULTS FOR DELINEATING GROUNDWATER PLUME
SITE 7 - FUEL DEPOT
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
CALVERTON, NEW YORK

CHEMICAL	4 (Source Area-Center)	BN/11 (Down-gradient-Center)	16 (Down-gradient-South)	BK/19 (Down-gradient-North)	24 (Up-gradient-North)	FD-GWGRD-00 (Down-gradient-South)
Volatile Organic Compounds (μg/L)						
BENZENE	ND	6 J	ND	ND	8.8 J	ND
TOLUENE	140	550	1.2 J	ND	28	ND
ETHYLBENZENE	290	220	3.7 J	ND	83	ND
XYLENES, TOTAL	2300	1100	24	ND	390	3.9 J
FREON 113	ND	ND	13 J	ND	ND	ND
Total Petroleum Hydrocarbons (mg/L)						
DIESEL RANGE ORGANICS	3.4	39	0.25	2.1	1.1	1.2
GASOLINE RANGE ORGANICS	5.8	11	ND	1.2	1.7	0.29

Notes:
ND = Not Detected
Other VOCs not detected
The directions in parentheses below the monitoring well names indicate location of well in reference to plume (see Figure 2-1)

TABLE 2-3

MONITORING WELL CHARACTERISTICS SUMMARY
SITE 7 - FUEL DEPOT
NWIRP CALVERTON, NEW YORK

Monitoring Well Number	Total Depth[1] (feet)	Approximate Depth to Water[1]	Screened Interval Depth (feet)	Filter Pack Interval Depth (feet)
FD-MW-07-I	42	12	32 - 42	30 – 44
FD-MW-08-S	20	12.5	10 - 20	8 – 22
FD-MW-09-S	20	12	10 - 20	8.5 – 22
FD-MW-10-S	20	12.1	10 - 20	8 – 22

[1] in feet below grade. Readings obtained during monitoring well installation.

TABLE 2-4

**SUMMARY OF STEP 2 (MNA) SAMPLES
SITE 7 – FUEL DEPOT AREA
NWIRP CALVERTON, NEW YORK**

Well Number	Sample Identification	Sample Analysis
FD-MW-07-S	FD-GW07S-00	VOCs, TPH (DRO & GRO) BTEX, and natural attenuation parameters
FD-MW-07-I	FD-MW07I-00	VOCs, TPH (DRO & GRO) BTEX, and natural attenuation parameters
FD-MW-10-S	FD-GW10S-00 FD-GW34D-00* (VOCs only)	VOCs, TPH (DRO & GRO) BTEX, and natural attenuation parameters
FD-BN/11*	FD-MWERM1BN* FD-GWFD-071900*	VOCs, TPH (DRO & GRO) BTEX, and natural attenuation parameters
FD-MW-03-S	FD-GW03S-00	VOCs, TPH (DRO & GRO) BTEX, and natural attenuation parameters
FD-MW-04S	FD-GW04S-00	VOCs, TPH (DRO & GRO) BTEX, and natural attenuation parameters
FD-MW-08-S	FD-GW08S-00	VOCs, TPH (GRO & DRO)
FD-MW-09-S	FD-GW09S-00	VOCs, TPH (GRO & DRO)

Notes:

VOCs = volatile organic compounds

TPH (GRO) = total petroleum hydrocarbon (gasoline range organics)

TPH (DRO) = total petroleum hydrocarbons (diesel range organics)

BTEX = benzene, toluene, ethylbenzene, and xylene

Natural attenuation parameters consist of BOD, COD, TOC, alkalinity, nitrate, nitrite, dissolved manganese and iron, methane, sulfate, carbon dioxide, orthophosphate, and sulfide.

TABLE 2-5

HYDRALIC CONDUCTIVITY TEST RESULTS
SITE 7 – FUEL DEPOT AREA
NWIRP CALVERTON, NEW YORK

Well Number	Hydraulic Conductivity, Test 1 (cm/sec)	Hydraulic Conductivity, Test 2 (cm/sec)
FD-MW-04-S Rising Head	1.50-01	1.50E-01
FD-MW-05-S Rising Head	1.97E-01	2.05E-01
FD-MW-06-S Rising Head	9.10E-02	8.93E-02
FD-MW-07-I Falling Head	1.80E-01	Not Analyzed
FD-MW-07-I Rising Head	2.38E-01	2.36E-01
FD-MW-08-S Rising Head	1.38E-01	1.61E-01
FD-MW-09-S Rising Head	9.02E-02	8.76E-02
FD-MW-10-S Rising Head	1.54E-01	1.54E-01

TABLE 2-6

MONITORED NATURAL ATTENUATION GROUNDWATER ANALYTICAL RESULTS
SITE 7 - FUEL DEPOT
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
CALVERTON, NEW YORK

CHEMICAL	FD-MW-03-S (Up-gradient)	FD-MW-04-S Source Area-North	FD-MW-07-I (Down-gradient-Center)	FD-MW-07-S (Down-gradient-Center)
Volatile Organic Compounds (µg/L)				
BENZENE	ND	ND	ND	ND
TOLUENE	ND	14 J	ND	ND
ETHYLBENZENE	ND	500	ND	ND
XYLENES, TOTAL	ND	4800	2.1 J	ND
FREON 113	ND	ND	17	ND
Biodegradation Indicators (mg/L)				
BIOCHEMICAL OXYGEN DEMAND	ND	ND	3.9	ND
CARBON DIOXIDE	ND	2.2	ND	ND
CHEMICAL OXYGEN DEMAND	ND	ND	ND	ND
CHLORIDE	2.8	4.4	8.2	5.4
DISSOLVED OXYGEN	7.17	9.69	0.22	4.79
HYDROGEN SULFIDE	2.0	0.5	0.3	0.0
METHANE	ND	0.19	0.087	0.032
NITRATE	2.8	0.37	0.3	ND
NITRITE	ND	ND	ND	ND
ORTHOPHOSPHATE	ND	ND	ND	ND
SULFATE	5	2.2	19.8	8.7
SULFIDE	ND	ND	ND	ND
TOTAL ALKALINITY	30.8	49.5	21.2	8.7
TOTAL ORGANIC CARBON	ND	1.6	1.4	1.1
OXIDATION REDUCTION POTENTIAL	66.1	-60	15.6	184
Inorganics (µg/L)				
DISSOLVED IRON	ND	3750	ND	3780
MANGANESE	ND	33	339	138
Total Petroleum Hydrocarbons (mg/L)				
DIESEL RANGE ORGANICS	ND	0.99	0.38	ND
GASOLINE RANGE ORGANICS	ND	4.8	ND	ND

TABLE 2-6

MONITORED NATURAL ATTENUATION GROUNDWATER ANALYTICAL RESULTS
SITE 7 - FUEL DEPOT
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
CALVERTON, NEW YORK

CHEMICAL	FD-MW-08-S (Down-gradient-South)	FD-MW-09-S (Down-gradient-North)	FD-MW-10-S (Down-gradient-Center)	BN/11 (Down-gradient-Center)
Volatile Organic Compounds (µg/L)				
BENZENE	ND	ND	1.3 J	ND
TOLUENE	ND	ND	3.2 J	75
ETHYLBENZENE	ND	ND	28	33
XYLENES, TOTAL	ND	ND	84	170
FREON 113	ND	ND	ND	ND
Biodegradation Indicators (mg/L)				
BIOCHEMICAL OXYGEN DEMAND	NA	NA	4.6	42.6
CARBON DIOXIDE	ND	ND	ND	16
CHEMICAL OXYGEN DEMAND	NA	NA	33.9	327
CHLORIDE	NA	NA	3.1	3.2
DISSOLVED OXYGEN	5.50	4.83	1.35	0.36
HYDROGEN SULFIDE	NA	NA	0.3	5.0
METHANE	NA	NA	1.6	1.0
NITRATE	NA	NA	ND	ND
NITRITE	NA	NA	ND	ND
ORTHOPHOSPHATE	NA	NA	0.5	ND
SULFATE	NA	NA	3.6	2.4
SULFIDE	NA	NA	ND	4.2
TOTAL ALKALINITY	NA	NA	72.2	222
TOTAL ORGANIC CARBON	NA	NA	9.2	ND
OXIDATION REDUCTION POTENTIAL	111	241	-98.8	-168.3
Inorganics (µg/L)				
DISSOLVED IRON	NA	NA	8630	7080
MANGANESE	NA	NA	173	85.6
Total Petroleum Hydrocarbons (mg/L)				
DIESEL RANGE ORGANICS	0.14	0.16	2.1	27
GASOLINE RANGE ORGANICS	ND	ND	0.83	5.7

Notes:
ND = Not Detected
NA = Not Analyzed
Acetone and 2-Butanone were detected in three and one samples, respectively, and are believed to be lab contaminants.
The value of Total Organic Carbon is reported as a Non-Detect for monitoring well BN/11 as a result of matrix complications (actual detection near 100 mg/L).
Biodegradation Indicators Ethane and Ethene were analyzed but not detected.
Dissolved Oxygen and Hydrogen Sulfide tests were conducted in the field, rather than at the lab.

TABLE 2-7

COMPARISON OF HISTORICAL GROUDWATER DATA (ug/L)
SITE 7 - FUEL DEPOT
NWIRP CALVERTON, NEW YORK

Well Identification	Location	Sample Date	Benzene	Toluene	Ethylbenzene	Xylene
FD-MW04-S	Source area	August 1994		33	180	1,550
		March 1995		45	200	1,600
		February 2000		5.2	120	1,100
		July 2000		14	500	4,800
FD-MW05-S	Source Area	August 1994			26	29
		March 1995				
		February 2000			110	460
FD-MW06-S	Source Area	August 1994		160	290	2400
		March 1995		23	145	855
		February 2000			28	170
24	Source Area	May 1990	2	68	23	182
		August 1991	14	130	84	450
		February 2000	8.8	28	83	390
16	Downgradient	June 1989				
		March 2000		1.2	24	13
19	Downgradient	June 1989	800	24	58	89
		March 2000				

Blank indicates a nondetect value.

1989 to 1991 data are from former Northrop Grumman reports that can be found in the 1992 SI report (HNUS 1992).

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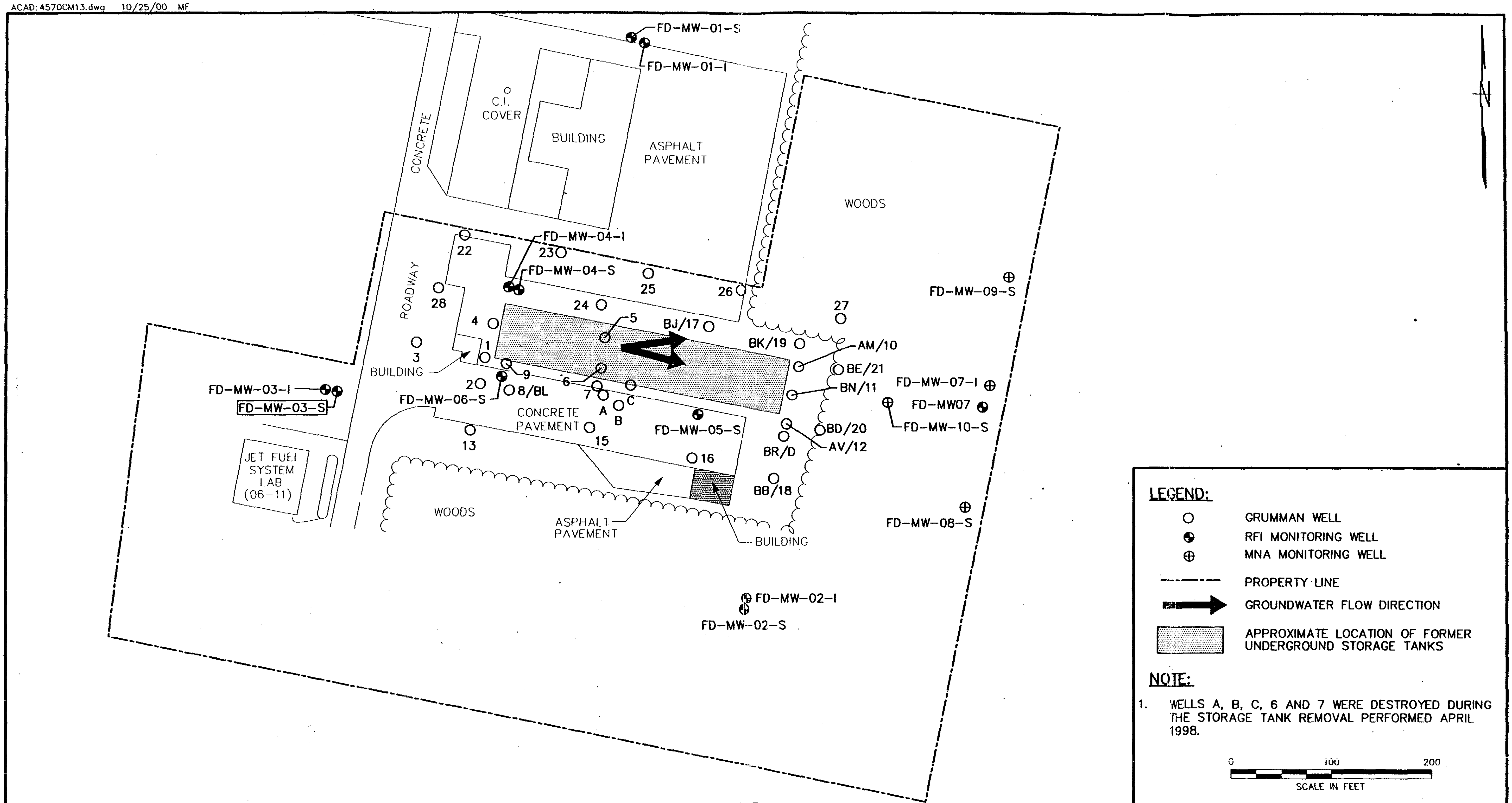

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY MF DATE 10/25/00

CHECKED BY DATE

COST/SCHED-AREA

SCALE AS NOTED

Tetra Tech NUS, Inc.

MONITORING WELL LOCATIONS
SITE 7 – FUEL DEPOT
NWIRP, CALVERTON, NY

CONTRACT NO. 4570

OWNER NO. 0189

APPROVED BY DATE

APPROVED BY DATE

DRAWING NO. FIGURE 2.1

REV. 0

FORM CADD NO. TtNUS_BH.DGN – REV 0 – 1/20/98

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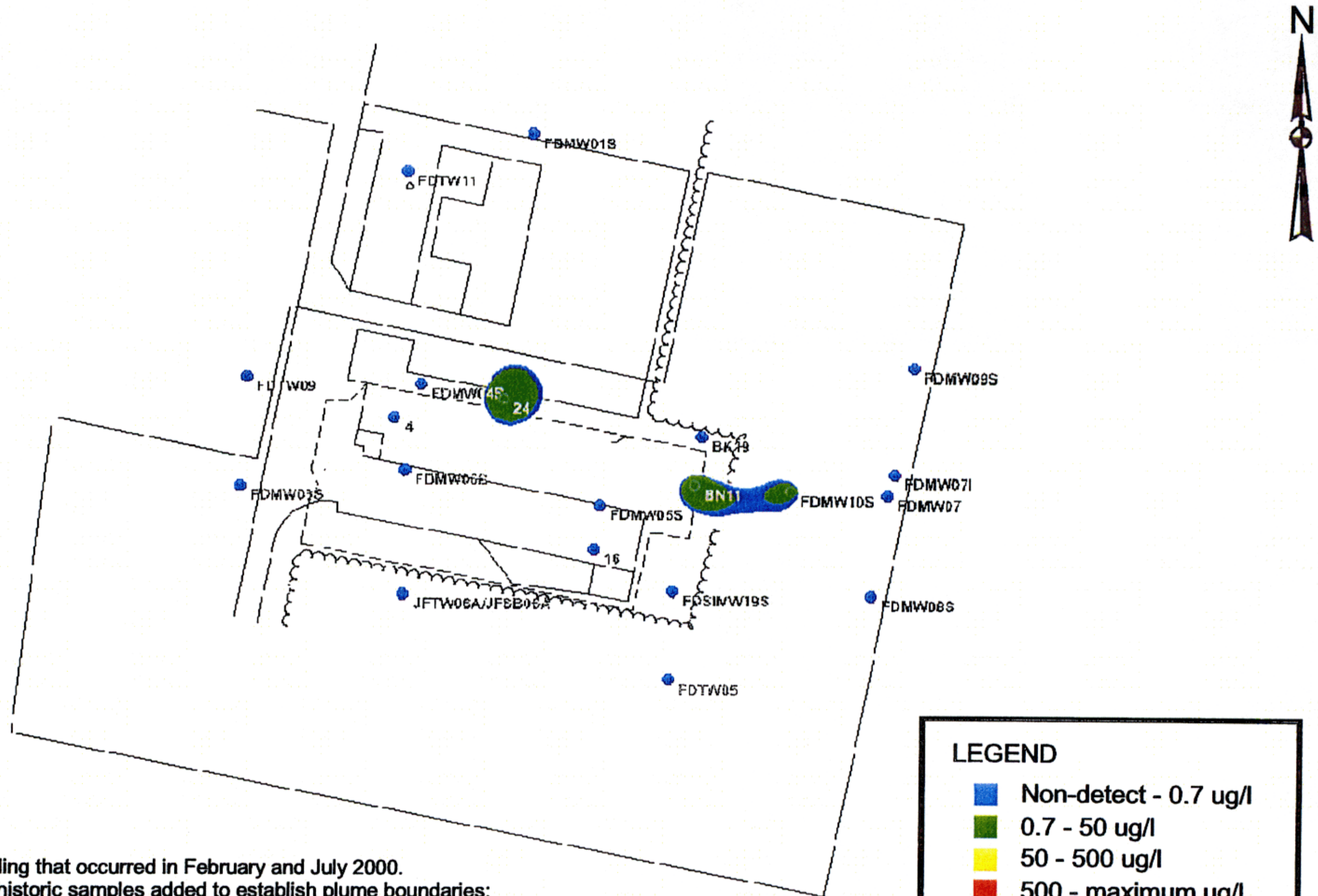


Notes:
(1) Results are based on sampling that occurred in February and July 2000.
(2) The following locations are historic samples added to establish plume boundaries: FDSIMW19S, JFTW06A/JFSB06A, FDTW05, FDTW09, and FDTW11.

DRAWN BY J. LAMEY — DATE 9/20/00

CHECKED BY — DATE

COST/SCHEDULE-AREA

SCALE AS NOTED

Tetra Tech NUS, Inc.

BENZENE PLUMES
SITE 7
NWIRP CALVERTON, NEW YORK

CONTRACT NUMBER N4570

OWNER NUMBER

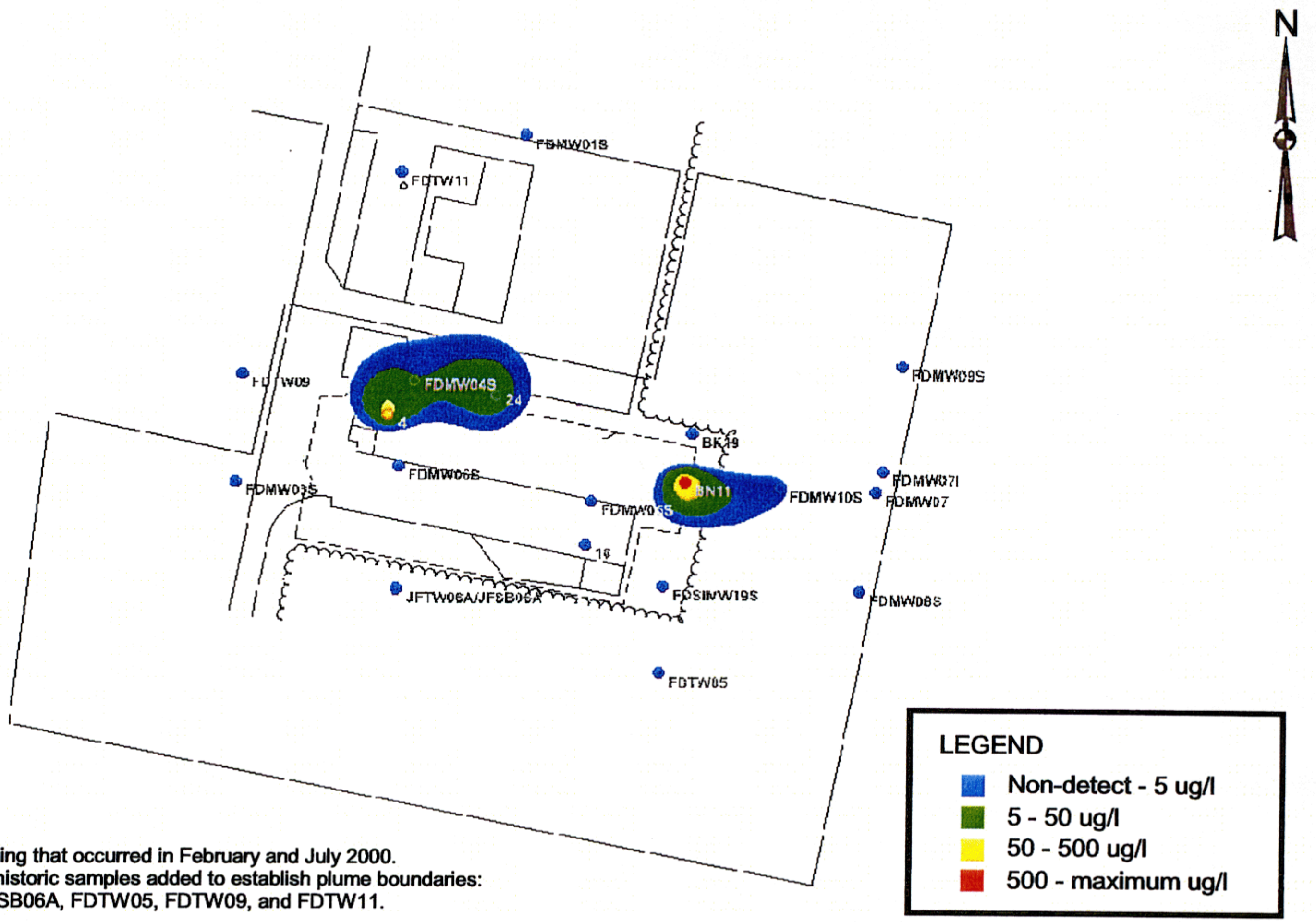
APPROVED BY — DATE

APPROVED BY — DATE

DRAWING NO Figure 2-2

REV 0

P:\GIS\NWIRP_CALVERTON\EVS\SITES7&10A_MAX.APR SITE 7 - BENZENE PLUME-REVISED 10/23/00 JAL



Notes:
(1) Results are based on sampling that occurred in February and July 2000.
(2) The following locations are historic samples added to establish plume boundaries: FDSIMW19S, JFTW06A/JFSB06A, FDTW05, FDTW09, and FDTW11.

DRAWN BY J. LAMEY	DATE 9/20/00	Tetra Tech NUS, Inc.	CONTRACT NUMBER N4570	OWNER NUMBER —
CHECKED BY	DATE	TOLUENE PLUMES SITE 7 NWIRP CALVERTON, NEW YORK	APPROVED BY —	DATE —
COST/SCHEDULE-AREA			APPROVED BY —	DATE —
SCALE AS NOTED			DRAWING NO. Figure 2-3	REV 0

P:\GIS\NWIRP_CALVERTON\EVS\SITES7&10A_MAX.APR SITE 7 - TOLUENE PLUME-REVISED 10/23/00 JAL

Notes:
(1) Results are based on sampling that occurred in February and July 2000.
(2) The following locations are historic samples added to establish plume boundaries:
FDSIMW19S, JFTW06A/JFSB06A, FDTW05, FDTW09, and FDTW11.

DRAWN BY J. LAMEY	DATE 9/20/00	Tetra Tech NUS, Inc.	CONTRACT NUMBER N4570	OWNER NUMBER —
CHECKED BY —	DATE —	ETHYLBENZENE PLUMES SITE 7 NWIRP CALVERTON, NEW YORK	APPROVED BY —	DATE —
COST/SCHEDULE-AREA			APPROVED BY —	DATE —
SCALE AS NOTED			DRAWING NO. Figure 2-4	REV 0

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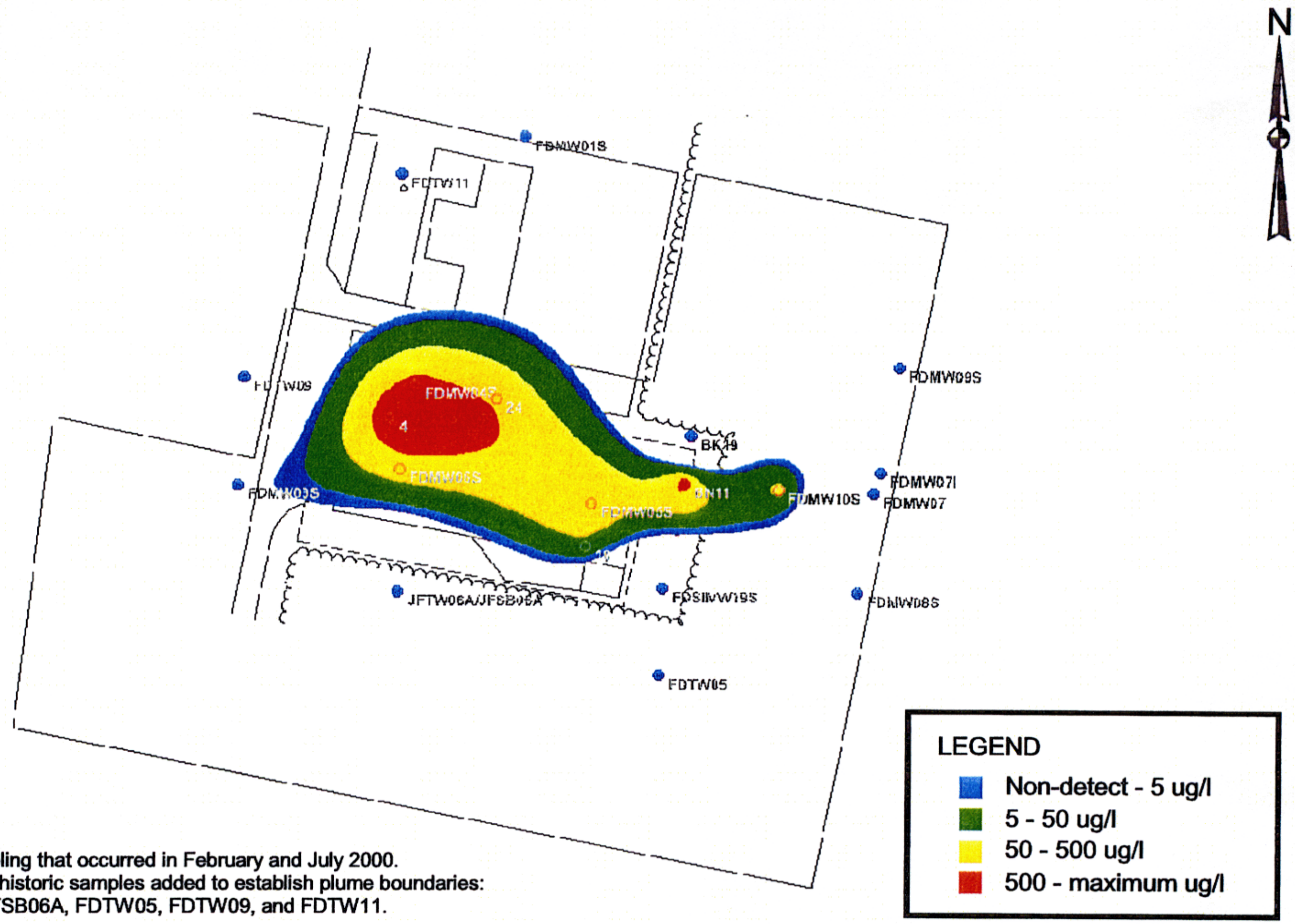


Notes:
(1) Results are based on sampling that occurred in February and July 2000.
(2) The following locations are historic samples added to establish plume boundaries: FDSIMW19S, JFTW06A/JFSB06A, FDTW05, FDTW09, and FDTW11.

DRAWN BY J. LAMEY / DATE 9/20/00	Tetra Tech NUS, Inc.	CONTRACT NUMBER N4570	OWNER NUMBER —
CHECKED BY — / DATE —	XYLENE PLUMES SITE 7 NWIRP CALVERTON, NEW YORK	APPROVED BY — / DATE —	
COST/SCHEDULE-AREA		APPROVED BY — / DATE —	
SCALE AS NOTED		DRAWING NO. Figure 2-5	REV 0

P:\GIS\NWIRP_CALVERTON\EVS\SITES7&10A_MAX.APR SITE 7 - XYLENES PLUME-REVISED 10/23/00 JAL

FIGURE 2-6

INITIAL BTEX GROUNDWATER DETECTIONS (APRIL 2000)
SITE 7 - FUEL DEPOT
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
CALVERTON, NEW YORK

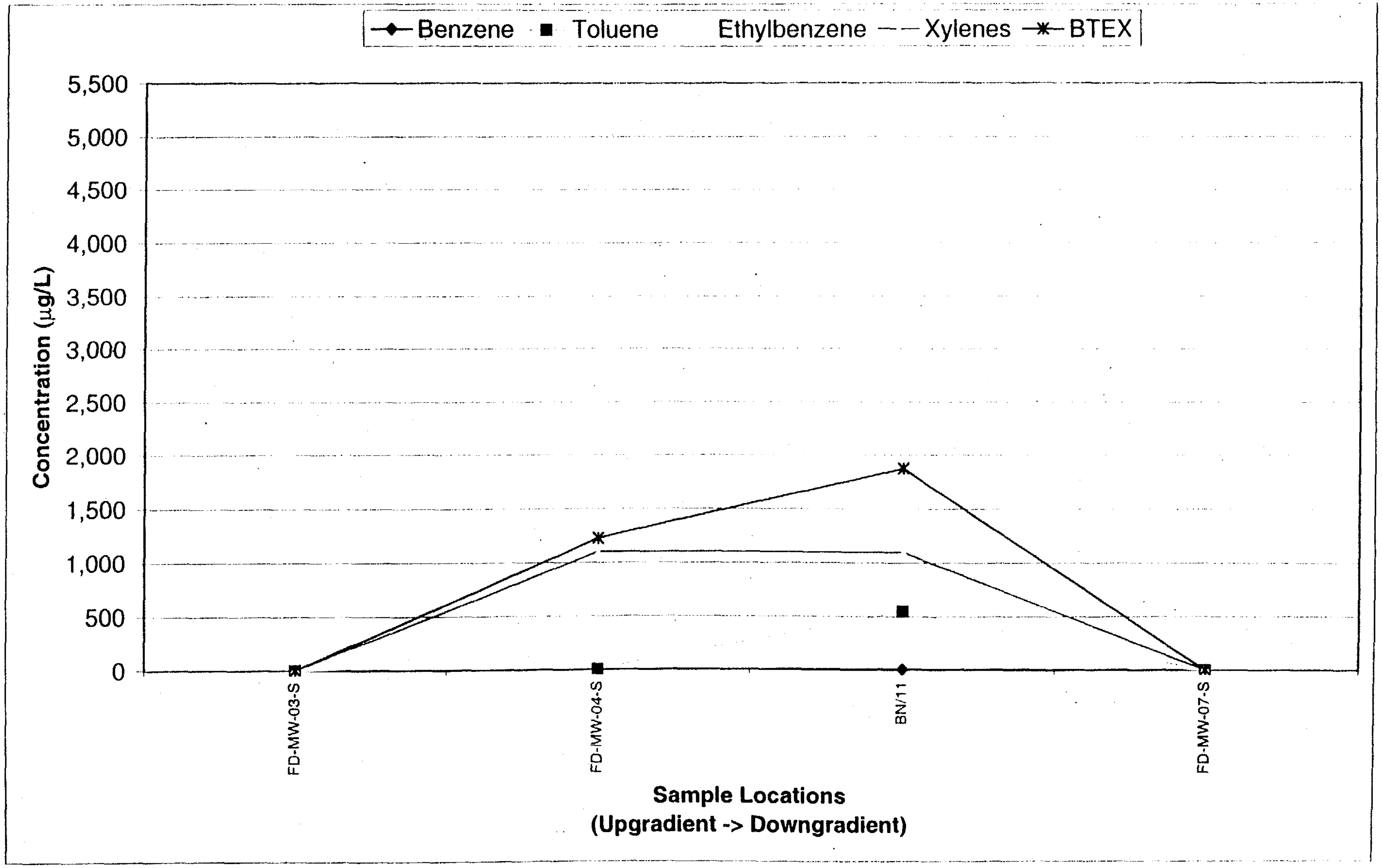


FIGURE 2-7

MONITORED NATURAL ATTENUATION BTEX GROUNDWATER DETECTIONS (JULY 2000)
SITE 7 - FUEL DEPOT
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
CALVERTON, NEW YORK

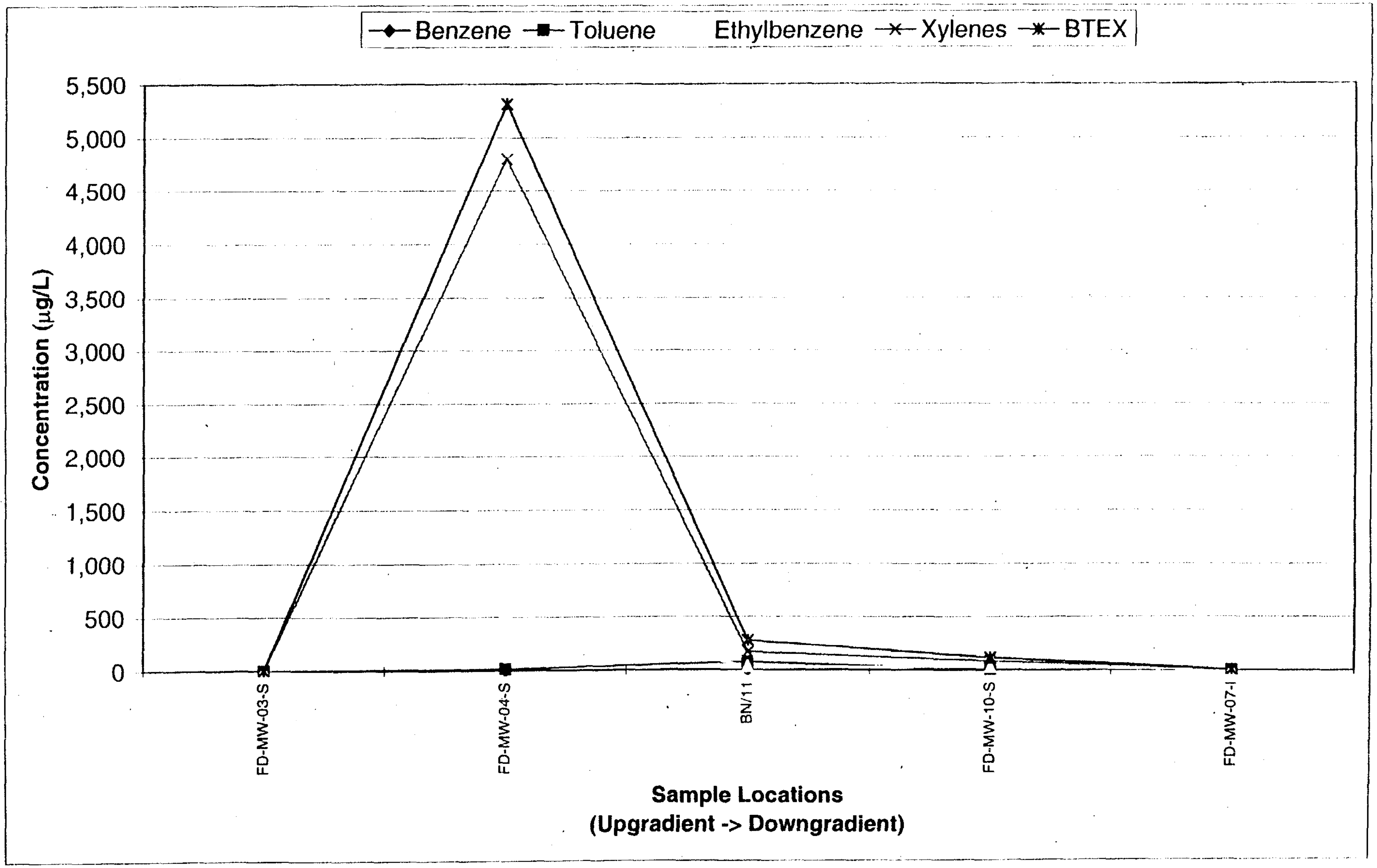


FIGURE 2-8

MONITORED NATURAL ATTENUATION GROUNDWATER DEGRADATION INDICATORS (JULY 2000) - METHANE
SITE 7 - FUEL DEPOT
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
CALVERTON, NEW YORK

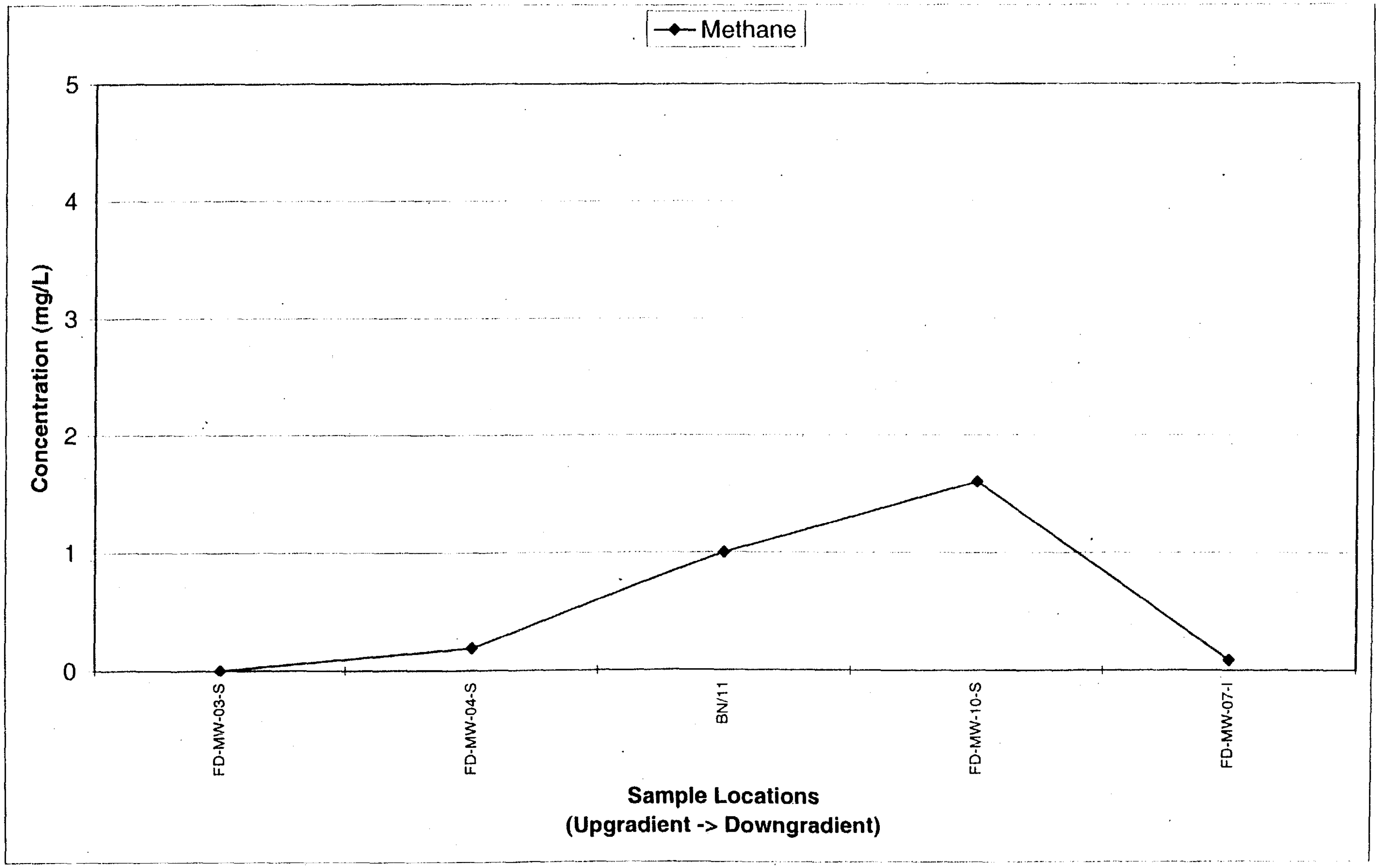
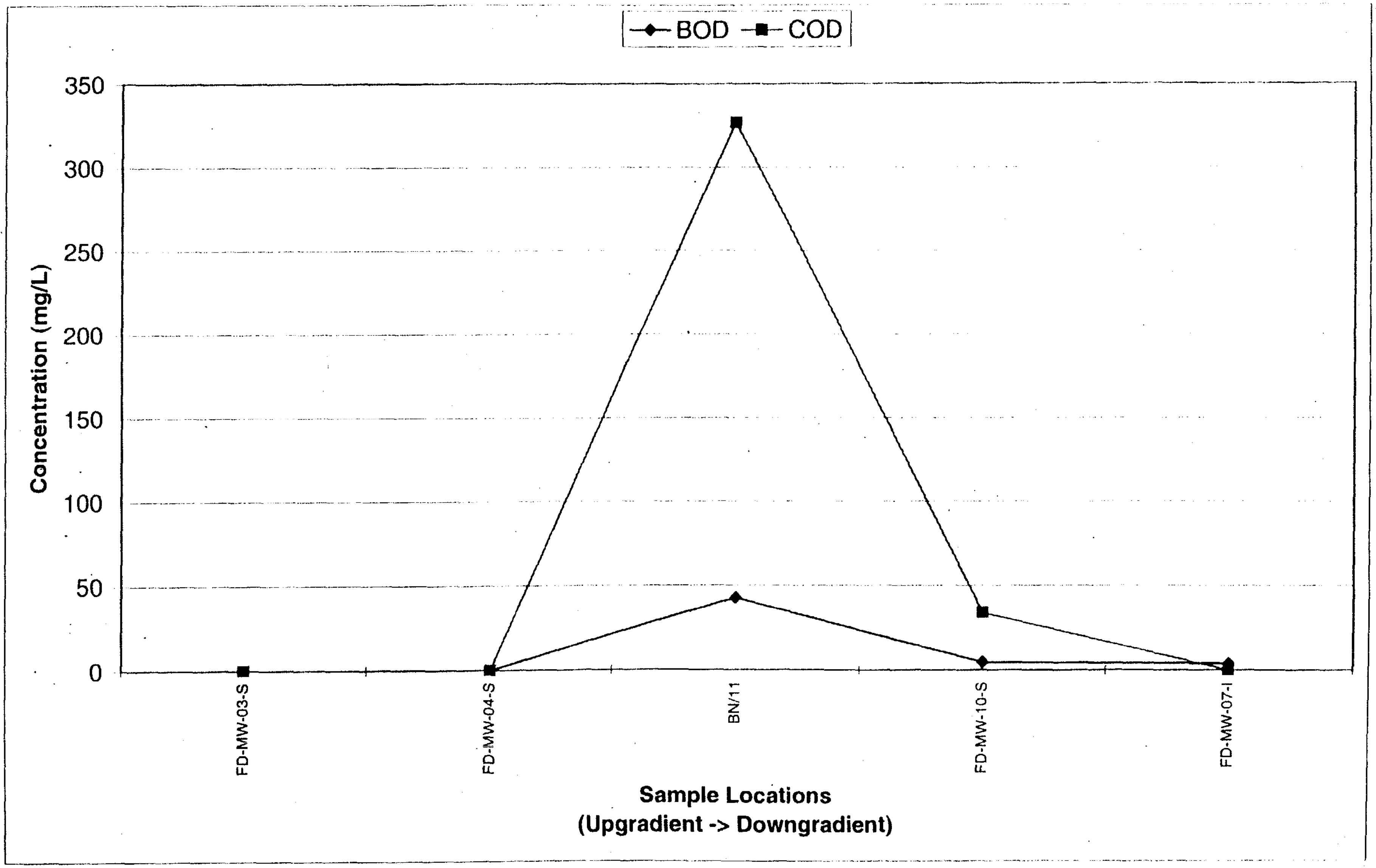


FIGURE 2-9

MONITIRED NATURAL ATTENUATION GROUNDWATER DEGRADATION INDICATORS (JULY 2000) - BOD, COD
SITE 7 - FUEL DEPOT
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
CALVERTON, NEW YORK



3.0 BIOSCREEN MODELING

3.1 MODEL DESCRIPTION

BIOSCREEN is simple, analytical, groundwater transport model that simulates the advection of a single contaminant in one dimension and the dispersion of the contaminant in two or three dimensions. The starting mass and dissolved concentration of a contaminant at the source are user-defined. As the contaminant migrates down-gradient, dispersion, adsorption, and biodegradation affect the contaminant concentration. Biodegradation can be included as a first-order decay term, or can be modeled as an instantaneous reaction that is controlled by the stoichiometric amounts of electron acceptors in the ambient groundwater. BIOSCREEN was developed as a screening tool to help evaluate the natural attenuation of dissolved hydrocarbons at spill sites involving petroleum hydrocarbons. The U.S. Environmental Protection Agency, the Air Force Center for Environmental Excellence, and Groundwater Services, Inc. developed the model. The User's Manual for this model (Newell et al., 1996) discusses in detail the mathematical development of the model code, the modeling assumptions, the input data requirements, and the limitations of the model.

3.2 MODEL INPUT PARAMETERS

Four different model runs were performed; one each for benzene, toluene, ethylbenzene, and xylenes. Table 3-1 lists the measured and estimated values of parameters that were entered as input parameters for the model runs. In each model run, the same values of hydraulic conductivity, hydraulic gradient, and porosity were used. The hydraulic conductivity is based on a single slug test in the shallowest portion of the aquifer. The hydraulic gradient is based on the groundwater elevations measured at the site along the centerline of the plume. The porosity value of 0.30 is estimated, based on values typically cited in scientific literature. The resulting seepage velocity is calculated to be 127 feet/year. The plume length was estimated to be roughly 400 feet long for purposes of estimating longitudinal and transverse dispersivity values; the BIOSCREEN model estimates these values as explained in the User's Manual (Newell et al., 1996).

The model runs are based on an assumed spill size of 1,680 gallons (about 5,400 kg) of JP-4 fuel. It is also assumed that the spill occurred in 1975. This starting mass of JP-4 was then multiplied by 0.74, 1.3, 4.0, and 2.3 percent to arrive at the starting masses of benzene, toluene, ethylbenzene, and xylenes, respectively, in the source area. These percentages are based on the typical composition of JP-4 fuel.

The biodegradation half-life is contaminant specific. The values used in the model runs are values that lie near the middle of the typical ranges that have been determined during field investigations and laboratory studies (see Howard et al., 1991; Newell et al., 1996). The half-life values were adjusted from the mean for each contaminant to calibrate model-predicted concentrations match measured concentrations in monitoring wells. The calibrated half-lives of ethylbenzene, benzene, toluene, and xylenes for this site were 1.0, 1.6, 1.2, and 4.0 months, respectively.

The source area is considered to be the area that once contained the underground storage tanks, and includes the area where wells 4, FD-MW-05-S, FD-MW-06-S, FD-MW-04-S, and BN/11 are/were located. Concentrations of contaminants found in these five wells between 1995 and 2000 were averaged and used to represent the concentration of contaminant in the source area (i.e., x = 0 feet) at time equals 25 years. Contaminant concentrations found in well FD-MW-10-S represent the concentration at about 80 feet down-gradient of the source at time equals 25 years. Contaminant concentrations found in well FD-MW-07-I represent the concentrations at about 200 feet down-gradient of the source at time equals 25 years.

Data were entered into the model for the instantaneous reaction alternative for representing biodegradation. The numbers are equal to 33 percent of the total available electron acceptors at the site. This was done because the mass of electron acceptors are being competitively used by each of the four primary contaminants, as well as the other non-hazardous organic compounds present in JP-4 and the groundwater system. The predictions for contaminant distributions using the instantaneous reaction option did not match the concentration data from the down-gradient monitoring wells. Therefore, the instantaneous reaction results for the model runs are presented for information and should not be used.

3.3 MODELING RESULTS

3.3.1 Benzene

The input data used in the benzene run are presented in Figure 3-1. The starting mass of benzene in the source area used in this modeling is 40 kg. The range of half-lives presented in the literature for benzene range from as low as 0.02 up to 2 years (Howard et al., 1991; Newell et al., 1996). Presumably, the shorter half-lives will occur in aerobic groundwater systems and the longer half-life values occur under anaerobic groundwater conditions. In the model run for Calverton Site 7, a half-life value of 0.2 years was used for the dissolved benzene in the plume. This value is the geometric mean of the values presented above and produced predicted concentrations that generally fit the concentrations measured at the site. The model-predicted distribution of benzene concentrations at 10, 25, and 50 years are displayed in Figures 3-2, 3-3, and 3-4, respectively (25 years is current conditions - 2000). The benzene values predicted at x = 80 feet at time = 25 years was 0.001 mg/L (Figure 3-3). The concentration detected in well FD-MW-10-S, which corresponds to this distance and time, was 0.0013 mg/L (1.3 μg/L). The model predicted a benzene concentration of 0.000 mg/L at 200 feet distance at time = 25 years. Benzene was not detected in well FD-MW-07-I, which corresponds to this distance. Therefore, the model results match relatively well with the measured concentrations in the two down-gradient wells. Note that at time equals 25 years, benzene concentrations in the plume near the source area would be approximately 0.003 mg/L. This value compared reasonably well with the observed concentration of nondetected to 0.0088 mg/L.

3.3.2 Toluene

The input data used in the model run for toluene are shown on Figure 3-5. The starting mass in the source area used in the model was 70 kg. The starting solute concentration in 1975 at the source was estimated to be 7.0 mg/L. The solute biodegradation half-life was estimated to be 0.10 years. This value falls within the range of half-lives presented by Howard et al. (1991) and Newell et al. (1996). The distribution of contaminants in the plume centerline at 10 years (1985), 25 years (2000), and 50 years (2025) are shown in Figures 3-6, 3-7, and 3-8, respectively. Note that the first order decay curves are the appropriate curves to evaluate. At time = 25 years (Figure 3-7), the predicted concentrations at 0, 80, and 200 feet were 0.248, 0.004, and 0.000 mg/L, respectively. Toluene concentrations recently detected in the source area, and 80 and 200 feet down-gradient were about 0.283 (average of five source area wells), 0.0032 (FD-MW-10-S), and 0.000 mg/L (FD-MW-07-I). These values match very well with the model-predicted values at time equals 25 years. At time equals 50 years (2025, Figure 3-8), the highest predicted concentration of toluene is 0.009 mg/L at the source.

3.3.3 Ethylbenzene

The input data used in the model run for ethylbenzene are shown on Figure 3-9. The starting mass in the source area was estimated to be 216 kg. This mass is based on the assumptions that 5,400 kg of JP-4 was released in 1975, and that ethylbenzene constitutes 4.0 percent of the fuel by weight. The starting solute concentration in 1975 at the source was estimated to be 7.5 mg/L. The solute biodegradation half-life was estimated to be 0.08 years. This value falls within the range of half-lives presented by Howard et al. (1991) and Newell et al. (1996). The distribution of contaminants in the plume centerline at 10 years (1985), 25 years (2000), and 50 years (2025) are shown in Figures 3-10, 3-11, and 3-12, respectively. Note that the first order decay curves are the appropriate curves to evaluate. At time = 25 years (Figure 3-11), the predicted ethylbenzene concentrations at 0, 80, and 200 feet were 2.222, 0.026, and 0.000 mg/L, respectively. Ethylbenzene concentrations recently detected in the source area, and 80 and 200 feet down-gradient ranged up to 0.5 (average of five source area wells), 0.028 (FD-MW-10-S), and 0.000 mg/L (FD-MW-07-I), respectively. The values for the two down-gradient wells match very well with the model-predicted values at time equals 25 years. The measured concentrations in the source area are less than the model-predicted value, indicating that the model may be conservative in the source area. At time equals 50 years (2025, Figure 3-12), the highest predicted concentration of ethylbenzene is 0.659

mg/L at the source. The amount of time predicted by the model for ethylbenzene to drop to 0.005 mg/L (the MCL) throughout the site is on the order of 150 years.

3.3.4 Xylenes

The input data used in the model run for xylenes are shown on Figure 3-13. The starting mass in the source area was estimated to be 124 kg. This mass is based on the assumptions that 5,400 kg of JP-4 was released in 1975, and that xylenes constitutes 2.3 percent of the fuel by weight. The starting solute concentration in 1975 at the source was estimated to be 9.0 mg/L. The solute biodegradation half-life was estimated to be 0.33 years. This value falls within the range of half-lives presented by Howard et al. (1991) and Newell et al. (1996). The distribution of contaminants in the plume centerline at 10 years (1985), 25 years (2000), and 50 years (2025) are shown in Figures 3-14, 3-15, and 3-16, respectively. Note that the first order decay curves are the appropriate curves to evaluate. At time = 25 years (Figure 3-15), the predicted xylenes concentrations at 0, 80, and 200 feet were 0.678, 0.084, and 0.003 mg/L, respectively. Xylenes concentrations recently detected in the source area, and 80 and 200 feet down-gradient were about 1.232 (average of five source area wells), 0.084 (FD-MW-10-S), and 0.0021 mg/L (FD-MW-07-I), respectively. The values for the two down-gradient wells match extremely well with the model-predicted values at time equals 25 years. The measured concentrations in the source area are greater than the model-predicted value. At time equals 50 years (2025, Figure 3-16), the highest predicted concentration of xylenes is 0.051 mg/L at the source. The amount of time predicted by the model for xylenes to drop to 0.005 mg/L (the MCL) everywhere is on the order of 75 years.

3.4 MODEL RESULTS OF HYPOTHETICAL SOURCE REMOVAL SCENARIO

Four new model runs were performed, using output results from the previous four runs at time equals 25 years (i.e., year 2000) as the starting conditions. The mass of each contaminant at the source was reduced by 90 percent, thereby simulating source remediation using possible methods. Thus, the starting mass of benzene, toluene, ethylbenzene, and xylenes at the source in 2000 was set at <0.1, 0.25, 6.4, and 0.93 kg, respectively. Using these new masses at the source, the time required for the four contaminants to fall below their respective MCLs everywhere in the model was on the order of 5 to 10 years. Thus, by reducing the contaminant mass at the source by 90 percent, the time necessary for contaminant concentrations to fall beneath the MCLs will be reduced from a predicted 150 years to about 10 years or less.

TABLE 3-1

VALUES OF INPUT PARAMETERS USED IN BIOSCREEN MODEL RUNS
SITE 7 - FUEL DEPOT
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
CALVERTON, NEW YORK

MODEL INPUT PARAMETER	Units	Benzene	Ethylbenzene	Toluene	Xylene	Comment
Source Thickness in Saturated Zone	ft	20	20	20	20	Estimated, based on vertical distribution of contaminants
Starting Mass at Source	kg	40	216	70	124	Estimated, based on percentages of benzene, toluene, ethylbenzene, and xylene typically found in JP-4. Assumes spill of 5,400 kg of JP-4 in 1975.
Starting Contaminant Concentration at Source	mg/L	9.0	7.5	26.0	9.0	Estimated to be equal to 5% of contaminant solubility in water
Hydraulic Conductivity (K)	cm/s	0.041	0.041	0.041	0.041	From slug test conducted in well FD-MW-04-S
	ft/day	116	116	116	116	
Hydraulic Gradient (I)	ft/ft	0.0009	0.0009	0.0009	0.0009	Measured using on-site groundwater elevations
Porosity (n)	unitless	0.3	0.3	0.3	0.3	Rough estimate for unconsolidated sediments
Seepage Velocity (V_s)	ft/yr	127	127	127	127	Calculated, $V_s = KI/n$
Longitudinal Dispersivity	ft	16.1	16.1	16.1	16.1	Estimated by model (Newell et al, 1996)
Transverse Dispersivity	ft	1.6	1.6	1.6	1.6	Estimated by model (Newell et al, 1996)
Vertical Dispersivity	ft	0.0	0.0	0.0	0.0	Estimated by model (Newell et al, 1996)
Solute Halflife (1st order decay)	years	0.2	0.08	0.1	0.33	Within ranges suggested by Howard et al. (1991) and Newell et al. (1996)
	months	1.6	1.0	1.2	4.0	
Source Halflife (1st order decay)	years	2.0	10.0	1.0	7.0	Calculated by BIOSCREEN (Newell et al., 1996)

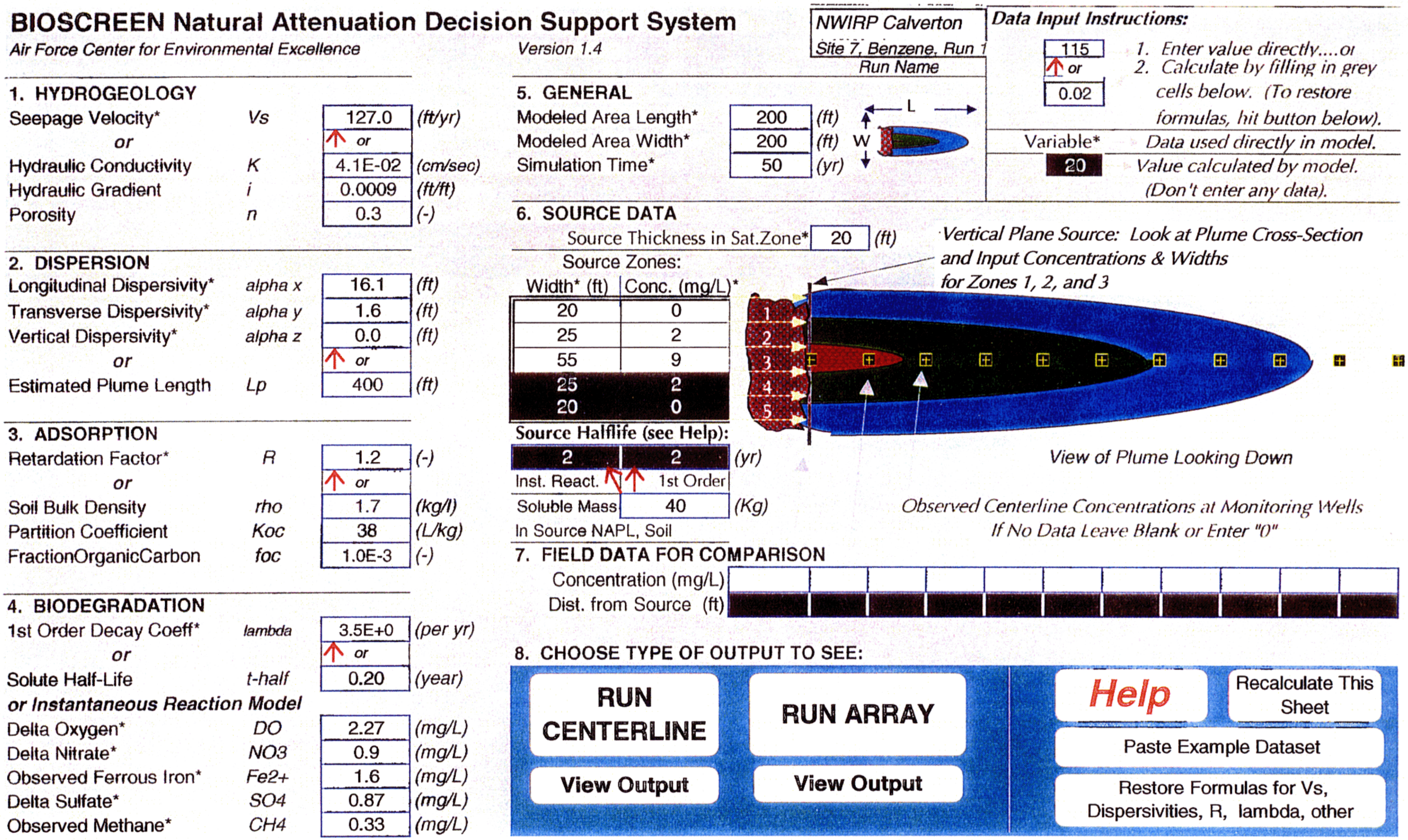
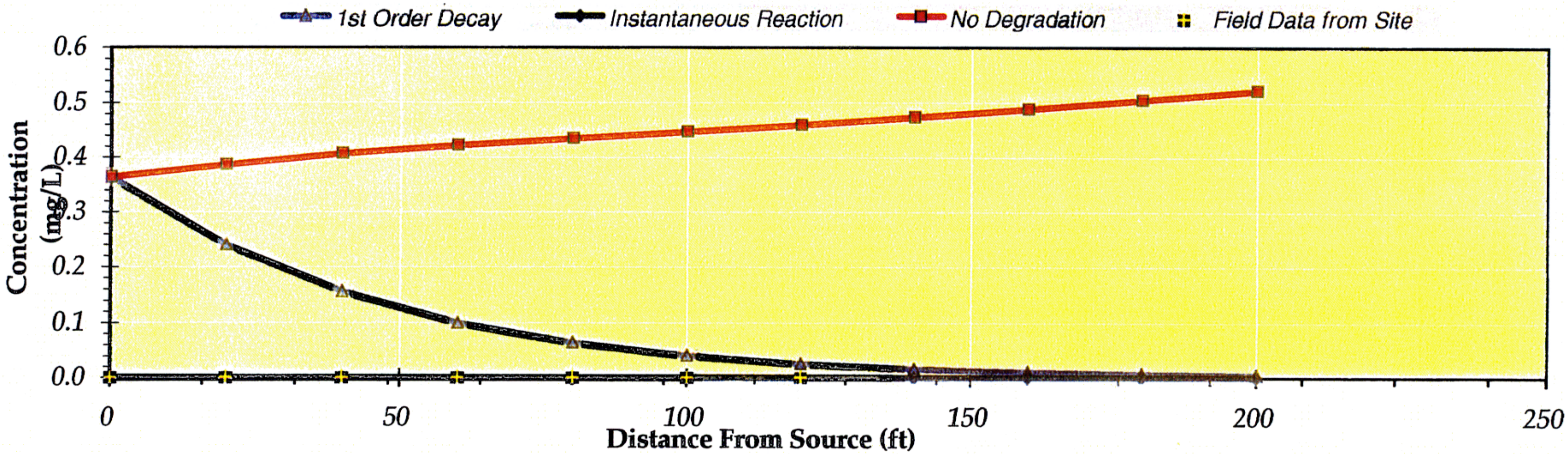


FIGURE 3-1. Input Data for Benzene Modeling Run Starting in Year 1975

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

TYPE OF MODEL	Distance from Source (ft) 0	20	40	60	80	100	120	140	160	180	200
No Degradation	0.364	0.387	0.407	0.422	0.435	0.447	0.460	0.474	0.489	0.505	0.522
1st Order Decay	0.364	0.240	0.156	0.100	0.064	0.041	0.026	0.017	0.011	0.007	0.004
Inst. Reaction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site											



Replay Animation

Next Timestep

Prev Timestep

Time:

10 Years

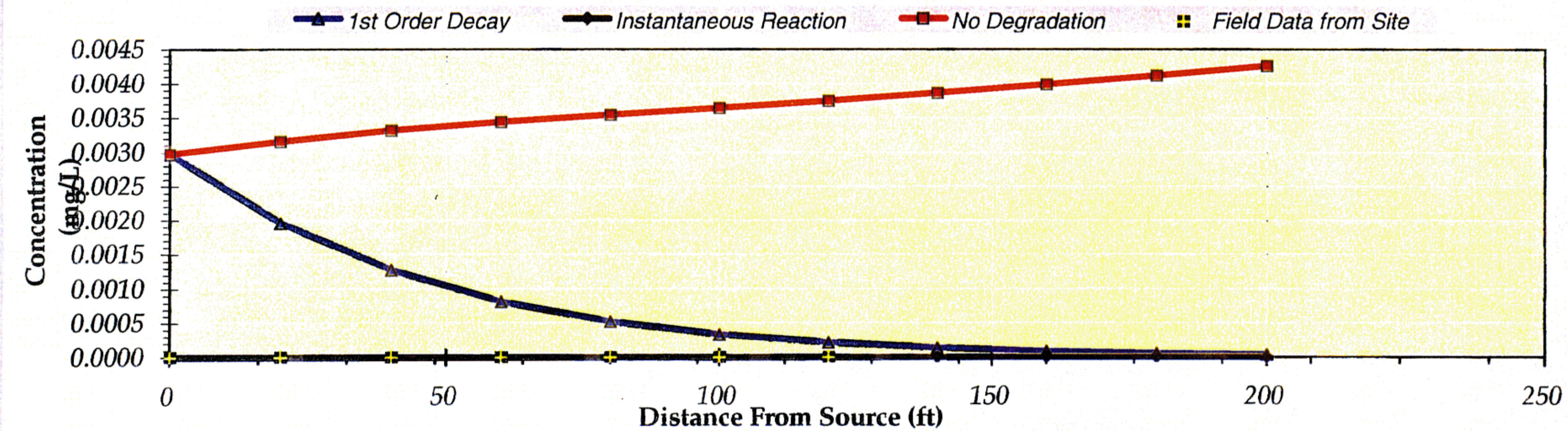
Return to Input

Recalculate This Sheet

FIGURE 3-2. Concentrations of Benzene along the Plume Centerline in 1985

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

	Distance from Source (ft)										
TYPE OF MODEL	0	20	40	60	80	100	120	140	160	180	200
No Degradation	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004
1st Order Decay	0.003	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000
Inst. Reaction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site											



Replay Animation | Next Timestep | Prev Timestep

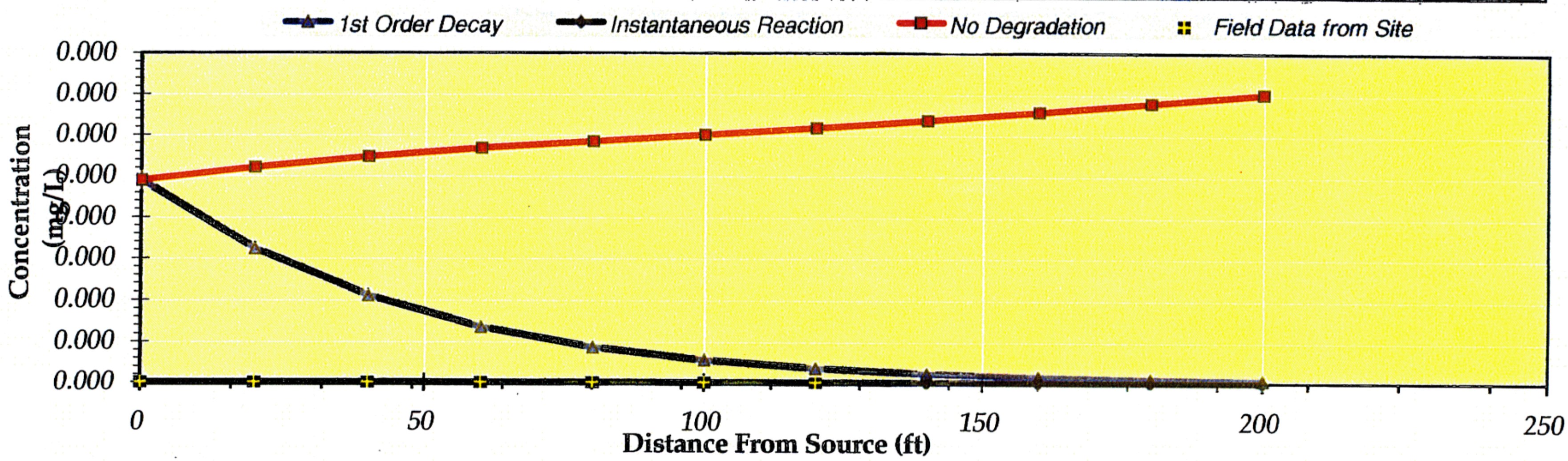
Time: *25 Years*

Return to Input | **Recalculate This Sheet**

FIGURE 3-3. Concentrations of Benzene along the Plume Centerline in 2000

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

TYPE OF MODEL	Distance from Source (ft) 0	20	40	60	80	100	120	140	160	180	200
No Degradation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1st Order Decay	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Inst. Reaction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site											



Calculate Animation

Time: 50 Years

Return to Input

Recalculate This Sheet

FIGURE 3-4. Concentrations of Benzene along the Plume Centerline in 2025

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence *Version 1.4*

NWIRP Calverton
Site 7, Toluene, Run 1
Run Name

Data Input Instructions:

115	1. Enter value directly....or
or	2. Calculate by filling in grey cells below. (To restore formulas, hit button below).
0.02	
Variable*	Data used directly in model.
20	Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	127.0	(ft/yr)
or		or	
Hydraulic Conductivity	K	4.1E-02	(cm/sec)
Hydraulic Gradient	i	0.0009	(ft/ft)
Porosity	n	0.3	(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	16.1	(ft)
Transverse Dispersivity*	alpha y	1.6	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		or	
Estimated Plume Length	Lp	400	(ft)

3. ADSORPTION

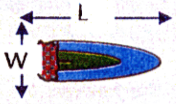
Retardation Factor*	R	1.8	(-)
or		or	
Soil Bulk Density	rho	1.7	(kg/l)
Partition Coefficient	Koc	135	(L/kg)
FractionOrganicCarbon	foc	1.0E-3	(-)

4. BIODEGRADATION

1st Order Decay Coeff*	lambda	6.9E+0	(per yr)
or		or	
Solute Half-Life	t-half	0.10	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	2.27	(mg/L)
Delta Nitrate*	NO3	0.9	(mg/L)
Observed Ferrous Iron*	Fe2+	1.6	(mg/L)
Delta Sulfate*	SO4	0.87	(mg/L)
Observed Methane*	CH4	0.33	(mg/L)

5. GENERAL

Modeled Area Length*	200	(ft)
Modeled Area Width*	200	(ft)
Simulation Time*	50	(yr)



6. SOURCE DATA

Source Thickness in Sat.Zone* 20 (ft)

Source Zones:

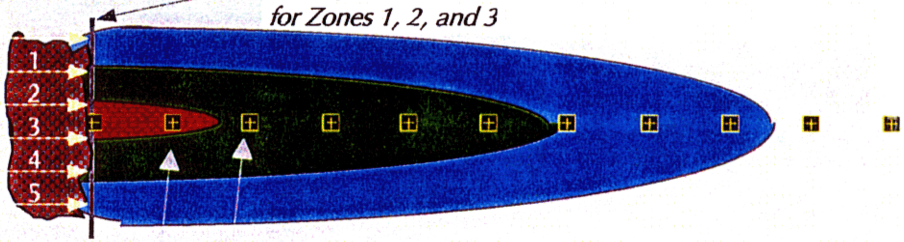
Width* (ft)	Conc. (mg/L)*
20	0
25	1
55	7
25	1
20	0

Source Halflife (see Help):

3	5	(yr)
Inst. React.	1st Order	
Soluble Mass	70	(Kg)

In Source NAPL, Soil

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Concentration (mg/L)											
Dist. from Source (ft)											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | Help | Recalculate This Sheet

View Output | View Output | Paste Example Dataset

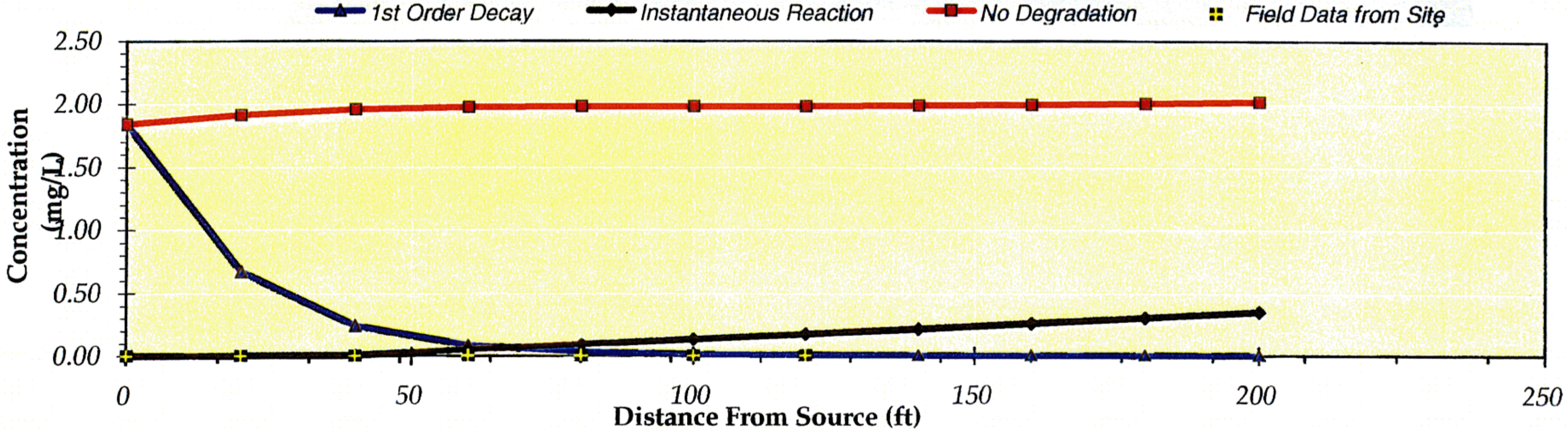
Restore Formulas for Vs, Dispersivities, R, lambda, other

FIGURE 3-5. Input Data for Toluene Modeling Run Starting in Year 1975

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

Distance from Source (ft)

TYPE OF MODEL	0	20	40	60	80	100	120	140	160	180	200
No Degradation	1.841	1.909	1.957	1.974	1.977	1.978	1.980	1.984	1.992	2.003	2.018
1st Order Decay	1.841	0.670	0.241	0.085	0.030	0.011	0.004	0.001	0.000	0.000	0.000
Inst. Reaction	0.000	0.000	0.003	0.051	0.093	0.133	0.173	0.215	0.258	0.304	0.351
Field Data from Site											



Replay Animation

Next Timestep

Prev Timestep

Time:

10 Years

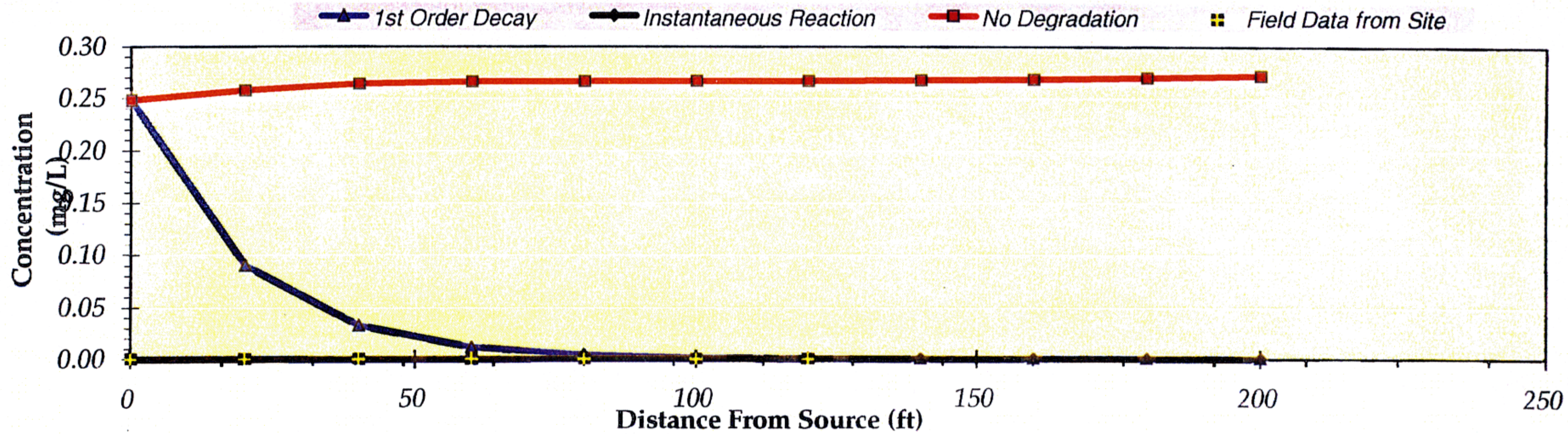
Return to Input

Recalculate This Sheet

FIGURE 3-6. Concentrations of Toluene along the Plume Centerline in 1985

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

	Distance from Source (ft)										
TYPE OF MODEL	0	20	40	60	80	100	120	140	160	180	200
No Degradation	0.248	0.257	0.264	0.266	0.267	0.267	0.267	0.268	0.269	0.270	0.272
1st Order Decay	0.248	0.090	0.033	0.012	0.004	0.001	0.000	0.000	0.000	0.000	0.000
Inst. Reaction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site											



Replay Animation

Next Timestep

Prev Timestep

Time: 25 Years

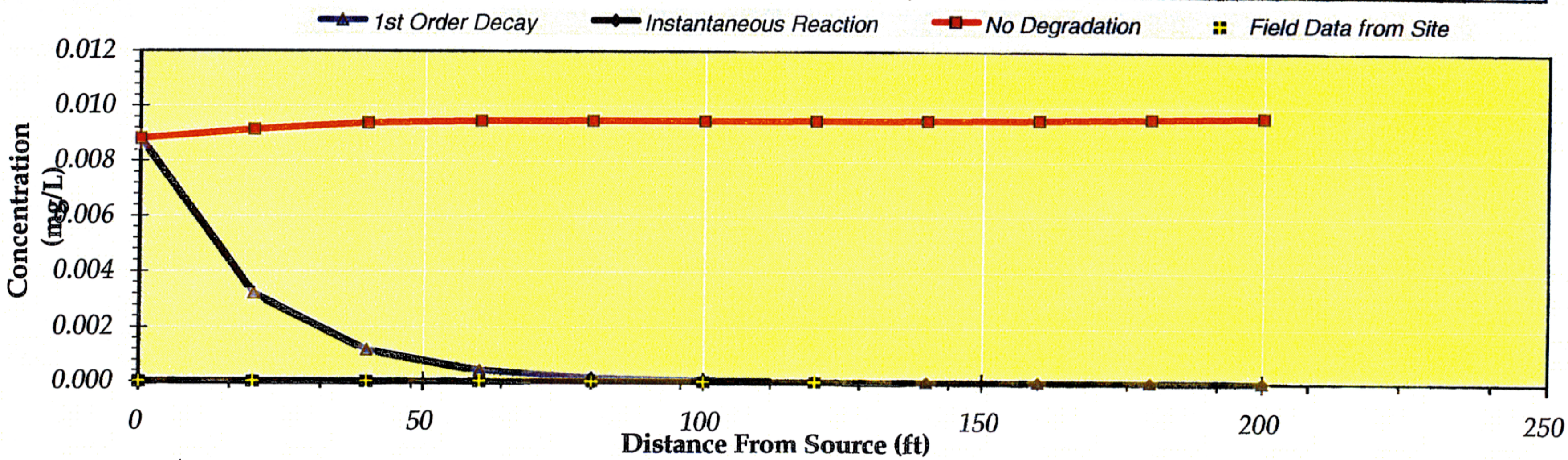
Return to Input

Recalculate This Sheet

FIGURE 3-7. Concentrations of Toluene along the Plume Centerline in 2000

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

TYPE OF MODEL	0	20	40	60	80	100	120	140	160	180	200
	Distance from Source (ft)										
No Degradation	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.010	0.010	0.010
1st Order Decay	0.009	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Inst. Reaction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site											



Replay Animation

Next Timestep

Prev Timestep

Time:

50 Years

Return to Input

Recalculate This Sheet

FIGURE 3-8. Concentrations of Toluene along the Plume Centerline in 2025

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

NWIRP Calverton
Site 7, Ethylbenzene, Run 1
Run Name

Data Input Instructions:

115	1. Enter value directly....or
↑ or	2. Calculate by filling in grey
0.02	cells below. (To restore formulas, hit button below).
Variable*	Data used directly in model.
20	Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	127.0	(ft/yr)
or		↑ or	
Hydraulic Conductivity	K	4.1E-02	(cm/sec)
Hydraulic Gradient	i	0.0009	(ft/ft)
Porosity	n	0.3	(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	16.1	(ft)
Transverse Dispersivity*	alpha y	1.6	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		↑ or	
Estimated Plume Length	Lp	400	(ft)

3. ADSORPTION

Retardation Factor*	R	1.5	(-)
or		↑ or	
Soil Bulk Density	rho	1.7	(kg/l)
Partition Coefficient	Koc	95	(L/kg)
FractionOrganicCarbon	foc	1.0E-3	(-)

4. BIODEGRADATION

1st Order Decay Coeff*	lambda	8.7E+0	(per yr)
or		↑ or	
Solute Half-Life	t-half	0.08	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	2.27	(mg/L)
Delta Nitrate*	NO3	0.9	(mg/L)
Observed Ferrous Iron*	Fe2+	1.6	(mg/L)
Delta Sulfate*	SO4	0.87	(mg/L)
Observed Methane*	CH4	0.33	(mg/L)

5. GENERAL

Modeled Area Length*	200	(ft)
Modeled Area Width*	200	(ft)
Simulation Time*	50	(yr)

L
W

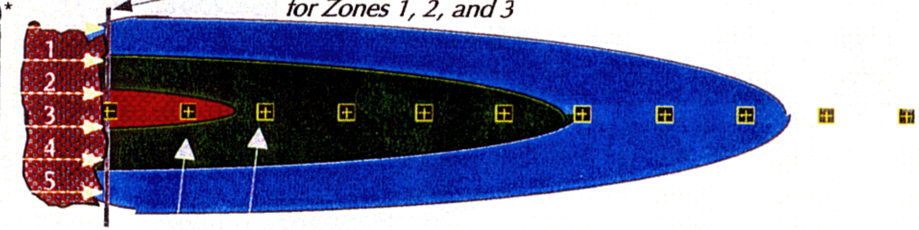
6. SOURCE DATA

Source Thickness in Sat.Zone* 20 (ft)

Source Zones:

Width* (ft)	Conc. (mg/L)*
20	0
25	1.5
55	7.5
25	1.5
20	0

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Source Halflife (see Help):

Inst. React.	1st Order	
10	10	(yr)

Soluble Mass 216 (Kg)
In Source NAPL, Soil

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Concentration (mg/L)											
Dist. from Source (ft)											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — View Output

RUN ARRAY — View Output

Help

Recalculate This Sheet

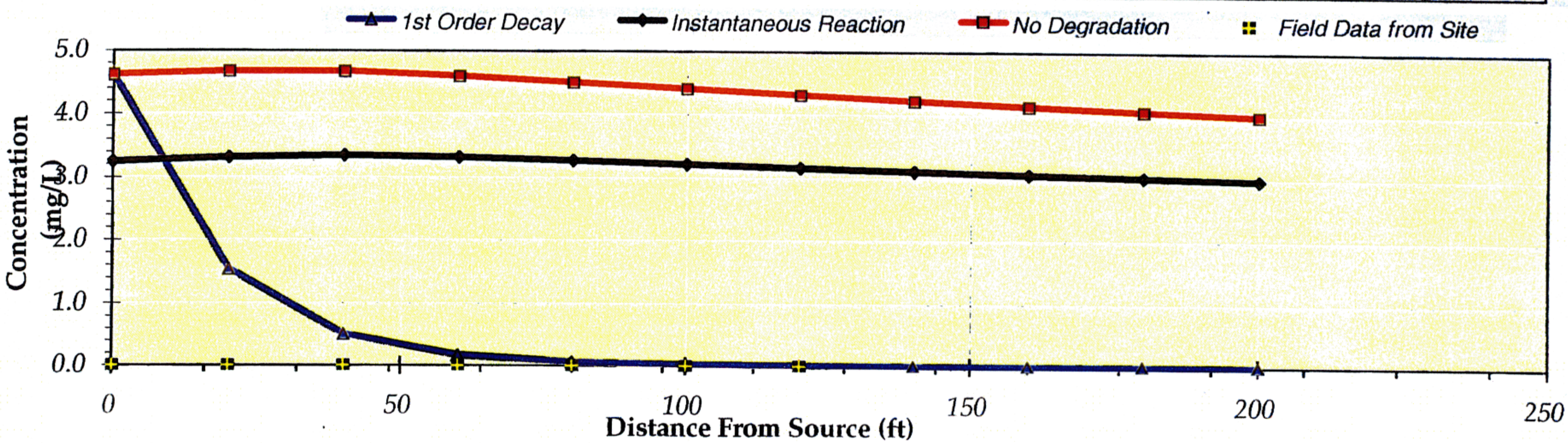
Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

FIGURE 3-9. Input Data for Ethylbenzene Modeling Run Starting in Year 1975

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

TYPE OF MODEL	Distance from Source (ft) 0	20	40	60	80	100	120	140	160	180	200
No Degradation	4.611	4.663	4.663	4.595	4.499	4.398	4.302	4.214	4.133	4.060	3.994
1st Order Decay	4.611	1.537	0.507	0.165	0.053	0.017	0.006	0.002	0.001	0.000	0.000
Inst. Reaction	3.242	3.314	3.344	3.319	3.271	3.216	3.162	3.112	3.065	3.022	2.983
Field Data from Site											



Replay Animation | Next Timestep | Prev Timestep | Time: 10 Years | Return to Input | Recalculate This Sheet

FIGURE 3-10. Concentrations of Ethylbenzene along the Plume Centerline in 1985

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

Distance from Source (ft)

TYPE OF MODEL	0	20	40	60	80	100	120	140	160	180	200
No Degradation	2.222	2.248	2.248	2.215	2.168	2.120	2.074	2.031	1.992	1.957	1.925
1st Order Decay	2.222	0.741	0.244	0.079	0.026	0.008	0.003	0.001	0.000	0.000	0.000
Inst. Reaction	0.328	0.356	0.369	0.364	0.350	0.334	0.318	0.303	0.288	0.274	0.262
Field Data from Site											

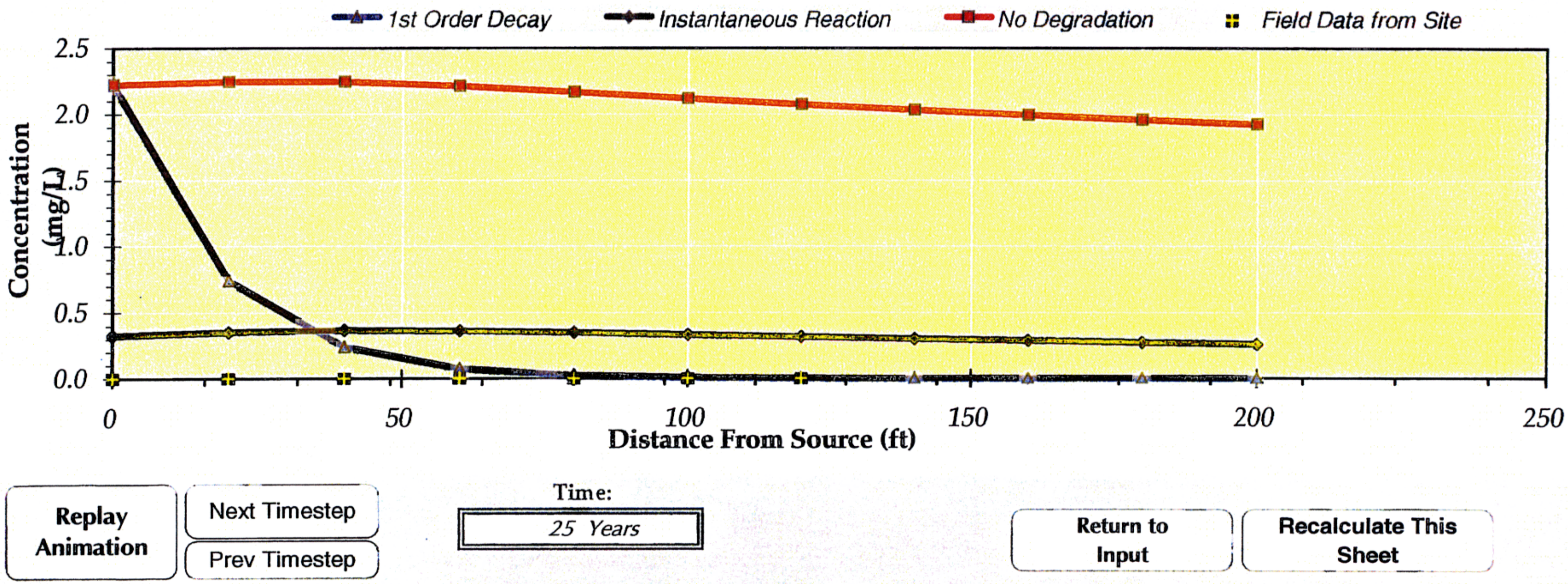
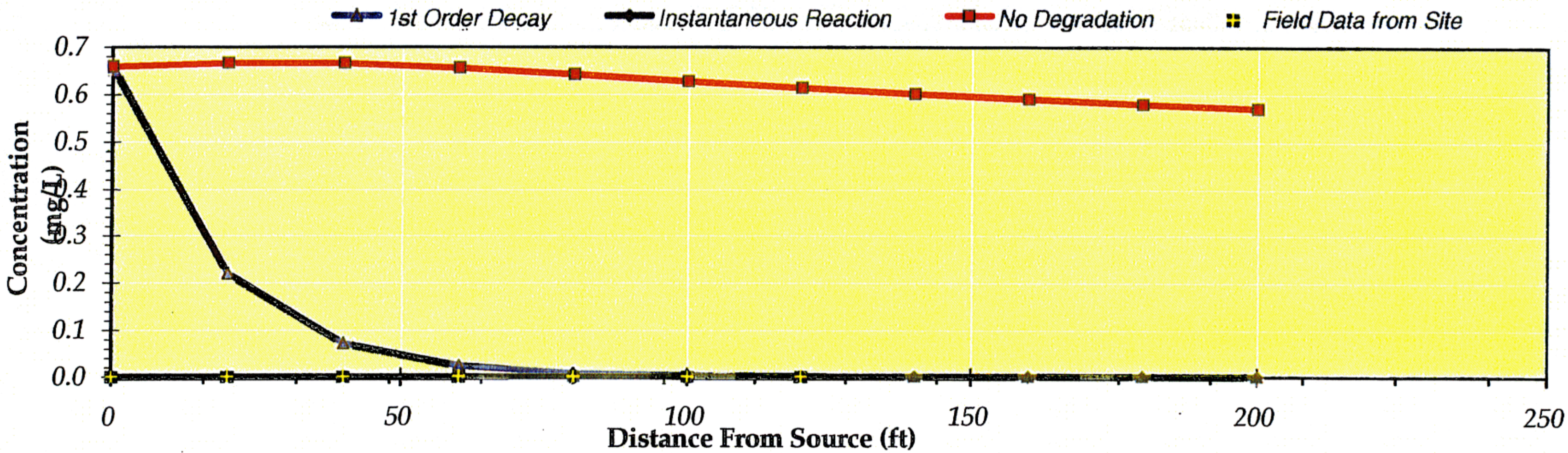


FIGURE 3-11. Concentrations of Ethylbenzene along the Plume Centerline in 2000

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

TYPE OF MODEL	0	20	40	60	80	100	120	140	160	180	200
	Distance from Source (ft)										
No Degradation	0.659	0.666	0.666	0.656	0.643	0.628	0.615	0.602	0.590	0.580	0.571
1st Order Decay	0.659	0.220	0.072	0.023	0.008	0.002	0.001	0.000	0.000	0.000	0.000
Inst. Reaction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site											



Replay Animation | Next Timestep | Prev Timestep

Time: *50 Years*

Return to Input | **Recalculate This Sheet**

FIGURE 3-12. Concentrations of Ethylbenzene along the Plume Centerline in 2025

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence

Version 1.4

NWIRP Calverton
Site 7, Xylene, Run 1
Run Name

Data Input Instructions:

115 ↑ or 0.02	1. Enter value directly....or 2. Calculate by filling in grey cells below. (To restore formulas, hit button below).
Variable*	Data used directly in model.
20	Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	127.0	(ft/yr)
or		↑ or	
Hydraulic Conductivity	K	4.1E-02	(cm/sec)
Hydraulic Gradient	i	0.0009	(ft/ft)
Porosity	n	0.3	(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	16.1	(ft)
Transverse Dispersivity*	alpha y	1.6	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		↑ or	
Estimated Plume Length	Lp	400	(ft)

3. ADSORPTION

Retardation Factor*	R	2.4	(-)
or		↑ or	
Soil Bulk Density	rho	1.7	(kg/l)
Partition Coefficient	Koc	240	(L/kg)
FractionOrganicCarbon	foc	1.0E-3	(-)

4. BIODEGRADATION

1st Order Decay Coeff*	lambda	2.1E+0	(per yr)
or		↑ or	
Solute Half-Life	t-half	0.33	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	2.27	(mg/L)
Delta Nitrate*	NO3	0.9	(mg/L)
Observed Ferrous Iron*	Fe2+	1.6	(mg/L)
Delta Sulfate*	SO4	0.87	(mg/L)
Observed Methane*	CH4	0.33	(mg/L)

5. GENERAL

Modeled Area Length*	200	(ft)
Modeled Area Width*	200	(ft)
Simulation Time*	50	(yr)

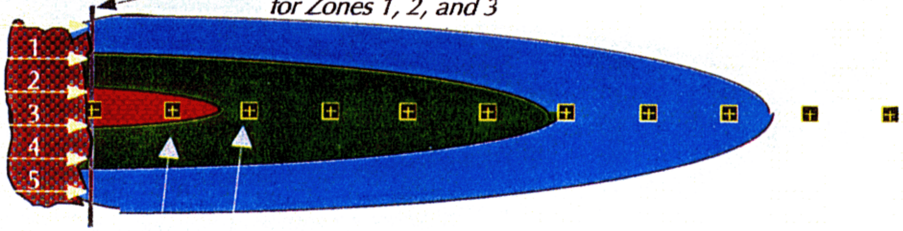
6. SOURCE DATA

Source Thickness in Sat.Zone* 20 (ft)

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3

Source Zones:

Width* (ft)	Conc. (mg/L)*
20	0
25	2
55	9
25	2
20	0



View of Plume Looking Down

Source Halflife (see Help):

5	7	(yr)
Inst. React.	1st Order	

Soluble Mass 124 (Kg)
In Source NAPL, Soil

7. FIELD DATA FOR COMPARISON

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

Concentration (mg/L)											
Dist. from Source (ft)											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | **View Output**

RUN ARRAY | **View Output**

Help

Recalculate This Sheet

Paste Example Dataset

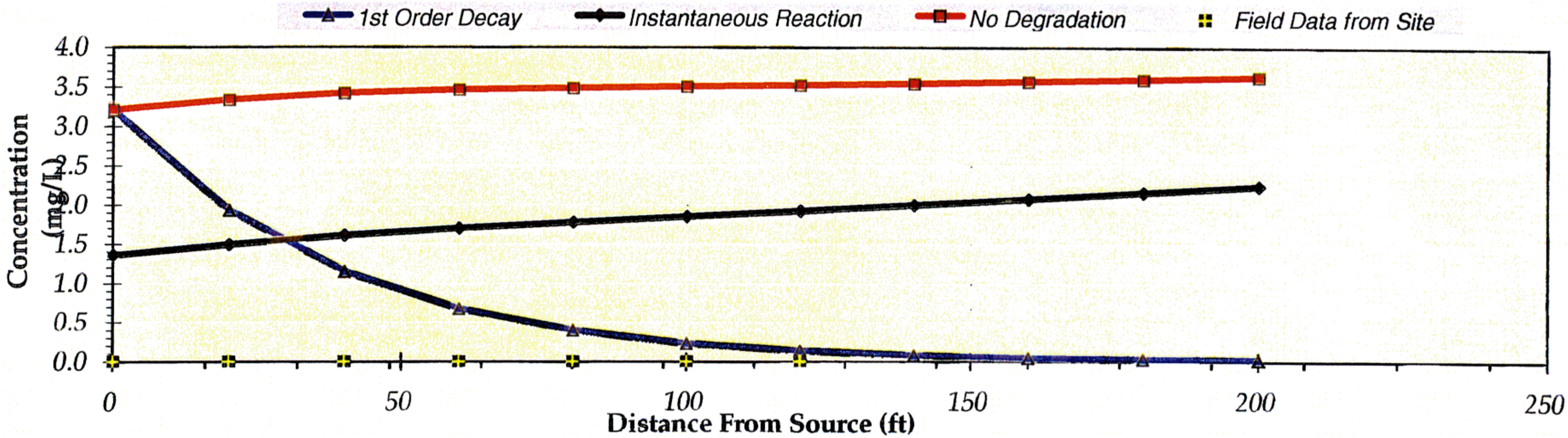
Restore Formulas for Vs, Dispersivities, R, lambda, other

FIGURE 3-13. Input Data for Xylene Modeling Run Starting in Year 1975

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

Distance from Source (ft)

TYPE OF MODEL	0	20	40	60	80	100	120	140	160	180	200
No Degradation	3.199	3.323	3.414	3.457	3.479	3.496	3.514	3.536	3.562	3.592	3.625
1st Order Decay	3.199	1.930	1.151	0.677	0.396	0.231	0.135	0.079	0.046	0.027	0.016
Inst. Reaction	1.355	1.495	1.616	1.706	1.783	1.856	1.929	2.005	2.083	2.164	2.246
Field Data from Site											



Replay Animation

Next Timestep

Prev Timestep

Time: 10 Years

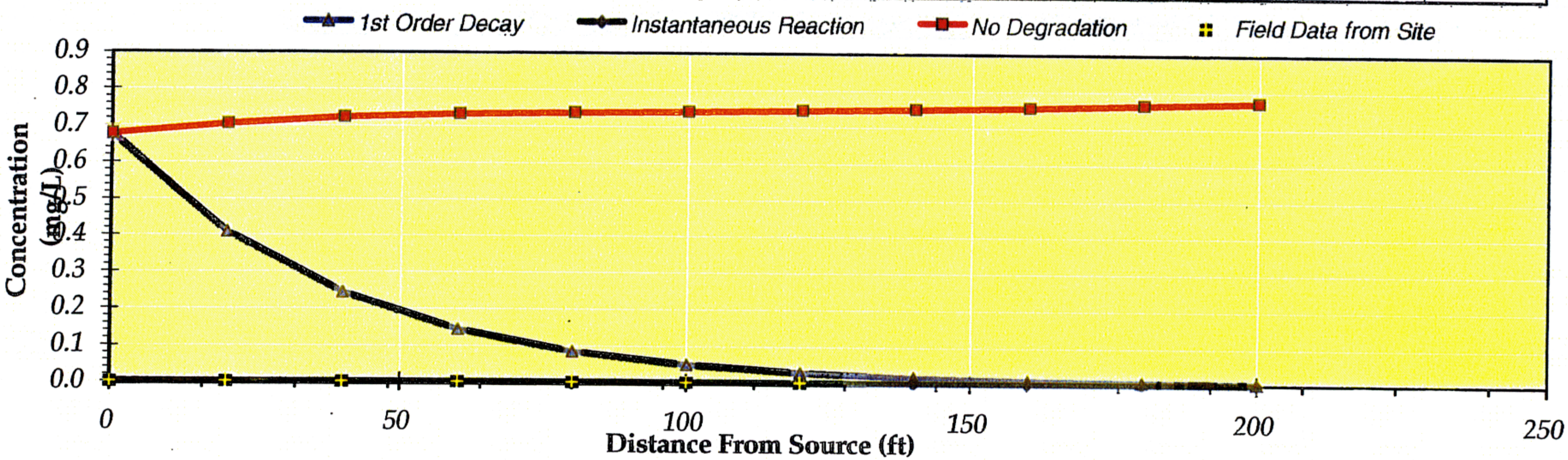
Return to Input

Recalculate This Sheet

FIGURE 3-14. Concentrations of Xylene along the Plume Centerline in 1985

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

TYPE OF MODEL	Distance from Source (ft)										
	0	20	40	60	80	100	120	140	160	180	200
No Degradation	0.678	0.704	0.723	0.733	0.737	0.741	0.745	0.750	0.756	0.764	0.772
1st Order Decay	0.678	0.409	0.244	0.143	0.084	0.049	0.029	0.017	0.010	0.006	0.003
Inst. Reaction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site											



Replay Animation

Next Timestep

Prev Timestep

Time:

25 Years

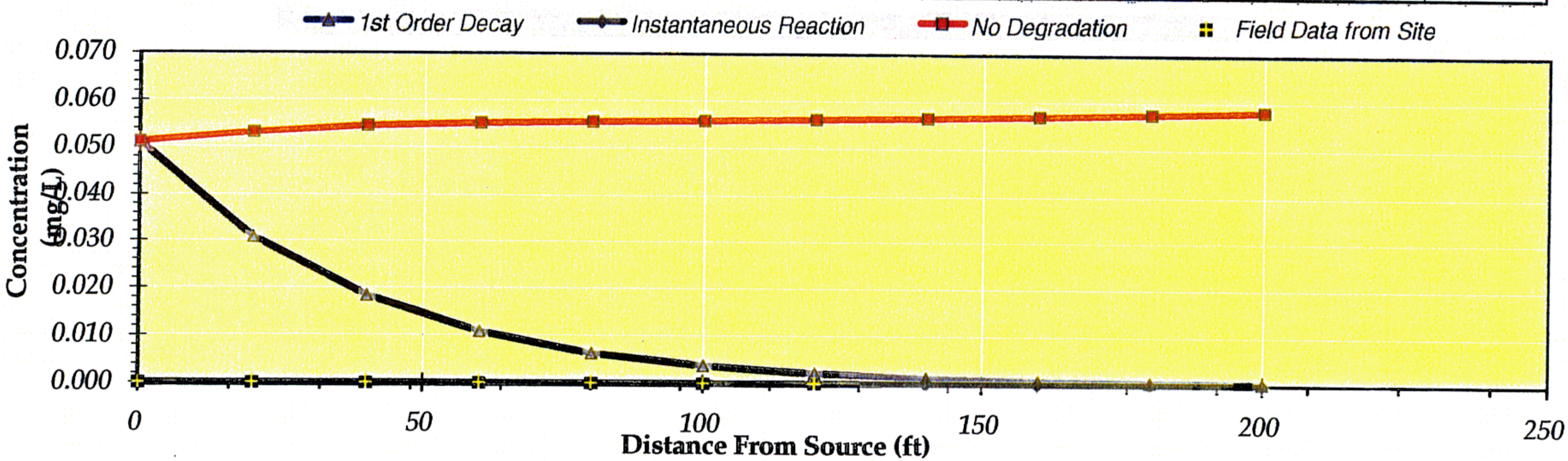
Return to Input

Recalculate This Sheet

FIGURE 3-15. Concentrations of Xylene along the Plume Centerline in 2000

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

TYPE OF MODEL	Distance from Source (ft) 0	20	40	60	80	100	120	140	160	180	200
No Degradation	0.051	0.053	0.054	0.055	0.056	0.056	0.056	0.057	0.057	0.058	0.058
1st Order Decay	0.051	0.031	0.018	0.011	0.006	0.004	0.002	0.001	0.001	0.000	0.000
Inst. Reaction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site											



Replay Animation

Next Timestep

Prev Timestep

Time:

50 Years

Return to Input

Recalculate This Sheet

FIGURE 3-16. Concentrations of Xylene along the Plume Centerline in 2025

4.0 SUMMARY AND CONCLUSIONS

The potential success of MNA is evaluated using three elements, namely evidence of biodegradation, plume stability, and modeling. Based on the site specific data presented in Section 2.0, there is strong evidence that biodegradation is occurring at the site. This evidence includes the decrease in oxygen and the increase in methane, carbon dioxide, and other parameters across the site.

Plume stability is not as well demonstrated for this site, however, BTEX compounds are not consistently detected in down gradient wells at distance equal to approximately one year of migration from the source areas (127 feet) indicating that contaminant migration is not rapid. However, BTEX concentrations have not changed significantly in the source area over the last decade.

The BIOSCREEN model runs and results found in Section 3.0 support the position that the contaminant plume at Site 7 is relatively stable. However, the plume is likely to remain for an extended period of time (estimated to be 150 years). In the event the source area treatment is implemented and operated to achieve 90% mass removal, then MCLs could be achieved in the groundwater in as little as 10 years.

REFERENCES

Halliburton NUS (HNUS), 1985. RCRA Facility Investigation Addendum for Naval Weapons Industrial Reserve Plant, Calverton, New York.

Halliburton NUS (HNUS), 1992. Final Site Investigation Naval Weapons Industrial Reserve Plant, Calverton, New York.

Howard, P.H., R.S. Boethling, W.F. Jarvis, W.M. Meylan, and E.M. Michalenko, 1991. Handbook of Environmental Degradation Rates. Lewis Publishers, Boca Raton, Florida.

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Tetra Tech NUS, Inc. (TtNUS), 2000a. Monitored Natural Attenuation Work Plan, Site 7 – Fuel Depot, Naval Weapons Industrial Reserve Plant, Calverton, New York.

Tetra Tech NUS, Inc. (TtNUS), 2000b. Phase 2 RCRA Facility Investigation for Site 7 – Fuel Depot Area, Naval Weapons Industrial Reserve Plant, Calverton, New York.

ATTACHMENT A
GROUNDWATER LEVEL MEASUREMENT LOG SHEETS
STEP 1, FEBRUARY 2000

Tetra Tech NUS, Inc.

GROUNDWATER LEVEL MEASUREMENT SHEET

Project Name: NWIRP Calverton **Project No.:** N4570

Location: Site 7 - Fuel Depot **Personnel:** S. Pelepko / V. Shickora

Weather Conditions: cool, cloudy, breezy, mid 40s (+) **Measuring Device:** Heron & Slope M-Scopes

Tidally Influenced: Yes ___ No X **Remarks:** Measurement referenced to top of PVC casing

Well or Piezometer Number	Date	Time	Elevation of Reference Point (feet)*	Total Well Depth (feet)*	Water Level Indicator Reading (feet)*	Thickness of Free Product (feet)*	Groundwater Elevation (feet)*	Comments
FD-MW-06-S	02-28-00	1318		22.50	17.74			PID = 1.2 ppm
16	02-28-00	1330		20 28.3	17.34			no J-plug PID: 0.0 ppm
FD-MW-05-S	02-28-00	1337		25.79	17.78			PID: 1.1 ppm
BN/11	02-28-00	1339		20.69	19.34			PID = 1.3 ppm
BR 10	02-28-00	1342		24.50	19.31			PID - 11.0 ppm
24	02-28-00	1347		29.30	16.44			PID - 4.1 ppm
FD-MW-01-S	02-28-00	1353		25.90	14.00			PID: 1.7 ppm
4	02-28-00	1355		25.31	17.79			PID: 2.2 ppm
FD-MW-03-S	02-28-00	1401		27.91	19.89			PID: 0.1 ppm
BK/19	02-28-00	1406		28.85	15.95			PID: 0.0 ppm
FD-MW07-S	02-28-00	1409		23.10	16.47			PID = 2.0 ppm
FD-MW-04-S	02-28-00	1413		26.84	19.70			PID: 0.0 ppm

* All measurements to the nearest 0.01 foot

ATTACHMENT B

GROUNDWATER SAMPLE LOG SHEETS, GROUNDWATER PURGE DATA SHEETS, CHAIN OF CUSTODY FORMS

STEP 1, FEBRUARY 2000

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: NWIRP Calverton
Project No.: N4570

Sample ID No.: FD-GW01S-00
Sample Location: FD-MW-01-S
Sampled By: S. Pelepko/V. Shickora
C.O.C. No.: #2

[] Domestic Well Data
■ Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Type of Sample:
■ Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 03-01-00 / Time: 1535 / Method: peristaltic/straw method	Color Visual	pH Standard	S.C. mS/cm	Temp. °C	Turbidity NTU	DO mg/l	ORP mV	Salinity %
	clear	5.88	0.141	14.0	0.0	8.23	290	0.0

PURGE DATA:

Date: 03-01-00	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Salinity
Method: peristaltic pump								
Monitor Reading (ppm): 0.0								
Well Casing Diameter & Material Type: 4" PVC								
Total Well Depth (TD): 26.84 FT								
Static Water Level (WL): 19.65 FT								
One Casing Volume(gal/L): 4.70								
Start Purge (hrs): 1358								
End Purge (hrs): 1530								
Total Purge Time (min): 92								
Total Vol. Purged (gal/L): 14.5								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOCs	HCL	40 mL glass vial	(2)
TPH (GRO)	HCL	40 mL glass vial	(2)
TPH (DRO)	~~none~~ HCl	1 L amber glass	(2)
	SP 03-01-00		

OBSERVATIONS / NOTES:

L.W.C. = T.D. - SWL = 26.84 FT - 19.65 FT = 7.19 FT
One Casing Volume = LWC × 0.653 gal/ft = 7.19 FT × 0.653 gal/ft = $\boxed{4.70 \text{ gal}}$
Occasional paint-fume odor noted during purging activities. Monitoring well located downwind from painting operation.
Refer to Groundwater Purge Data Sheet for purge details.

Circle If Applicable: MS/MSD	Duplicate ID No.:	Signature(s): Seth Pelepko

Tetra Tech NUS, Inc.

GROUNDWATER PURGE DATA SHEET

PROJECT SITE NAME: NWIRP Calverton
PROJECT NUMBER: N4570
WELL ID.: FD-MW-01-S
DATE: 03-01-00

Time	Water Level	Flow	pH	Cond.	Turb.	DO	Temp.	ORP	Sal.	Comments
1358	19.65	0.650	5.38	0.178	25	8.66	13.2	286	0.0	clear
1408	19.65	0.580	5.83	0.146	4.9	8.01	14.1	295	0.0	clear
1418	19.65	0.560	5.80	0.141	0.0	7.66	14.1	285	0.0	clear
1428	19.65	0.560	5.90	0.141	0.0	7.87	14.3	257	0.0	clear
1438	19.65	0.560	5.94	0.143	0.0	8.08	14.2	283	0.0	clear
1448	19.65	0.535	5.90	0.142	0.0	8.16	14.1	285	0.0	clear
1458	19.66	0.540	5.95	0.142	0.0	7.97	14.1	291	0.0	clear
1508	19.65	0.490	5.93	0.140	0.0	8.22	14.0	285	0.0	clear
1518	19.65	0.485	5.97	0.141	0.0	8.24	14.0	287	0.0	clear
1528	19.65	0.525	5.88	0.141	0.0	8.23	14.0	290	0.0	clear
1530	end purge									
										Pump possibly malfunctioning. Flow rate decreasing even with direct power source.

SIGNATURE(S): Seth [signature]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: NWIRP Calverton
Project No.: N4570

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: FD-GW03S-00
Sample Location: FD-MW-03-S
Sampled By: S. Pelepko/V. Shiokora
C.O.C. No.: #1
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Salinity
Date: 3-1-00	Visual	Standard	mS/cm	°C	NTU	mg/l	mV	%
Time: 1235								
Method: peristaltic/straw method	Clear	6.96	0.100	12.60	10	8.66	306	0.0

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Salinity
Date: 3-1-00								
Method: peristaltic pump								
Monitor Reading (ppm): 0								
Well Casing Diameter & Material	(See groundwater purge data sheets)							
Type: 4-inch / PVC								
Total Well Depth (TD): 27.91'								
Static Water Level (WL): 19.87'								
One Casing Volume(gal/L): 5.25								
Start Purge (hrs): 1035								
End Purge (hrs): 1230								
Total Purge Time (min): 115								
Total Vol. Purged (gal/L): 15.5								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOCs	HCL	40 mL glass vial	2
TPH (GRO)	HCL	40 mL glass vial	2
TPH (DRO)	~~none~~ HCl 5002 ...	1 L amber glass	2

OBSERVATIONS / NOTES:

8.04' standing water x 0.653 gallon per ft. = 5.25 gallon per volume
No odors or stains observed

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
		[signature]

Tetra Tech NUS, Inc.

GROUNDWATER PURGE DATA SHEET

PROJECT SITE NAME: NWIRP Calverton
PROJECT NUMBER: N4570
WELL ID.: FD-MW-03-S
DATE: 3-1-00

Time	Water Level	Flow ML/Min	pH	Cond.	Turb.	DO	Temp.	ORP	Sal.	Comments
1025	19.87'	–	–	–	–	–	–	–	–	0.0ppm (Initial)
start → 1035	19.87'	625	6.78	0.100	83.5	7.80	12.24	67	0.0	No odors
1050	19.87'	600	6.91	0.102	151.8	8.74	11.92	221	0.0	"
1105	19.87'	560	6.92	0.104	75.1	8.69	12.42	237	0.0	"
1120	19.87'	500	6.96	0.103	47.2	8.78	12.22	251	0.0	"
1135	19.87'	495	6.96	0.099	22.3	8.74	12.19	268	0.0	"
1145	19.87'	490	6.99	0.100	20.8	8.80	12.16	280	0.0	"
1155	19.87'	490	6.95	0.102	18.7	8.70	12.31	293	0.0	"
1205	19.87'	485	6.96	0.101	11.4	8.64	12.52	295	0.0	"
1215	19.87'	480	6.95	0.101	10.7	8.60	12.61	298	0.0	"
1220	19.87'	480	6.96	0.102	9.9	8.59	12.23	299	0.0	"
1225	19.87	475	6.96	0.100	10.6	8.66	12.60	306	0.0	"

SIGNATURE(S): [signature]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: NWIRP Calverton
Project No.: N4570

[] Domestic Well Data
[x] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: FD-GW04S-00
Sample Location: FD-MW-04-S
Sampled By: S. Pelepko/V. Shickora
C.O.C. No.: Quanterra 64892
Type of Sample:
[x] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Salinity
Date: 2-29-00	Visual	Standard	mS/cm	°C	NTU	mg/l	mV	%
Time: 1600								
Method: peristaltic/straw method	clear	6.25	0.112	12.82	11.6	5.37	57	0.0

PURGE DATA:

Date: 2-29-00	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Salinity
Method: peristaltic pump								
Monitor Reading (ppm): 0								
Well Casing Diameter & Material	See groundwater purge data sheets							
Type: 4 inch / PVC								
Total Well Depth (TD): 25.90								
Static Water Level (WL): 18.98								
One Casing Volume(gal/L): 4.52								
Start Purge (hrs): 1435								
End Purge (hrs): 1555								
Total Purge Time (min): 80								
Total Vol. Purged(gal/L): 14								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOCs	HCL	40 mL glass vial	2
TPH (GRO)	HCL	40 mL glass vial	2
TPH (DRO)	~~none~~ HCl	1 L amber glass	2
	5p [illegible]		

OBSERVATIONS / NOTES:

6.92' standing water x 0.653 gallons per ft = 4.52 gallons per volume
No odors noted

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): [signature]

Tetra Tech NUS, Inc.

GROUNDWATER PURGE DATA SHEET

PROJECT SITE NAME: NWIRP Calverton
PROJECT NUMBER: N4570
WELL ID.: FD-MW-04-S
DATE: 02-29-00

Time	Water Level	Flow ML/Min	pH	Cond.	Turb.	DO	Temp.	ORP	Sal.	Comments
1230	18.98'	—	—	—	—	—	—	—	—	Initial Reading
1435	18.99'	650	6.19	0.095	25.8	7.95	12.45	278	0.0	0 ppm
1448	18.99'	670	5.72	0.103	15.5	6.68	12.87	246	0.0	No odor
1500	18.99'	650	5.80	0.106	18.8	5.83	12.79	171	0.0	"
1510	18.99'	650	5.84	0.108	13.7	5.86	12.86	119	0.0	"
1520	18.99'	650	5.93	0.112	18.4	5.70	12.74	90	0.0	"
1530	18.99'	650	6.08	0.113	14.1	5.68	12.79	80	0.0	"
1540	18.99'	650	6.17	0.112	12.2	5.59	12.81	63	0.0	"
1545	18.99'	650	6.24	0.113	11.8	5.39	12.80	60	0.0	"
1550	18.99'	650	6.25	0.112	11.6	5.37	12.82	58	0.0	"
~~1555~~										

SIGNATURE(S): [signature]

Tetra Tech NUS, Inc

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: NWIRP Calverton
Project No.: N4570

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: FD-GW06S-00
Sample Location: FD-MW-06-S
Sampled By: S. Pelepko/V Shickora
C.O.C. No.: Quanterra 64842
Type of Sample:
[■] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Salinity
Date: 02-29-00								
Time: 0922	Visual	Standard	mS/cm	°C	NTU	mg/l	mV	%
Method: peristaltic/straw method	clear	6.10	0.192	12.94	0.8	6.19	34	0.0

PURGE DATA:

Date: 02-29-00	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Salinity
Method: peristaltic pump								
Monitor Reading (ppm): 1.5	See	Groundwater		purge	data	sheets		
Well Casing Diameter & Material								
Type: 4 inch / PVC								
Total Well Depth (TD): 22.50								
Static Water Level (WL): 17.80								
One Casing Volume(gal/L): 3.06								
Start Purge (hrs): 0820								
End Purge (hrs): 0920								
Total Purge Time (min): 60								
Total Vol. Purged(gal/L): ~9.5								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOCs	HCL	40 mL glass vial	2
TPH (GRO)	HCL	40 mL glass vial	2
TPH (DRO)	~~none~~ HCl SP [illegible]	1 L amber glass	2

OBSERVATIONS / NOTES:

4.7' standing water x 0.653 gallons per ft = 3.069 gallons per well volume
Slight fuel oil odor from groundwater

Circle if Applicable:		Signature(s):
MS/MSD	Duplicate ID No.:	[signature]

Tetra Tech NUS, Inc.

GROUNDWATER PURGE DATA SHEET

PROJECT SITE NAME: NWIRP Calverton
PROJECT NUMBER: N4570
WELL ID.: FD-MW-06-S
DATE: 02-29-00

Time	Water Level	Flow ml/min	pH	Cond.	Turb.	DO	Temp.	ORP	Sal.	Comments
0800	17.80'	–	–	–	–	–	–	–	–	Initial readings
Start→ 0820	17.82'	700	5.62	0.322	19.2	6.20	12.82	190	0.0	1.5 ppm PID
0835	17.82'	725	5.96	0.238	7.4	6.27	13.19	65	0.0	Slight fuel oil odor
0845	17.81'	705	5.98	0.219	3.8	6.19	12.97	42	0.0	"
0855	17.81'	675	6.03	0.204	2.9	6.17	12.73	41	0.0	"
0905	17.81'	650	6.10	0.198	2.1	6.22	13.01	36	0.0	"
0910	17.81'	650	6.10	0.195	0.5	6.19	12.84	35	0.0	"
0915	17.81'	640	6.11	0.193	0.5	6.20	13.05	36	0.0	"
0920	17.81'	650	6.10	0.192	0.8	6.19	12.94	34	0.0	"

SIGNATURE(S): [signature]

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Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: NWIRP Calverton
Project No.: N4570

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[X] QA Sample Type: Field duplicate / MS/MSD

Sample ID No.: FD-GW07S-00
Sample Location: FD-MW-07-S
Sampled By: S. Pelepko/V. Shickora
C.O.C. No.: #2
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 3-2-00	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Salinity
Time: 1025	Visual	Standard	mS/cm	°C	NTU	mg/l	mV	%
Method: peristaltic/straw method	Clear	5.17	0.092	11.1	0.6	5.21	164	0.0

PURGE DATA:

Date: 3-2-00	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Salinity
Method: peristaltic pump								
Monitor Reading (ppm): 2.0								
Well Casing Diameter & Material								
Type: 4 inch / PVC								
Total Well Depth (TD): 23.10'								
Static Water Level (WL): 16.42'								
One Casing Volume(gal/L): 4.36								
Start Purge (hrs): 0900								
End Purge (hrs): 1020								
Total Purge Time (min): 100								
Total Vol. Purged (gal/L): 13.2								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOCs	HCL	40 mL glass vial	8
TPH (GRO)	HCL	40 mL glass vial	4
TPH (DRO)	~~none~~ HCl SP 03-01-00	1 L amber glass	4

OBSERVATIONS / NOTES:

6.68' standing water x 0.653 gallons per ft = 4.36 gallons per volume
Collected MS/MSD for VOCs only.
Refer to Groundwater Purge Data Sheet for purge details.

Circle if Applicable:		Signature(s):
MS/MSD	Duplicate ID No.:	
X	GWFD-030200 Assigned Time: 1100	[signature]

Tetra Tech NUS, Inc.

GROUNDWATER PURGE DATA SHEET

PROJECT SITE NAME: NWIRP Calverton
PROJECT NUMBER: N4570
WELL ID.: FD-MW-07-S
DATE: 3-2-00

Time	Water Level	Flow mL/min	pH	Cond.	Turb.	DO	Temp.	ORP	Sal.	Comments
0850	16.42'	–	–	–	–	–	–	–	–	0.0ppm PID
Start 0900	16.42'	700	4.80 ~~5.32~~	0.132	225.0	7.12	10.0	259	0.0	cloudy. No odor
0915	16.42'	640	5.18	0.083	80.2	5.32	11.1	210	0.0	no odors
0930	16.42'	650	5.25	0.078	11.4	5.51	10.9	190	0.0	clear - No odors
0940	16.42'	650	5.17	0.080	3.5	5.42	11.0	193	0.0	"
0950	16.42'	650	5.15	0.084	1.4	5.31	10.9	180	0.0	"
1000	16.42'	650	5.12	0.086	0.8	5.26	11.2	182	0.0	"
1010	16.42'	650	5.16	0.089	0.7	5.13	11.1	168	0.0	"
1015	16.42'	650	5.17	0.091	0.8	5.22	11.2	168	0.0	"
1020	16.42'	650	5.17	0.092	0.6	5.21	11.1	164	0.0	"
1025 → Sample										

SIGNATURE(S): [signature]

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Tetra Tech NUS, Inc

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: NWIRP Calverton
Project No.: N7570

[] Domestic Well Data
[x] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: FD-GW05S-00
Sample Location: FD-MW-05-S
Sampled By: S. Polepko
C.O.C. No.: Quanterra 64892
Type of Sample:
[x] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Salinity
Date: 02-24-00	Visual	Standard	mS/cm	°C	NTU	mg/l	mV	%
Time: 1320								
Method: peristaltic pump/low flow	clear	5.84	0.193	13.3	6	8.50	30	0.0

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Salinity
Date: 02-24-00								
Method: peristaltic pump								
Monitor Reading (ppm): 1.1								
Well Casing Diameter & Material								
Type: 4" PVC								
Total Well Depth (TD): 25.79 FT								
Static Water Level (WL): 17.76 FT								
One Casing Volume(gal/L): 5.24								
Start Purge (hrs): 1142								
End Purge (hrs): 1317								
Total Purge Time (min): 95								
Total Vol. Purged (gal/L): 16								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOCs	HCl	40 ml glass vial	(2)
TPH (GRO)	HCl	40 ml glass vial	(2)
TPH (DRO)	HCl	1L amber glass	(2)

OBSERVATIONS / NOTES:

L.W.C. = TD - SWL = 25.79 FT - 17.76 FT = 8.03 FT
One Casing Volume = LWC x 0.653 gal/ft = 8.03 FT x 0.653 gal/ft = $\boxed{5.24 \text{ gal}}$
Fuel odor noted over discharge water
Refer to Groundwater Purge Data Sheet for purge details.

Circle If Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): Scott Polepko

Tetra Tech NUS, Inc.

GROUNDWATER PURGE DATA SHEET

PROJECT SITE NAME: NWIRP Calverton
PROJECT NUMBER: N4570
WELL ID.: FO-MW-05-S
DATE: 02-29-00

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (L/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Sal. (%)	Comments
1142	17.76	0.625	5.88	0.226	66	7.19	11.8	45	0.0	brn tint, fuel odor
1147	17.84	0.625	5.96	0.187	20	5.64	14.0	10	0.0	v. lt. brn tint, fuel odor
1152	—	0.625	5.91	0.198	34	5.12	13.9	12	0.0	as above
1157	17.80	0.625	5.93	0.197	15	6.71	13.7	14	0.0	v lt tint, fuel odor
1202	17.79	0.625	5.91	0.190	8	7.22	13.5	19	0.0	clear, fuel odor
1212	17.77	0.625	5.89	0.199	15	7.48	14.1	25	0.0	as above
1222	17.79	0.625	5.82	0.193	9	5.60	13.5	25	0.0	as above
1232	17.78	0.625	5.80	0.193	9	7.17	13.6	29	0.0	as above
1242	17.79	0.625	5.81	0.191	7	7.34	14.0	29	0.0	as above
1252	17.79	0.625	5.79	0.193	13	7.44	13.9	37	0.0	as above
1257	17.79	0.625	5.80	0.194	5	7.27	13.7	28	0.0	as above
1302	17.78	0.625	5.86	0.193	6	6.66	13.6	32	0.0	as above
1307	17.78	0.625	5.83	0.193	6	8.44	13.8	25	0.0	as above
1312	17.79	0.625	5.84	0.193	6	8.50	13.3	30	0.0	as above
1317	end purge									

SIGNATURE(S): Scott [illegible]

PAGE 2 OF 2

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: NWIRP Calverton
Project No.: N4570

[] Domestic Well Data
■ Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: FD-GWGRD-00
Sample Location: BR/D
Sampled By: S Pelepko/V. Shiokora
C.O.C. No.: Guadalerra 64891
Type of Sample:
■ Low Concentration
[] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Salinity
Date: 02-24-00	Visual	Standard	mS/cm	°C	NTU	mg/l	mV	%
Time: ~~1455~~ 1555								
Method: peristaltic/straw method	clear	5.60	0.112	12.1	0	6.69	47	0.0

PURGE DATA:

Date: 02-24-00	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Salinity
Method: peristaltic pump								
Monitor Reading (ppm): 11.0								
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD): 24.50								
Static Water Level (WL): 19.31								
One Casing Volume(gal/L): 0.85								
Start Purge (hrs): 1521								
End Purge (hrs): 1550								
Total Purge Time (min): 29								
Total Vol. Purged (gal/L): 3.0								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOCs	HCL	40 mL glass vial	(2)
TPH (GRO)	HCL	40 mL glass vial	(2)
TPH (DRO)	~~none~~ HCl Spl...	1 L amber glass	(2)

OBSERVATIONS / NOTES:

L.W.C. = 24.50 FT (TD) - 19.31 FT (SWL) = 5.19 FT
One Casing Volume = 0.163 gal/FT × L.W.C. = 0.163 gal/FT × 5.19 FT = $\boxed{0.85 \text{ gal}}$
Strong fuel odor noted over discharge water.
Refer to Groundwater Purge Data Sheet for purge details.

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

GROUNDWATER PURGE DATA SHEET

PROJECT SITE NAME: NWIRP Calverton **WELL ID.:** BR/D

PROJECT NUMBER: N4570 **DATE:** 02-28-00

Time	Water Level	Flow	pH	Cond.	Turb.	DO	Temp.	ORP	Sal.	Comments
1521	19.31	0.375	5.60	0.182	10	3.82	12.5	54	0.0	Strong fuel odor, [illegible]
1526	—	0.340	5.78	0.124	0	5.42	13.0	28	0.0	as above
1531	—	0.390	5.75	0.116	0	3.46	13.0	24	0.0	as above
1536	—	0.380	5.75	0.112	0	6.46	12.7	29	0.0	as above
1541	—	0.380	5.79	0.111	0	6.59	12.2	39	0.0	as above
1546	19.41	0.390	5.60	0.112	0	6.69	12.1	47	0.0	as above
1550	end purge									

SIGNATURE(S): [signature]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: NWIRP Calverton
Project No.: N4570

[] Domestic Well Data
[■] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: FD-GWGR11-00
Sample Location: BN/11
Sampled By: S. Pelepko/V. Shickora
C.O.C. No.: Quanterra 64891
Type of Sample:
[■] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 2-28-00	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Salinity
Time: 1615	Visual	Standard	mS/cm	°C	NTU	mg/l	mV	%
Method: peristaltic/straw method	Tinted	6.24	0.630	12.51	60.2	3.61	-14	0.0

PURGE DATA:

Date: 2-28-00	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Salinity
Method: peristaltic pump								
Monitor Reading (ppm): 1.3		See	purge	data	Sheets			
Well Casing Diameter & Material								
Type: 4" PVC								
Total Well Depth (TD): 20.61								
Static Water Level (WL): 19.34								
One Casing Volume(gal/L): 0.88								
Start Purge (hrs): 1520								
End Purge (hrs): 1600								
Total Purge Time (min): 40								
Total Vol. Purged(gal/L): 7.12								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOCs	HCL	40 mL glass vial	(2)
TPH (GRO)	HCL	40 mL glass vial	(2)
TPH (DRO)	~~none~~ HCl SP 02-28-00	1 L amber glass	(2)

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
		[signature]

Tetra Tech NUS, Inc.

GROUNDWATER PURGE DATA SHEET

PROJECT SITE NAME: NWIRP Calverton **WELL ID.:** BN/11
PROJECT NUMBER: N4570 **DATE:** 2-28 00

Time	Water Level	Flow	pH	Cond.	Turb.	DO	Temp.	ORP	Sal.	Comments
1435	19.34'	—	—	—	—	—	—	—	—	1.3 ppm PID
Start → 1520	19.34'	550	5.48	.454	720	4.53	12.18	111	0.0	0.0 ppm
1525	19.50'	600	5.54	.521	600	3.56	12.28	6	0.0	
1530	19.48'	600	6.06	.549	303	1.30	13.12	-41	0.0	
1535	19.47'	600	6.10	.552	275	1.28	13.25	-40	0.0	
1540	19.45'	600	6.25	.635	97.5	3.70	13.49	-14	0.0	
1545	19.44'	620	6.23	.640	61.8	3.83	12.90	-14	0.0	
1550	19.44'	610	6.24	.638	58.7	3.86	12.95	-12	0.0	
1555	19.43'	610	6.25	.633	62.5	3.53	12.37	-12	0.0	
1600	19.43'	600	6.24	.630	60.2	3.61	12.51	-14	0.0	

SIGNATURE(S): [signature]

Tetra Tech NUS, Inc

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: NWIRP Calverton
Project No.: N4570

Sample ID No.: FD-GWGR19-00
Sample Location: BK/19
Sampled By: S. Pelepko/V. Shiokora
C.O.C. No.: #1
Type of Sample:
■ Low Concentration
[] High Concentration

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

SAMPLING DATA:

Date: 3-1-00	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Salinity
Time: 1607	Visual	Standard	mS/cm	°C	NTU	mg/l	mV	%
Method: peristaltic/straw method	clear	6.78	0.327	13.41	21.2	3.80	-39	0.0

PURGE DATA:

Date: 3-1-00	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Salinity
Method: peristaltic pump								
Monitor Reading (ppm): 0								
Well Casing Diameter & Material								
Type: 4 inch / PVC		(See groundwater purge data sheets)						
Total Well Depth (TD): 28.85'								
Static Water Level (WL): 15.95'								
One Casing Volume(gal/L): 8.42								
Start Purge (hrs): 1355								
End Purge (hrs): 1605								
Total Purge Time (min): 130								
Total Vol. Purged (gal/L): 26								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOCs	HCL	40 mL glass vial	2
TPH (GRO)	HCL	40 mL glass vial	2
TPH (DRO)	~~none~~ HCl SP 03/1/00	1 L amber glass	2

OBSERVATIONS / NOTES:

12.9' standing water x 0.653 gallons per ft = 8.42 gallons per volume
No odors or stains observed

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
		[signature]

Tetra Tech NUS, Inc.

GROUNDWATER PURGE DATA SHEET

PROJECT SITE NAME: NWIRP Calverton
PROJECT NUMBER: N4570
WELL ID.: BK/19
DATE: 3-1-00

	Time	Water Level	Flow ML/min	pH	Cond.	Turb.	DO	Temp.	ORP	Sal.	Comments
	1350	15.95'	—	—	—	—	—	—	—	—	0.0 ppm PID
start→	1355	15.95'	700	6.79	0.334	28.5	4.55	13.69	-13	0.0	No odor
	1410	15.95'	690	6.82	0.337	21.1	4.02	13.70	-35	0.0	"
	1425	15.95'	700	6.85	0.336	27.9	4.08	13.92	-47	0.0	"
	1440	15.95'	700	6.82	0.338	74.4	3.86	13.75	-44	0.0	"
	1455	15.95'	700	6.84	0.332	41.5	3.93	13.05	-37	0.0	"
	1510	15.95'	700	6.79	0.328	29.0	3.87	13.33	-44	0.0	"
	1525	15.95'	700	6.77	0.329	23.1	3.68	13.50	-40	0.0	"
	1540	15.95'	695	6.77	0.328	22.5	3.77	13.37	-39	0.0	"
	1555	15.95'	695	6.78	0.329	21.4	3.82	13.45	-39	0.0	"
	1600	15.95'	695	6.78	0.328	20.9	3.85	13.51	-37	0.0	"
	1605	15.95'	700	6.78	0.327	21.2	3.80	13.41	-39	0.0	"

SIGNATURE(S): [signature]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page 1 of 2

Project Site Name:	NWIRP Calverton	Sample ID No.:	FD-GWGR4-00
Project No.:	N4570	Sample Location:	4
		Sampled By:	S. Pelepko/V. Shickora
[] Domestic Well Data		C.O.C. No.:	~~[illegible]~~ 64492
[X] Monitoring Well Data		Type of Sample:	
[] Other Well Type:		■ Low Concentration	
[] QA Sample Type:		[] High Concentration	

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Salinity
Date: 2-29-00	Visual	Standard	mS/cm	°C	NTU	mg/l	mV	%
Time: 1135								
Method: peristaltic/straw method	CLEAR	6.31	0.203	13.33	0.8	3.87	12	0.0

PURGE DATA:

Date: 2-29-00	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Salinity
Method: peristaltic pump								
Monitor Reading (ppm): 1.8								
Well Casing Diameter & Material	See groundwater purge data sheets							
Type: 4 inch / PVC								
Total Well Depth (TD): 25.31'								
Static Water Level (WL): 19.71'								
One Casing Volume(gal/L): 3.65								
Start Purge (hrs): 1020								
End Purge (hrs): 1130								
Total Purge Time (min): 70								
Total Vol. Purged (gal/L): 11								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOCs	HCL	40 mL glass vial	2
TPH (GRO)	HCL	40 mL glass vial	2
TPH (DRO)	~~none~~ HCl	1 L amber glass	2
	[illegible]		

OBSERVATIONS / NOTES:

5.6' standing water x 0.653 gallons per Ft. = 3.65 gallons per volume
Fuel oil odor from well and groundwater

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
		[illegible signature]

Tetra Tech NUS, Inc.

GROUNDWATER PURGE DATA SHEET

PROJECT SITE NAME: NWIRP Calverton **WELL ID.:** 4
PROJECT NUMBER: N4570 **DATE:** 02-29-00

Time	Water Level	Flow ML/min	pH	Cond.	Turb.	DO	Temp.	ORP	Sal.	Comments
1015	19.71'	—	—	—	—	—	—	—	—	Initial Reading
1020	19.72'	500	5.66	0.137	75.8	4.66	11.47	168	0.0	1.8 ppm PID
1030	19.72'	560	5.95	0.172	45.5	3.60	12.40	91	0.0	Fuel oil odor
1040	19.72'	575	6.02	0.178	10.2	3.68	12.69	58	0.0	"
1050	19.72'	550	6.05	0.190	7.6	3.75	12.86	39	0.0	"
1100	19.72'	560	6.24	0.197	5.2	3.73	13.04	~~20~~ 20	0.0	"
1110	19.72'	560	6.20	0.199	4.8	3.85	13.01	19	0.0	"
1115	19.72'	575	6.26	0.199	3.6	3.77	13.12	15	0.0	"
1120	19.72'	575	6.32	0.201	2.9	3.83	13.40	13	0.0	"
1125	19.72'	575	6.31	0.203	0.8	3.87	13.33	12	0.0	"
11										

SIGNATURE(S): [signature]

Tetra Tech NUS, Inc

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: NWIRP Calverton
Project No.:

[] Domestic Well Data
[x] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: FO-GWGR16-00
Sample Location: 16
Sampled By: S. Polepko
C.O.C. No.: Quanterra 64893
Type of Sample:
[x] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Salinity
Date: 02-24-00								
Time: 1625	Visual	Standard	mS/cm	°C	NTU	mg/l	mV	%
Method: Peristaltic pump low-flow	clear	5.43	0.065	12.7	4	8.49	295	0.0

PURGE DATA:

Date: 02-24-00	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Salinity
Method: Peristaltic pump								
Monitor Reading (ppm): 0.0								
Well Casing Diameter & Material								
Type: 4" PVC								
Total Well Depth (TD): 28.23 FT								
Static Water Level (WL): 17.41 FT								
One Casing Volume(gal/L): 7.07								
Start Purge (hrs): 1415								
End Purge (hrs): 1620								
Total Purge Time (min): 125								
Total Vol. Purged (gal/L): 21.5								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOCs	HCl	40 ml glass vial	(2)
TPH (GRO)	HCl	40 ml glass vial	(2)
TPH (DRO)	HCl	1 L amber glass	(2)

OBSERVATIONS / NOTES:

No J-Plug present
L.W.C. = TD - SWL = 28.23 FT - 17.41 FT = 10.82 FT
One Casing Volume = L.W.C × ~~4"~~ 0.653 gal/ft (4" PVC) = 10.82 Ft × 0.653 gal/ft = $\boxed{7.07 \text{ gal}}$
Refer to Groundwater Purge Data Sheet for purge details.

Circle if Applicable:		Signature(s):
MS/MSD	Duplicate ID No.:	[signature]

Tetra Tech NUS, Inc.

GROUNDWATER PURGE DATA SHEET

PROJECT SITE NAME: NWIRP Calverton
PROJECT NUMBER: N4570
WELL ID.: 1K
DATE: 02-24-00

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (L/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Sal. (%)	Comments
1415	17.41	0.650	5.47	0.083	96	7.01	12.3	173	0.0	brn tint
1425	17.42	0.650	5.65	0.083	48	6.51	13.1	213	0.0	lt brn tint
1435	17.42	0.650	5.53	0.083	37	8.19	12.8	241	0.0	v. lt tint
1445	17.42	0.650	5.55	0.082	24	7.72	13.0	257	0.0	as above
1455	17.42	0.650	5.53	0.084	28	8.01	12.4	255	0.0	as above
1505	17.42	0.650	5.50	0.082	32	9.34	12.7	265	0.0	as above
1515	17.42	0.650	5.49	0.084	8	7.97	13.0	270	0.0	clear
1525	17.42	0.650	5.47	0.083	33	9.05	12.5	291	0.0	clear
1535	17.43	0.650	5.49	0.082	10	8.18	12.7	286	0.0	clear
1545	17.43	0.650	5.48	0.083	5	6.75	12.8	278	0.0	clear
1555	17.43	0.625	5.48	0.083	14	8.01	12.5	292	0.0	clear
1605	17.44	0.625	5.45	0.084	4	7.57	12.6	298	0.0	clear
1610	17.44	0.625	5.50	0.085	4	8.23	12.4	300	0.0	clear
1615	17.44	0.625	5.43	0.085	4	8.49	12.7	295	0.0	clear
16:20	end purge									

SIGNATURE(S): [illegible]

PAGE 2 OF 2

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page 1 of 2

Project Site Name: NWIRP Calverton
Project No.: N4570

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: FD-GWGR24-00
Sample Location: 24
Sampled By: S. Pelepko/V. Shlokora
C.O.C. No.: #1
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Salinity
Date: 3-1-00	Visual	Standard	mS/cm	°C	NTU	mg/l	mV	%
Time: 0945								
Method: peristaltic/straw method	clear	6.61	0.154	12.92	7.0	3.46	7	0.0

PURGE DATA:

Date: 3-1-00	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Salinity
Method: peristaltic pump								
Monitor Reading (ppm): 1.1								
Well Casing Diameter & Material								
Type: 4 inch / PVC		(See groundwater purge data sheet)						
Total Well Depth (TD): 29.30'								
Static Water Level (WL): 16.45'								
One Casing Volume(gal/L): 8.39								
Start Purge (hrs): 0725								
End Purge (hrs): 0945								
Total Purge Time (min): 140								
Total Vol. Purged (gal/L): 25								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOCs	HCL	40 mL glass vial	2
TPH (GRO)	HCL	40 mL glass vial	2
TPH (DRO)	~~none~~ HCl SP 03-01-00	1 L amber glass	2

OBSERVATIONS / NOTES:

12.85' standing water x 0.653 gallons per ft. = 8.39 gallons per volume
Slight fuel oil odor in groundwater at this location

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

GROUNDWATER PURGE DATA SHEET

PROJECT SITE NAME: NWIRP Calverton
PROJECT NUMBER: N4570
WELL ID.: 24
DATE: 3-1-00

Time	Water Level	Flow mL/Min	pH	Cond.	Turb.	DO	Temp.	ORP	Sal.	Comments
0720	16.45'	—	—	—	—	—	—	—	-	1.1 ppm FID
start→ 0725	16.46'	660	5.95	0.110	188.2	3.47	11.13	138	0.0	Fuel oil odor (slight)
0740	16.46'	675	6.40	0.112	40.5	3.85	12.00	84	0.0	"
0755	16.46'	675	6.54	0.120	18.4	3.75	12.41	50	0.0	"
0810	16.46'	680	6.59	0.130	12.9	3.66	12.65	26	0.0	"
0825	16.46'	685	6.59	0.158	11.6	3.56	12.90	21	0.0	"
0840	16.46'	685	6.57	0.151	8.8	3.20	13.01	9	0.0	"
0855	16.46'	685	6.59	0.156	7.2	3.51	12.49	16	0.0	very slight fuel oil odor
0910	16.46'	685	6.61	0.153	7.5	3.54	12.58	12	0.0	"
0925	16.46'	685	6.60	0.153	8.6	3.61	12.95	8	0.0	"
0930	16.46'	685	6.61	0.154	7.2	3.35	12.70	9	0.0	"
0935	16.46'	690	6.60	0.153	6.4	3.49	12.83	8	0.0	"
0940	16.46'	695	6.61	0.154	7.0	3.46	12.92	7	0.0	"

SIGNATURE(S): [signature]

PAGE 2 OF 2

TETRA TECH NUS INC. Fax:4129214040 Sep 26 2000 8:43 P.22

Chain of Custody Record

Quanterra, Inc. - Pittsburgh PA Lab
450 William Pitt Way
Pittsburgh PA 15238

Quanterra

QUA-4124

Field	Value
Client	TETRA TECH NUS, Inc.
Address	FOSTER PLAZA 7, 661 ANDERSEN DRIVE
City	PITTSBURGH
State	PA
Zip Code	15220-2745
Project Name	NWIRP CALVERTON - SITE 7
Contract/Purchase Order/Quote No.	N4570 * 0400 CTO 0189
Project Manager	DAVID BRAYACK
Telephone Number (Area Code)/Fax Number	(412) 921-8375 / 921-4040
Site Contact	SETH PELEPKO
Carrier/Waybill Number	810817874037 / FED EX
Date	02-28-00
Lab Number	
Chain Of Custody Number	54891
Page	1 of 1

Analysis: TCL VOCs; TPH (GRO); TPH (DRO); TEMP BLANK

Sample I.D. No. and Description	Date	Time	Sample Type	Total Volume	Containers Type	Containers No.	Preservative	Condition on Receipt	TCL VOCs	TPH (GRO)	TPH (DRO)	TEMP BLANK
FD-GWGRD-00	02-28-00	1555	AQUEOUS	2.16 L	40 mL / 1L AMBER	4 / 2	HCl		2	2	2	
FD-GWGR11-00	02-28-00	1615	AQUEOUS	2.16 L	40 mL / 1L AMBER	4 / 2	HCl		2	2	2	
GWTB-022800	02-28-00	—	AQUEOUS	40 mL	40 mL glass	1	HCl		1			
TEMPERATURE BLANK	02-28-00	—	AQUEOUS	40 mL	40 mL glass	1	—					1

Special Instructions

Possible Hazard Identification: [X] Non Hazard [ ] Flammable [ ] Skin Irritant [ ] Poison B [ ] Unknown

Sample Disposal: [ ] Return To Client [ ] Disposal By Lab [ ] Archive For ____ Months

Turn Around Time Required: [X] Normal [ ] Rush

QC Level: [ ] I. [ ] II. [ ] III.

Project Specific (Specify)

	Date	Time		Date	Time
1. Relinquished By: Seth Pelepko	02-28-00	1800	1. Received By		
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

Chain of Custody Record

Quanterra, Inc. - Pittsburgh PA Lab
450 William Pitt Way
Pittsburgh PA 15238

Quanterra

QUA-4124

Client: TETRA TECH NUS, INC.

Address: FOSTER PLAZA 7, 661 ANDERSEN DRIVE

City: PITTSBURGH **State:** PA **Zip Code:** 15220-2745

Project Name: NWIRP CALVERTON - SITE 7

Contract/Purchase Order/Quote No.: N4570 # 0400 CTO 0189

Project Manager: DAVID BRAYACK

Telephone Number (Area Code)/Fax Number: (412) 921-8375 / 921-4040

Site Contact: SETH PELEPKO

Carrier/Waybill Number: FED EX / 8108178734 75

Date: 03-01-00 ~~02-29-00~~

Lab Number:

Chain Of Custody Number: 54892

Page 1 **of**

Sample I.D. No. and Description	Date	Time	Sample Type	Total Volume	Containers Type	Containers No.	Preservative	Condition on Receipt	TCL VOCs (40 mL)	TPH (GRO) (40 mL)	TPH (DRO) (1L)	TEMPERATURE								
FD-GW06S-00	02-29-00	0922	AQUEOUS	2.16 L	40 mL Glass / 1L Amber	4 / 2	HCl		2	2	2									
FD-GWGR4-00	02-29-00	1135	AQUEOUS	2.16L	40 mL Glass / 1L Amber	4 / 2	HCl		2	2	2									
FD-GW05S-00	02-29-00	1320	AQUEOUS	2.16 L	40 mL Glass / 1L Amber	4 / 2	HCl		2	2	2									
FD-GWGR16-00	02-29-00	1625	AQUEOUS	2.16 L	40 mL Glass / 1L Amber	4 / 2	HCl		2	2	2									
FD-GW049-00	02-29-00	1600	AQUEOUS	2.16 L	40 mL Glass / 1L Amber	4 / 2	HCl		2	2	2									
GWTB-022900	02-29-00	—	AQUEOUS	40 mL	40 mL Glass	1	HCl		1											
TEMPERATURE BLANK	02-29-00	—	AQUEOUS	100 mL	HDPE / 40 mL Glass	2	—					2								

Special Instructions

Possible Hazard Identification
[X] Non-Hazard [ ] Flammable [ ] Skin Irritant [ ] Poison B [ ] Unknown

Sample Disposal
[ ] Return To Client [X] Disposal By Lab [ ] Archive For ______ Months

Turn Around Time Required
[X] Normal [ ] Rush

QC Level
[ ] I [ ] II [ ] III

Project Specific (Specify)

	Date	Time		Date	Time
1. Relinquished By: Seth Pelepko	03-01-00 ~~02-29-00~~	0900 ~~1830~~	1. Received By		
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

TETRA TECH NUS INC. Fax:4129214040 Sep 26 2000 8:39 P.03

TETRA TECH NUS, INC.
FOSTER PLAZA 7
661 ANDERSEN DRIVE
PITTSBURGH, PA 15220-2745
(412) 921-7090

CHAIN OF CUSTODY RECORD
#1

PROJECT NO.: N4570# CTO 0189 0400

SITE NAME: NWIRP CALVERTON - SITE 7

SAMPLERS (SIGNATURE): Seth [signature]

STATION NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	TCL VOCs (40 ml vials)	TPH (GRO) (40 ml vials)	TPH (DRO) (1L Amber)	TEMPERATURE (40 ml VOA vials)			REMARKS
1	03/01/00	0945		X	FD-GWGR24-00	6	2	2	2				
2	03/01/00	1435		X	FD-GW03S-00	6	2	2	2				
4	03/01/00	1607		X	FD-GWGR19-00	6	2	2	2				
3	03/01/00	1535		X	FD-GW01S-00	6	2	2	2				
	03/01/00	—		X	GWTB-030100	1	1						
	03/01/00	—		X	TEMPERATURE BLANK	2				2			

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):
Seth [signature]	03/01/00 1230				

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED FOR LABORATORY BY (SIGNATURE):	DATE / TIME:	REMARKS:
				Shipped via Fed Ex Airbill No.: 8106 7873464

TETRA TECH NUS INC. Fax:4129214040 Sep 26 2000 8:40 P.04

TETRA TECH NUS, INC.
FOSTER PLAZA 7
661 ANDERSEN DRIVE
PITTSBURGH, PA 15220-2745
(412) 921-7090

CHAIN OF CUSTODY RECORD

#2

TETRA TECH NUS INC. Fax:4129214040 Sep 26 2000 8:40 P.05

PROJECT NO.: N4570 * 0400 CTO 0189

SITE NAME: NWIRP CALVERTON - SITE 7

SAMPLERS (SIGNATURE):

STATION NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CON-TAINERS	TCL VOCs (40 ml glass)	TPH (GRO) (40 ml glass)	TPH (DRO) (1 L Amber)	TEMPERATURE (6 oz HDPE)			REMARKS
1	03/02/00	1025		X	FD-GW07S-00	10	6	2	2				do MS/MSD for TCL VOCs only
2	03/02/00	1100		X	GWFD-030200	6	2	2	2				
	03/02/00	—		X	GWTB-030200	1	1						
	03/02/00	—		X	TEMPERATURE BLANK	1				1			

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):
[signature]	03-02-00 1800				
RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):
RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED FOR LABORATORY BY (SIGNATURE):	DATE / TIME:	REMARKS: Shipped via Fed Ex Airbill No.: 810817873453	

ATTACHMENT C

SOIL BORING LOG SHEETS

STEP 2, JUNE 2000

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NWIRP Calverton
PROJECT NUMBER: 4570
DRILLING COMPANY: Delta Well & Pump
DRILLING RIG: Failing Model F-10

BORING NUMBER: FO-MW-10S
DATE: 6-22-00
GEOLOGIST: Vince Sanchora
DRILLER: Mike Pellegrino

Time	Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
1136		1	/	Auger				Orange-Brown fine		(moist)	0	0	0	0
		2	/	↓				grain Silty Sand						
		3	/	↓				(some clay, peat, pebbles)						
		4	/	↓										
		5	/	↓										
1145	1	6	2/4	17/24				Tan-White fine grain		(moist)	0	0	0	0
		7	4/6	↓				Sand with some						
		8	/	Auger				rounded quartz pebbles						
		9	/	↓										
		10	/	↓										
1154	2	11	1/4	15/24				Tan-white fine to		(moist)	0	0	0	0
		12	5/6	↓				Medium grain Sand						
1302	3	13	2/2	18/24	GW					(wet at ≈12.1')				
		14	3/4	↓				Same as above			0	0	0	0
1308	4	15	3/1	18/24										
		16	3/6	↓				Same as above		Saturated	0	0	0	0
1315	5	17	1/3	9/24										
		18	5/5	↓				Tan-white fine to Med.						
1322	6	19	2/3					Grain Sand (some quartz pebbles)		Saturated	0	0	0	0
		20	2/2											
1328	7	21	6/6											
		22	9/11					Same as above		Saturated	0	0	0	0
		23	/		EOB									
		24	/											
		25	/											

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0

Remarks: 3.25" I.D. x 5' HSA - 2" x 2' Stainless split spoons
140 pound Hammer - No odors or stains observed
roughly 15 gallons of decon water added to Augers to prevent Flowing Sand

Converted to Well: Yes X No ____ Well I.D. #: FO-MW-10S

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NWIRP Calverton
PROJECT NUMBER: 4570
DRILLING COMPANY: Delta Well + Pump
DRILLING RIG: Failing F-10
BORING NUMBER: FD-MW-08S
DATE: 6-22-00
GEOLOGIST: Vince Shickora
DRILLER: Mike Pellegrino

Time	Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
0812		1		Auger				Dark Brown Fine grain		(moist)	0	0	0	0
		2		↓				Silty Sand						
		3						(some clay + pebbles)						
		4						Same as above						
		5		↓										
0818	1	6	3/5	14/24				Tan-white Fine grain		(moist)	0	0	0	0
		7	9/13	↓				Sand (some quartz pebbles)						
		8		Auger										
		9												
		10		↓										
0825	2	11	10/10	15/24				Same as above		(moist)	0	0	0	0
		12	11/14	↓										
0834	3	13	2/5	13/24	GW			Same as above		(wet at ≈12.5')	0	0	0	0
		14	7/9	↓										
0839	4	15	1/2	16/24				Same as above		Saturated	0	0	0	0
		16	4/8	↓										
0846	5	17	4/2	11/24				Same as above		Saturated	0	0	0	0
		18	7/7	↓										
0851	6	19	1/2	4/24				Same as above		Saturated	0	0	0	0
		20	1/2	↓										
0856	7	21	3/3											
		22	4/8					Same as above		Saturated	0	0	0	0
		23			EOB									
		24												
		25												

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0

Remarks: 3.25" x 5' HSA - 2" x 2' stainless Split Spoons
140 pound Hammer - No stains or odors observed
Roughly 10 gallons of decon water added to Augers to prevent Flowing Sand

Converted to Well: Yes X No ______ Well I.D. #: FD-MW-08S

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NWIRP Calverton
PROJECT NUMBER: 4570
DRILLING COMPANY: Delta Well + Pump
DRILLING RIG: Failing Model F-10

BORING NUMBER: FD-MW-09S
DATE: 6-20-00
GEOLOGIST: Vince Shickora
DRILLER: Mike Pellegrino

Time	Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ
0754		1		Auger				Brown Fine to Medium		(Moist)	0	0	0	0
		2		↓				Grain Silty Sand						
		3						(Some clay + pebbles)						
		4												
		5		↓										
0803	1	6	3 / 3	17/24				Tan-White fine		(moist)	0	0	0	0
		7	4 / 9	↓				grained Sand						
		8		Auger										
		9												
		10		↓										
0812	2	11	3 / 6	16/24				Tan-White Fine to			0	0	0	
		12	7 / 14	↓	GW			Medium grain Sand		(wet at 12' BGS)				
0819	3	13	3 / 4	14/24										
		14	4 / 8	↓				Same as above		Saturated	0	0	0	0
0825	4	15	3 / 3	11/24										
		16	3 / 4	↓				Same as above		Saturated	0	0	0	
0834	5	17	7 / 5	14/24										
		18	6 / 9	↓				Same as above		Saturated	0	0	0	
0840	6	19	3 / 4	11/24										
		20	3 / 6	↓				Same as above		Saturated	0	0	0	
0848	7	21	2 / 3	15/24	EoB									
		22	2 / 3	↓	↓			Same as above		Saturated	0	0	0	0
		23												
		24												
		25												

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0

Remarks: 3.25" x 5' HSA - 2" x 2' Stainless split Spoons
140 pound Hammer - roughly 15 gallons decon water added to prevent Flowing Sand
No stains or odors observed.

Converted to Well: Yes X No ____ Well I.D. #: FD-MW-09S

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NWIRP Calverton
PROJECT NUMBER: 4570
DRILLING COMPANY: Delta Well + Pump
DRILLING RIG: Failing Model F-10
BORING NUMBER: FD-MW-07I
DATE: 6-20-00
GEOLOGIST: Vince Shickora
DRILLER: Mike Pellegrino

Time	Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
1326		1		Auger				Dark Brown Fine grain		(moist)	0	0	0	0
		2						Silty Sand						
		3												
		4												
		5												
1343	1	6	2 / 3	15/24				Brown-Tan Fine		(moist)	0	0	0	0
		7	4 / 5					grain Sand (some silt)						
		8		Auger										
		9												
		10												
1357	2	11	1 / 3	14/24				Tan-White Fine			0	0	0	0
		12	5 / 7		GW			grain Sand		(wet at 12' BGS)				
		13		Auger										
		14												
		15												
1413	3	16	12 / 8	16/24				Tan-white Fine grain		Saturated	0	0	0	0
		17	9 / 9					Sand with a few quartz						
		18		Auger				pebbles						
		19												
		20												
1421	4	21	6 / 3	21/24				Same as above			0	0	0	0
		22	2 / 2							Saturated				
		23		Auger										
		24												
		25						Same as above						

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0

Remarks: 3.25" x 5' HSA – 2" x 2' Stainless Split Spoons
140 pound Hammer
Roughly 25 gallons of drillers decon water added in Augers to prevent Flowing Sand.

Converted to Well: Yes X No ____ Well I.D. #: FD-MW-07I

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NWIRP Calverton
PROJECT NUMBER: 4570
DRILLING COMPANY: Delta Well + Pump
DRILLING RIG: Failing F-10
BORING NUMBER: FD-MW-07I
DATE: 6-20-00
GEOLOGIST: Vince Shickora
DRILLER: Mike Pellegrino

Time	Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Sample	Sampler BZ	Borehole**	Driller BZ**
1427	5	26	2/4	19/24				Tan-white fine to Med.		saturated	0	0	0	0
		27	3/4	↓				grain sand with some						
		28		Auger				rounded quartz pebbles						
		29												
		30		↓										
1437	6	31	4/3	23/24				Same as above		Saturated	0	0	0	0
		32	3/5	↓										
1449	7	33	10/12	15/24				Same as above		Saturated	0	0	0	0
		34	9/6	↓										
'58	8	35	3/2	6/24				Same as above		saturated	0	0	0	0
		36	2/5	↓										
1510	9	37	2/1	13/24				Same as above		saturated	0	0	0	0
		38	2/5	↓										
1521	10	39	2/2	3/24				Same as above		saturated	0	0	0	0
		40	4/9	↓										
1532	11	41	4/5	17/24	6-20-00 VAS									
		42	8/12	↓	MP			Same as above		Saturated	0	0	0	0
VAS	~~12~~	43			EOB									
		44			↓									

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: (see previous page) No stains or odors observed

Drilling Area Background (ppm): 0

Converted to Well: Yes X No ____ Well I.D. #: FD-MW-07I

ATTACHMENT D

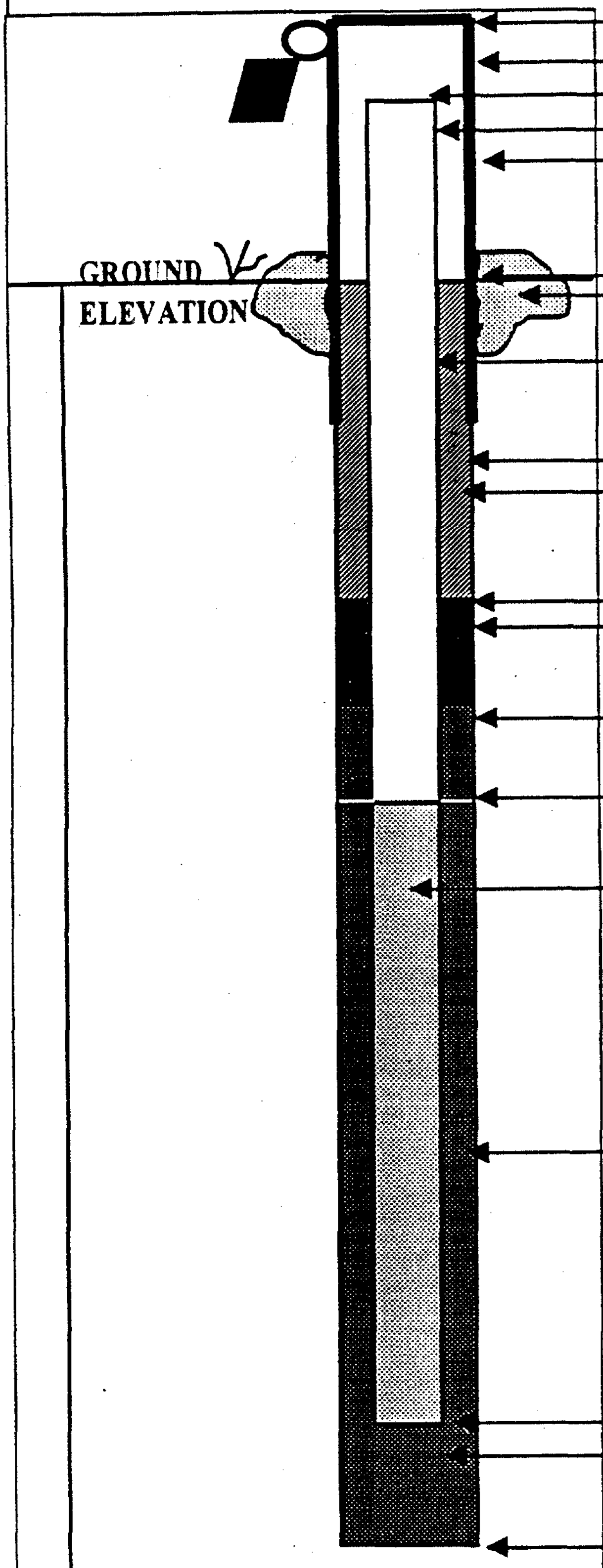
MONITORING WELL CONSTRUCTION SHEETS

STEP 2, JUNE 2000

BORING NO.: FD-MW-10S

Tetra Tech NUS, Inc. **OVERBURDEN MONITORING WELL SHEET**

PROJECT:	NWIRP Calverton	DRILLING Co.:	Delta Well	BORING No.:	FD-MW-10S
PROJECT No.:	4570	DRILLER:	Mike Pellegrino	DATE COMPLETED:	6-22-00
SITE:	Fuel Depot	DRILLING METHOD:	HSA	NORTHING:	
GEOLOGIST:	Vince Shickora	DEV. METHOD:		EASTING:	



ELEVATION OF TOP OF SURFACE CASING:

STICK-UP TOP OF SURFACE CASING:

ELEVATION OF TOP OF RISER PIPE:

RISER STICK-UP ABOVE GROUND SURFACE: ≈ 2.5 ft.

I.D. OF SURFACE CASING: 6 inch

TYPE OF SURFACE CASING: Steel

GROUND ELEVATION:

TYPE OF SURFACE SEAL:

RISER PIPE I.D.: 4 inch

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 10 inch

TYPE OF BACKFILL: Cement / Bentonite Grout

ELEVATION / DEPTH OF SEAL: 6'

TYPE OF SEAL: 1/4" Bentonite Pellets

ELEVATION / DEPTH TOP OF FILTER PACK: 8'

ELEVATION / DEPTH TOP OF SCREEN: 10'

TYPE OF SCREEN: PVC

SLOT SIZE X LENGTH: 0.02" x 10'

I.D. OF SCREEN: 4 inch

TYPE OF FILTER PACK: #1 Silica Sand

ELEVATION / DEPTH BOTTOM OF SCREEN: 20'

ELEVATION / DEPTH BOTTOM OF FILTER PACK: 22'

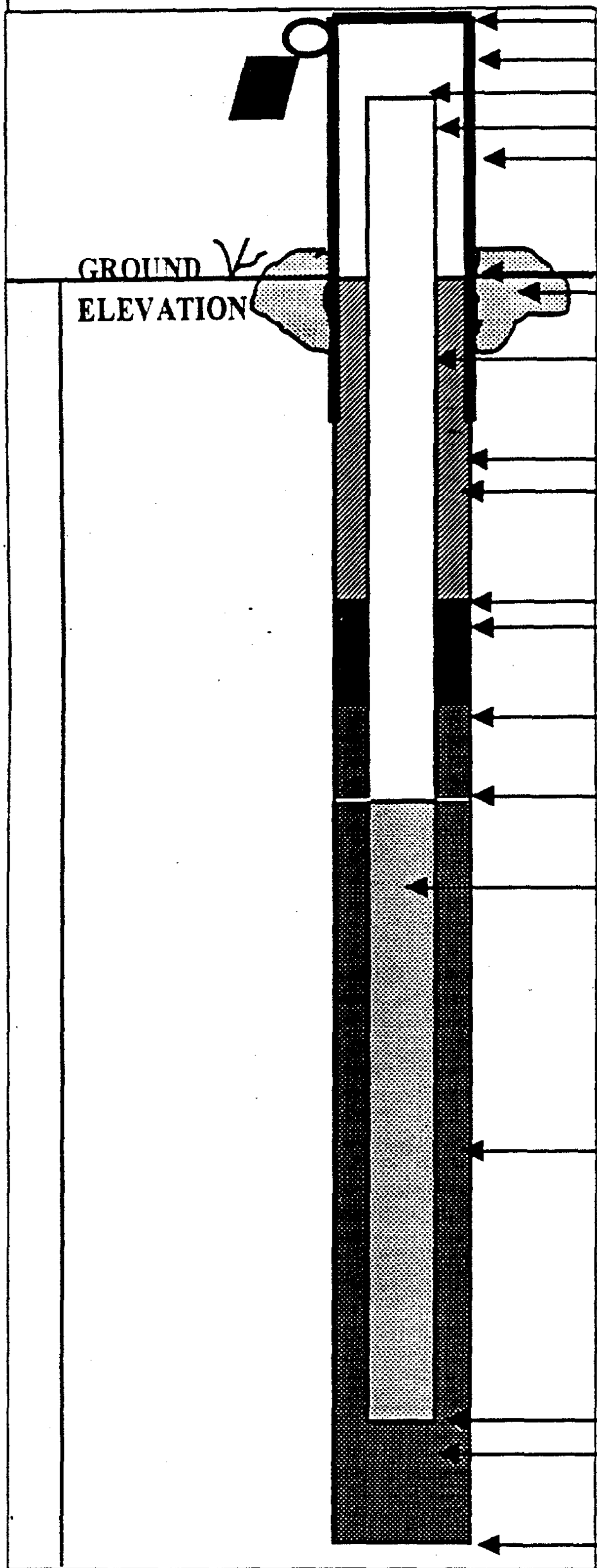
TYPE OF BACKFILL BELOW WELL: -- #1 Silica Sand

ELEVATION / DEPTH OF BOREHOLE: 22'

BORING NO.: FD-MW 09

Tetra Tech NUS, Inc. **OVERBURDEN MONITORING WELL SHEET**

PROJECT:	NWIRP Calverton	DRILLING Co.:	Delta Well	BORING No.:	FD-MW-
PROJECT No.:	4570	DRILLER:	Mike Pellegrino	DATE COMPLETED:	6-20-00
SITE:	Fuel Depot	DRILLING METHOD:	HSA	NORTHING:	
GEOLOGIST:	Vince Shickora	DEV. METHOD:		EASTING:	



ELEVATION OF TOP OF SURFACE CASING:

STICK -UP TOP OF SURFACE CASING:

ELEVATION OF TOP OF RISER PIPE:

RISER STICK-UP ABOVE GROUND SURFACE: ≈2.5 Ft.

I.D. OF SURFACE CASING: 6 inch

TYPE OF SURFACE CASING: Steel

GROUND ELEVATION:

TYPE OF SURFACE SEAL:

RISER PIPE I.D.: 4 inch

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 10 inch

TYPE OF BACKFILL:
Cement / Bentonite Grout

ELEVATION / DEPTH OF SEAL: 6.5'

TYPE OF SEAL: 1/4" Bentonite Pellets

ELEVATION / DEPTH TOP OF FILTER PACK: 8.5'

ELEVATION / DEPTH TOP OF SCREEN: 10'

TYPE OF SCREEN: PVC

SLOT SIZE X LENGTH: 0.02" X 10'

I.D. OF SCREEN: 4 inch

TYPE OF FILTER PACK:
#1 Silica Sand

ELEVATION / DEPTH BOTTOM OF SCREEN: 0'

ELEVATION / DEPTH BOTTOM OF FILTER PACK: 22

TYPE OF BACKFILL BELOW WELL:
-- #1 Silica Sand

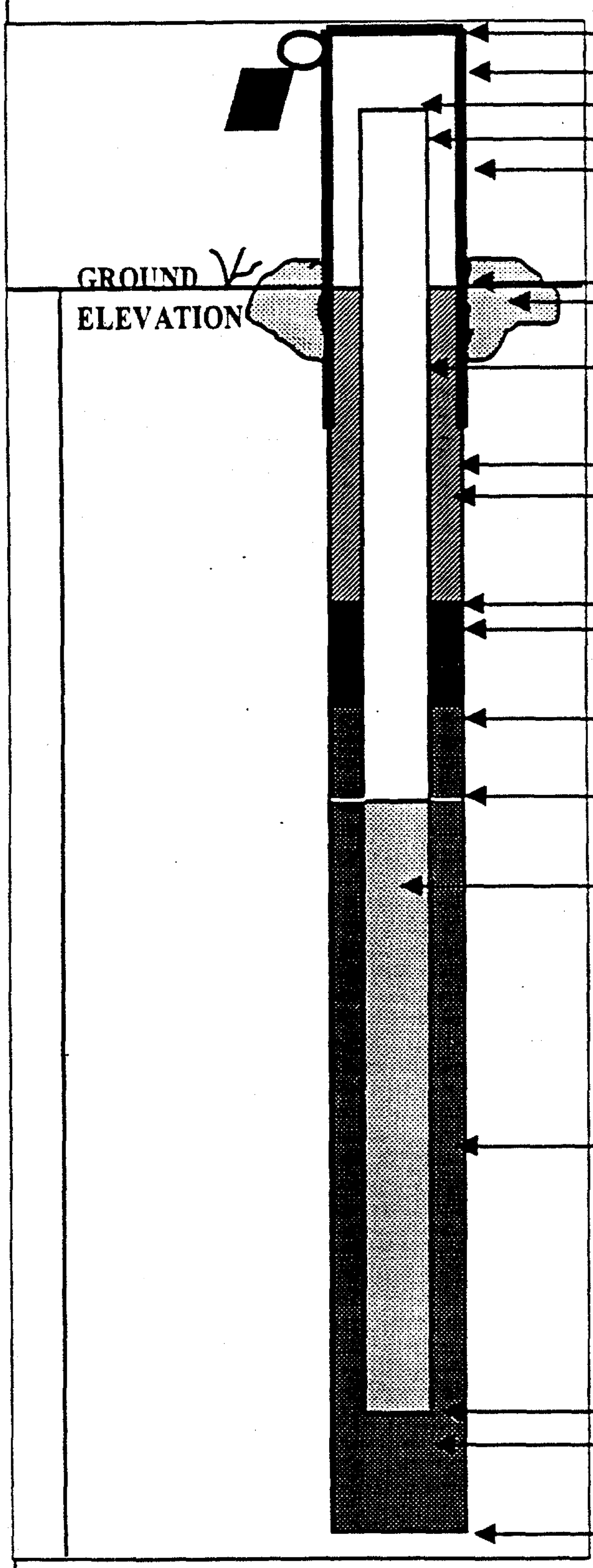
ELEVATION / DEPTH OF BOREHOLE: 22'

BORING NO.: FD-MW-08

Tetra Tech NUS, Inc.

OVERBURDEN MONITORING WELL SHEET

PROJECT:	NWIRP Calverton	DRILLING Co.:	Delta Well	BORING No.:	FD-MW-08S
PROJECT No.:	4570	DRILLER:	Mike Pellegrino	DATE COMPLETED:	6-22-00
SITE:	Fuel Depot	DRILLING METHOD:	HSA	NORTHING:	
GEOLOGIST:	Vince Shickora	DEV. METHOD:		EASTING:	



ELEVATION OF TOP OF SURFACE CASING:

STICK -UP TOP OF SURFACE CASING:

ELEVATION OF TOP OF RISER PIPE:

RISER STICK-UP ABOVE GROUND SURFACE: ≈2.5 ft.

I.D. OF SURFACE CASING: 6 inch

TYPE OF SURFACE CASING: Steel

GROUND ELEVATION:

TYPE OF SURFACE SEAL:

RISER PIPE I.D.: 4 inch

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 10 inch

TYPE OF BACKFILL: Cement/Bentonite Grout

ELEVATION / DEPTH OF SEAL: 6'

TYPE OF SEAL: 1/4" Bentonite Pellets

ELEVATION / DEPTH TOP OF FILTER PACK: 8'

ELEVATION / DEPTH TOP OF SCREEN: 10'

TYPE OF SCREEN: PVC

SLOT SIZE X LENGTH: 0.02" x 10'

I.D. OF SCREEN: 4 inch

TYPE OF FILTER PACK: #1 Silica Sand

ELEVATION / DEPTH BOTTOM OF SCREEN: 20'

ELEVATION / DEPTH BOTTOM OF FILTER PACK: 22'

TYPE OF BACKFILL BELOW WELL:

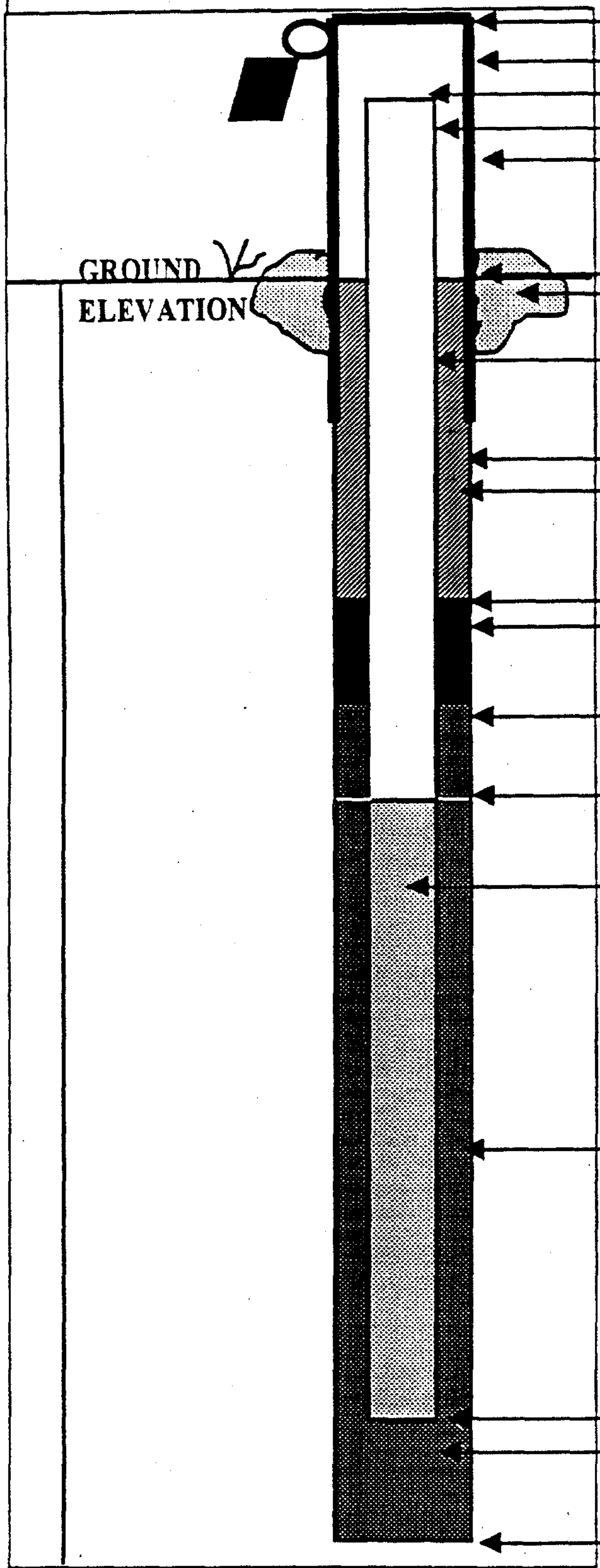
-- #1 Silica Sand

ELEVATION / DEPTH OF BOREHOLE: 22'

BORING NO.: FD-MW-07

Tetra Tech NUS, Inc. **OVERBURDEN MONITORING WELL SHEET**

PROJECT:	NWIRP Calverton	DRILLING Co.:	Delta Well	BORING No.:	FD-MW-07
PROJECT No.:	4570	DRILLER:	Mike Pellegrino	DATE COMPLETED:	6-21-00
SITE:	Fuel Depot	DRILLING METHOD:	HSA	NORTHING:	
GEOLOGIST:	Vince Shickora	DEV. METHOD:		EASTING:	



ELEVATION OF TOP OF SURFACE CASING: ______

STICK-UP TOP OF SURFACE CASING: ______

ELEVATION OF TOP OF RISER PIPE: ______

RISER STICK-UP ABOVE GROUND SURFACE: ≈ 2.5'

I.D. OF SURFACE CASING: 6 inch

TYPE OF SURFACE CASING: Steel

GROUND ELEVATION: ______

TYPE OF SURFACE SEAL: ______

RISER PIPE I.D.: 4 inch

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 10 inch

TYPE OF BACKFILL: Cement / Bentonite Grout

ELEVATION / DEPTH OF SEAL: 28'

TYPE OF SEAL: Bentonite Pellets

ELEVATION / DEPTH TOP OF FILTER PACK: 30'

ELEVATION / DEPTH TOP OF SCREEN: 32'

TYPE OF SCREEN: PVC

SLOT SIZE X LENGTH: 0.02" X 10'

I.D. OF SCREEN: 4 inch

TYPE OF FILTER PACK: #1 Silica Sand

ELEVATION / DEPTH BOTTOM OF SCREEN: ______

ELEVATION / DEPTH BOTTOM OF FILTER PACK: 44'

TYPE OF BACKFILL BELOW WELL: ______

-- #1 Silica Sand

ELEVATION / DEPTH OF BOREHOLE: 44'

ATTACHMENT E

MONITORING WELL DEVELOPMENT LOG SHEETS

STEP 2, JUNE 2000

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: FD-MW-07I
Site: Fuel Depot
Date Installed:
Date Developed: 6-29-00
Dev. Method: submers. pump
Pump Type:

Depth to Bottom (ft.):
Static Water Level Before (ft.):
Static Water Level After (ft.):
Screen Length (ft.):
Specific Capacity:
Casing ID (in.): 4"

Responsible Personnel: D. Whalen
Drilling Co.: Delta
Project Name: NWIRP Calverton
Project Number:

Time	Pump Flow Rate (GPM)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (mS/cm)	D.O. (mg/L)	Turbidity (NTU)	ORP	Remarks (odor, color, etc.)
1116	2.5	—		14.0	5.79	124	5.59	348	189	lt. Brn
1122	2.5	15	14.43	15.3	5.85	125	5.70	290	185	"
1130	2.5	35		15.6	5.86	123	4.70	195	182	"
1138	2.5	55	14.50	16.23	5.88	124	4.79	28	164	cloudy
1146	2.5	75		16.4	5.86	123	4.22	14	165	clear
1154	2.5	95	14.52	16.1	5.88	123	4.54	5.6	164	"

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: FD-MW-08$
Site: Fuel Depot
Date Installed:
Date Developed: 6-29-00
Dev. Method: Submers. pump
Pump Type:

Depth to Bottom (ft.):
Static Water Level Before (ft.): 14.75
Static Water Level After (ft.):
Screen Length (ft.):
Specific Capacity:
Casing ID (in.): 4

Responsible Personnel: D. Whalen
Drilling Co.: Delta
Project Name: NWIRP Calverton
Project Number:

Time	Pump Flow Rate (GPM)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (mS/cm)	D.O. (mg/L)	Turbidity (NTU)	ORP	Remarks (odor, color, etc.)
1305	0.7	—	14.75	14.5	5.93	79	7.80	1605	169	lt. Brown
1310	1.5	3.5		18.39	6.01	71	8.31	565	166	"
1315	1.5	11		19.21	6.09	71	8.81	360	164	"
1320	1.5	18.5		16.29	6.02	65	8.35	172	129	"
1325	1.5	26	14.84	15.02	5.79	63	8.45	55	178	cloudy
1330	1.5	33.5		15.09	5.71	62	8.17	27	183	
1335	1.5	41		15.22	5.64	62	8.14	18	188	clear
1340	1.5	48.5	14.84	15.20	5.59	63	8.17	16	193	"
1345	1.5	56		15.21	5.56	64	8.10	14	196	"
1350	1.5	63.5		15.24	5.54	64	8.11	10	198	"
1355	1.5	71		15.18	5.55	66	8.05	9	198	"
1400	1.5	78.5	14.84	15.25	5.54	64	7.80	9	200	"

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: FD-MW-09$
Site: Fuel Depot
Date Installed:
Date Developed: 6-29-00
Dev. Method: submers. pump
Pump Type:

Depth to Bottom (ft.): 23' TOC
Static Water Level Before (ft.): 14.
Static Water Level After (ft.):
Screen Length (ft.):
Specific Capacity:
Casing ID (in.): 4"

Responsible Personnel: D. Whalen
Drilling Co.: Delta
Project Name: NWIRP Calverton
Project Number:

Time	Pump Flow Rate (GPM)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (mS/cm)	D.O. (mg/L)	Turbidity (NTU)	ORP	Remarks (odor, color, etc.)
0935	0.5	0		13.3	6.58	240	8.70	1440	81.6	lt. BRN
0940	1.25	4	14.33	16.13	5.57	97	7.11	865	125	lt. BRN
0945	"	10		17.14	5.22	93	7.10	269	151	lt. BRN
0950	"	16	14.33	17.14	5.22	96	7.17	83	164	"
0955	"	22		17.14	5.22	98	6.66	87	175	"
1000	"	28	14.33	17.16	5.21	103	7.17	68	183	"
1005		34		17.16	5.22	104	7.20	48	188	cloudy, lt. BRN
1010		40		17.22	5.18	100	6.99	106	193	"
1020		52		17.17	5.23	115	6.70	41	196	"
1025		58		17.21	5.25	116	6.35	88	200	"
1030		64		17.22	5.27	116	6.75	13.8	205	clear
1035		70		17.25	5.27	115	6.42	10.0	206	clear

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: FD-MW-10S
Site: Fuel depot
Date Installed:
Date Developed: 6-29-00
Dev. Method: submers. pump
Pump Type:

Depth to Bottom (ft.): 20'
Static Water Level Before (ft.):
Static Water Level After (ft.):
Screen Length (ft.):
Specific Capacity:
Casing ID (in.): 4"

Responsible Personnel: D. Whalen
Drilling Co.: Delta
Project Name: NWIRP Calverton
Project Number:

Time	Pump Flow Rate (GPM)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (mS/cm)	D.O. (mg/L)	Turbidity (NTU)	ORP	Remarks (odor, color, etc.)
1443	1	—	16.30	15.81	6.06	158	6.23	656	2.3	lt. BRN slight oil odor
1448	1.5	5		18.59	6.21	163	4.13	122	-59	" "
1455	1.5	15.5	16.37	17.85	6.31	155	4.20	50	-79	" "
1500	1.5	23		18.05	6.31	159	4.23	42	-81	cloudy
1505	1.5	30.5		16.91	6.35	158	4.36	31	-84	clear
1510	1.5	38		17.25	6.37	154	4.94	26	-83	"
1520	1.5	53 ~~45.5~~		17.34	6.39	155	4.08	22	-83	"
1525	1.5	60.5		17.49	6.39	153	4.20	12	-85	"
1535	1.5	68		17.10	6.37	154	3.68	11	84	"
1540		75.5		17.33	6.39	153	3.86	9	-85	"

ATTACHMENT F

GROUNDWATER LEVEL MEASUREMENT LOG SHEETS

STEP 2, JULY 2000

Tetra Tech NUS, Inc.

GROUNDWATER LEVEL MEASUREMENT SHEET

Project Name: Calverton
Project No.: 3853
Location: Calverton NY
Personnel: Chuck Meyer / Jessica Dinelli
Weather Conditions: Sunny Warm mid 80's
Measuring Device:
Tidally Influenced: Yes ___ No ___
Remarks:

Well or Piezometer Number	Date	Time	Elevation of Reference Point (feet)*	Total Well Depth (feet)*	Water Level Indicator Reading (feet)*	Thickness of Free Product (feet)*	Groundwater Elevation (feet)*	Comments
FD-MW-01S	7/14/00	0804		26.80	18.73	0.00		127 ppm
FD-MW-01I	7/14/00	0809		55.90	18.40	0.00		6.3 ppm
FD-MW-02S	7/14/00	0820		25.15	17.21	0.00		4.0 ppm
FD-MW-02I	7/14/00	0827		51.91	17.35	0.00		1.5 ppm
FD-MW-03S	7/14/00	1002		28.10	18.91	0.00		0.0 ppm
FD-MW-03I	7/14/00	0954		61.65	18.95	0.00		0.0 ppm
FD-MW-04S	7/14/00	0942		57.12	17.65	0.00		4.5 ppm
FD-MW-04I	7/14/00	0939		26.05	18.06	0.00		2.6 ppm
FD-MW-05S	7/14/00	0921		25.93	16.95	0.00		26.0 ppm
FD-MW-06S	7/14/00	0927		22.95	16.85	0.00		33.0 ppm
FD-MW-07S	7/14/00	0850		22.92	15.67	0.00		2.5 ppm
FD-MW-07I	7/14/00	0845		44.20	14.81	0.00		160 ppm
FD-MW-08S	7/14/00	0858		23.40	15.13	0.00		0.0 ppm
FD-MW-09S	7/14/00	0905		22.65	16.69	0.00		0.0 PPM
FD-MW-10S	7/14/00	0910		22.80	14.64	0.00		12.0 PPM

* All measurements to the nearest 0.01 foot

ATTACHMENT G

GROUNDWATER SAMPLE LOG SHEETS, LOW FLOW PURGE DATA SHEETS, NATURAL ATTENUATION PARAMETER LOG SHEETS, CHAIN OF CUSTODY FORMS

STEP 2, JULY 2000

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Calverton
Project No.: 3853

[] Domestic Well Data
[x] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: FD-GW07S-00
Sample Location: MW07S
Sampled By: JD
C.O.C. No.:
Type of Sample:
[x] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 7/17/00 Time: 1640 Method: Rediflow pump	Color Visual	pH Standard	S.C. mS/cm	Temp. °C	Turbidity NTU	DO mg/l	TBD ORP	TBD
	clear	5.12	0.063	15.87	110.0	4.79	184	

PURGE DATA:

Date: 7/17/00	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	TBD	TBD
Method: Rediflow pump								
Monitor Reading (ppm): 0.0								
Well Casing Diameter & Material								
Type: 4" PVC								
Total Well Depth (TD): 22.92								
Static Water Level (WL): 15.56								
One Casing Volume(gal/L): 4.80								
Start Purge (hrs): 1405								
End Purge (hrs): 1625								
Total Purge Time (min): 140								
Total Vol. Purged (gal/L): 20								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOA	HCL	40 ml VOA Vial	2
DRO	4C	Liter Amber Glass	2
GRO	HCl	40 ml VOA Vial	2
TOC	H2SO4	40 ml VOA Vial	2
COD	H2SO4	500 ml Poly	1
Dissolved Iron & Manganese	HNO3	500 ml Poly	1
CO2, Ethane, Ethene, Methane	4C	40 ml VOA Vial	3
Sulfide		Liter Poly	1
BOD	4C	Liter Poly	1
Chloride, Nitrate, Nitrite, Ortho, Sulfate	4C	Liter Poly	1

OBSERVATIONS / NOTES:

22.92
-15.56
7.36
0.653 gal per foot
2208
3680
4416
4.80608

The pump intake was set at 19 feet BTOC

Circle if Applicable:

MS/MSD —

Duplicate ID No.:

Signature(s): [signature] for Jessica Donelli

TBD: To Be Determined

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Calverton WELL ID.: FD-MW07S
PROJECT NUMBER: 3853 DATE: 7/17/00

Time (Hrs.)	Water Level (Ft. below TOC)	Flow* (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb.** (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
1405	15.61	600	4.63	0.061	25.6	7.60	13.71	289	* difficulty w/
1410	15.60	450	4.61	0.059	19.3	6.65	14.76	292	pump - difficulty
1415	15.60	450	4.63	0.057	8.0	6.55	15.11	297	adjusting Flow
1420	15.60	450	4.63	0.057	0.0	6.61	15.25	296	rate.
14.30	15.60	550	4.73	0.057	20.1	6.21	16.02	285	
1435	15.60	650	4.74	0.058	14.4	4.99	16.40	269	** water visually
1445	15.60	650	4.87	0.058	70.7	6.31	17.45	258	appears clear.
1450	15.60	450	4.90	0.059	74.3	5.72	16.59	250	
1455	15.60	350	4.91	0.059	77.0	5.49	16.44	245	
1500	15.60	500	4.92	0.059	92.4	5.34	16.74	243	
1505	15.60	500	5.07	0.060	109.0	5.11	15.80	220	
1510	15.60	350	5.05	0.060	127.0	4.95	16.11	217	
1515	15.60	800	5.06	0.060	76.0	5.97	16.92	215	
1520	15.60	800	5.10	0.061	~~[illegible]~~ 63.8	5.49	15.99	209	
1530	15.60	550	5.12	0.060	67.8	4.99	15.39	200	
1535	15.60	200	5.11	0.061	89.1	5.00	15.60	200	
1540	15.60	200	5.21	0.064	96.5	4.86	15.99	186	
1545	15.60	200	5.12	0.062	123.0	4.99	17.01	187	
1550	15.60	550	5.12	0.062	123.0	5.74	18.24	189	
1555	15.60	550	5.16	0.063	113.0	5.21	17.06	185	
1600	15.60	500	5.17	0.063	126.0	5.04	16.82	182	
1605	15.60	280	5.13	0.062	108.0	4.99	16.55	185	
1610	15.60	150	5.13	0.063	117.0	4.86	16.79	183	
1615	15.60	650	5.17	0.064	72.4	4.74	14.97	178	
1620	15.60	250	5.12	0.063	110.0	4.79	15.87	184	
1625	Stop Purging								
1640	Begin Sampling								

SIGNATU[illegible] S): [signature]

PAGE 2 OF 2

Tetra Tech NUS, Inc.

SAMPLE LOG SHEET
NATURAL ATTENUATION PARAMETERS

Project Site Name: Calverton
Project No.: 3853
Sampled By: Chuck Meyer

Sample ID No.: FD-GW07S-00
Sample Location: FD-MW07S
Duplicate: ☐

SAMPLING DATA:

	Color (Visual)	pH (SU)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (Meter, mg/l)	Sal. (%)	ORP mV
Date: 7/17/00								
Time: 1640								
Method: Redi-flow Pump	Clear	5.12	0.063	15.87	110.0	4.79	—	184

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Divalent Iron

Equipment: HACH IR-18C

Analysis Time: 1650

Concentration: 2.0 mg/L

Notes:

Carbon Dioxide:

Equipment: Chemetrics Test Kit

Analysis Time: 1655

Range Used:	Range	Concentration ppm
☒	10 to 100 ppm	40
☐	100 to 1000 ppm	
☐	250 to 2500 ppm	

Concentration: 40 ppm

Notes:

Dissolved Oxygen

Equipment: Chemetrics Test Kit NA

Analysis Time:

Range Used:	Range	Concentration ppm
☐	0 to 1 ppm	
☐	1 to 12 ppm	

Concentration: ppm

Notes:

Hydrogen Sulfide

Equipment: HACH HS-C

Analysis Time: 1659

Concentration: 0.0 mg/L

Notes:

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Calverton
Project No.: 3853

[] Domestic Well Data
[x] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: FD-GW07I-00
Sample Location: MW07I
Sampled By: Chuck Meyer
C.O.C. No.:
Type of Sample:
[x] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	TBD	TBD
Date: 7/18/00	Visual	Standard	mS/cm	°C	NTU	mg/l	ORP	
Time: 1105								
Method: Rediflow Pump	clear	5.80	0.117	15.79	0.8	0.22	15.6	

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	TBD	TBD
Date: 7/18/00								
Method: Rediflow Pump								
Monitor Reading (ppm): 189.00								
Well Casing Diameter & Material Type: 4" PVC								
Total Well Depth (TD): 44.20								
Static Water Level (WL): 14.73								
One Casing Volume(gal/L): 19.24								
Start Purge (hrs): 0840								
End Purge (hrs): 1101								
Total Purge Time (min): 141								
Total Vol. Purged (gal/L): 20								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOA	HCL	40 ml VOA Vial	2
DRO	4C	Liter Amber Glass	2
GRO	HCl	40 ml VOA Vial	2
TOC	H2SO4	40 ml VOA Vial	2
COD	H2SO4	500 ml Poly	1
Dissolved Iron & Manganese	HNO3	500 ml Poly	1
CO2, Ethane, Ethene, Methane	4C	40 ml VOA Vial	3
Sulfide		Liter Poly	1
BOD	4C	Liter Poly	1
Chloride, Nitrate, Nitrite, Ortho, Sulfate	4C	Liter Poly	1

OBSERVATIONS / NOTES:

44.20
14.73
29.47
0.653
8841
14735
17682
1924391

The pump intake was placed 40 feet BTOC. After a conversation with PM Dave Brayack it was determined that we would remove 3 screen volumes rather than 3 case volumes from the well with a total purge volume of 19.54 gallons.

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): [signature] for Chuck Meyer

TBD: To Be Determined

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Calverton
PROJECT NUMBER: 3853

WELL ID.: FD-GW07I-00
DATE: 7/18/00

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
0840	14.73	650	6.08	0.117	5.6	1.15	13.48	-6.0	
0845	14.73	650	5.77	0.118	3.3	0.61	14.28	0.3	
0850	14.73	480	5.78	0.118	2.2	0.55	14.71	0.3	
0855	14.73	550	5.80	0.118	1.5	0.51	14.86	0.3	
0900	14.73	460	5.81	0.117	1.1	0.47	15.13	1.0	
0905	14.73	460	5.80	0.117	0.6	0.43	15.25	3.0	
0910	14.73	480	5.81	0.117	0.4	0.39	15.36	4.0	
0915	14.73	480	5.80	0.117	0.3	0.38	15.46	4.8	
0920	14.73	480	5.80	0.117	0.3	0.37	15.41	5.8	
0925	14.73	480	5.80	0.117	0.2	0.35	15.47	6.0	
0930	14.73	480	5.80	0.117	0.2	0.33	15.47	6.8	
0935	14.73	480	5.80	0.117	0.2	0.32	15.48	8.0	
0940	14.73	480	5.80	0.117	0.1	0.31	15.54	8.3	
0945	14.73	480	5.80	0.117	0.2	0.30	15.54	8.7	
0950	14.73	480	5.80	0.117	0.2	0.30	15.56	9.6	
0955	14.73	480	5.80	0.117	0.2	0.30	15.58	10.2	
1000	14.73	480	5.80	0.117	0.3	0.28	15.56	10.7	
1005	14.73	480	5.80	0.117	0.4	0.27	15.61	10.3	
1010	14.73	480	5.80	0.117	0.4	0.26	15.62	11.3	
1015	14.73	480	5.80	0.117	0.5	0.25	15.69	11.6	
1020	14.73	480	5.80	0.117	0.6	0.24	15.68	12.1	
1025	14.73	480	5.80	0.117	0.6	0.23	15.75	13.1	
1030	14.73	500	5.80	0.117	0.7	0.24	15.72	13.2	
1035	14.73	500	5.80	0.117	0.7	0.23	15.74	13.7	
1040	14.73	480	5.80	0.117	0.7	0.23	15.75	13.9	
1045	14.73	500	5.80	0.117	0.8	0.23	15.74	15.0	
1050	14.73	500	5.8	0.117	0.8	0.22	15.77	15.2	
1055	14.73	500	5.80	0.117	0.8	0.22	15.79	15.3	
1100	14.73	500	5.80	0.117	0.8	0.22	15.79	15.6	

SIGNATURE(S): ____________________

Tetra Tech NUS, Inc.

SAMPLE LOG SHEET
NATURAL ATTENUATION PARAMETERS

Project Site Name: Calverton

Project No.: 3853

Sampled By: Jessica Donteller

Sample ID No.: FD-GW07I-00

Sample Location: FD-MW07I

Duplicate: ☐

SAMPLING DATA:

	Color (Visual)	pH (SU)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (Meter, mg/l)	Sal. (%)	ORP mV
Date: 7/18/00								
Time: 1105								
Method: Redi-Flow Pump	Clear	5.80	0.117	15.79	0.8	0.22	—	151.6

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Divalent Iron

Equipment: HACH IR-18C

Analysis Time: 1115

Concentration: 0.0 mg/L

Notes:

Carbon Dioxide:

Equipment: Chemetrics Test Kit

Analysis Time: 1125

Range Used:	Range	Concentration ppm
☒	10 to 100 ppm	40
☐	100 to 1000 ppm	
☐	250 to 2500 ppm	

Concentration: 40 ppm

Notes:

Dissolved Oxygen

Equipment: Chemetrics Test Kit N/A

Analysis Time:

Range Used:	Range	Concentration ppm
☐	0 to 1 ppm	
☐	1 to 12 ppm	

Concentration: 0.22 meter reading ppm

Notes:

Hydrogen Sulfide

Equipment: HACH HS-C

Analysis Time: 1130

Concentration: 0.3 mg/L

Notes:

Tetra Tech NUS, Inc.

SAMPLE LOG SHEET
NATURAL ATTENUATION PARAMETERS

Project Site Name: Calverton

Project No.: 3853

Sampled By: Jessica Daniell

Sample ID No.: FD-GW07I-00

Sample Location: FDMW07I

Duplicate: ☒

SAMPLING DATA:

	Color (Visual)	pH (SU)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (Meter, mg/l)	Sal. (%)	ORP mV
Date: 7/18/00								
Time: 1105								
Method: Redi-flow pump	clear	5.80	0.117	15.79	0.8	0.22	-	15.6

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Divalent Iron

Equipment: HACH IR-18C

Analysis Time: 1120

Concentration: 0.0 mg/L

Notes:

Carbon Dioxide:

Equipment: Chemetrics Test Kit

Analysis Time: 1126

Range Used:	Range	Concentration ppm
☒	10 to 100 ppm	40
☐	100 to 1000 ppm	
☐	250 to 2500 ppm	

Concentration: 40 ppm

Notes:

Dissolved Oxygen

Equipment: Chemetrics Test Kit N/A

Analysis Time:

Range Used:	Range	Concentration ppm
☐	0 to 1 ppm	
☐	1 to 12 ppm	

Concentration: 0.22 ppm meter reading

Notes:

Hydrogen Sulfide

Equipment: HACH HS-C

Analysis Time: 1135

Concentration: 0.3 mg/L

Notes:

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Calverton
Project No.: 3853

[] Domestic Well Data
[x] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: FD-GW10S-00
Sample Location: MW10S
Sampled By: Chuck Metzer
C.O.C. No.:
Type of Sample:
[x] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	TBD	TBD
Date: 7/17/00								
Time: 1635	Visual	Standard	mS/cm	°C	NTU	mg/l	ORP	
Method: Rediflow Pump	Clear	6.32	0161	15.89	1.8	1.35	-98.8	

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	TBD	TBD
Date: 7/17/00								
Method: Rediflow Pump								
Monitor Reading (ppm): 0.0								
Well Casing Diameter & Material								
Type: 4" PVC								
Total Well Depth (TD): 23.00								
Static Water Level (WL): 16.60								
One Casing Volume(gal/L): 4.20								
Start Purge (hrs): 1405								
End Purge (hrs): 1545								
Total Purge Time (min): 100								
Total Vol. Purged (gal/L): 14.0								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOA	HCL	40 ml VOA Vial	2
DRO	4C	Liter Amber Glass	2
GRO	HCl	40 ml VOA Vial	2
TOC	H2SO4	40 ml VOA Vial	2
COD	H2SO4	500 ml Poly	1
Dissolved Iron & Manganese	HNO3	500 ml Poly	1
CO2, Ethane, Ethene, Methane	4C	40 ml VOA Vial	3
Sulfide		Liter Poly	1
BOD	4C	Liter Poly	1
Chloride, Nitrate, Nitrite, Ortho, Sulfate	4C	Liter Poly	1

OBSERVATIONS / NOTES:

23.00
-16.60
6.40
× 0.653 gal per foot
4.20 gal 1 vol

Pump was set a 20 feet BTOC for purging

Circle if Applicable:		Signature(s):
MS/MSD —	Duplicate ID No.: —	[signature]

TBD: To Be Determined

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Calverton
PROJECT NUMBER: 3853
WELL ID.: FD-MW10S-00
DATE: 7/17/00

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
1405	16.60	300	6.27	180	9.9	1.25	15.13	-76.3	
1410	16.61	600	6.30	183	8.2	0.98	15.11	-89.9	
1415	16.61	550	6.31	177	7.5	1.01	15.36	-97.2	
1420	16.61	500	6.32	174	6.7	1.04	15.64	-102.1	
1425	16.61	500	6.32	185	6.0	1.09	15.69	-102.9	
1430	16.61	500	6.32	169	5.3	1.15	15.73	-103.1	
1435	16.61	500	6.32	165	4.9	1.26	15.75	-103.2	
1440	16.61	500	6.33	163	4.5	1.32	15.82	-103.9	
1445	16.61	500	6.32	163	4.4	1.34	15.83	-101.9	
1450	16.61	500	6.32	163	4.3	1.36	15.84	-102.6	
1455	16.61	500	6.33	163	4.0	1.34	15.88	-102.5	
1500	16.61	500	6.32	162	3.7	1.38	15.95	-102.0	
1505	16.61	500	6.33	160	3.0	1.42	16.02	-101.2	
1510	16.61	500	6.34	159	2.7	1.46	16.12	-100.3	
1515	16.61	500	6.34	158.	2.5	1.48	16.28	-99.5	
1520	16.61	500	6.33	163	2.4	1.42	16.09	-98.6	
1525	16.61	500	6.33	163	2.2	1.38	15.99	-99.2	
1530	16.61	500	6.33	163	2.0	1.34	15.89	-99.4	
1535	16.61	500	6.32	161	2.0	1.35	15.88	-99.2	
1540	16.61	500	6.32	161	1.8	1.35	15.89	-98.8	
1545	Purging was completed after removing 14 gallons from the well								
1550	Natural Attenuation parameters were collected								
1635	sampling for Natural Attenuation parameters TCL VOC DRO + GRO								

SIGNATURE(S):

Tetra Tech NUS, Inc.

SAMPLE LOG SHEET
NATURAL ATTENUATION PARAMETERS

Project Site Name: Calverton

Project No.: 3853

Sampled By: Chuck Meyer

Sample ID No.: FD-GW105-00

Sample Location: FD-MW105

Duplicate: ☐

SAMPLING DATA:

Date: 7/17/00	Color (Visual)	pH (SU)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (Meter, mg/l)	Sal. (%)	ORP mV
Time: 1635								
Method: Rediflow Pump	Clear	6.32	0.161	15.89	1.8	1.35	–	-98.8

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Divalent Iron

Equipment: HACH IR-18C

Analysis Time: 1700

Concentration: 4.25 mg/L

Notes:

Carbon Dioxide:

Equipment: Chemetrics Test Kit

Analysis Time: 1707

Range Used:	Range	Concentration ppm
☒	10 to 100 ppm	68
☐	100 to 1000 ppm	
☐	250 to 2500 ppm	

Concentration: 68 ppm

Notes:

Dissolved Oxygen

Equipment: Chemetrics Test Kit N/A

Analysis Time: N/A

Range Used:	Range	Concentration ppm
☐	0 to 1 ppm	
☐	1 to 12 ppm	

Concentration: 1.35 meter reading ppm

Notes:

Hydrogen Sulfide

Equipment: HACH HS-C

Analysis Time: 1711

Concentration: 0.3 mg/L

Notes:

SAMPLE LOG SHEET
NATURAL ATTENUATION PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: Calverton

Project No.: 3853

Sampled By: Chuck Magee

Sample ID No.: FD-GW105-00

Sample Location: FD-MW105

Duplicate: ☒

SAMPLING DATA:

	Color (Visual)	pH (SU)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (Meter, mg/l)	Sal. (%)	ORP mV
Date: 7/12/00								
Time: 1635								
Method: Rediflow pump	Clear	6.32	0.161	15.89	1.8	1.35	—	-98.8

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Divalent Iron

Equipment: HACH IR-18C

Analysis Time: 1702

Concentration: 4.5 mg/L

Notes:

Carbon Dioxide:

Equipment: Chemetrics Test Kit

Analysis Time: 1708

Range Used:	Range	Concentration ppm
☒	10 to 100 ppm	70
☐	100 to 1000 ppm	
☐	250 to 2500 ppm	

Concentration: 70 ppm

Notes:

Dissolved Oxygen

Equipment: Chemetrics Test Kit

Analysis Time:

Range Used:	Range	Concentration ppm
☐	0 to 1 ppm	
☐	1 to 12 ppm	

Concentration: 1.35 ppm meter reading

Notes:

Hydrogen Sulfide

Equipment: HACH HS-C

Analysis Time: 1714

Concentration: 0.3 mg/L

Notes:

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Chimerton Naval Base
Project No.:

[] Domestic Well Data
[x] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: FD-MW-10S
Sample Location: FD-MW10S
Sampled By: JD/CM
C.O.C. No.:
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 7/11/00	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Time: 1758	Visual	Standard	mS/cm	°C	NTU	mg/l	mV	NA
Method: Rediflow	Clear	6.22	0.175	15.06	5.1	2.29	-100	N/A

PURGE DATA:

Date: 7/11/00	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Method: Rediflow								
Monitor Reading (ppm): 0.0								
Well Casing Diameter & Material								
Type: 4in PVC								
Total Well Depth (TD): 22.8ft								
Static Water Level (WL): 16.6ft								
One Casing Volume(gal/L): 24								
Start Purge (hrs): 1620								
End Purge (hrs): 1757								
Total Purge Time (min): 97								
Total Vol. Purged (gal/L): 12 gal								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOC	HCl	40 ml - glass bottles (2)	2

OBSERVATIONS / NOTES:

2280
16.60
6.20
.653
1860
3100
3720
~~4960~~

The pump was set at 20 feet BTOC

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	YES ~~FD-MW15D~~ FD-GW340	JD

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Calverton Naval Base
PROJECT NUMBER:
WELL ID.: FD-MW105
DATE: 7/11/00

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
1620	~~16.70~~ 16.65	300	6.20	0.205	27.2	3.97	15.77	-61	✓ Fuel odor in GW ✓
1625	~~16.70~~ 16.65	500	6.23	0.197	22.7	2.01	14.79	-69	no sheen - no reading
1630	16.65	540	6.22	0.192	16.0	1.99	15.30	-69	on PID (0.0ppm)
1635	16.65	600	6.22	0.186	10.2	2.11	15.25	-68	
1640	16.65	600	6.21	0.181	8.0	2.49	15.33	-65	
1645	16.65	350	6.21	0.182	8.9	2.50	15.72	-64	
1650	16.65	650	6.20	0.170	~~8.0~~	3.02	15.57	-58	
1655	16.65	550	6.20	0.173	8.2	3.03	15.48	-59	
1700	16.65	500	6.20	0.172	8.4	2.84	15.16	-57	
1705	16.65	550	6.20	0.173	9.0	2.84	15.37	-58	
1710	16.65	500	6.20	0.175	9.4	2.82	15.20	-60	
1715	16.65	500	6.20	0.172	10.7	2.74	15.32	-58	
1720	16.65	550	6.20	0.171	12.4	2.72	15.43	-59	
1725	16.65	450	6.20	0.171	13.4	2.78	15.59	-56	
1730	16.65	400	6.20	0.166	13.9	2.93	15.62	-54	
1735	16.65	600	6.20	0.167	14.8	2.91	15.36	-54	
1740	16.65	630	6.21	0.172	6.1	2.49	15.17	-58	
1745	16.65	650	6.22	0.176	5.9	2.38	15.20	-59	
1750	16.65	630	6.22	0.177	5.8	2.30	15.08	-60	
1755	16.65	650	6.22	0.175	5.1	2.29	15.06	-60	
1757	Stop Purging								
1758	Begin Sampling								

SIGNATURE(S): [signature]

PAGE 2 **OF** 2

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Calverton
Project No.: 3853

[] Domestic Well Data
[x] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: FD-MWERM1BN ~~FD-GWGRH-00~~
Sample Location: FD-BN11
Sampled By: JD
C.O.C. No.:
Type of Sample:
[x] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	TBD	TBD
Date: 7/19/00	Visual	Standard	mS/cm	°C	NTU	mg/l	ORP	
Time: 1615								
Method: Peristaltic Straw	Orange Brown	5.85	0.362	15.92	35.7	0.36	-168.3	

PURGE DATA:

Date: 7/19/00	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	TBD	TBD
Method: Peristaltic Pump								
Monitor Reading (ppm): 0.0								
Well Casing Diameter & Material								
Type: 4" PVC								
Total Well Depth (TD): 20.65								
Static Water Level (WL): 18.45								
One Casing Volume(gal/L): 1.44								
Start Purge (hrs): 1450								
End Purge (hrs): 1603								
Total Purge Time (min): 73								
Total Vol. Purged (gal/L): 4.5								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOA	HCL	40 ml VOA Vial	2
DRO	4C	Liter Amber Glass	2
GRO	HCl	40 ml VOA Vial	2
TOC	H2SO4	40 ml VOA Vial	2
COD	H2SO4	500 ml Poly	1
Dissolved Iron & Manganese	HNO3	500 ml Poly	1
CO2, Ethane, Ethene, Methane	4C	40 ml VOA Vial	3
Sulfide		Liter Poly	1
BOD	4C	Liter Poly	1
Chloride, Nitrate, Nitrite, Ortho, Sulfate	4C	Liter Poly	1

OBSERVATIONS / NOTES:

20.65
- 18.45
2.20
0.653 gal per foot
1.4366

The pump intake was placed 20 feet BTOC

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	FD-GWFD-071900

Signature(s): [signature] for Jessica Darelli

TBD: To Be Determined

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: calverton
PROJECT NUMBER: 3853

WELL ID.: FD-GWGB11-00
DATE: 7/19/00

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
1450	18,58	400	5.64	0.134	61.7	1.94	16.40	-76.5	
1455	18.65	250	5.61	0.161	65.2	1.33	16.16	-92.8	
1500	18,58	250	5.79	0.261	63.2	0.84	16.20	-117.8	
1505	18.57	250	5.87	0.308	50.7	0.69	16.28	-130.7	
1510	18.56	250	5.91	0.330	44.6	0.63	16.33	-140.6	
1515	18.56	250	5.84	0.342	40.2	0.62	16.36	-149.6	
1520	18.56	150	5.90	0.342	34.9	0.62	16.32	-152.0	
1525	18.56	200	5.88	0.346	38.4	0.65	16.27	153.2	
1530	18.56	200	5.86	0.344	38.4	0.56	16.10	154.4	
1535	18.56	225	5.86	0.348	39.4	0.50	16.04	-175.4	
1540	18.56	225	5.86	0.350	38.5	0.45	16.02	-180.6	
1545	18.56	225	5.85	0.354	37.2	0.40	16.02	-173.2	
1550	18.56	225	5.86	0.360	35.0	0.35	15.92	-169.3	
1555	18.56	225	5.85	0.361	34.4	0.37	15.92	-174.3	
1600	18.56	225	5.86	0.362	35.7	0.36	15.92	-168.3	

SIGNATURE(S):

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Tetra Tech NUS, Inc.

SAMPLE LOG SHEET
NATURAL ATTENUATION PARAMETERS

Project Site Name: Calverton

Project No.: 3853

Sampled By: Jessica Darnell

Sample ID No.: FD-GW6 1211-00

Sample Location: FD-BW11

Duplicate: ☐

SAMPLING DATA:

	Color (Visual)	pH (SU)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (Meter, mg/l)	Sal. (%)	ORP mV
Date: 7/14/00								
Time: 1615								
Method: Rediflow Pump	orange Brown	5.85	0.362	15.92	35.7	0.36	—	-168.3

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Divalent Iron

Equipment: HACH IR-18C

Analysis Time: 1640

Concentration: 4.8 mg/L

Notes:

Carbon Dioxide:

Equipment: Chemetrics Test Kit

Analysis Time: 1647

Range Used:	Range	Concentration ppm
☒	10 to 100 ppm	70
☐	100 to 1000 ppm	
☐	250 to 2500 ppm	

Concentration: 70 ppm

Notes:

Dissolved Oxygen

Equipment: Chemetrics Test Kit N/A

Analysis Time:

Range Used:	Range	Concentration ppm
☐	0 to 1 ppm	
☐	1 to 12 ppm	

Concentration: 0.36 DO meter ppm

Notes:

Hydrogen Sulfide

Equipment: HACH HS-C

Analysis Time: 1655

Concentration: 5.0 mg/L

Notes:

Tetra Tech NUS, Inc.

SAMPLE LOG SHEET
NATURAL ATTENUATION PARAMETERS

Project Site Name: Culverton
Project No.: 3853
Sampled By: Jessica Danielle

Sample ID No.: FD-GW6R11-00
Sample Location: FD-BN11
Duplicate: ☒

SAMPLING DATA:

	Color (Visual)	pH (SU)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (Meter, mg/l)	Sal. (%)	ORP mV
Date: 7/19/00								
Time: 1615								
Method: Rediflow Pump	Orange Brown	5.85	0.362	15.92	35.7	0.36	—	-368.3

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Divalent Iron

Equipment: HACH IR-18C

Analysis Time: 1643

Concentration: 4.4 mg/L

Notes:

Carbon Dioxide:

Equipment: Chemetrics Test Kit

Analysis Time: 1649

Range Used:	Range	Concentration ppm
☒	10 to 100 ppm	70
☐	100 to 1000 ppm	
☐	250 to 2500 ppm	

Concentration: 70 ppm

Notes:

Dissolved Oxygen

Equipment: Chemetrics Test Kit N/A

Analysis Time:

Range Used:	Range	Concentration ppm
☐	0 to 1 ppm	
☐	1 to 12 ppm	

Concentration: 0.36 DO meter ppm

Notes:

Hydrogen Sulfide

Equipment: HACH HS-C

Analysis Time: 1659

Concentration: 5.0 mg/L

Notes:

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page 1 of 2

Project Site Name:	Calverton	Sample ID No.:	FD-GW03S-00
Project No.:	3853	Sample Location:	FD MW03S
		Sampled By:	JD
[] Domestic Well Data		C.O.C. No.:	
[x] Monitoring Well Data		Type of Sample:	
[] Other Well Type:		[x] Low Concentration	
[] QA Sample Type:		[] High Concentration	

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. °C	Turbidity NTU	DO mg/l	TBD ORP	TBD
Date: 7/19/00								
Time: 1130								
Method: Rediflow Pump	Clear	6.68	0.091	16.58	0.60	7.17	66.1	

PURGE DATA:

Date: 7/19/00	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	TBD	TBD
Method: Rediflow Pump								
Monitor Reading (ppm): 0.0								
Well Casing Diameter & Material								
Type: 4" PVC								
Total Well Depth (TD): 28.00								
Static Water Level (WL): 18.83								
One Casing Volume(gal/L): 5.98								
Start Purge (hrs): 0935								
End Purge (hrs): 1127								
Total Purge Time (min): 112								
Total Vol. Purged (gal/L): 20								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOA	HCL	40 ml VOA Vial	2
DRO	4C	Liter Amber Glass	2
GRO	HCl	40 ml VOA Vial	2
TOC	H2SO4	40 ml VOA Vial	2
COD	H2SO4	500 ml Poly	1
Dissolved Iron & Manganese	HNO3	500 ml Poly	1
CO2, Ethane, Ethene, Methane	4C	40 ml VOA Vial	3
Sulfide		Liter Poly	1
BOD	4C	Liter Poly	1
Chloride, Nitrate, Nitrite, Ortho, Sulfate	4C	Liter Poly	1

OBSERVATIONS / NOTES:

28.00
- 18.83
9.17
x 0.653 gal per foot
5.98

The pump intake was set at 23.5 feet BTOC

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): [signature] for Jessica Arelli

TBD: To Be Determined

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Calverton
PROJECT NUMBER: 3853

WELL ID.: FD-GW03S-00
DATE: 7/19/00

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
0935	18.84	800	6.59	0.078	17.8	9.95	16.40	59.4	
0940	18.84	430	6.64	0.078	20.4	9.53	16.85	58.2	
0945	18.84	350	6.21	0.081	42.7	8.98	17.76	58.3	
1000	18.83	500	6.70	0.083	17.7	8.59	20.14	29.3	
1005	18.83	500	6.68	0.085	18.4	8.45	20.27	23.9	
1010	18.83	500	6.64	0.089	16.4	7.93	17.11	35.9	
1015	18.83	350	6.67	0.088	16.9	7.86	18.06	38.5	
1020	18.83	300	6.69	0.091	15.3	7.37	15.84	45.6	
1025	18.83	250	6.68	0.090	15.3	7.42	16.03	45.6	
1030	18.83	200	6.70	0.090	15.3	7.44	16.19	46.0	
1035	18.83	800	6.73	0.090	15.5	7.91	16.41	49.7	
1040	18.83	800	6.70	0.090	15.4	7.83	16.75	51.0	
1045	18.83	800	6.70	0.090	15.4	7.65	16.67	51.7	
1050	18.83	800	6.68	0.090	15.3	7.63	16.68	51.7	
1055	18.83	800	6.69	0.090	15.7	7.55	16.61	54.7	
1100	18.83	800	6.67	0.090	15.6	7.59	16.58	56.9	
1105	18.83	800	6.67	0.090	15.6	7.54	16.49	60.1	Used the Lamotte
1110	18.83	800	6.67	0.090	0.62	7.34	16.49	60.9	turbidity meter for
1115	18.83	800	6.66	0.090	0.66	7.33	16.55	63.2	more accurate readings
1120	18.83	800	6.68	0.090	0.65	7.36	16.58	64.4	All other parameters
1125	18.83	800	6.68	0.091	0.60	7.17	16.58	66.1	were consistent

SIGNATURE(S): ______________________

Tetra Tech NUS, Inc.

SAMPLE LOG SHEET
NATURAL ATTENUATION PARAMETERS

Project Site Name: Calverton

Project No.: 3853

Sampled By: Jessica Danelli

Sample ID No.: FD-GW035-00

Sample Location: FD-MW035

Duplicate: ☐

SAMPLING DATA:

	Color (Visual)	pH (SU)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (Meter, mg/l)	Sal. (%)	ORP mV
Date: 7/19/00								
Time: 1130								
Method: Rediflow Pump	Clear	6.68	0.891	16.58	0.60	7.17	—	66.1

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Divalent Iron

Equipment: HACH IR-18C

Analysis Time: 1150

Concentration: 0.0 mg/L

Notes:

Carbon Dioxide:

Equipment: Chemetrics Test Kit

Analysis Time: 1157

Range Used:	Range	Concentration ppm
☒	10 to 100 ppm	> 10
☐	100 to 1000 ppm	
☐	250 to 2500 ppm	

Concentration: > 10 ppm

Notes:

Dissolved Oxygen

Equipment: Chemetrics Test Kit

Analysis Time:

NA

Range Used:	Range	Concentration ppm
☐	0 to 1 ppm	
☐	1 to 12 ppm	

Concentration: ppm

Notes:

Hydrogen Sulfide

Equipment: HACH HS-C

Analysis Time: 1205

Concentration: 2.0 mg/L

Notes:

Tetra Tech NUS, Inc.

SAMPLE LOG SHEET
NATURAL ATTENUATION PARAMETERS

Project Site Name: Calverton

Project No.: 3853

Sampled By: Jessica Donnelli

Sample ID No.: FD-GW035-00

Sample Location: FD-MW035

Duplicate: ☒

SAMPLING DATA:

	Color (Visual)	pH (SU)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (Meter, mg/l)	Sal. (%)	ORP mV
Date: 7/19/00								
Time: 1130								
Method: Rediflow Pump	clear	6.68	0.091	16.58	0.60	7.17	–	66.1

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Divalent Iron

Equipment: HACH IR-18C

Analysis Time: 1154

Concentration: 0.1 mg/L

Notes:

Carbon Dioxide:

Equipment: Chemetrics Test Kit

Analysis Time: 1200

Range Used:	Range	Concentration ppm
☒	10 to 100 ppm	> 10
☐	100 to 1000 ppm	
☐	250 to 2500 ppm	

Concentration: > 10 ppm

Notes:

Dissolved Oxygen

Equipment: Chemetrics Test Kit

Analysis Time:

Range Used:	Range	Concentration ppm
☐	0 to 1 ppm	
☐	1 to 12 ppm	

Concentration: ppm

Notes:

Hydrogen Sulfide

Equipment: HACH HS-C

Analysis Time: 1210

Concentration: 2.0 mg/L

Notes:

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name:	Calverton	Sample ID No.:	FD-GW04S-00
Project No.:	3853	Sample Location:	FD-MW04S
		Sampled By:	Chuck Mizell
[] Domestic Well Data		C.O.C. No.:	
[x] Monitoring Well Data		Type of Sample:	
[] Other Well Type:		[x] Low Concentration	
[] QA Sample Type:		[] High Concentration	

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	TBD	TBD
Date: 7/19/00	Visual	Standard	mS/cm	°C	NTU	mg/l	ORP	
Time: 1140								
Method: Rediflow Pump	clear	6.11	0.123	17.91	0.81	9.69	-60	

PURGE DATA:

Date: 7/19/00	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	TBD	TBD
Method: Rediflow Pump								
Monitor Reading (ppm): 0.0								
Well Casing Diameter & Material								
Type: 4" PVC								
Total Well Depth (TD): 26.00								
Static Water Level (WL): 17.97								
One Casing Volume(gal/L): 5.24								
Start Purge (hrs): 0935								
End Purge (hrs): 1135								
Total Purge Time (min): 120								
Total Vol. Purged (gal/L): 18.0								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOA	HCL	40 ml VOA Vial	2
DRO	4C	Liter Amber Glass	2
GRO	HCl	40 ml VOA Vial	2
TOC	H2SO4	40 ml VOA Vial	2
COD	H2SO4	500 ml Poly	1
Dissolved Iron & Manganese	HNO3	500 ml Poly	1
CO2, Ethane, Ethene, Methane	4C	40 ml VOA Vial	3
Sulfide		Liter Poly	1
BOD	4C	Liter Poly	1
Chloride, Nitrate, Nitrite, Ortho, Sulfate	4C	Liter Poly	1

OBSERVATIONS / NOTES:

26.00
17.97
8.03
x 0.653 gal per foot
5.24 gal

The pump intake was set at 22 feet BTOC

Circle if Applicable:		Signature(s):
MS/MSD —	Duplicate ID No.: —	[signature]

TBD: To Be Determined

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Calverton

PROJECT NUMBER: 3853

WELL ID.: FD-MW04B

DATE: 7/19/00

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
0935	17.99	550	6.08	0.101	14.25	18.09	16.39	179	
0940	17.99	650	6.10	0.099	10.34	17.56	17.16	162	
0945	17.99	550	6.10	0.099	7.76	17.26	17.70	120	
0950	17.99	650	6.10	0.099	5.27	16.63	17.40	74	
0955	17.99	450	6.09	0.099	4.36	16.36	17.65	45	
1000	17.99	450	6.08	0.099	4.25	16.05	17.81	14	
1005	17.99	450	6.08	0.099	4.23	15.32	17.83	0	
1010	17.99	450	6.08	0.099	4.17	14.27	17.87	-9	
1015	17.99	450	6.07	0.101	4.02	13.76	17.89	-29	
1020	17.99	450	6.08	0.108	3.91	12.89	17.90	-33	
1025	17.99	450	6.07	0.110	3.79	12.13	17.91	-47	
1030	17.99	450	6.07	0.112	3.70	11.45	17.92	-55	
1035	17.99	450	6.08	0.116	2.50	11.25	18.13	-59	
1040	17.99	450	6.08	0.117	2.47	11.13	18.01	-59	
1045	17.99	450	6.09	0.119	2.43	10.87	17.93	-59	
1050	17.99	450	6.09	0.120	2.37	10.43	17.95	-60	
1055	17.99	500	6.10	0.122	2.35	10.03	17.91	-62	
1100	17.99	500	6.10	0.122	2.35	9.97	17.91	-63	
1105	17.99	500	6.10	0.122		9.83	17.92	-61	
1110	17.99	500	6.11	0.122		9.79	17.92	-60	
1115	17.99	500	6.11	0.123		9.70	17.91	-60	
1120	17.99	500	6.11	0.122		9.72	17.90	-60	
1125	17.99	500	6.11	0.123	1.08	9.67	17.90	-60	
1130	17.99	500	6.11	0.123	0.82	9.66	17.91	-60	
1135	17.99	500	6.11	0.123	0.81	9.69	17.91	-60	

Purging complete after removing 18 gallons from the well

1140 sampling was begun for natural attenuation parameters TCL VOC DRO GRO

SIGNATURE(S):

PAGE 2 OF 2

Tetra Tech NUS, Inc.

SAMPLE LOG SHEET
NATURAL ATTENUATION PARAMETERS

Project Site Name: Calverton

Project No.: 3853

Sampled By: Chuck Myers

Sample ID No.: FD-GW04S-00

Sample Location: MW04S

Duplicate: ☐

SAMPLING DATA:

	Color (Visual)	pH (SU)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (Meter, mg/l)	Sal. (%)	ORP mV
Date: 7/19/00								
Time: 1140								
Method: Rediflow pump	clear	6.11	0.133	17.91	0.81	9.69	—	-60

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Divalent Iron

Equipment: HACH IR-18C

Analysis Time: 1200

Concentration: 2.2 mg/L

Notes:

Carbon Dioxide:

Equipment: Chemetrics Test Kit

Analysis Time: 1205

Range Used:	Range	Concentration ppm
☒	10 to 100 ppm	30
☐	100 to 1000 ppm	
☐	250 to 2500 ppm	

Concentration: 30 ppm

Notes:

Dissolved Oxygen

Equipment: Chemetrics Test Kit N/A

Analysis Time:

Range Used:	Range	Concentration ppm
☐	0 to 1 ppm	
☐	1 to 12 ppm	

Concentration: ppm

Notes:

Hydrogen Sulfide

Equipment: HACH HS-C

Analysis Time: 1215

Concentration: 0.5 mg/L

Notes:

Tetra Tech NUS, Inc.

SAMPLE LOG SHEET
NATURAL ATTENUATION PARAMETERS

Project Site Name: Calverton

Project No.: 3853

Sampled By: Chuck Meier

Sample ID No.: FD-GW04S-00

Sample Location: FD-MW04S

Duplicate: ☒

SAMPLING DATA:

Date: 7-19-00	Color (Visual)	pH (SU)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (Meter, mg/l)	Sal. (%)	ORP mV
Time: 1140								
Method: Low Flow								

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Divalent Iron

Equipment: HACH IR-18C

Analysis Time: 1203

Concentration: 2.4 mg/L

Notes:

Carbon Dioxide:

Equipment: Chemetrics Test Kit

Analysis Time: 1210

Range Used:	Range	Concentration ppm
☒	10 to 100 ppm	30
☐	100 to 1000 ppm	
☐	250 to 2500 ppm	

Concentration: 30 ppm

Notes:

Dissolved Oxygen

Equipment: Chemetrics Test Kit N/A

Analysis Time:

Range Used:	Range	Concentration ppm
☐	0 to 1 ppm	
☐	1 to 12 ppm	

Concentration: ppm

Notes:

Hydrogen Sulfide

Equipment: HACH HS-C

Analysis Time: 1220

Concentration: 0.5 mg/L

Notes:

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Calverton
Project No.:

[] Domestic Well Data
[] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: FD-GW08S-00
Sample Location: FD-MW08S
Sampled By: JD
C.O.C. No.:
Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 7/18/00	Color	pH	S.C.	Temp.	Turbidity	DO	TBD	TBD
Time: 1540	Visual	Standard	mS/cm	°C	NTU	mg/l	ORP mV	
Method: Rediflow	Clear	4.64	0.059	15.05	0.1	5.50	110.0	N/A

PURGE DATA:

Date: 7/18/00	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	TBD	TBD
Method: Rediflow Pump								
Monitor Reading (ppm): 0.0								
Well Casing Diameter & Material								
Type: 4" PVC								
Total Well Depth (TD): 22.50								
Static Water Level (WL): 15.01								
One Casing Volume(gal/L): 4.89								
Start Purge (hrs): 1340								
End Purge (hrs): 1537								
Total Purge Time (min): 117								
Total Vol. Purged (gal/L): 20gal								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
DRO	None	1L Amber bottles	2
GRO	HCl	40ml Clear bottles	2
TCL VOCs	HCl	40 ml Clear Bottles	2

OBSERVATIONS / NOTES:

22.50
15.01
7.49

~15gal for total of 3 well screen volumes.

Sample depth 18.75ft R

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s): JD

TBD: To Be Determined

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Calverton

PROJECT NUMBER: 3853

WELL ID.: FD-MW08S

DATE: 7/18/00

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
1340	15.01	800	4.76	0.046	21.1	8.57	15.15	93.4	
1345	15.06	300	4.64	0.048	24.2	7.73	16.52	97.4	
1350	15.02	800	5.05	0.053	4.5	8.02	17.30	101.3	
1415	15.01	300	4.87	0.049	8.4	7.48	16.57	109.4	
1420	15.01	300	4.95	0.051	1.2	6.03	15.12	80.6	
1425	15.01	800	5.00	0.050	0.9	5.90	14.72	87.8	
1430	15.01	300	5.33	0.051	1.2	5.78	17.12	74.1	
1435	15.01	700	4.70	0.050	2.1	5.92	17.06	75.1	
1440	15.01	700	4.68	0.050	1.2	4.69	14.51	80.3	
1445	15.01	700	4.65	0.050	0.4	5.51	15.82	85.7	
1450	15.01	750	4.64	0.049	0.3	5.48	17.41	88.6	
1455	15.01	750	4.65	0.050	0.3	5.64	16.00	93.0	
1500	15.01	250	4.66	0.050	0.2	5.20	16.77	95.6	
1505	15.01	650	4.68	0.050	0.2	5.34	15.34	98.9	
1510	15.01	600	4.66	0.050	1.2	4.99	14.44	103.2	
1515	15.01	500	4.66	0.050	0.2	5.84	14.05	106.5	
1520	15.01	500	4.66	0.050	0.1	5.17	13.63	107.1	
1525	15.01	500	4.67	0.050	0.2	5.33	14.57	110.1	
1530	15.01	500	4.64	0.050	0.5	5.21	15.71	110.1	
1535	15.01	500	4.68	0.050	0.1	5.50	15.05	111.0	

SIGNATURE(S): ____________________

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page 1 of 2

Project Site Name: Calverton
Project No.:

[] Domestic Well Data
[x] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: FD-GW09-00
Sample Location: FD-MW09
Sampled By: JD / CM
C.O.C. No.:
Type of Sample:
[x] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 7/18/00	Color	pH	S.C.	Temp.	Turbidity	DO	TBD	TBD
Time: 1243	Visual	Standard	mS/cm	°C	NTU	mg/l	ORP mv	
Method: Rediflow	Clear	4.45	0.059	15.93	1.46	4.83	241	N/D

PURGE DATA:

Date: 7/18/00	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	TBD	TBD
Method: Rediflow Pump								
Monitor Reading (ppm): 0.0								
Well Casing Diameter & Material								
Type: 4" PVC								
Total Well Depth (TD): 22.65								
Static Water Level (WL): 14.52								
One Casing Volume(gal/L): 5.22								
Start Purge (hrs): 1030								
End Purge (hrs): 1240								
Total Purge Time (min): 130								
Total Vol. Purged (gal/L): 17 gal								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOC	HCL	40 ml VOA	
GRO	HCl	40 ml VOA	
DRO	4°C	1 Liter Amber	

OBSERVATIONS / NOTES:

22.65
14.52
8.13
.653
2439
4065
4898

Pump was set at 19 feet BTOC

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	~	JD

TBD: To Be Determined

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: ______________________ **WELL ID.:** FD-MW09-00

PROJECT NUMBER: ______________________ **DATE:** 7/18/00

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
1030	14.52	250	4.62	0.063	25.3	6.65	14.66	260	
1035	14.54	350	4.63	0.061	21.2	6.59	14.79	263	
1040	14.54	350	4.62	0.061	12.5	6.33	15.01	265	
1045	14.54	350	4.61	0.061	15.3	6.09	15.57	267	
1050	14.54	350	4.61	0.062	14.0	5.98	16.04	268	
1055	14.54	500	4.59	0.062	14.3	5.67	15.94	267	
1100	14.54	500	4.59	0.062	14.0	5.46	15.83	266	
1105	14.54	600	4.58	0.061	2.22	5.29	15.72	260	
1110	14.54	550	4.58	0.061	2.10	5.23	15.59	257	
1115	14.54	500	4.58	0.061	2.10	5.17	15.59	255	
1120	14.54	500	4.58	0.061	1.94	5.10	15.54	252	
1125	14.54	400	4.58	0.061	1.89	5.10	15.75	251	
1130	14.54	400	4.57	0.060	1.90	5.08	16.08	250	
1135	14.54	400	4.58	0.061	2.26	4.93	16.33	248	
1140	14.54	400	4.59	0.061	2.03	4.90	16.44	245	
1145	14.54	400	4.58	0.060	2.09	4.93	16.48	244	
1150	14.54	400	4.57	0.060	2.07	4.99	16.52	244	
1155	14.54	450	4.56	0.060	1.73	4.95	16.57	244	
1200	14.54	450	4.55	0.060	1.80	4.98	16.45	244	
1205	14.54	450	4.54	0.060	1.67	4.88	16.54	244	
1210	14.54	440	4.53	0.060	1.50	4.86	16.53	244	
1215	14.54	500	4.52	0.060	1.41	4.85	16.56	244	
1220	14.54	500	4.51	0.060	1.75	4.87	16.50	244	
1225	14.54	450	4.49	0.060	1.40	4.87	16.30	243	
1230	14.54	450	4.47	0.060	1.43	4.82	16.19	242	
1235	14.54	500	4.45	0.059	1.46	4.83	15.93	241	
1240	Stop Purging								
1243	Begin Sampling								

SIGNATURE(S): [illegible]

CHAIN OF CUSTODY RECORD

PROJECT NO.:	SITE NAME:
3833	Calverton

SAMPLERS (SIGNATURE): [illegible signature] / [illegible signature]

STATION NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	40ml VOA Vials HCl TCL VOCs	[illegible] Poly NaOH Zinc Acetate	[illegible]	40ml VOA Vials H_2SO_4 [illegible]	[illegible] HCl TCL [illegible]	[illegible]	[illegible] COD	Amber Glass [illegible]	REMARKS
	7/19/	[illegible]		X	TB-071900	2	2								[illegible] Blank supplied by Lab
	7/19/00	0655		X	FB-071900-Pot	2	2								
	7/19/00	0700		X	FB-071900-DI	2	2								
	7/19/00	1130		X	FD-GW03S-00		2	1	2	2	2	1	1	1	
	7/19/00	1140		X	FD-GW04S-00		6	1	2	2	2	1	2	1	DO MS/MSD on TCL VOC analysis only
	7/19/00	1815		X	FD-MWERMIBN		2	1	2	2	2	1	2	1	
	7/19/00	1500		X	FD-GWFD-071900		2	1	2	2	2	1	2	Ø	
	7/17/00	1640		X	FD-GW07S-0									1	
	7/17/00	1235		X	FD-GW10S-00									1	
	7/15/00	1105		X	FD-GW07I-00									1	
	7/19/00	1730		X	RB-071900	2	2								
	7/20/00	0715		X	FB-072000-Filt	2	2								

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):
[illegible signature]	7/20/00 1700				
RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):
RELINQUI BY (SIGNATURE):	DATE / TIME:	RECEIVED FOR LABORATORY BY (SIGNATURE):	DATE / TIME:	REMARKS: Shipped via Federal Express [illegible] [illegible] 9335	

Chain of Custody Record

Quanterra, Inc. - Pittsburgh PA Lab
450 William Pitt Way
Pittsburgh PA 15238

Quanterra

QUA-4124

Client: Tetra Tech NUS	Project Manager: Dave Brayack	Date: 7/17/00	Chain Of Custody Number: 67911
Address: Foster Plazza	Telephone Number (Area Code)/Fax Number: 412 921 8375	Lab Number:	Page ____ of ____
City: Pittsburgh / State: PA / Zip Code:	Site Contact: Vince Shickora		
Project Name: Calverton	Carrier/Waybill Number: Federal Express 810917875250		
Contract/Purchase Order/Quote No.:			

Sample I.D. No. and Description	Date	Time	Sample Type	Total Volume	Containers Type	Containers No.	Preservative	Condition on Receipt	Analysis: 1 Liter Poly chloride nitrate nitrite ortho sulfate
FD-GW078-00	7/17/00	1140	GW	1L	Poly	1	4°C		1
FD-GW10S-00	7/17/00	1635	GW	1L	Poly	1	4°C		1

Special Instructions

Possible Hazard Identification
☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return To Client ☒ Disposal By Lab ☐ Archive For ________ Months

Turn Around Time Required
☒ Normal ☐ Rush

QC Level
☐ I. ☐ II. ☐ III.

Project Specific (Specify)

	Date	Time		Date	Time
1. Relinquished By: Charles Magle	7/17/00	2000	1. Received By		
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

[redacted]

Chain of Custody Record

Quanterra, Inc. - Pittsburgh PA Lab
450 William Pitt Way
Pittsburgh PA 15238

Quanterra

QUA-4124

Client	Project Manager	Date	Chain Of Custody Number
Tetra Tech NUS	Dave Brayack	7/17/00	67910
Address	**Telephone Number (Area Code)/Fax Number**	**Lab Number**	**Page ___ of ___**
~~600 Cla~~ Foster Plazza	412 921 8375		

City	State	Zip Code	Site Contact
Pittsburgh	PA		Vince Shickova
Project Name			**Carrier/Waybill Number**
CAlverton			810817875240
Contract/Purchase Order/Quote No.			

Analysis

Sample I.D. No. and Description	Date	Time	Sample Type	Total Volume	Containers Type	Containers No.	Preservative	Condition on Receipt	500ml Poly HNO_3 TAL metals	1 Liter Poly NaOH Zinc Sulfide	40ml VOA Vials Methane Ethane Ethene	40ml VOA Vials H_2SO_4 TOC	500ml Poly H_2SO_4 COD	1 Liter Poly BOD	1 Liter Amber DRO DRO	40ml VOA Vials HCl GRO	40ml VOA Vials HCl TCL VOA			
TB-071700	7/17/00	0700	QA	80ml	40ml Vials	2	HCl										2			
FD-GW07S-00	7/17/00	1640	GW	70L					1	1	3	2	1	1	2	2	2			
FD-GW10S-00	7/17/00	1635	GW	1L					1	1	3	2	1	1	2	2	2			

Special Instructions

Possible Hazard Identification

☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal

☐ Return To Client ☒ Disposal By Lab ☐ Archive For ______ Months

Turn Around Time Required

☒ Normal ☐ Rush

QC Level

☐ I. ☐ II. ☐ III.

Project Specific (Specify)

1. Relinquished By	Date	Time	1. Received By	Date	Time
Charles Mayer	7/17/00	1800			
2. Relinquished By	**Date**	**Time**	**2. Received By**	**Date**	**Time**
3. Relinquished By	**Date**	**Time**	**3. Received By**	**Date**	**Time**

Comments

QUA-4124

Chain of Custody Record

Quanterra, Inc. - Pittsburgh PA Lab
450 William Pitt Way
Pittsburgh PA 15238

Quanterra

Client: Tetra Tech NUS	Project Manager: Dave Brayack	Date: 7/18/00	Chain Of Custody Number: 67912
Address: Foster Plaza	Telephone Number (Area Code)/Fax Number: 412 921 8375	Lab Number:	Page 1 of 1
City: Pittsburgh State: PA Zip Code: 15238	Site Contact:		
Project Name: Calverton	Carrier/Waybill Number: Federal Express 8808178275261		
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description	Date	Time	Sample Type	Total Volume	Containers Type	Containers No.	Preservative	Condition on Receipt	Analysis: 1 Liter Poly Chloride, Nitrate	Nitrite, Ortho Sulfate										
FD-GW07E-00	7/18/00	1105	GW	1 Liter	Poly	1	4°C		1											

Special Instructions

Possible Hazard Identification

☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal

☐ Return To Client ☐ Disposal By Lab ☐ Archive For ______ Months

Turn Around Time Required

☒ Normal ☐ Rush

QC Level

☐ I. ☐ II. ☐ III.

Project Specific (Specify)

	Date	Time		Date	Time
1. Relinquished By: Charles Meyer	7/18/00	1800	1. Received By		
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

CHAIN OF CUSTODY RECORD

PROJECT NO.:	SITE NAME:
CTO 210	Calverton

SAMPLERS (SIGNATURE): [illegible signatures]

STATION NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	TCL VOC	[illegible]	[illegible]	[illegible]	TOC	COD	BOD	DRO	GRO / REMARKS
	[illegible]	[illegible]		X	TE-071500	2	2								
	7/15/[illegible]	1105		X	FD-GW07I-00		2	1	3	2	1	1	2		2
	7/15/[illegible]	1540		X	FD-GW088-00		2						2		2
	7/15/[illegible]	1243		X	FD-GW095-00		2						2		2

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):
[signature]	7/15/[illegible] 1800				
RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):
RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED FOR LABORATORY BY (SIGNATURE):	DATE / TIME:	REMARKS: Shipped Via FedEx [illegible] Airbill No. 510817875[illegible]3	

CHAIN OF CUSTODY RECORD

PROJECT NO.: 3853 CTO

SITE NAME: Calverton

SAMPLERS (SIGNATURE): [signature]

STATION NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	[illegible] BOD						REMARKS
	7/19/00	1130		X	FD-GW03S-00	1	1						
	7/19/00	1140		X	FD-GW04S-00	1	1						
	7/19/00	1615		X	FD-RINSERMIEN	1	1						
	7/19/00	1500		X	FD-GWFD-071900	1	1						

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):
[signature]	7/19/00 2030				

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED FOR LABORATORY BY (SIGNATURE):	DATE / TIME:	REMARKS:
				Air bill Number 305372174729

Chain of Custody Record

Quanterra, Inc. - Pittsburgh PA Lab
460 William Pitt Way
Pittsburgh PA 15238

Quanterra

QUA-4124

Client	Tetratech NUS
Address	Foster Plaza
City	/Pittsburgh
State	PA
Zip Code	
Project Name	Calverton
Contract/Purchase Order/Quote No.	
Project Manager	Dave Brayack
Telephone Number (Area Code)/Fax Number	412 921 8375
Site Contact	
Carrier/Waybill Number	Federal Express Airbill No #10817975272
Date	7/19/00
Lab Number	
Chain Of Custody Number	67802
Page	of

Analysis

Sample I.D. No. and Description	Date	Time	Sample Type	Total Volume	Containers Type	Containers No.	Preservative	Condition on Receipt	1 Liter poly Chloride, Nitrate Nitrite, Ortho Sulfate
FD-GW03S-00	7/19/00	1130	GW	1 Liter	Poly	1	4°C		1
FD-GW04S-00	7/19/00	1140	GW	1 Liter	poly	1	4°C		1
FD-NWERMIGN	7/19/00	1615	GW	1 Liter	poly	1	4°C		1
FD-GWFD-071900	7/19/00	1800	GW	1 Liter	poly	1	4°C		1

Special Instructions

Possible Hazard Identification
☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return To Client ☐ Disposal By Lab ☐ Archive For ____ Months

Turn Around Time Required
☒ Normal ☐ Rush

QC Level
☐ I. ☐ II. ☐ III.

Project Specific (Specify)

1. Relinquished By [illegible]	Date 7/19/00	Time 2030	1. Received By	Date	Time
2. Relinquished By	Date	Time	2. Received By	Date	Time
3. Relinquished	Date	Time	3. Received By	Date	Time

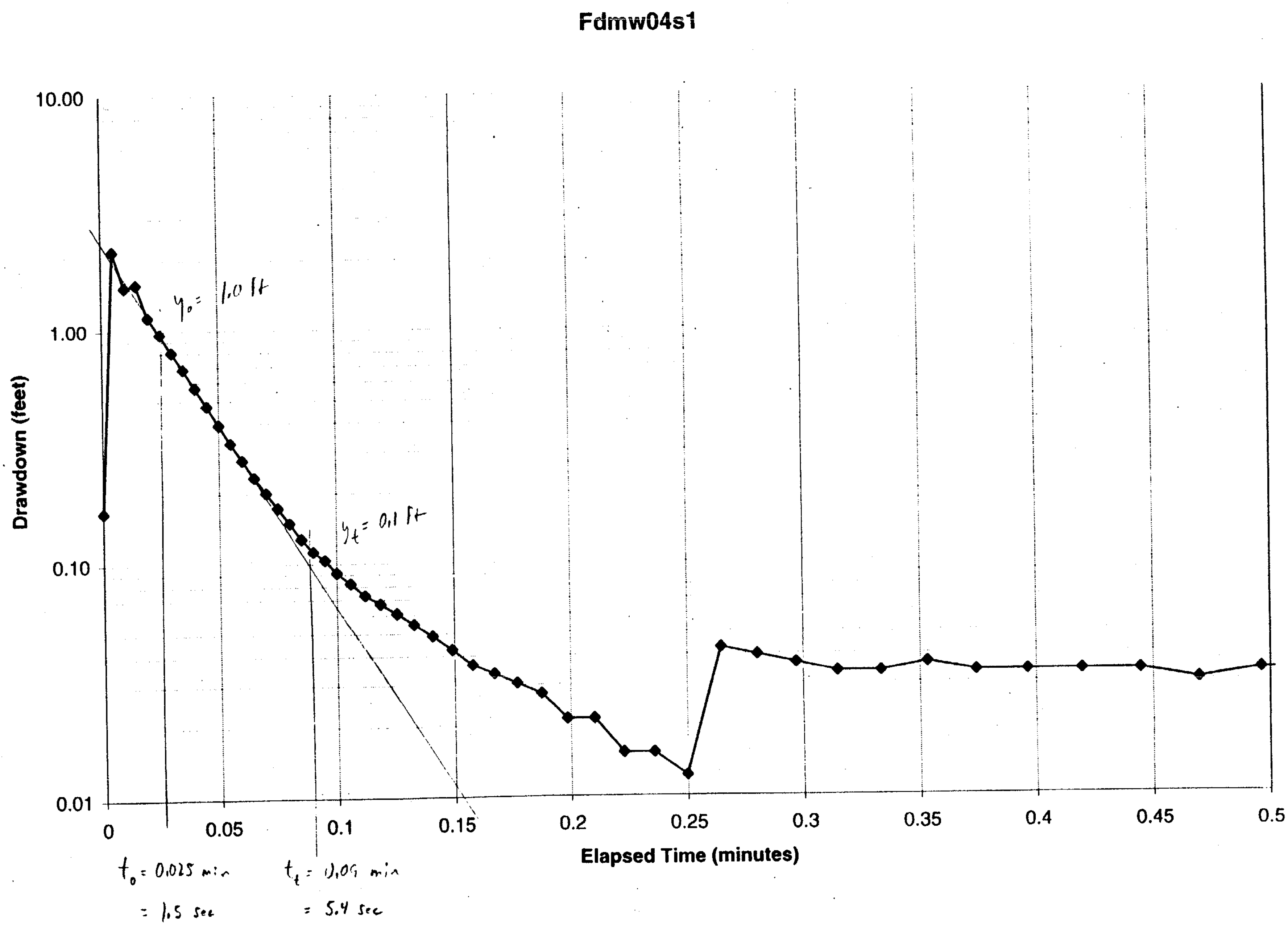
CHAIN OF CUSTODY RECORD

PROJECT NO.: 3853-0300	SITE NAME: NWIRP Calverton
SAMPLERS (SIGNATURE): [signatures]	

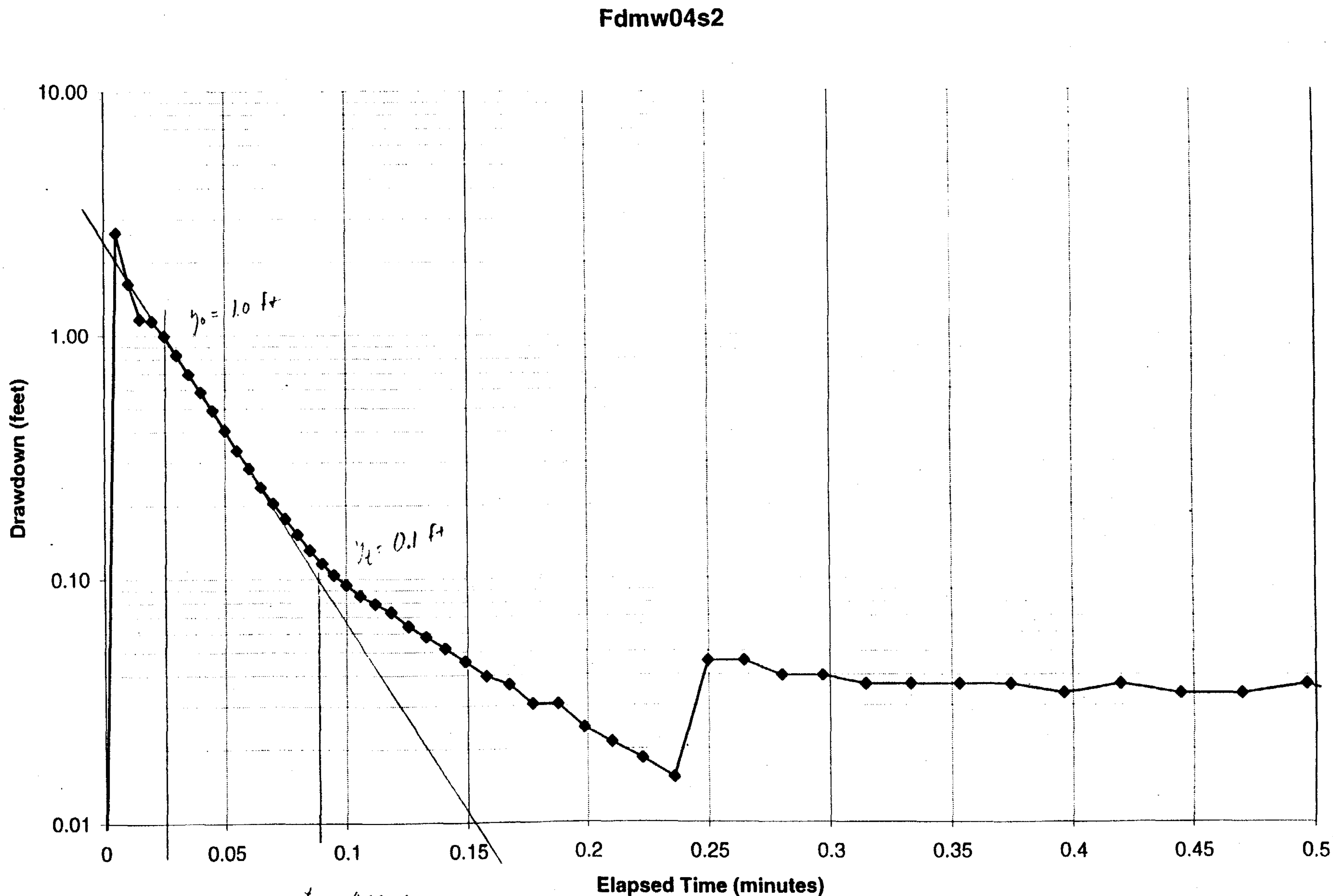
STATION NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	40 ml Vials VOCs						REMARKS
	7/11/00	1025		X	SA-TW-113-20-01	2	2						
	7/11/00	1115		X	SA-TW-113-35-01	2	2						
	7/11/00	1238		X	SA-TW-113-60-01	2	2						
	7/11/00	1345		X	SA-TW-113-75-01	2	2						
	7/11/00	1435		X	SA-TW-113-95-01	2	2						
	7/10/00	0911		X	(Trip Blank) TB-071100	2	2						
	7/11/00	1503		X	ECM-MW02-0007	2	2						
	7/11/00	1758		X	FD-GW10S-00	2	2						
	7/11/00	1942		X	FD-GW34D-00	2	2						~~3~~.5
										8			
					Temperature Blank	1							

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):
[signature]	7/12/00 0800				
RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):
RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED FOR LABORATORY BY (SIGNATURE):	DATE / TIME:	REMARKS:	

ATTACHMENT H
SLUG TEST DATA



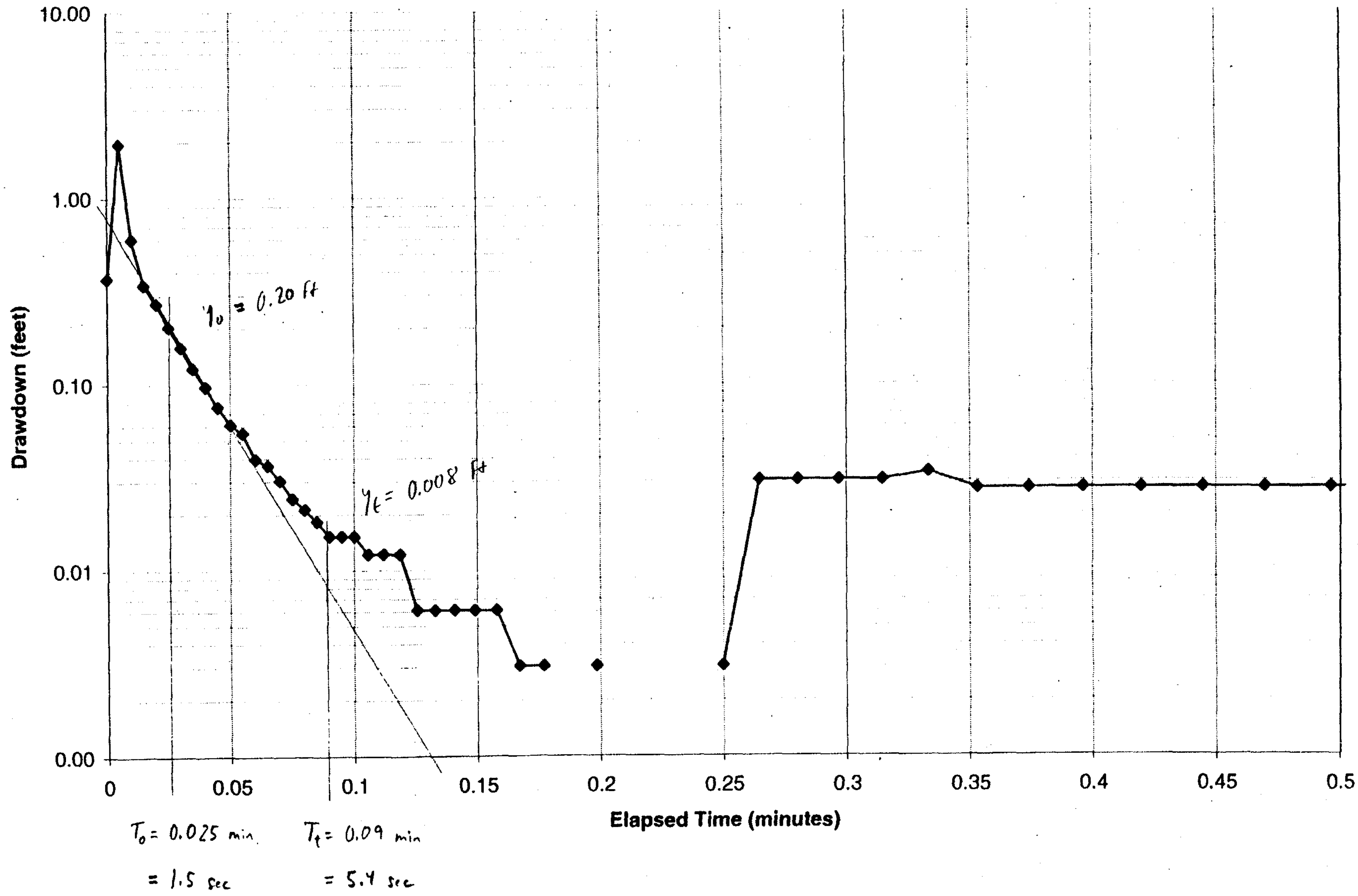
Fdmw04s1
Drawdown (feet)
10.00
1.00
0.10
0.01
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Elapsed Time (minutes)
y_0 = 1.0 ft
y_t = 0.1 ft
t_0 = 0.025 min
= 1.5 sec
t_t = 0.09 min
= 5.4 sec



t_0 = 0.025 min = 1.5 sec

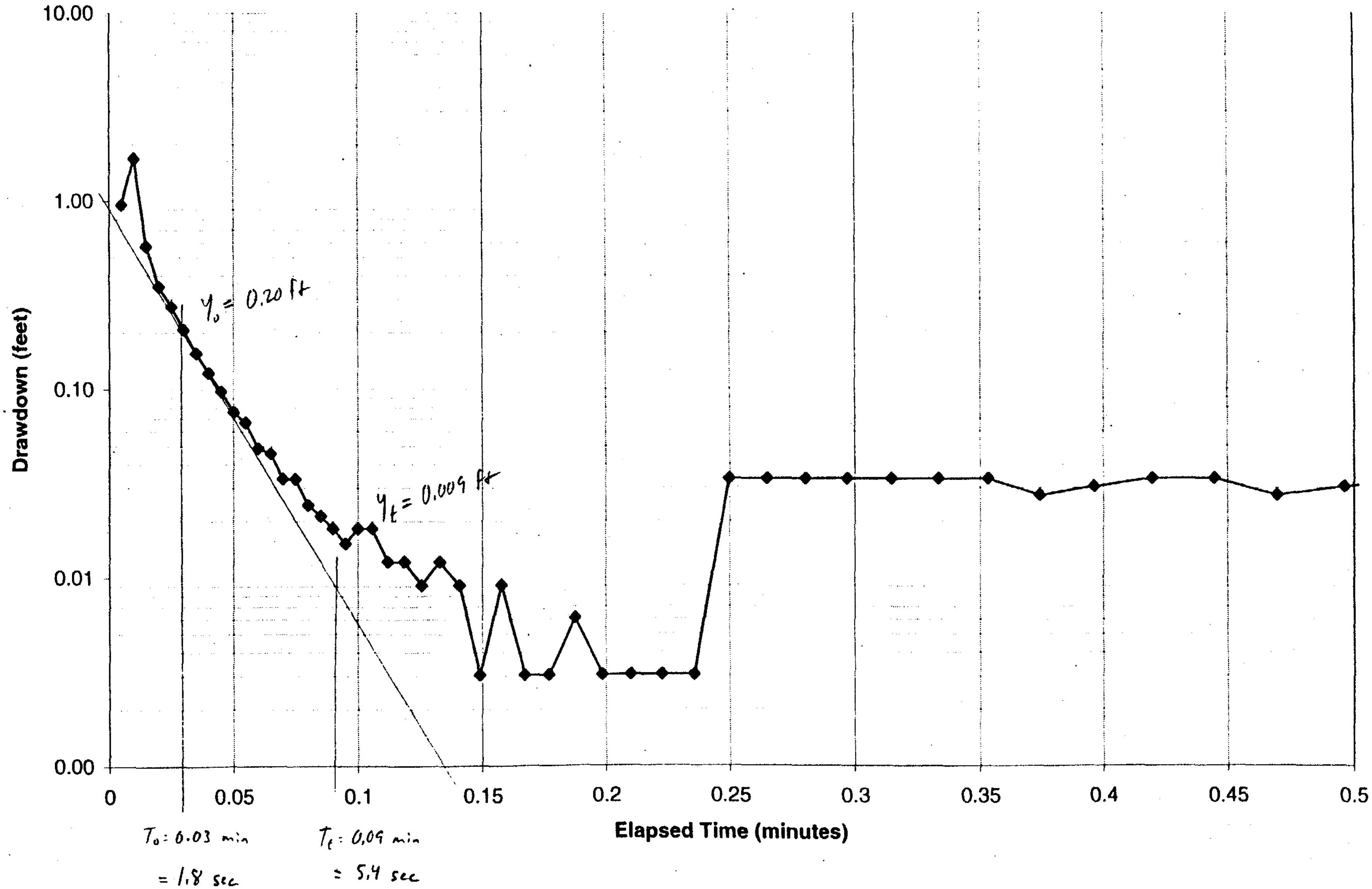
t_t = 0.09 min = 5.4 sec

Fdmw05s1

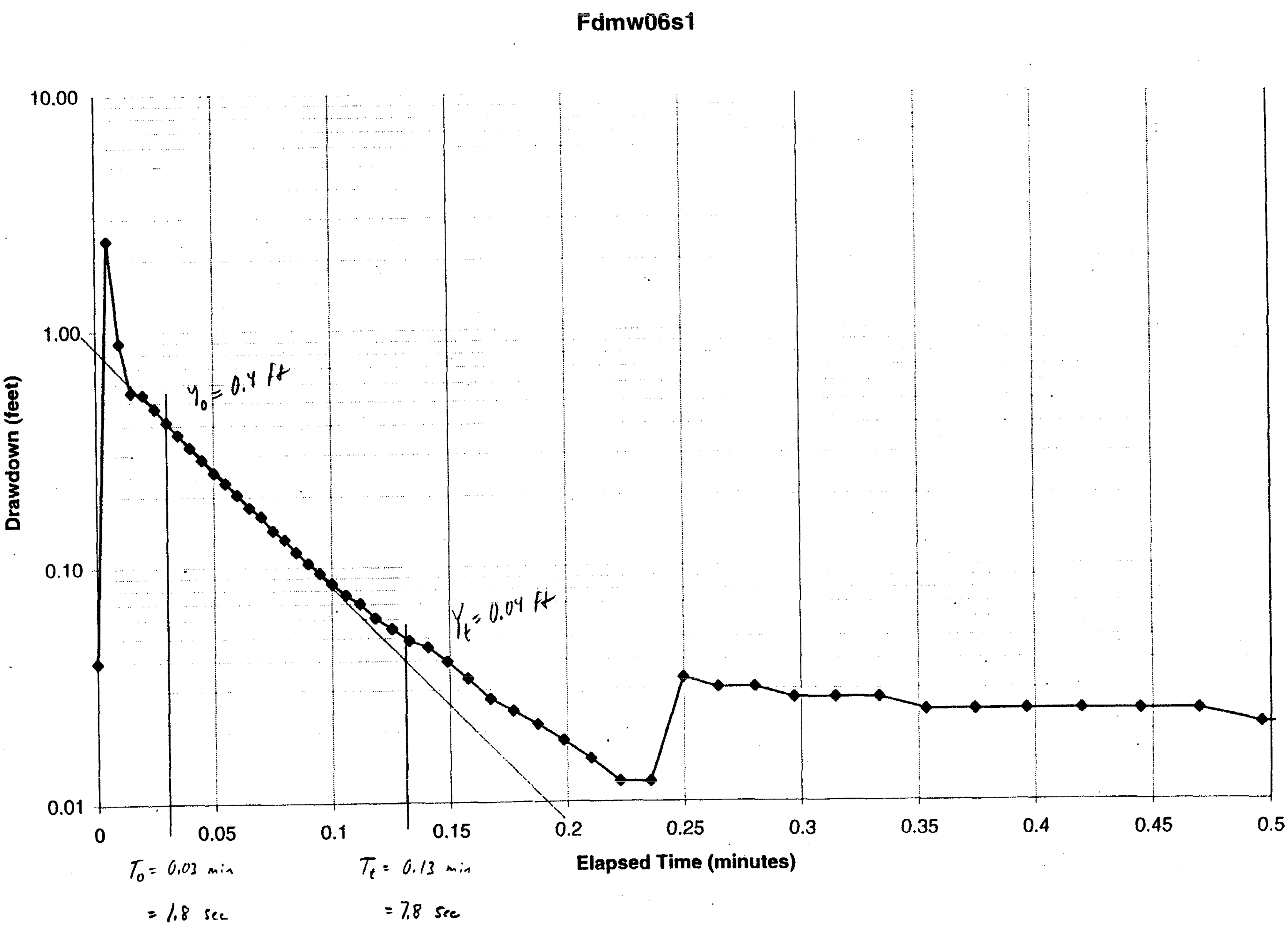


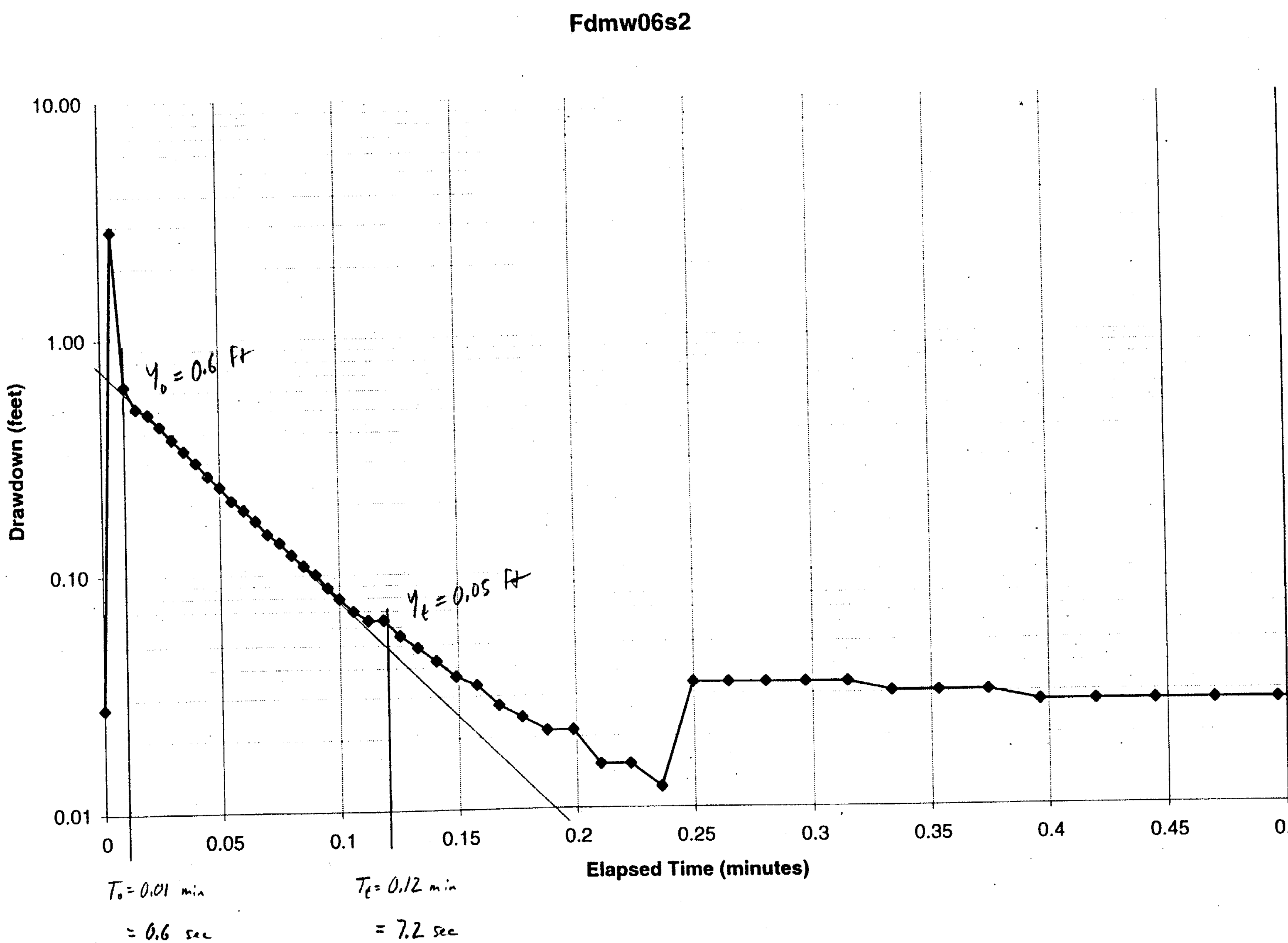
10.00
1.00
0.10
0.01
0.00
Drawdown (feet)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Elapsed Time (minutes)
y_0 = 0.20 ft
y_t = 0.008 ft
T_0 = 0.025 min
= 1.5 sec
T_t = 0.09 min
= 5.4 sec

Fdmw05s2



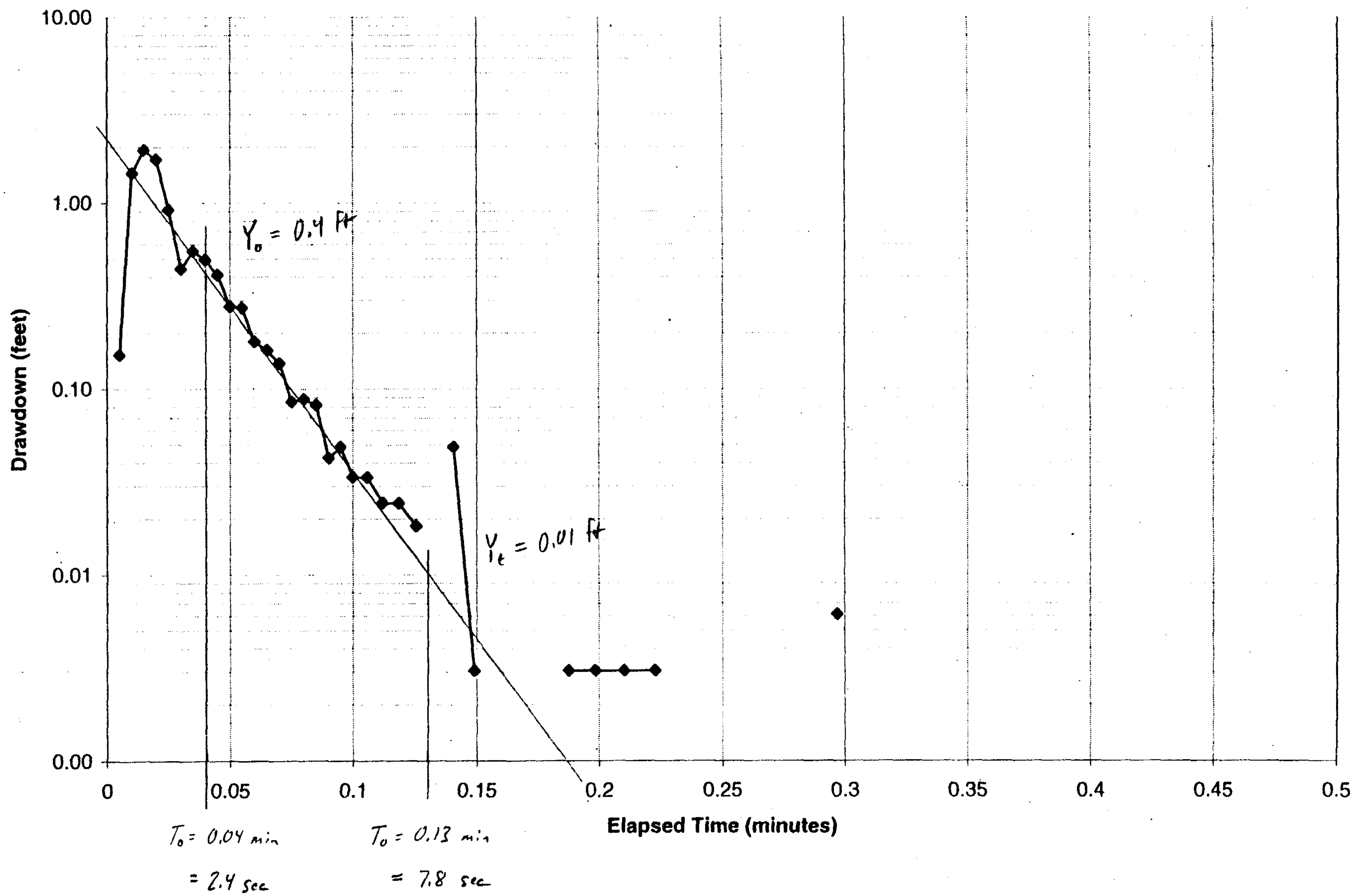
10.00
1.00
0.10
0.01
0.00
Drawdown (feet)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Elapsed Time (minutes)
$y_0 = 0.20$ ft
$y_t = 0.009$ ft
T_0: 0.03 min
= 1.8 sec
T_t: 0.09 min
= 5.4 sec

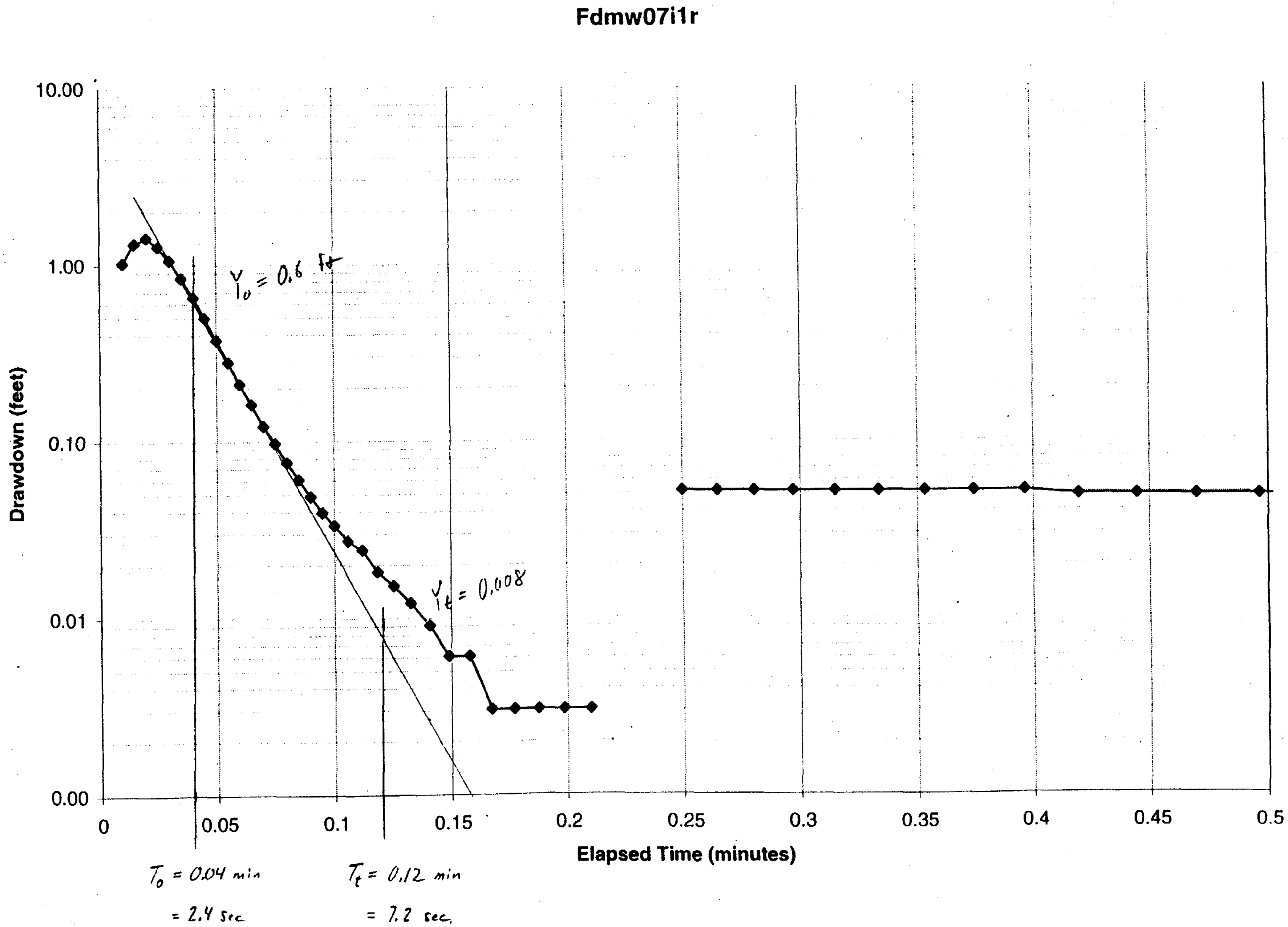

Fdmw06s1
Drawdown (feet)
10.00
1.00
0.10
0.01
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Elapsed Time (minutes)
Y_0 = 0.4 ft
Y_t = 0.04 ft
T_0 = 0.03 min
= 1.8 sec
T_t = 0.13 min
= 7.8 sec



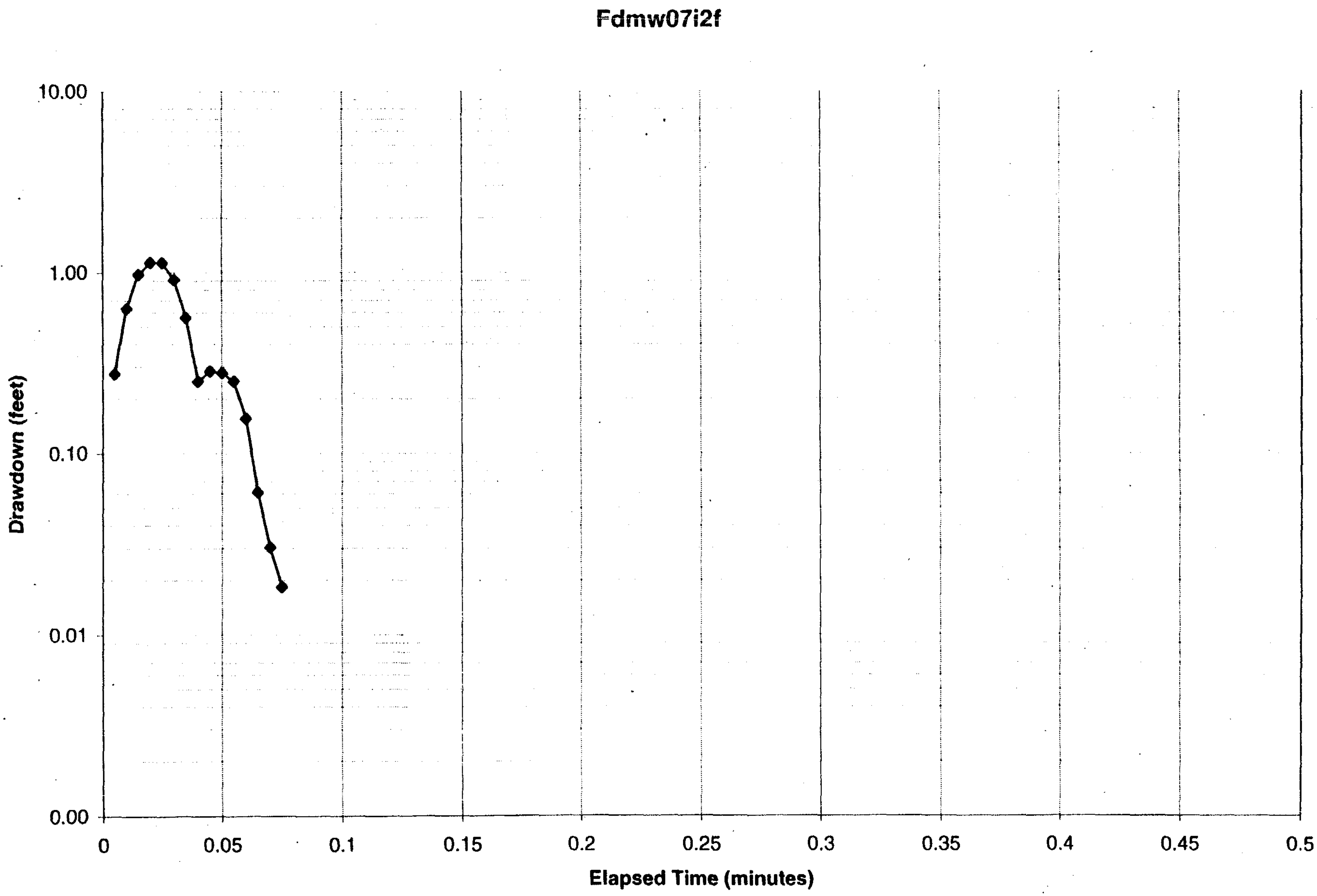
Fdmw06s2
10.00
1.00
0.10
0.01
Drawdown (feet)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Elapsed Time (minutes)
$y_0 = 0.6$ Ft
$y_t = 0.05$ Ft
$T_0 = 0.01$ min
$= 0.6$ sec
$T_t = 0.12$ min
$= 7.2$ sec

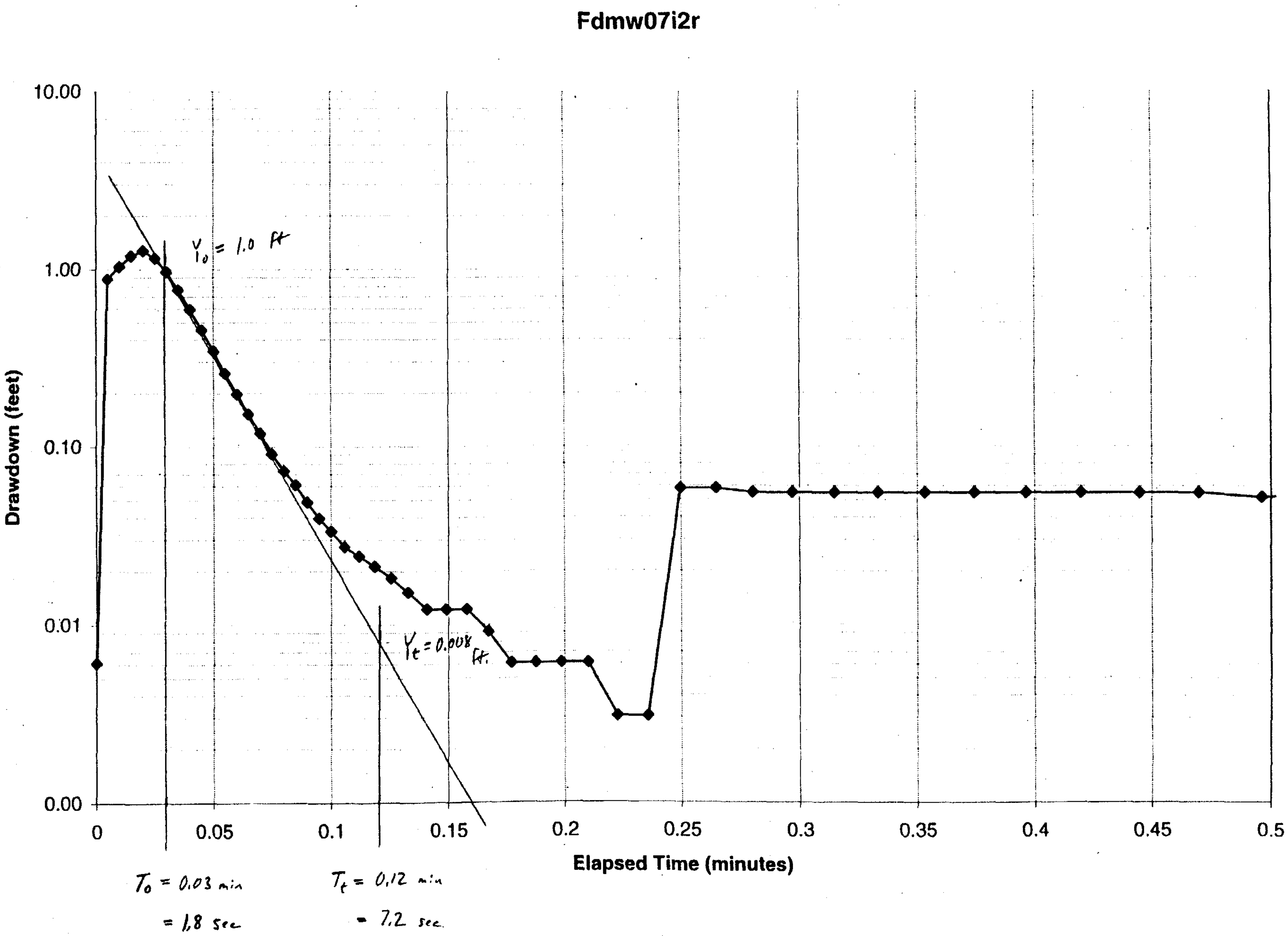
Fdmw07i1f

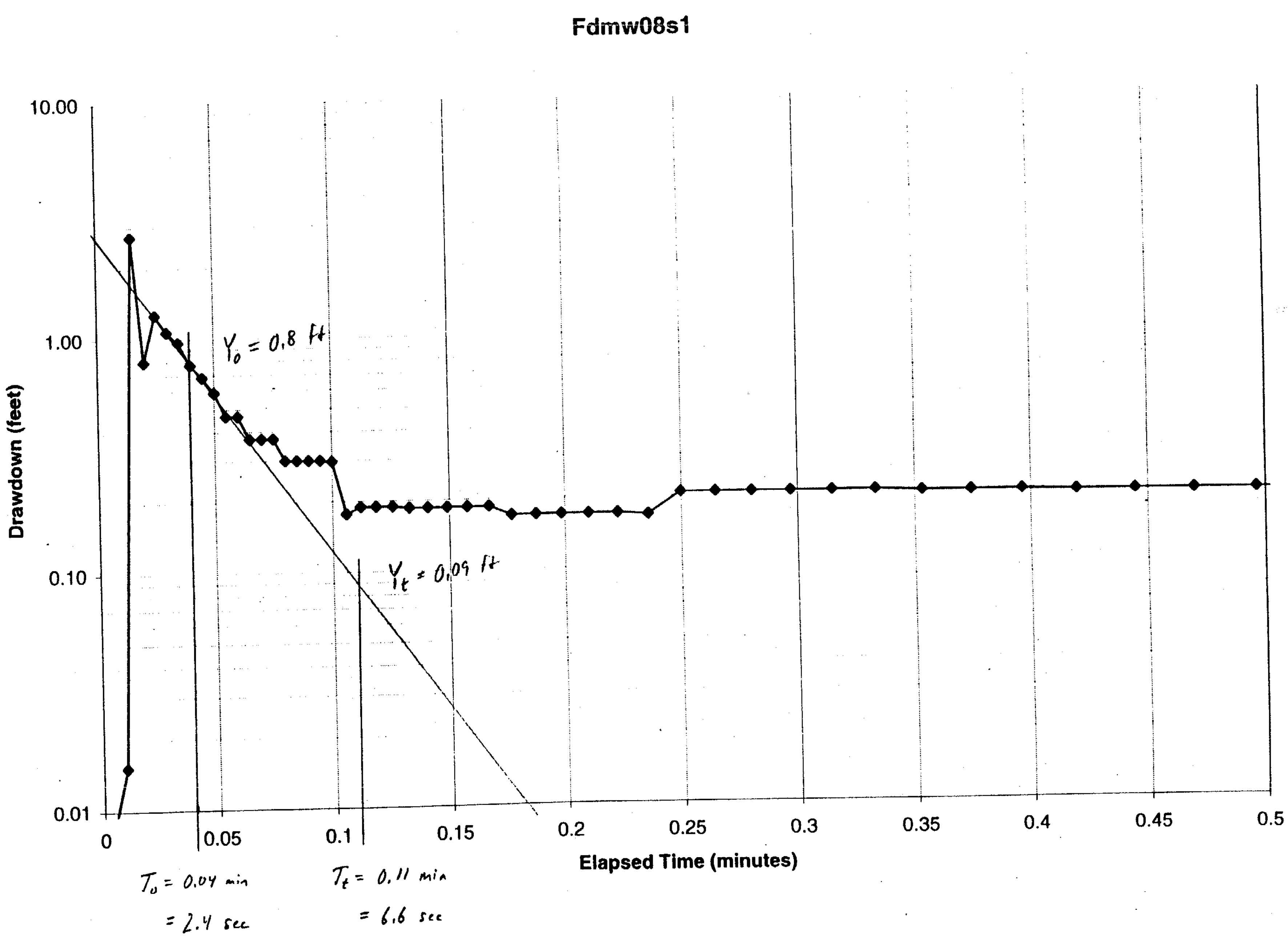

Drawdown (feet)
10.00
1.00
0.10
0.01
0.00
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Elapsed Time (minutes)
$Y_o = 0.4$ ft
$Y_t = 0.01$ ft
$T_o = 0.04$ min
$= 2.4$ sec
$T_o = 0.13$ min
$= 7.8$ sec



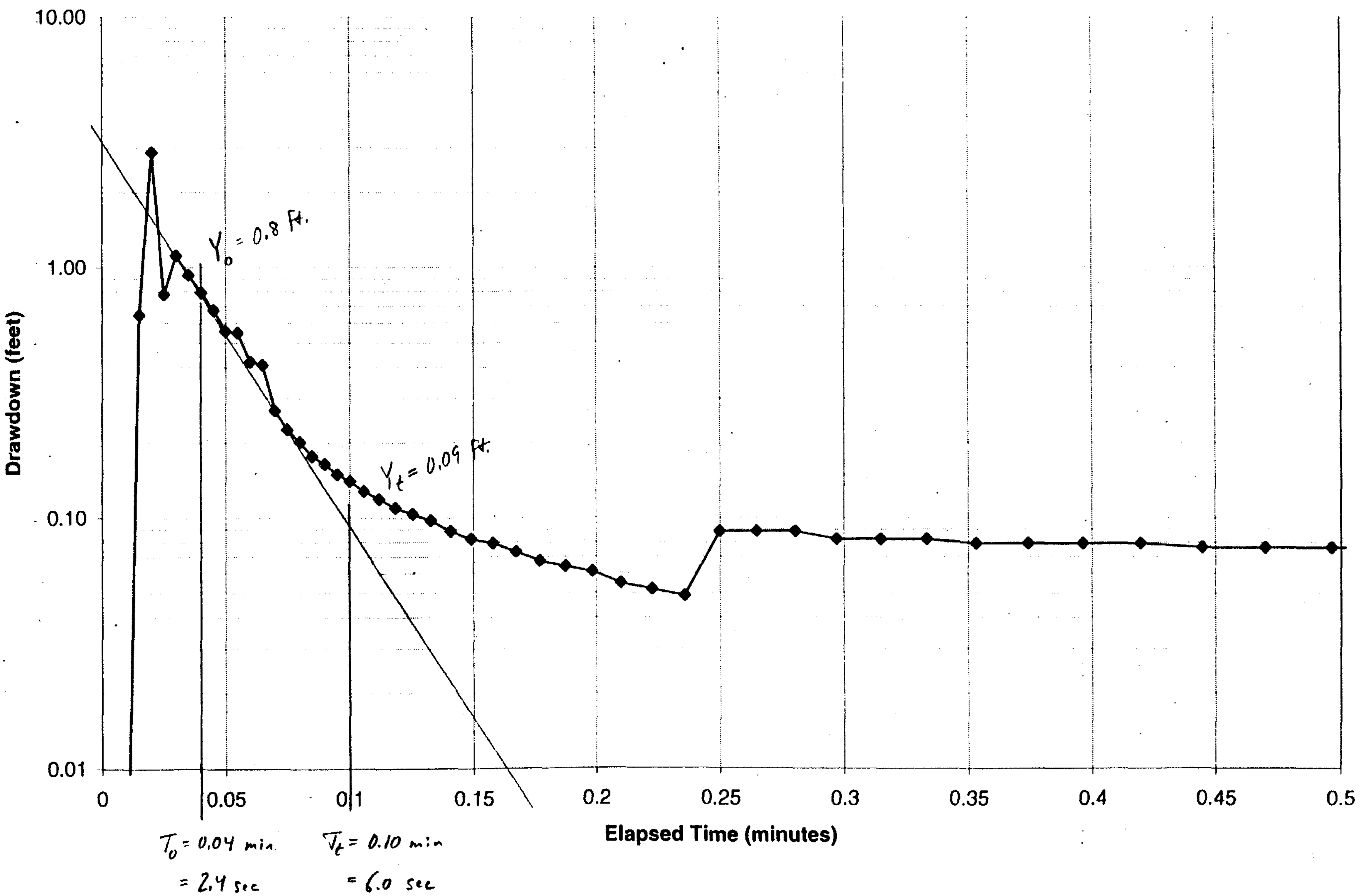
Fdmw07i1r
Drawdown (feet)
10.00
1.00
0.10
0.01
0.00
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Elapsed Time (minutes)
$Y_0 = 0.6$ ft
$Y_t = 0.008$
$T_0 = 0.04$ min
$= 2.4$ sec
$T_t = 0.12$ min
$= 7.2$ sec.


Fdmw07i2f
10.00
1.00
0.10
0.01
0.00
Drawdown (feet)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Elapsed Time (minutes)

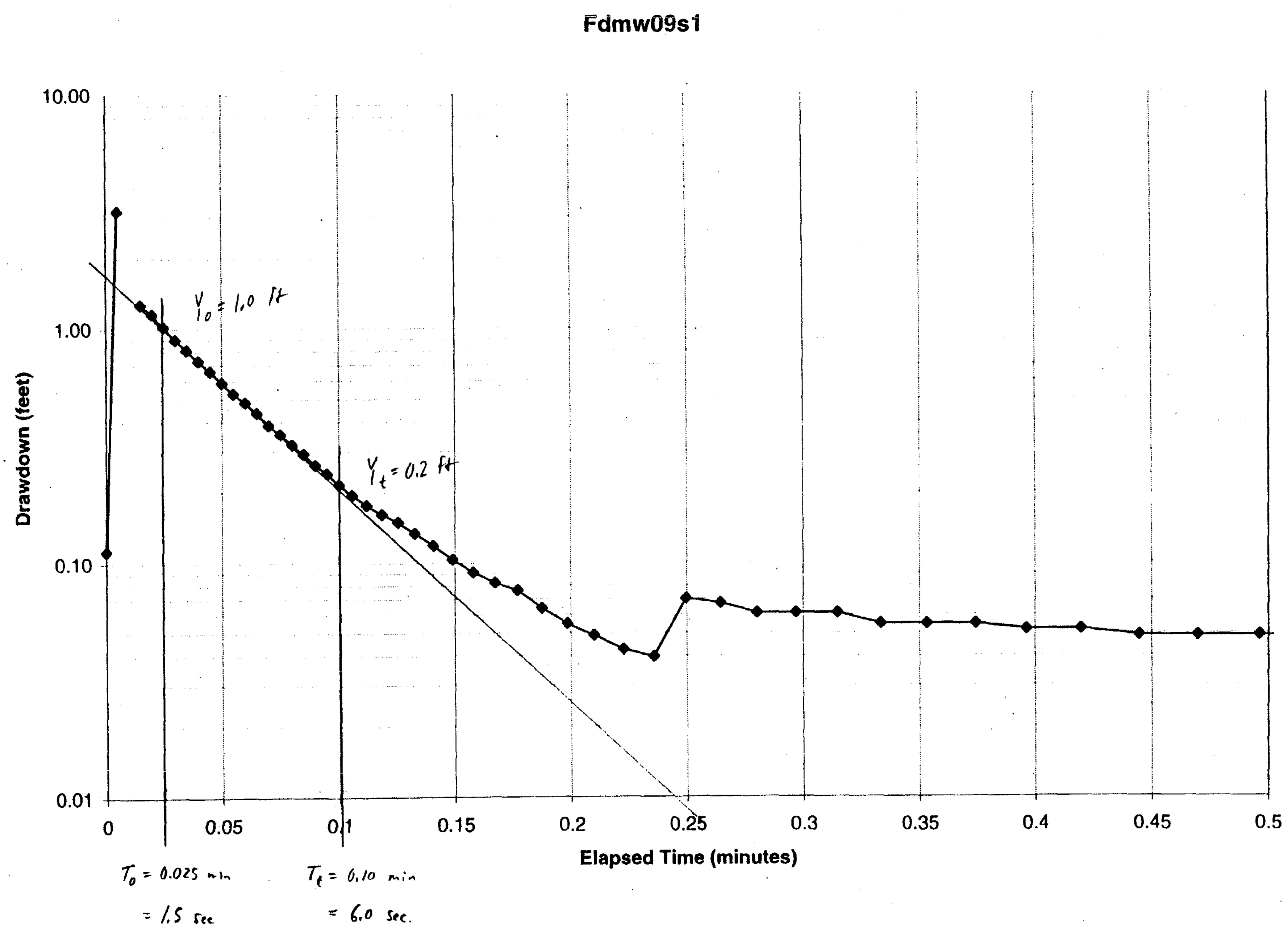

Fdmw07i2r
Drawdown (feet)
10.00
1.00
0.10
0.01
0.00
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Elapsed Time (minutes)
$Y_0 = 1.0$ ft
$Y_t = 0.008$ ft.
$T_0 = 0.03$ min
$= 1.8$ sec
$T_t = 0.12$ min
$= 7.2$ sec


Fdmw08s1
Drawdown (feet)
10.00
1.00
0.10
0.01
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Elapsed Time (minutes)
Y0 = 0.8 ft
Yt = 0.09 ft
T0 = 0.04 min
= 2.4 sec
Tt = 0.11 min
= 6.6 sec

Fdmw08s2

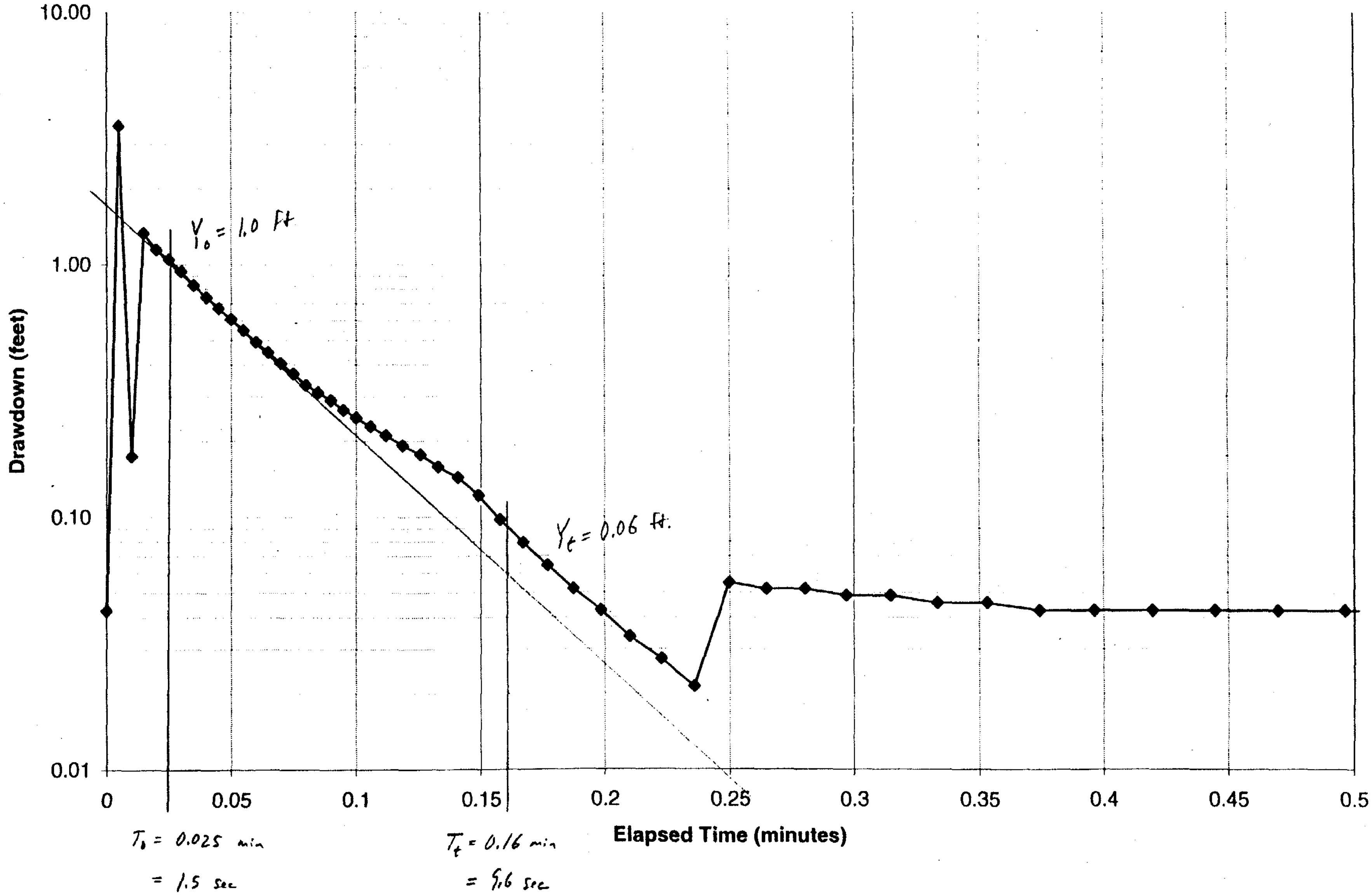


10.00
1.00
0.10
0.01
Drawdown (feet)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Elapsed Time (minutes)
Y_o = 0.8 Ft.
Y_t = 0.09 Ft.
T_o = 0.04 min.
= 2.4 sec
T_t = 0.10 min
= 6.0 sec

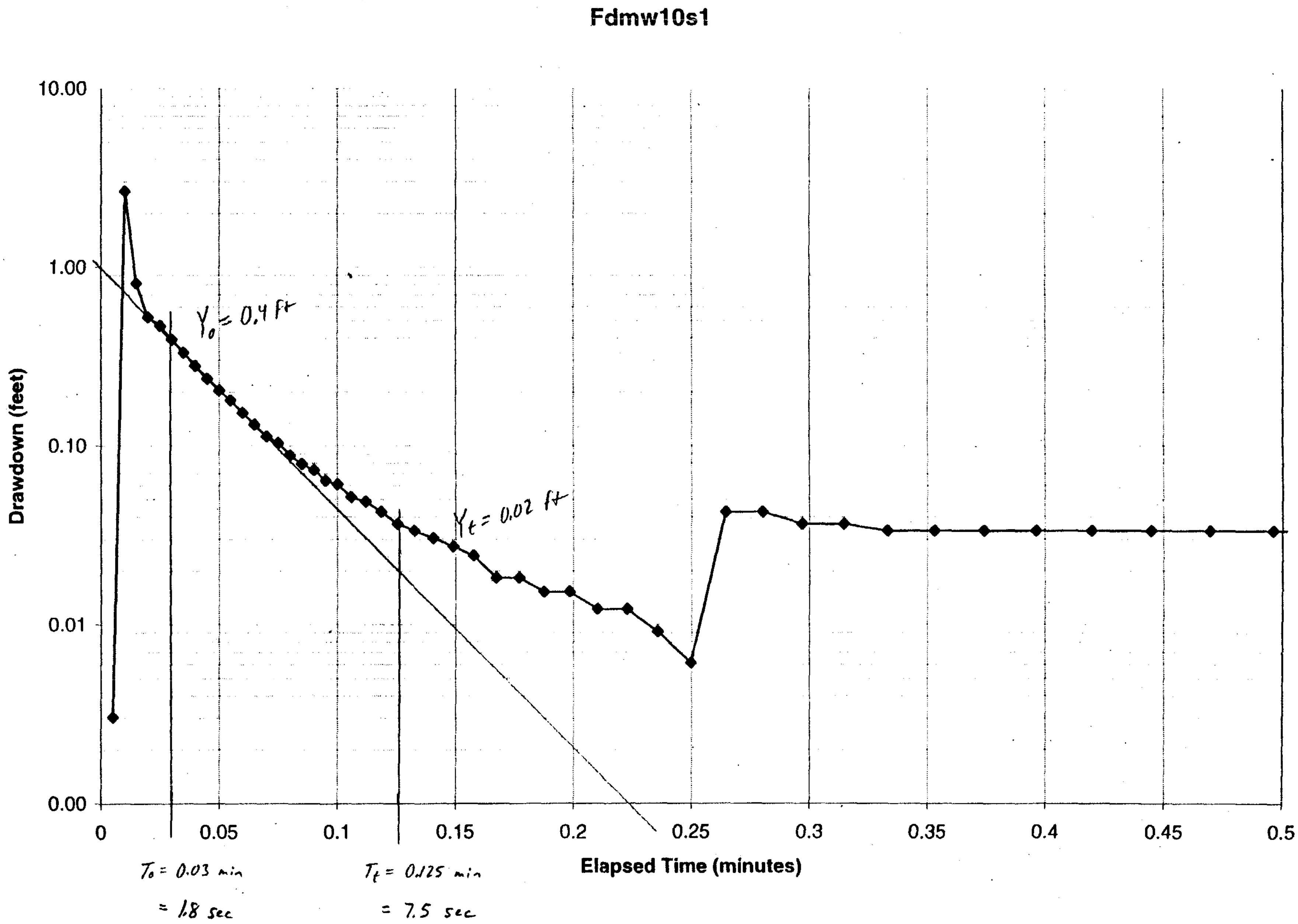


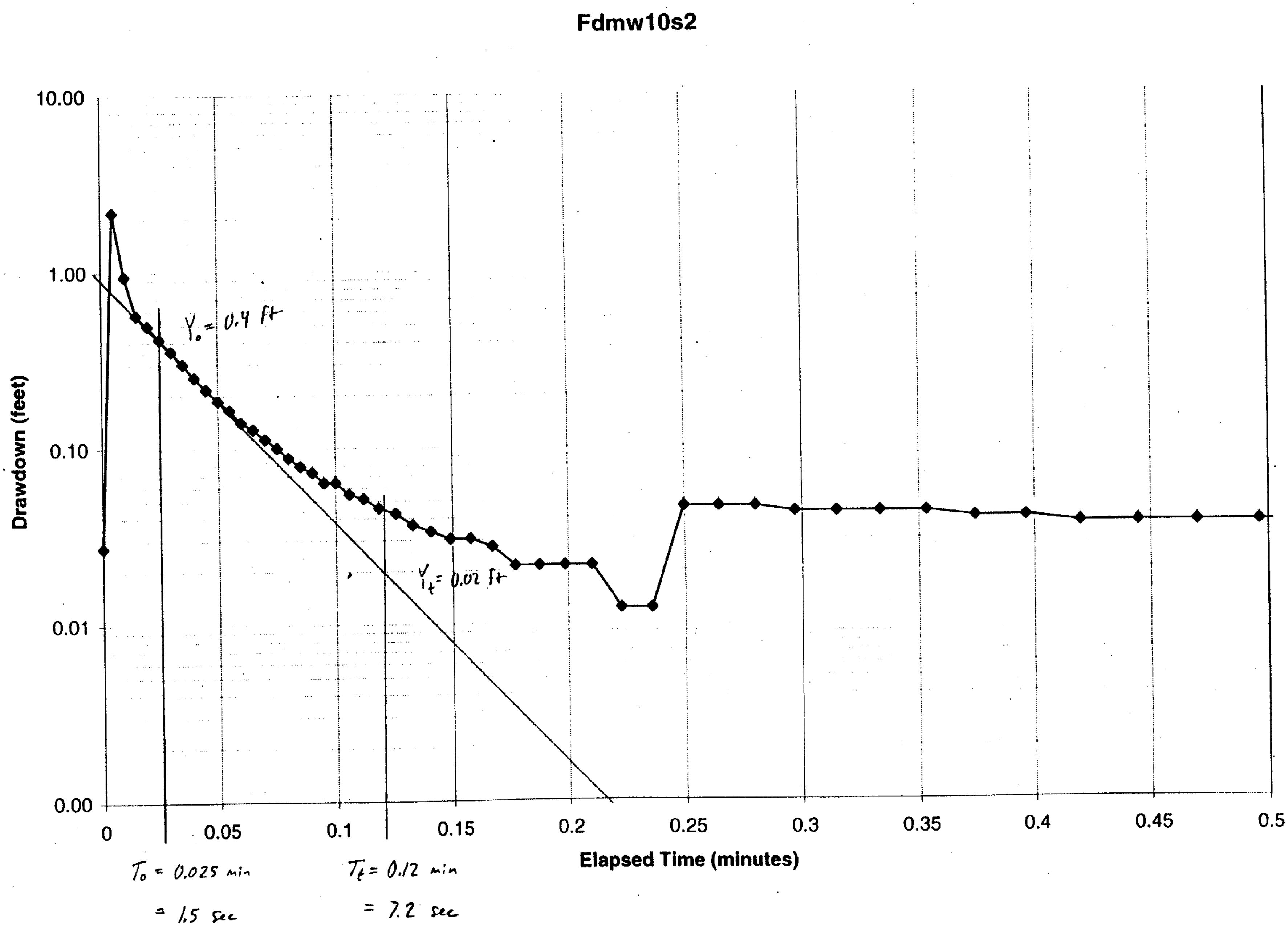
Fdmw09s1
Drawdown (feet)
10.00
1.00
0.10
0.01
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Elapsed Time (minutes)
$Y_0 = 1.0$ ft
$Y_t = 0.2$ ft
$T_0 = 0.025$ min
= 1.5 sec
$T_t = 0.10$ min
= 6.0 sec.

Fdmw09s2



10.00
1.00
0.10
0.01
Drawdown (feet)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Elapsed Time (minutes)
Y0 = 1.0 Ft
Yt = 0.06 Ft.
T0 = 0.025 min
= 1.5 sec
Tt = 0.16 min
= 9.6 sec


Fdmw10s1
10.00
1.00
0.10
0.01
0.00
Drawdown (feet)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Elapsed Time (minutes)
Y0 = 0.4 ft
Yt = 0.02 ft
T0 = 0.03 min
= 1.8 sec
Tt = 0.125 min
= 7.5 sec


Fdmw10s2
10.00
1.00
0.10
0.01
0.00
Drawdown (feet)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Elapsed Time (minutes)
Y_o = 0.4 ft
Y_t = 0.02 ft
T_o = 0.025 min
= 1.5 sec
T_t = 0.12 min
= 7.2 sec

SLUG TEST:	FD-MW-04S1				
Scn Int L=	7.46	Tyo=	1.5	sec	
WT to Well Bt H=	7.46	Yo=	1	feet	
Aq Depth D=	55				
Rad Borehole Rw=	0.417	Tyt=	5.4	sec	
Case Rcase=	0.167	Yt=	0.1	feet	
Cal Eff Rc' Rc=	0.268				
One used in K calc Rc=	0.268				
L\Rw=	17.89				
A=	2.1				
B=	0.3				
C=	1.6				
IF D>H			IF D=H		
LN(Re/Rw)=	1.7295198		LN(Re/Rw)=	2.1239449	
Re=	2.3510235		Re=	3.4878162	
K=	4.92E-03	ft/sec	K=	6.04E-03	ft/sec
	1.50E-01	cm/sec		1.84E-01	cm/sec

SLUG TEST:	FD-MW-04S2				
Scn Int L=	7.46	Tyo=	1.5	sec	
WT to Well Bt H=	7.46	Yo=	1	feet	
Aq Depth D=	55				
Rad Borehole Rw=	0.417	Tyt=	5.4	sec	
Case Rcase=	0.167	Yt=	0.1	feet	
Cal Eff Rc' Rc=	0.268				
One used in K calc Rc=	0.268				
L\Rw=	17.89				
A=	2.1				
B=	0.3				
C=	1.6				
IF D>H			IF D=H		
LN(Re/Rw)=	1.7295198		LN(Re/Rw)=	2.1239449	
Re=	2.3510235		Re=	3.4878162	
K=	4.92E-03	ft/sec	K=	6.04E-03	ft/sec
	1.50E-01	cm/sec		1.84E-01	cm/sec

SLUG TEST:	FD-MW-05S1				
Scn Int L=	8.42	Tyo=	1.5	sec	
WT to Well Bt H=	8.42	Yo=	0.2	feet	
Aq Depth D=	55				
Rad Borehole Rw=	0.417	Tyt=	5.4	sec	
Case Rcase=	0.167	Yt=	0.008	feet	
Cal Eff Rc' Rc=	0.268				
One used in K calc Rc=	0.268				
L\Rw=	20.19				
A=	2.2				
B=	0.3				
C=	1.7				
IF D>H			IF D=H		
LN(Re/Rw)=	1.8347177		LN(Re/Rw)=	2.221161	
Re=	2.6118235		Re=	3.8439171	
K=	6.46E-03	ft/sec	K=	7.82E-03	ft/sec
	1.97E-01	cm/sec		2.38E-01	cm/sec

SLUG TEST:	FD-MW-05S2				
Scn Int L=	8.42	Tyo=	1.8	sec	
WT to Well Bt H=	8.42	Yo=	0.2	feet	
Aq Depth D=	55				
Rad Borehole Rw=	0.417	Tyt=	5.4	sec	
Case Rcase=	0.167	Yt=	0.009	feet	
Cal Eff Rc' Rc=	0.268				
One used in K calc Rc=	0.268				
L\Rw=	20.19				
A=	2.2				
B=	0.3				
C=	1.7				
IF D>H			IF D=H		
LN(Re/Rw)=	1.8347177		LN(Re/Rw)=	2.221161	
Re=	2.6118235		Re=	3.8439171	
K=	6.74E-03	ft/sec	K=	8.16E-03	ft/sec
	2.05E-01	cm/sec		2.49E-01	cm/sec

SLUG TEST:	FD-MW-06S1				
Scn Int L=	8.53	Tyo=	1.8	sec	
WT to Well Bt H=	8.53	Yo=	0.4	feet	
Aq Depth D=	55				
Rad Borehole Rw=	0.417	Tyt=	7.8	sec	
Case Rcase=	0.167	Yt=	0.04	feet	
Cal Eff Rc' Rc=	0.268				
One used in K calc Rc=	0.268				
L\Rw=	20.46				
A=	2.2				
B=	0.3				
C=	1.7				
IF D>H			IF D=H		
LN(Re/Rw)=	1.8479994		LN(Re/Rw)=	2.2343609	
Re=	2.6467445		Re=	3.894993	
K=	2.99E-03	ft/sec	K=	3.61E-03	ft/sec
	9.10E-02	cm/sec		1.10E-01	cm/sec

SLUG TEST:	FD-MW-06S2				
Scn Int L=	8.53	Tyo=	0.6	sec	
WT to Well Bt H=	8.53	Yo=	0.6	feet	
Aq Depth D=	55				
Rad Borehole Rw=	0.417	Tyt=	7.2	sec	
Case Rcase=	0.167	Yt=	0.05	feet	
Cal Eff Rc' Rc=	0.268				
One used in K calc Rc=	0.268				
L\Rw=	20.46				
A=	2.2				
B=	0.3				
C=	1.7				
IF D>H			IF D=H		
LN(Re/Rw)=	1.8479994		LN(Re/Rw)=	2.2343609	
Re=	2.6467445		Re=	3.894993	
K=	2.93E-03	ft/sec	K=	3.54E-03	ft/sec
	8.93E-02	cm/sec		1.08E-01	cm/sec

SLUG TEST:	FD-MW-07IF1				
Scn Int L=	10	Tyo=	2.4	sec	
WT to Well Bt H=	28.68	Yo=	0.4	feet	
Aq Depth D=	55				
Rad Borehole Rw=	0.417	Tyt=	7.8	sec	
Case Rcase=	0.167	Yt=	0.01	feet	
Cal Eff Rc' Rc=	0.268				
One used in K calc Rc=	0.268				
L\Rw=	23.98				
A=	2.25				
B=	0.35				
C=	1.8				
IF D>H			IF D=H		
LN(Re/Rw)=	2.4136218		LN(Re/Rw)=	2.9845947	
Re=	4.6597079		Re=	8.2476283	
K=	5.92E-03	ft/sec	K=	7.32E-03	ft/sec
	1.80E-01	cm/sec		2.23E-01	cm/sec

SLUG TEST:	FD-MW-07IR1				
Scn Int L=	10	Tyo=	2.4	sec	
WT to Well Bt H=	28.68	Yo=	0.6	feet	
Aq Depth D=	55				
Rad Borehole Rw=	0.417	Tyt=	7.2	sec	
Case Rcase=	0.167	Yt=	0.008	feet	
Cal Eff Rc' Rc=	0.268				
One used in K calc Rc=	0.268				
L\Rw=	23.98				
A=	2.25				
B=	0.35				
C=	1.8				
IF D>H			IF D=H		
LN(Re/Rw)=	2.4136218		LN(Re/Rw)=	2.9845947	
Re=	4.6597079		Re=	8.2476283	
K=	7.80E-03	ft/sec	K=	9.64E-03	ft/sec
	2.38E-01	cm/sec		2.94E-01	cm/sec

SLUG TEST:	FD-MW-07IR2				
Scn Int L=	10	Tyo=	1.8	sec	
WT to Well Bt H=	28.68	Yo=	1	feet	
Aq Depth D=	55				
Rad Borehole Rw=	0.417	Tyt=	7.2	sec	
Case Rcase=	0.167	Yt=	0.008	feet	
Cal Eff Rc' Rc=	0.268				
One used in K calc Rc=	0.268				
L\Rw=	23.98				
A=	2.25				
B=	0.35				
C=	1.8				
IF D>H			IF D=H		
LN(Re/Rw)=	2.4136218		LN(Re/Rw)=	2.9845947	
Re=	4.6597079		Re=	8.2476283	
K=	7.75E-03	ft/sec	K=	9.58E-03	ft/sec
	2.36E-01	cm/sec		2.92E-01	cm/sec

SLUG TEST:	FD-MW-08S1				
Scn Int L=	6.85	Tyo=	2.4	sec	
WT to Well Bt H=	6.85	Yo=	0.8	feet	
Aq Depth D=	55				
Rad Borehole Rw=	0.417	Tyt=	6.6	sec	
Case Rcase=	0.167	Yt=	0.09	feet	
Cal Eff Rc' Rc=	0.268				
One used in K calc Rc=	0.268				
L\Rw=	16.43				
A=	2				
B=	0.3				
C=	1.55				
IF D>H			IF D=H		
LN(Re/Rw)=	1.6625363		LN(Re/Rw)=	2.051843	
Re=	2.1987022		Re=	3.2451902	
K=	4.53E-03	ft/sec	K=	5.60E-03	ft/sec
	1.38E-01	cm/sec		1.71E-01	cm/sec

SLUG TEST:	FD-MW-08S2				
Scn Int L=	6.85	Tyo=	2.4	sec	
WT to Well Bt H=	6.85	Yo=	0.8	feet	
Aq Depth D=	55				
Rad Borehole Rw=	0.417	Tyt=	6	sec	
Case Rcase=	0.167	Yt=	0.09	feet	
Cal Eff Rc' Rc=	0.268				
One used in K calc Rc=	0.268				
L\Rw=	16.43				
A=	2				
B=	0.3				
C=	1.55				
IF D>H			IF D=H		
LN(Re/Rw)=	1.6625363		LN(Re/Rw)=	2.051843	
Re=	2.1987022		Re=	3.2451902	
K=	5.29E-03	ft/sec	K=	6.53E-03	ft/sec
	1.61E-01	cm/sec		1.99E-01	cm/sec

SLUG TEST:	FD-MW-09S1				
Scn Int L=	7.57	Tyo=	1.5	sec	
WT to Well Bt H=	7.57	Yo=	1	feet	
Aq Depth D=	55				
Rad Borehole Rw=	0.417	Tyt=	6	sec	
Case Rcase=	0.167	Yt=	0.2	feet	
Cal Eff Rc' Rc=	0.268				
One used in K calc Rc=	0.268				
L\Rw=	18.15				
A=	2.1				
B=	0.3				
C=	1.65				
IF D>H			IF D=H		
LN(Re/Rw)=	1.7440707		LN(Re/Rw)=	2.1260722	
Re=	2.3854831		Re=	3.4952439	
K=	2.96E-03	ft/sec	K=	3.61E-03	ft/sec
	9.02E-02	cm/sec		1.10E-01	cm/sec

SLUG TEST:	FD-MW-09S2				
Scn Int L=	7.57	Tyo=	1.5	sec	
WT to Well Bt H=	7.57	Yo=	1	feet	
Aq Depth D=	55				
Rad Borehole Rw=	0.417	Tyt=	9.6	sec	
Case Rcase=	0.167	Yt=	0.06	feet	
Cal Eff Rc' Rc=	0.268				
One used in K calc Rc=	0.268				
L\Rw=	18.15				
A=	2.1				
B=	0.3				
C=	1.65				
IF D>H			IF D=H		
LN(Re/Rw)=	1.7440707		LN(Re/Rw)=	2.1260722	
Re=	2.3854831		Re=	3.4952439	
K=	2.87E-03	ft/sec	K=	3.50E-03	ft/sec
	8.76E-02	cm/sec		1.07E-01	cm/sec

SLUG TEST:	FD-MW-10S1				
Scn Int L=	5.62	Tyo=	1.8	sec	
WT to Well Bt H=	5.62	Yo=	0.4	feet	
Aq Depth D=	55				
Rad Borehole Rw=	0.417	Tyt=	7.5	sec	
Case Rcase=	0.167	Yt=	0.02	feet	
Cal Eff Rc' Rc=	0.268				
One used in K calc Rc=	0.268				
L\Rw=	13.48				
A=	1.9				
B=	0.28				
C=	1.4				
IF D>H			IF D=H		
LN(Re/Rw)=	1.5081115		LN(Re/Rw)=	1.8982783	
Re=	1.8840854		Re=	2.783222	
K=	5.06E-03	ft/sec	K=	6.38E-03	ft/sec
	1.54E-01	cm/sec		1.94E-01	cm/sec

SLUG TEST:	FD-MW-10S2				
Scn Int L=	5.62	Tyo=	1.5	sec	
WT to Well Bt H=	5.62	Yo=	0.4	feet	
Aq Depth D=	55				
Rad Borehole Rw=	0.417	Tyt=	7.2	sec	
Case Rcase=	0.167	Yt=	0.02	feet	
Cal Eff Rc' Rc=	0.268				
One used in K calc Rc=	0.268				
L\Rw=	13.48				
A=	1.9				
B=	0.28				
C=	1.4				
IF D>H			IF D=H		
LN(Re/Rw)=	1.5081115		LN(Re/Rw)=	1.8982783	
Re=	1.8840854		Re=	2.783222	
K=	5.06E-03	ft/sec	K=	6.38E-03	ft/sec
	1.54E-01	cm/sec		1.94E-01	cm/sec

In-Situ Inc.	Troll	
Report generated:	10/23/00	7:49:32
Report from file:	S:\GOODR\CALVER~1\MW04S1.BIN	
DataMgr Version	2.31.0.0	
Serial number:	10751	
Firmware Version	7.1	
Unit name:	Troll 4000	
Test name:		FD-MW04-S-1
Test defined on:	10/3/00	10:17:01
Test started on:	10/3/00	10:17:38
Test stopped on:	10/3/00	10:28:20
Test extracted on:	10/3/00	10:51:58

Data gathered using Logarithmic testing
Maximum time between data points: 1.0000 Minutes.
Number of data samples: 102

TOTAL DATA SAMPLES 102

Channel number [2]

Measurement type:	Pressure/Level	
Channel name:	Pressure	
Sensor Range:	15 PSI.	
Specific gravity:	1	
Mode:	Surface	
User-defined reference:	0	Meters H2O
Referenced on:	channel definition.	
Pressure head at reference:	2.186	Meters H2O

Date	Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/3/00	10:17	0	-0.055	0.17
10/3/00	10:17	0.005	-0.717	2.19
10/3/00	10:17	0.01	-0.504	1.54
10/3/00	10:17	0.015	-0.518	1.58
10/3/00	10:17	0.02	-0.375	1.14
10/3/00	10:17	0.025	-0.317	0.97
10/3/00	10:17	0.03	-0.265	0.81
10/3/00	10:17	0.035	-0.224	0.68
10/3/00	10:17	0.04	-0.187	0.57
10/3/00	10:17	0.045	-0.156	0.48
10/3/00	10:17	0.05	-0.129	0.39
10/3/00	10:17	0.055	-0.108	0.33
10/3/00	10:17	0.06	-0.091	0.28
10/3/00	10:17	0.065	-0.077	0.23

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/3/00 10:17	0.07	-0.066	0.20
10/3/00 10:17	0.075	-0.057	0.17
10/3/00 10:17	0.08	-0.049	0.15
10/3/00 10:17	0.085	-0.042	0.13
10/3/00 10:17	0.09	-0.037	0.11
10/3/00 10:17	0.095	-0.034	0.10
10/3/00 10:17	0.1	-0.03	0.09
10/3/00 10:17	0.1058	-0.027	0.08
10/3/00 10:17	0.112	-0.024	0.07
10/3/00 10:17	0.1185	-0.022	0.07
10/3/00 10:17	0.1255	-0.02	0.06
10/3/00 10:17	0.1328	-0.018	0.05
10/3/00 10:17	0.1407	-0.016	0.05
10/3/00 10:17	0.149	-0.014	0.04
10/3/00 10:17	0.1578	-0.012	0.04
10/3/00 10:17	0.1672	-0.011	0.03
10/3/00 10:17	0.177	-0.01	0.03
10/3/00 10:17	0.1875	-0.009	0.03
10/3/00 10:17	0.1985	-0.007	0.02
10/3/00 10:17	0.2102	-0.007	0.02
10/3/00 10:17	0.2227	-0.005	0.02
10/3/00 10:17	0.2358	-0.005	0.02
10/3/00 10:17	0.2498	-0.004	0.01
10/3/00 10:17	0.2647	-0.014	0.04
10/3/00 10:17	0.2803	-0.013	0.04
10/3/00 10:17	0.297	-0.012	0.04
10/3/00 10:17	0.3147	-0.011	0.03
10/3/00 10:17	0.3333	-0.011	0.03
10/3/00 10:17	0.3532	-0.012	0.04
10/3/00 10:18	0.3742	-0.011	0.03
10/3/00 10:18	0.3963	-0.011	0.03
10/3/00 10:18	0.4198	-0.011	0.03
10/3/00 10:18	0.4447	-0.011	0.03
10/3/00 10:18	0.4697	-0.01	0.03
10/3/00 10:18	0.4963	-0.011	0.03
10/3/00 10:18	0.5247	-0.011	0.03
10/3/00 10:18	0.5547	-0.01	0.03
10/3/00 10:18	0.5863	-0.009	0.03
10/3/00 10:18	0.6213	-0.01	0.03
10/3/00 10:18	0.658	-0.009	0.03
10/3/00 10:18	0.6963	-0.009	0.03
10/3/00 10:18	0.738	-0.01	0.03
10/3/00 10:18	0.7813	-0.01	0.03
10/3/00 10:18	0.828	-0.01	0.03
10/3/00 10:18	0.8763	-0.01	0.03
10/3/00 10:18	0.928	-0.01	0.03
10/3/00 10:18	0.983	-0.01	0.03
10/3/00 10:18	1.0413	-0.011	0.03
10/3/00 10:18	1.103	-0.009	0.03

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/3/00 10:18	1.168	-0.01	0.03
10/3/00 10:18	1.238	-0.01	0.03
10/3/00 10:18	1.3113	-0.012	0.04
10/3/00 10:19	1.3897	-0.01	0.03
10/3/00 10:19	1.473	-0.01	0.03
10/3/00 10:19	1.5613	-0.01	0.03
10/3/00 10:19	1.6547	-0.009	0.03
10/3/00 10:19	1.753	-0.009	0.03
10/3/00 10:19	1.858	-0.009	0.03
10/3/00 10:19	1.968	-0.009	0.03
10/3/00 10:19	2.0847	-0.009	0.03
10/3/00 10:19	2.2097	-0.009	0.03
10/3/00 10:19	2.3413	-0.009	0.03
10/3/00 10:20	2.4813	-0.009	0.03
10/3/00 10:20	2.6297	-0.009	0.03
10/3/00 10:20	2.7863	-0.009	0.03
10/3/00 10:20	2.953	-0.009	0.03
10/3/00 10:20	3.1297	-0.009	0.03
10/3/00 10:20	3.3163	-0.009	0.03
10/3/00 10:21	3.5147	-0.009	0.03
10/3/00 10:21	3.7247	-0.01	0.03
10/3/00 10:21	3.9463	-0.009	0.03
10/3/00 10:21	4.1813	-0.01	0.03
10/3/00 10:22	4.4297	-0.009	0.03
10/3/00 10:22	4.693	-0.009	0.03
10/3/00 10:22	4.973	-0.009	0.03
10/3/00 10:22	5.2697	-0.009	0.03
10/3/00 10:23	5.583	-0.009	0.03
10/3/00 10:23	5.9147	-0.009	0.03
10/3/00 10:23	6.2663	-0.01	0.03
10/3/00 10:24	6.6397	-0.009	0.03
10/3/00 10:24	7.0347	-0.01	0.03
10/3/00 10:25	7.453	-0.009	0.03
10/3/00 10:25	7.8963	-0.01	0.03
10/3/00 10:25	8.3663	-0.009	0.03
10/3/00 10:26	8.8647	-0.01	0.03
10/3/00 10:27	9.3913	-0.009	0.03
10/3/00 10:27	9.9497	-0.01	0.03
10/3/00 10:28	10.5413	-0.01	0.03

In-Situ Inc. Troll

Report generated:	10/23/00	8:10:39
Report from file:	S:\GOODR\CALVER~1\MW04S2.BIN	
DataMgr Version	2.31.0.0	
Serial number:	10751	
Firmware Version	7.1	
Unit name:	Troll 4000	
Test name:		FD-MW04-S-2
Test defined on:	10/3/00	10:40:01
Test started on:	10/3/00	10:40:25
Test stopped on:	10/3/00	10:51:35
Test extracted on:	10/3/00	10:52:41

Data gathered using Logarithmic testing
Maximum time between data points: 1.0000 Minutes.
Number of data samples: 102

TOTAL DATA SAMPLES 102

Channel number [2]

Measurement type:	Pressure/Level	
Channel name:	Pressure	
Sensor Range:	15 PSI.	
Specific gravity:	1	
Mode:	Surface	
User-defined reference:	0	Meters H2O
Referenced on:	channel definition.	
Pressure head at reference:	2.186	Meters H2O

Date	Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/3/00	10:40	0	-0.002	0.01
10/3/00	10:40	0.005	-0.863	2.63
10/3/00	10:40	0.01	-0.536	1.63
10/3/00	10:40	0.015	-0.383	1.17
10/3/00	10:40	0.02	-0.376	1.15
10/3/00	10:40	0.025	-0.327	1.00
10/3/00	10:40	0.03	-0.273	0.83
10/3/00	10:40	0.035	-0.228	0.69
10/3/00	10:40	0.04	-0.192	0.59
10/3/00	10:40	0.045	-0.161	0.49
10/3/00	10:40	0.05	-0.133	0.41
10/3/00	10:40	0.055	-0.11	0.34
10/3/00	10:40	0.06	-0.093	0.28
10/3/00	10:40	0.065	-0.078	0.24

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/3/00 10:40	0.07	-0.067	0.20
10/3/00 10:40	0.075	-0.058	0.18
10/3/00 10:40	0.08	-0.05	0.15
10/3/00 10:40	0.085	-0.043	0.13
10/3/00 10:40	0.09	-0.038	0.12
10/3/00 10:40	0.095	-0.034	0.10
10/3/00 10:40	0.1	-0.031	0.09
10/3/00 10:40	0.1058	-0.028	0.09
10/3/00 10:40	0.112	-0.026	0.08
10/3/00 10:40	0.1185	-0.024	0.07
10/3/00 10:40	0.1255	-0.021	0.06
10/3/00 10:40	0.1328	-0.019	0.06
10/3/00 10:40	0.1407	-0.017	0.05
10/3/00 10:40	0.149	-0.015	0.05
10/3/00 10:40	0.1578	-0.013	0.04
10/3/00 10:40	0.1672	-0.012	0.04
10/3/00 10:40	0.177	-0.01	0.03
10/3/00 10:40	0.1875	-0.01	0.03
10/3/00 10:40	0.1985	-0.008	0.02
10/3/00 10:40	0.2102	-0.007	0.02
10/3/00 10:40	0.2227	-0.006	0.02
10/3/00 10:40	0.2358	-0.005	0.02
10/3/00 10:40	0.2498	-0.015	0.05
10/3/00 10:40	0.2647	-0.015	0.05
10/3/00 10:40	0.2803	-0.013	0.04
10/3/00 10:40	0.297	-0.013	0.04
10/3/00 10:40	0.3147	-0.012	0.04
10/3/00 10:40	0.3333	-0.012	0.04
10/3/00 10:40	0.3532	-0.012	0.04
10/3/00 10:40	0.3742	-0.012	0.04
10/3/00 10:40	0.3963	-0.011	0.03
10/3/00 10:40	0.4198	-0.012	0.04
10/3/00 10:40	0.4447	-0.011	0.03
10/3/00 10:40	0.4697	-0.011	0.03
10/3/00 10:40	0.4963	-0.012	0.04
10/3/00 10:40	0.5247	-0.01	0.03
10/3/00 10:40	0.5547	-0.012	0.04
10/3/00 10:41	0.5863	-0.011	0.03
10/3/00 10:41	0.6213	-0.01	0.03
10/3/00 10:41	0.658	-0.01	0.03
10/3/00 10:41	0.6963	-0.01	0.03
10/3/00 10:41	0.738	-0.01	0.03
10/3/00 10:41	0.7813	-0.01	0.03
10/3/00 10:41	0.828	-0.011	0.03
10/3/00 10:41	0.8763	-0.011	0.03
10/3/00 10:41	0.928	-0.01	0.03
10/3/00 10:41	0.983	-0.01	0.03
10/3/00 10:41	1.0413	-0.01	0.03
10/3/00 10:41	1.103	-0.01	0.03

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/3/00 10:41	1.168	-0.01	0.03
10/3/00 10:41	1.238	-0.01	0.03
10/3/00 10:41	1.3113	-0.011	0.03
10/3/00 10:41	1.3897	-0.011	0.03
10/3/00 10:41	1.473	-0.01	0.03
10/3/00 10:41	1.5613	-0.01	0.03
10/3/00 10:42	1.6547	-0.01	0.03
10/3/00 10:42	1.753	-0.01	0.03
10/3/00 10:42	1.858	-0.01	0.03
10/3/00 10:42	1.968	-0.01	0.03
10/3/00 10:42	2.0847	-0.01	0.03
10/3/00 10:42	2.2097	-0.01	0.03
10/3/00 10:42	2.3413	-0.01	0.03
10/3/00 10:42	2.4813	-0.01	0.03
10/3/00 10:43	2.6297	-0.009	0.03
10/3/00 10:43	2.7863	-0.009	0.03
10/3/00 10:43	2.953	-0.01	0.03
10/3/00 10:43	3.1297	-0.009	0.03
10/3/00 10:43	3.3163	-0.009	0.03
10/3/00 10:43	3.5147	-0.01	0.03
10/3/00 10:44	3.7247	-0.009	0.03
10/3/00 10:44	3.9463	-0.009	0.03
10/3/00 10:44	4.1813	-0.009	0.03
10/3/00 10:44	4.4297	-0.009	0.03
10/3/00 10:45	4.693	-0.009	0.03
10/3/00 10:45	4.973	-0.009	0.03
10/3/00 10:45	5.2697	-0.009	0.03
10/3/00 10:45	5.583	-0.009	0.03
10/3/00 10:46	5.9147	-0.009	0.03
10/3/00 10:46	6.2663	-0.009	0.03
10/3/00 10:47	6.6397	-0.009	0.03
10/3/00 10:47	7.0347	-0.009	0.03
10/3/00 10:47	7.453	-0.009	0.03
10/3/00 10:48	7.8963	-0.009	0.03
10/3/00 10:48	8.3663	-0.009	0.03
10/3/00 10:49	8.8647	-0.009	0.03
10/3/00 10:49	9.3913	-0.01	0.03
10/3/00 10:50	9.9497	-0.009	0.03
10/3/00 10:50	10.5413	-0.011	0.03

In-Situ Inc. Troll

Report generated:	10/23/00	8:22:00
Report from file:	S:\GOODR\CALVER~1\MW05S1.BIN	
DataMgr Version	2.31.0.0	
Serial number:	10751	
Firmware Version	7.1	
Unit name:	Troll 4000	
Test name:		FD-MW05-S-1
Test defined on:	10/3/00	8:37:10
Test started on:	10/3/00	8:38:46
Test stopped on:	10/3/00	8:50:10
Test extracted on:	10/3/00	9:07:52

Data gathered using Logarithmic testing
Maximum time between data points: 1.0000 Minutes.
Number of data samples: 103

TOTAL DATA SAMPLES 103

Channel number [2]

Measurement type:	Pressure/Level	
Channel name:	Pressure	
Sensor Range:	15 PSI.	
Specific gravity:	1	
Mode:	Surface	
User-defined reference:	0	Meters H2O
Referenced on:	channel definition.	
Pressure head at reference:	2.446	Meters H2O

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/3/00 8:38	0	-0.121	0.37
10/3/00 8:38	0.005	-0.64	1.95
10/3/00 8:38	0.01	-0.198	0.60
10/3/00 8:38	0.015	-0.112	0.34
10/3/00 8:38	0.02	-0.089	0.27
10/3/00 8:38	0.025	-0.067	0.20
10/3/00 8:38	0.03	-0.052	0.16
10/3/00 8:38	0.035	-0.04	0.12
10/3/00 8:38	0.04	-0.032	0.10
10/3/00 8:38	0.045	-0.025	0.08
10/3/00 8:38	0.05	-0.02	0.06
10/3/00 8:38	0.055	-0.018	0.05
10/3/00 8:38	0.06	-0.013	0.04
10/3/00 8:38	0.065	-0.012	0.04

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/3/00 8:38	0.07	-0.01	0.03
10/3/00 8:38	0.075	-0.008	0.02
10/3/00 8:38	0.08	-0.007	0.02
10/3/00 8:38	0.085	-0.006	0.02
10/3/00 8:38	0.09	-0.005	0.02
10/3/00 8:38	0.095	-0.005	0.02
10/3/00 8:38	0.1	-0.005	0.02
10/3/00 8:38	0.1058	-0.004	0.01
10/3/00 8:38	0.112	-0.004	0.01
10/3/00 8:38	0.1185	-0.004	0.01
10/3/00 8:38	0.1255	-0.002	0.01
10/3/00 8:38	0.1328	-0.002	0.01
10/3/00 8:38	0.1407	-0.002	0.01
10/3/00 8:38	0.149	-0.002	0.01
10/3/00 8:38	0.1578	-0.002	0.01
10/3/00 8:38	0.1672	-0.001	0.00
10/3/00 8:38	0.177	-0.001	0.00
10/3/00 8:38	0.1875	0	0.00
10/3/00 8:38	0.1985	-0.001	0.00
10/3/00 8:38	0.2102	0	0.00
10/3/00 8:38	0.2227	0	0.00
10/3/00 8:39	0.2358	0	0.00
10/3/00 8:39	0.2498	-0.001	0.00
10/3/00 8:39	0.2647	-0.01	0.03
10/3/00 8:39	0.2803	-0.01	0.03
10/3/00 8:39	0.297	-0.01	0.03
10/3/00 8:39	0.3147	-0.01	0.03
10/3/00 8:39	0.3333	-0.011	0.03
10/3/00 8:39	0.3532	-0.009	0.03
10/3/00 8:39	0.3742	-0.009	0.03
10/3/00 8:39	0.3963	-0.009	0.03
10/3/00 8:39	0.4198	-0.009	0.03
10/3/00 8:39	0.4447	-0.009	0.03
10/3/00 8:39	0.4697	-0.009	0.03
10/3/00 8:39	0.4963	-0.009	0.03
10/3/00 8:39	0.5247	-0.009	0.03
10/3/00 8:39	0.5547	-0.009	0.03
10/3/00 8:39	0.5863	-0.009	0.03
10/3/00 8:39	0.6213	-0.009	0.03
10/3/00 8:39	0.658	-0.009	0.03
10/3/00 8:39	0.6963	-0.008	0.02
10/3/00 8:39	0.738	-0.008	0.02
10/3/00 8:39	0.7813	-0.009	0.03
10/3/00 8:39	0.828	-0.008	0.02
10/3/00 8:39	0.8763	-0.008	0.02
10/3/00 8:39	0.928	-0.008	0.02
10/3/00 8:39	0.983	-0.008	0.02
10/3/00 8:39	1.0413	-0.008	0.02
10/3/00 8:39	1.103	-0.008	0.02

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/3/00 8:39	1.168	-0.008	0.02
10/3/00 8:40	1.238	-0.008	0.02
10/3/00 8:40	1.3113	-0.008	0.02
10/3/00 8:40	1.3897	-0.008	0.02
10/3/00 8:40	1.473	-0.008	0.02
10/3/00 8:40	1.5613	-0.008	0.02
10/3/00 8:40	1.6547	-0.008	0.02
10/3/00 8:40	1.753	-0.008	0.02
10/3/00 8:40	1.858	-0.008	0.02
10/3/00 8:40	1.968	-0.008	0.02
10/3/00 8:40	2.0847	-0.008	0.02
10/3/00 8:40	2.2097	-0.009	0.03
10/3/00 8:41	2.3413	-0.01	0.03
10/3/00 8:41	2.4813	-0.008	0.02
10/3/00 8:41	2.6297	-0.008	0.02
10/3/00 8:41	2.7863	-0.009	0.03
10/3/00 8:41	2.953	-0.009	0.03
10/3/00 8:41	3.1297	-0.009	0.03
10/3/00 8:42	3.3163	-0.008	0.02
10/3/00 8:42	3.5147	-0.009	0.03
10/3/00 8:42	3.7247	-0.009	0.03
10/3/00 8:42	3.9463	-0.009	0.03
10/3/00 8:42	4.1813	-0.009	0.03
10/3/00 8:43	4.4297	-0.008	0.02
10/3/00 8:43	4.693	-0.009	0.03
10/3/00 8:43	4.973	-0.008	0.02
10/3/00 8:44	5.2697	-0.009	0.03
10/3/00 8:44	5.583	-0.009	0.03
10/3/00 8:44	5.9147	-0.009	0.03
10/3/00 8:45	6.2663	-0.009	0.03
10/3/00 8:45	6.6397	-0.008	0.02
10/3/00 8:45	7.0347	-0.009	0.03
10/3/00 8:46	7.453	-0.009	0.03
10/3/00 8:46	7.8963	-0.009	0.03
10/3/00 8:47	8.3663	-0.009	0.03
10/3/00 8:47	8.8647	-0.009	0.03
10/3/00 8:48	9.3913	-0.009	0.03
10/3/00 8:48	9.9497	-0.008	0.02
10/3/00 8:49	10.5413	-0.009	0.03
10/3/00 8:49	11.168	-0.008	0.02

In-Situ Inc. Troll

Report generated:	10/23/00	8:28:07
Report from file:	S:\GOODR\CALVER~1\MW05S2.BIN	
DataMgr Version	2.31.0.0	
Serial number:	10751	
Firmware Version	7.1	
Unit name:	Troll 4000	
Test name:		FD-MW05-S-2
Test defined on:	10/3/00	8:53:33
Test started on:	10/3/00	8:56:16
Test stopped on:	10/3/00	9:07:34
Test extracted on:	10/3/00	9:08:28

Data gathered using Logarithmic testing
  Maximum time between data points: 1.0000 Minutes.
  Number of data samples: 103

TOTAL DATA SAMPLES 103

Channel number [2]

Measurement type:	Pressure/Level	
Channel name:	Pressure	
Sensor Range:	15 PSI.	
Specific gravity:	1	
Mode:	Surface	
User-defined reference:	0	Meters H2O
Referenced on:	channel definition.	
Pressure head at reference:	2.448	Meters H2O

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/3/00 8:56	0	0.002	-0.01
10/3/00 8:56	0.005	-0.313	0.95
10/3/00 8:56	0.01	-0.552	1.68
10/3/00 8:56	0.015	-0.188	0.57
10/3/00 8:56	0.02	-0.115	0.35
10/3/00 8:56	0.025	-0.09	0.27
10/3/00 8:56	0.03	-0.068	0.21
10/3/00 8:56	0.035	-0.051	0.16
10/3/00 8:56	0.04	-0.04	0.12
10/3/00 8:56	0.045	-0.032	0.10
10/3/00 8:56	0.05	-0.025	0.08
10/3/00 8:56	0.055	-0.022	0.07
10/3/00 8:56	0.06	-0.016	0.05
10/3/00 8:56	0.065	-0.015	0.05

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/3/00 8:56	0.07	-0.011	0.03
10/3/00 8:56	0.075	-0.011	0.03
10/3/00 8:56	0.08	-0.008	0.02
10/3/00 8:56	0.085	-0.007	0.02
10/3/00 8:56	0.09	-0.006	0.02
10/3/00 8:56	0.095	-0.005	0.02
10/3/00 8:56	0.1	-0.006	0.02
10/3/00 8:56	0.1058	-0.006	0.02
10/3/00 8:56	0.112	-0.004	0.01
10/3/00 8:56	0.1185	-0.004	0.01
10/3/00 8:56	0.1255	-0.003	0.01
10/3/00 8:56	0.1328	-0.004	0.01
10/3/00 8:56	0.1407	-0.003	0.01
10/3/00 8:56	0.149	-0.001	0.00
10/3/00 8:56	0.1578	-0.003	0.01
10/3/00 8:56	0.1672	-0.001	0.00
10/3/00 8:56	0.177	-0.001	0.00
10/3/00 8:56	0.1875	-0.002	0.01
10/3/00 8:56	0.1985	-0.001	0.00
10/3/00 8:56	0.2102	-0.001	0.00
10/3/00 8:56	0.2227	-0.001	0.00
10/3/00 8:56	0.2358	-0.001	0.00
10/3/00 8:56	0.2498	-0.011	0.03
10/3/00 8:56	0.2647	-0.011	0.03
10/3/00 8:56	0.2803	-0.011	0.03
10/3/00 8:56	0.297	-0.011	0.03
10/3/00 8:56	0.3147	-0.011	0.03
10/3/00 8:56	0.3333	-0.011	0.03
10/3/00 8:56	0.3532	-0.011	0.03
10/3/00 8:56	0.3742	-0.009	0.03
10/3/00 8:56	0.3963	-0.01	0.03
10/3/00 8:56	0.4198	-0.011	0.03
10/3/00 8:56	0.4447	-0.011	0.03
10/3/00 8:56	0.4697	-0.009	0.03
10/3/00 8:56	0.4963	-0.01	0.03
10/3/00 8:56	0.5247	-0.011	0.03
10/3/00 8:56	0.5547	-0.011	0.03
10/3/00 8:56	0.5863	-0.009	0.03
10/3/00 8:56	0.6213	-0.009	0.03
10/3/00 8:56	0.658	-0.01	0.03
10/3/00 8:56	0.6963	-0.008	0.02
10/3/00 8:57	0.738	-0.009	0.03
10/3/00 8:57	0.7813	-0.009	0.03
10/3/00 8:57	0.828	-0.008	0.02
10/3/00 8:57	0.8763	-0.008	0.02
10/3/00 8:57	0.928	-0.009	0.03
10/3/00 8:57	0.983	-0.009	0.03
10/3/00 8:57	1.0413	-0.009	0.03
10/3/00 8:57	1.103	-0.009	0.03

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/3/00 8:57	1.168	-0.009	0.03
10/3/00 8:57	1.238	-0.009	0.03
10/3/00 8:57	1.3113	-0.009	0.03
10/3/00 8:57	1.3897	-0.009	0.03
10/3/00 8:57	1.473	-0.009	0.03
10/3/00 8:57	1.5613	-0.009	0.03
10/3/00 8:57	1.6547	-0.008	0.02
10/3/00 8:58	1.753	-0.009	0.03
10/3/00 8:58	1.858	-0.009	0.03
10/3/00 8:58	1.968	-0.009	0.03
10/3/00 8:58	2.0847	-0.01	0.03
10/3/00 8:58	2.2097	-0.009	0.03
10/3/00 8:58	2.3413	-0.009	0.03
10/3/00 8:58	2.4813	-0.009	0.03
10/3/00 8:58	2.6297	-0.008	0.02
10/3/00 8:59	2.7863	-0.009	0.03
10/3/00 8:59	2.953	-0.009	0.03
10/3/00 8:59	3.1297	-0.01	0.03
10/3/00 8:59	3.3163	-0.01	0.03
10/3/00 8:59	3.5147	-0.009	0.03
10/3/00 8:59	3.7247	-0.008	0.02
10/3/00 9:00	3.9463	-0.008	0.02
10/3/00 9:00	4.1813	-0.009	0.03
10/3/00 9:00	4.4297	-0.009	0.03
10/3/00 9:00	4.693	-0.008	0.02
10/3/00 9:01	4.973	-0.009	0.03
10/3/00 9:01	5.2697	-0.01	0.03
10/3/00 9:01	5.583	-0.008	0.02
10/3/00 9:02	5.9147	-0.008	0.02
10/3/00 9:02	6.2663	-0.009	0.03
10/3/00 9:02	6.6397	-0.008	0.02
10/3/00 9:03	7.0347	-0.008	0.02
10/3/00 9:03	7.453	-0.008	0.02
10/3/00 9:04	7.8963	-0.008	0.02
10/3/00 9:04	8.3663	-0.009	0.03
10/3/00 9:05	8.8647	-0.008	0.02
10/3/00 9:05	9.3913	-0.008	0.02
10/3/00 9:06	9.9497	-0.009	0.03
10/3/00 9:06	10.5413	-0.011	0.03
10/3/00 9:07	11.168	-0.009	0.03

In-Situ Inc. Troll

Report generated:	10/23/00 8:29:08
Report from file:	S:\GOODR\CALVER~1\MW06S1.BIN
DataMgr Version	2.31.0.0
Serial number:	10751
Firmware Version	7.1
Unit name:	Troll 4000
Test name:	FD-MW06-S-1
Test defined on:	10/3/00 7:36:45
Test started on:	10/3/00 7:37:08
Test stopped on:	10/3/00 7:49:03
Test extracted on:	10/3/00 8:09:55

Data gathered using Logarithmic testing
Maximum time between data points: 1.0000 Minutes.
Number of data samples: 104

TOTAL DATA SAMPLES 104

Channel number [2]

Measurement type:	Pressure/Level
Channel name:	Pressure
Sensor Range:	15 PSI.
Specific gravity:	1
Mode:	Surface
User-defined reference:	0 Meters H2O
Referenced on:	channel definition.
Pressure head at reference:	1.613 Meters H2O

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown feet H2O
10/3/00 7:37	0	-0.013	0.04
10/3/00 7:37	0.005	-0.799	2.44
10/3/00 7:37	0.01	-0.293	0.89
10/3/00 7:37	0.015	-0.181	0.55
10/3/00 7:37	0.02	-0.177	0.54
10/3/00 7:37	0.025	-0.155	0.47
10/3/00 7:37	0.03	-0.136	0.41
10/3/00 7:37	0.035	-0.12	0.37
10/3/00 7:37	0.04	-0.106	0.32
10/3/00 7:37	0.045	-0.094	0.29
10/3/00 7:37	0.05	-0.083	0.25
10/3/00 7:37	0.055	-0.075	0.23
10/3/00 7:37	0.06	-0.067	0.20
10/3/00 7:37	0.065	-0.059	0.18

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown feet H2O
10/3/00 7:37	0.07	-0.054	0.16
10/3/00 7:37	0.075	-0.047	0.14
10/3/00 7:37	0.08	-0.043	0.13
10/3/00 7:37	0.085	-0.038	0.12
10/3/00 7:37	0.09	-0.034	0.10
10/3/00 7:37	0.095	-0.031	0.09
10/3/00 7:37	0.1	-0.028	0.09
10/3/00 7:37	0.1058	-0.025	0.08
10/3/00 7:37	0.112	-0.023	0.07
10/3/00 7:37	0.1185	-0.02	0.06
10/3/00 7:37	0.1255	-0.018	0.05
10/3/00 7:37	0.1328	-0.016	0.05
10/3/00 7:37	0.1407	-0.015	0.05
10/3/00 7:37	0.149	-0.013	0.04
10/3/00 7:37	0.1578	-0.011	0.03
10/3/00 7:37	0.1672	-0.009	0.03
10/3/00 7:37	0.177	-0.008	0.02
10/3/00 7:37	0.1875	-0.007	0.02
10/3/00 7:37	0.1985	-0.006	0.02
10/3/00 7:37	0.2102	-0.005	0.02
10/3/00 7:37	0.2227	-0.004	0.01
10/3/00 7:37	0.2358	-0.004	0.01
10/3/00 7:37	0.2498	-0.011	0.03
10/3/00 7:37	0.2647	-0.01	0.03
10/3/00 7:37	0.2803	-0.01	0.03
10/3/00 7:37	0.297	-0.009	0.03
10/3/00 7:37	0.3147	-0.009	0.03
10/3/00 7:37	0.3333	-0.009	0.03
10/3/00 7:37	0.3532	-0.008	0.02
10/3/00 7:37	0.3742	-0.008	0.02
10/3/00 7:37	0.3963	-0.008	0.02
10/3/00 7:37	0.4198	-0.008	0.02
10/3/00 7:37	0.4447	-0.008	0.02
10/3/00 7:37	0.4697	-0.008	0.02
10/3/00 7:37	0.4963	-0.007	0.02
10/3/00 7:37	0.5247	-0.007	0.02
10/3/00 7:37	0.5547	-0.007	0.02
10/3/00 7:37	0.5863	-0.007	0.02
10/3/00 7:37	0.6213	-0.007	0.02
10/3/00 7:37	0.658	-0.007	0.02
10/3/00 7:37	0.6963	-0.007	0.02
10/3/00 7:37	0.738	-0.007	0.02
10/3/00 7:37	0.7813	-0.007	0.02
10/3/00 7:37	0.828	-0.006	0.02
10/3/00 7:38	0.8763	-0.006	0.02
10/3/00 7:38	0.928	-0.006	0.02
10/3/00 7:38	0.983	-0.006	0.02
10/3/00 7:38	1.0413	-0.006	0.02
10/3/00 7:38	1.103	-0.006	0.02

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown feet H2O
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10/3/00 7:38	1.168	-0.006	0.02
10/3/00 7:38	1.238	-0.006	0.02
10/3/00 7:38	1.3113	-0.006	0.02
10/3/00 7:38	1.3897	-0.006	0.02
10/3/00 7:38	1.473	-0.006	0.02
10/3/00 7:38	1.5613	-0.006	0.02
10/3/00 7:38	1.6547	-0.006	0.02
10/3/00 7:38	1.753	-0.006	0.02
10/3/00 7:38	1.858	-0.006	0.02
10/3/00 7:39	1.968	-0.007	0.02
10/3/00 7:39	2.0847	-0.006	0.02
10/3/00 7:39	2.2097	-0.006	0.02
10/3/00 7:39	2.3413	-0.006	0.02
10/3/00 7:39	2.4813	-0.006	0.02
10/3/00 7:39	2.6297	-0.006	0.02
10/3/00 7:39	2.7863	-0.006	0.02
10/3/00 7:40	2.953	-0.006	0.02
10/3/00 7:40	3.1297	-0.006	0.02
10/3/00 7:40	3.3163	-0.006	0.02
10/3/00 7:40	3.5147	-0.005	0.02
10/3/00 7:40	3.7247	-0.005	0.02
10/3/00 7:41	3.9463	-0.006	0.02
10/3/00 7:41	4.1813	-0.006	0.02
10/3/00 7:41	4.4297	-0.005	0.02
10/3/00 7:41	4.693	-0.005	0.02
10/3/00 7:42	4.973	-0.005	0.02
10/3/00 7:42	5.2697	-0.005	0.02
10/3/00 7:42	5.583	-0.005	0.02
10/3/00 7:43	5.9147	-0.005	0.02
10/3/00 7:43	6.2663	-0.005	0.02
10/3/00 7:43	6.6397	-0.005	0.02
10/3/00 7:44	7.0347	-0.004	0.01
10/3/00 7:44	7.453	-0.005	0.02
10/3/00 7:45	7.8963	-0.006	0.02
10/3/00 7:45	8.3663	-0.005	0.02
10/3/00 7:45	8.8647	-0.005	0.02
10/3/00 7:46	9.3913	-0.006	0.02
10/3/00 7:47	9.9497	-0.006	0.02
10/3/00 7:47	10.5413	-0.006	0.02
10/3/00 7:48	11.168	-0.006	0.02
10/3/00 7:48	11.8313	-0.007	0.02

In-Situ Inc. Troll

Report generated:	10/23/00	8:31:48
Report from file:	S:\GOODR\CALVER~1\MW06S2.BIN	
DataMgr Version	2.31.0.0	
Serial number:	10751	
Firmware Version	7.1	
Unit name:	Troll 4000	
Test name:		FD-MW06-S-2
Test defined on:	10/3/00	7:56:34
Test started on:	10/3/00	7:57:06
Test stopped on:	10/3/00	8:09:36
Test extracted on:	10/3/00	8:10:57

Data gathered using Logarithmic testing
Maximum time between data points: 1.0000 Minutes.
Number of data samples: 104

TOTAL DATA SAMPLES 104

Channel number [2]

Measurement type:	Pressure/Level	
Channel name:	Pressure	
Sensor Range:	15 PSI.	
Specific gravity:	1	
Mode:	Surface	
User-defined reference:	0	Meters H2O
Referenced on:	channel definition.	
Pressure head at reference:	1.615	Meters H2O

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/3/00 7:57	0	-0.009	0.03
10/3/00 7:57	0.005	-0.933	2.84
10/3/00 7:57	0.01	-0.208	0.63
10/3/00 7:57	0.015	-0.168	0.51
10/3/00 7:57	0.02	-0.159	0.48
10/3/00 7:57	0.025	-0.141	0.43
10/3/00 7:57	0.03	-0.124	0.38
10/3/00 7:57	0.035	-0.111	0.34
10/3/00 7:57	0.04	-0.099	0.30
10/3/00 7:57	0.045	-0.087	0.27
10/3/00 7:57	0.05	-0.078	0.24
10/3/00 7:57	0.055	-0.068	0.21
10/3/00 7:57	0.06	-0.062	0.19
10/3/00 7:57	0.065	-0.056	0.17

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/3/00 7:57	0.07	-0.049	0.15
10/3/00 7:57	0.075	-0.045	0.14
10/3/00 7:57	0.08	-0.04	0.12
10/3/00 7:57	0.085	-0.036	0.11
10/3/00 7:57	0.09	-0.033	0.10
10/3/00 7:57	0.095	-0.029	0.09
10/3/00 7:57	0.1	-0.026	0.08
10/3/00 7:57	0.1058	-0.023	0.07
10/3/00 7:57	0.112	-0.021	0.06
10/3/00 7:57	0.1185	-0.021	0.06
10/3/00 7:57	0.1255	-0.018	0.05
10/3/00 7:57	0.1328	-0.016	0.05
10/3/00 7:57	0.1407	-0.014	0.04
10/3/00 7:57	0.149	-0.012	0.04
10/3/00 7:57	0.1578	-0.011	0.03
10/3/00 7:57	0.1672	-0.009	0.03
10/3/00 7:57	0.177	-0.008	0.02
10/3/00 7:57	0.1875	-0.007	0.02
10/3/00 7:57	0.1985	-0.007	0.02
10/3/00 7:57	0.2102	-0.005	0.02
10/3/00 7:57	0.2227	-0.005	0.02
10/3/00 7:57	0.2358	-0.004	0.01
10/3/00 7:57	0.2498	-0.011	0.03
10/3/00 7:57	0.2647	-0.011	0.03
10/3/00 7:57	0.2803	-0.011	0.03
10/3/00 7:57	0.297	-0.011	0.03
10/3/00 7:57	0.3147	-0.011	0.03
10/3/00 7:57	0.3333	-0.01	0.03
10/3/00 7:57	0.3532	-0.01	0.03
10/3/00 7:57	0.3742	-0.01	0.03
10/3/00 7:57	0.3963	-0.009	0.03
10/3/00 7:57	0.4198	-0.009	0.03
10/3/00 7:57	0.4447	-0.009	0.03
10/3/00 7:57	0.4697	-0.009	0.03
10/3/00 7:57	0.4963	-0.009	0.03
10/3/00 7:57	0.5247	-0.009	0.03
10/3/00 7:57	0.5547	-0.009	0.03
10/3/00 7:57	0.5863	-0.009	0.03
10/3/00 7:57	0.6213	-0.009	0.03
10/3/00 7:57	0.658	-0.009	0.03
10/3/00 7:57	0.6963	-0.009	0.03
10/3/00 7:57	0.738	-0.009	0.03
10/3/00 7:57	0.7813	-0.009	0.03
10/3/00 7:57	0.828	-0.008	0.02
10/3/00 7:57	0.8763	-0.008	0.02
10/3/00 7:58	0.928	-0.008	0.02
10/3/00 7:58	0.983	-0.008	0.02
10/3/00 7:58	1.0413	-0.008	0.02
10/3/00 7:58	1.103	-0.008	0.02

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/3/00 7:58	1.168	-0.008	0.02
10/3/00 7:58	1.238	-0.009	0.03
10/3/00 7:58	1.3113	-0.008	0.02
10/3/00 7:58	1.3897	-0.008	0.02
10/3/00 7:58	1.473	-0.008	0.02
10/3/00 7:58	1.5613	-0.009	0.03
10/3/00 7:58	1.6547	-0.009	0.03
10/3/00 7:58	1.753	-0.009	0.03
10/3/00 7:58	1.858	-0.009	0.03
10/3/00 7:59	1.968	-0.008	0.02
10/3/00 7:59	2.0847	-0.009	0.03
10/3/00 7:59	2.2097	-0.007	0.02
10/3/00 7:59	2.3413	-0.008	0.02
10/3/00 7:59	2.4813	-0.009	0.03
10/3/00 7:59	2.6297	-0.009	0.03
10/3/00 7:59	2.7863	-0.009	0.03
10/3/00 8:00	2.953	-0.008	0.02
10/3/00 8:00	3.1297	-0.008	0.02
10/3/00 8:00	3.3163	-0.008	0.02
10/3/00 8:00	3.5147	-0.008	0.02
10/3/00 8:00	3.7247	-0.007	0.02
10/3/00 8:01	3.9463	-0.009	0.03
10/3/00 8:01	4.1813	-0.008	0.02
10/3/00 8:01	4.4297	-0.007	0.02
10/3/00 8:01	4.693	-0.008	0.02
10/3/00 8:02	4.973	-0.007	0.02
10/3/00 8:02	5.2697	-0.008	0.02
10/3/00 8:02	5.583	-0.007	0.02
10/3/00 8:03	5.9147	-0.007	0.02
10/3/00 8:03	6.2663	-0.007	0.02
10/3/00 8:03	6.6397	-0.007	0.02
10/3/00 8:04	7.0347	-0.007	0.02
10/3/00 8:04	7.453	-0.007	0.02
10/3/00 8:04	7.8963	-0.007	0.02
10/3/00 8:05	8.3663	-0.007	0.02
10/3/00 8:05	8.8647	-0.007	0.02
10/3/00 8:06	9.3913	-0.008	0.02
10/3/00 8:07	9.9497	-0.008	0.02
10/3/00 8:07	10.5413	-0.008	0.02
10/3/00 8:08	11.168	-0.009	0.03
10/3/00 8:08	11.8313	-0.009	0.03

In-Situ Inc. Troll

Report generated:	10/23/00	8:33:51
Report from file:	S:\GOODR\CALVER~1\MW07I1F.BIN	
DataMgr Version	2.31.0.0	
Serial number:	10751	
Firmware Version	7.1	
Unit name:	Troll 4000	
Test name:		FD-MW07-I-1F
Test defined on:	10/2/00	17:02:58
Test started on:	10/2/00	17:03:56
Test stopped on:	10/2/00	17:16:03
Test extracted on:	10/2/00	17:34:08

Data gathered using Logarithmic testing
Maximum time between data points: 1.0000 Minutes.
Number of data samples: 104

TOTAL DATA SAMPLES 104

Channel number [2]

Measurement type:	Pressure/Level	
Channel name:	Pressure	
Sensor Range:	15 PSI.	
Specific gravity:	1	
Mode:	Surface	
User-defined reference:	0	Meters H2O
Referenced on:	channel definition.	
Pressure head at reference:	7.291	Meters H2O

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/2/00 17:03	0	0	0.00
10/2/00 17:03	0.005	0.05	0.15
10/2/00 17:03	0.01	0.474	1.44
10/2/00 17:03	0.015	0.632	1.93
10/2/00 17:03	0.02	0.563	1.72
10/2/00 17:03	0.025	0.302	0.92
10/2/00 17:03	0.03	0.145	0.44
10/2/00 17:03	0.035	0.181	0.55
10/2/00 17:03	0.04	0.162	0.49
10/2/00 17:03	0.045	0.135	0.41
10/2/00 17:03	0.05	0.091	0.28
10/2/00 17:03	0.055	0.09	0.27
10/2/00 17:03	0.06	0.059	0.18
10/2/00 17:03	0.065	0.053	0.16

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/2/00 17:04	0.07	0.045	0.14
10/2/00 17:04	0.075	0.028	0.09
10/2/00 17:04	0.08	0.029	0.09
10/2/00 17:04	0.085	0.027	0.08
10/2/00 17:04	0.09	0.014	0.04
10/2/00 17:04	0.095	0.016	0.05
10/2/00 17:04	0.1	0.011	0.03
10/2/00 17:04	0.1058	0.011	0.03
10/2/00 17:04	0.112	0.008	0.02
10/2/00 17:04	0.1185	0.008	0.02
10/2/00 17:04	0.1255	0.006	0.02
10/2/00 17:04	0.1328	-0.001	0.00
10/2/00 17:04	0.1407	0.016	0.05
10/2/00 17:04	0.149	0.001	0.00
10/2/00 17:04	0.1578	-0.001	0.00
10/2/00 17:04	0.1672	-0.005	-0.02
10/2/00 17:04	0.177	-0.002	-0.01
10/2/00 17:04	0.1875	0.001	0.00
10/2/00 17:04	0.1985	0.001	0.00
10/2/00 17:04	0.2102	0.001	0.00
10/2/00 17:04	0.2227	0.001	0.00
10/2/00 17:04	0.2358	0	0.00
10/2/00 17:04	0.2498	0	0.00
10/2/00 17:04	0.2647	0	0.00
10/2/00 17:04	0.2803	0	0.00
10/2/00 17:04	0.297	0.002	0.01
10/2/00 17:04	0.3147	0	0.00
10/2/00 17:04	0.3333	-0.018	-0.05
10/2/00 17:04	0.3532	-0.017	-0.05
10/2/00 17:04	0.3742	-0.018	-0.05
10/2/00 17:04	0.3963	-0.018	-0.05
10/2/00 17:04	0.4198	-0.018	-0.05
10/2/00 17:04	0.4447	-0.018	-0.05
10/2/00 17:04	0.4697	-0.018	-0.05
10/2/00 17:04	0.4963	-0.017	-0.05
10/2/00 17:04	0.5247	-0.018	-0.05
10/2/00 17:04	0.5547	-0.017	-0.05
10/2/00 17:04	0.5863	-0.018	-0.05
10/2/00 17:04	0.6213	-0.018	-0.05
10/2/00 17:04	0.658	-0.017	-0.05
10/2/00 17:04	0.6963	-0.017	-0.05
10/2/00 17:04	0.738	-0.017	-0.05
10/2/00 17:04	0.7813	-0.018	-0.05
10/2/00 17:04	0.828	-0.017	-0.05
10/2/00 17:04	0.8763	-0.017	-0.05
10/2/00 17:04	0.928	-0.017	-0.05
10/2/00 17:04	0.983	-0.017	-0.05
10/2/00 17:04	1.0413	-0.017	-0.05
10/2/00 17:05	1.103	-0.017	-0.05

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/2/00 17:05	1.168	-0.016	-0.05
10/2/00 17:05	1.238	-0.017	-0.05
10/2/00 17:05	1.3113	-0.017	-0.05
10/2/00 17:05	1.3897	-0.017	-0.05
10/2/00 17:05	1.473	-0.018	-0.05
10/2/00 17:05	1.5613	-0.017	-0.05
10/2/00 17:05	1.6547	-0.018	-0.05
10/2/00 17:05	1.753	-0.018	-0.05
10/2/00 17:05	1.858	-0.018	-0.05
10/2/00 17:05	1.968	-0.017	-0.05
10/2/00 17:06	2.0847	-0.017	-0.05
10/2/00 17:06	2.2097	-0.017	-0.05
10/2/00 17:06	2.3413	-0.017	-0.05
10/2/00 17:06	2.4813	-0.017	-0.05
10/2/00 17:06	2.6297	-0.017	-0.05
10/2/00 17:06	2.7863	-0.017	-0.05
10/2/00 17:06	2.953	-0.018	-0.05
10/2/00 17:07	3.1297	-0.018	-0.05
10/2/00 17:07	3.3163	-0.018	-0.05
10/2/00 17:07	3.5147	-0.018	-0.05
10/2/00 17:07	3.7247	-0.018	-0.05
10/2/00 17:07	3.9463	-0.017	-0.05
10/2/00 17:08	4.1813	-0.017	-0.05
10/2/00 17:08	4.4297	-0.017	-0.05
10/2/00 17:08	4.693	-0.018	-0.05
10/2/00 17:08	4.973	-0.018	-0.05
10/2/00 17:09	5.2697	-0.017	-0.05
10/2/00 17:09	5.583	-0.017	-0.05
10/2/00 17:09	5.9147	-0.018	-0.05
10/2/00 17:10	6.2663	-0.018	-0.05
10/2/00 17:10	6.6397	-0.018	-0.05
10/2/00 17:10	7.0347	-0.018	-0.05
10/2/00 17:11	7.453	-0.017	-0.05
10/2/00 17:11	7.8963	-0.018	-0.05
10/2/00 17:12	8.3663	-0.018	-0.05
10/2/00 17:12	8.8647	-0.018	-0.05
10/2/00 17:13	9.3913	-0.017	-0.05
10/2/00 17:13	9.9497	-0.018	-0.05
10/2/00 17:14	10.5413	-0.018	-0.05
10/2/00 17:15	11.168	-0.017	-0.05
10/2/00 17:15	11.8313	-0.018	-0.05

In-Situ Inc. Troll

Report generated:	10/23/00 8:35:27
Report from file:	S:\GOODR\CALVER~1\MW07I1R.BIN
DataMgr Version	2.31.0.0
Serial number:	10751
Firmware Version	7.1
Unit name:	Troll 4000
Test name:	FD-MW07-I-1R
Test defined on:	10/2/00 17:19:16
Test started on:	10/2/00 17:20:43
Test stopped on:	10/2/00 17:33:05
Test extracted on:	10/2/00 17:34:45

Data gathered using Logarithmic testing
Maximum time between data points: 1.0000 Minutes.
Number of data samples: 104

TOTAL DATA SAMPLES 104

Channel number [2]

Measurement type:	Pressure/Level
Channel name:	Pressure
Sensor Range:	15 PSI.
Specific gravity:	1
Mode:	Surface
User-defined reference:	0 Meters H2O
Referenced on:	channel definition.
Pressure head at reference:	7.289 Meters H2O

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/2/00 17:20	0	0.003	-0.01
10/2/00 17:20	0.005	0.001	0.00
10/2/00 17:20	0.01	-0.335	1.02
10/2/00 17:20	0.015	-0.432	1.32
10/2/00 17:20	0.02	-0.467	1.42
10/2/00 17:20	0.025	-0.416	1.27
10/2/00 17:20	0.03	-0.349	1.06
10/2/00 17:20	0.035	-0.277	0.84
10/2/00 17:20	0.04	-0.215	0.66
10/2/00 17:20	0.045	-0.164	0.50
10/2/00 17:20	0.05	-0.123	0.37
10/2/00 17:20	0.055	-0.092	0.28
10/2/00 17:20	0.06	-0.069	0.21
10/2/00 17:20	0.065	-0.053	0.16

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/2/00 17:20	0.07	-0.04	0.12
10/2/00 17:20	0.075	-0.032	0.10
10/2/00 17:20	0.08	-0.025	0.08
10/2/00 17:20	0.085	-0.02	0.06
10/2/00 17:20	0.09	-0.016	0.05
10/2/00 17:20	0.095	-0.013	0.04
10/2/00 17:20	0.1	-0.011	0.03
10/2/00 17:20	0.1058	-0.009	0.03
10/2/00 17:20	0.112	-0.008	0.02
10/2/00 17:20	0.1185	-0.006	0.02
10/2/00 17:20	0.1255	-0.005	0.02
10/2/00 17:20	0.1328	-0.004	0.01
10/2/00 17:20	0.1407	-0.003	0.01
10/2/00 17:20	0.149	-0.002	0.01
10/2/00 17:20	0.1578	-0.002	0.01
10/2/00 17:20	0.1672	-0.001	0.00
10/2/00 17:20	0.177	-0.001	0.00
10/2/00 17:20	0.1875	-0.001	0.00
10/2/00 17:20	0.1985	-0.001	0.00
10/2/00 17:20	0.2102	-0.001	0.00
10/2/00 17:20	0.2227	0	0.00
10/2/00 17:20	0.2358	0	0.00
10/2/00 17:20	0.2498	-0.017	0.05
10/2/00 17:20	0.2647	-0.017	0.05
10/2/00 17:20	0.2803	-0.017	0.05
10/2/00 17:21	0.297	-0.017	0.05
10/2/00 17:21	0.3147	-0.017	0.05
10/2/00 17:21	0.3333	-0.017	0.05
10/2/00 17:21	0.3532	-0.017	0.05
10/2/00 17:21	0.3742	-0.017	0.05
10/2/00 17:21	0.3963	-0.017	0.05
10/2/00 17:21	0.4198	-0.016	0.05
10/2/00 17:21	0.4447	-0.016	0.05
10/2/00 17:21	0.4697	-0.016	0.05
10/2/00 17:21	0.4963	-0.016	0.05
10/2/00 17:21	0.5247	-0.016	0.05
10/2/00 17:21	0.5547	-0.017	0.05
10/2/00 17:21	0.5863	-0.017	0.05
10/2/00 17:21	0.6213	-0.017	0.05
10/2/00 17:21	0.658	-0.017	0.05
10/2/00 17:21	0.6963	-0.017	0.05
10/2/00 17:21	0.738	-0.017	0.05
10/2/00 17:21	0.7813	-0.017	0.05
10/2/00 17:21	0.828	-0.017	0.05
10/2/00 17:21	0.8763	-0.018	0.05
10/2/00 17:21	0.928	-0.017	0.05
10/2/00 17:21	0.983	-0.016	0.05
10/2/00 17:21	1.0413	-0.016	0.05
10/2/00 17:21	1.103	-0.016	0.05

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/2/00 17:21	1.168	-0.017	0.05
10/2/00 17:21	1.238	-0.016	0.05
10/2/00 17:22	1.3113	-0.016	0.05
10/2/00 17:22	1.3897	-0.016	0.05
10/2/00 17:22	1.473	-0.016	0.05
10/2/00 17:22	1.5613	-0.016	0.05
10/2/00 17:22	1.6547	-0.016	0.05
10/2/00 17:22	1.753	-0.016	0.05
10/2/00 17:22	1.858	-0.016	0.05
10/2/00 17:22	1.968	-0.017	0.05
10/2/00 17:22	2.0847	-0.017	0.05
10/2/00 17:22	2.2097	-0.016	0.05
10/2/00 17:23	2.3413	-0.016	0.05
10/2/00 17:23	2.4813	-0.016	0.05
10/2/00 17:23	2.6297	-0.017	0.05
10/2/00 17:23	2.7863	-0.017	0.05
10/2/00 17:23	2.953	-0.016	0.05
10/2/00 17:23	3.1297	-0.016	0.05
10/2/00 17:24	3.3163	-0.016	0.05
10/2/00 17:24	3.5147	-0.016	0.05
10/2/00 17:24	3.7247	-0.016	0.05
10/2/00 17:24	3.9463	-0.016	0.05
10/2/00 17:24	4.1813	-0.016	0.05
10/2/00 17:25	4.4297	-0.016	0.05
10/2/00 17:25	4.693	-0.016	0.05
10/2/00 17:25	4.973	-0.016	0.05
10/2/00 17:25	5.2697	-0.016	0.05
10/2/00 17:26	5.583	-0.017	0.05
10/2/00 17:26	5.9147	-0.016	0.05
10/2/00 17:26	6.2663	-0.016	0.05
10/2/00 17:27	6.6397	-0.016	0.05
10/2/00 17:27	7.0347	-0.016	0.05
10/2/00 17:28	7.453	-0.016	0.05
10/2/00 17:28	7.8963	-0.016	0.05
10/2/00 17:29	8.3663	-0.016	0.05
10/2/00 17:29	8.8647	-0.018	0.05
10/2/00 17:30	9.3913	-0.016	0.05
10/2/00 17:30	9.9497	-0.016	0.05
10/2/00 17:31	10.5413	-0.016	0.05
10/2/00 17:31	11.168	-0.016	0.05
10/2/00 17:32	11.8313	-0.016	0.05

In-Situ Inc. | Troll

Report generated:	10/23/00	8:36:39
Report from file:	S:\GOODR\CALVER~1\MW07I2F.BIN	
DataMgr Version	2.31.0.0	
Serial number:	10751	
Firmware Version	7.1	
Unit name:	Troll 4000	
Test name:		FD-MW07-I-2F
Test defined on:	10/2/00	17:56:17
Test started on:	10/2/00	17:56:34
Test stopped on:	10/2/00	18:08:05
Test extracted on:	10/2/00	18:23:04

Data gathered using Logarithmic testing
  Maximum time between data points: 1.0000 Minutes.
  Number of data samples: 103

TOTAL DATA SAMPLES 103

Channel number [2]

Measurement type:	Pressure/Level	
Channel name:	Pressure	
Sensor Range:	15 PSI.	
Specific gravity:	1	
Mode:	Surface	
User-defined reference:	0	Meters H2O
Referenced on:	channel definition.	
Pressure head at reference:	7.311	Meters H2O

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/2/00 17:56	0	-0.003	-0.01
10/2/00 17:56	0.005	0.09	0.27
10/2/00 17:56	0.01	0.207	0.63
10/2/00 17:56	0.015	0.319	0.97
10/2/00 17:56	0.02	0.371	1.13
10/2/00 17:56	0.025	0.371	1.13
10/2/00 17:56	0.03	0.299	0.91
10/2/00 17:56	0.035	0.184	0.56
10/2/00 17:56	0.04	0.082	0.25
10/2/00 17:56	0.045	0.093	0.28
10/2/00 17:56	0.05	0.091	0.28
10/2/00 17:56	0.055	0.082	0.25
10/2/00 17:56	0.06	0.051	0.16
10/2/00 17:56	0.065	0.02	0.06

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
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10/2/00 17:56	0.07	0.01	0.03
10/2/00 17:56	0.075	0.006	0.02
10/2/00 17:56	0.08	-0.016	-0.05
10/2/00 17:56	0.085	-0.046	-0.14
10/2/00 17:56	0.09	-0.041	-0.12
10/2/00 17:56	0.095	-0.027	-0.08
10/2/00 17:56	0.1	-0.018	-0.05
10/2/00 17:56	0.1058	-0.016	-0.05
10/2/00 17:56	0.112	-0.011	-0.03
10/2/00 17:56	0.1185	-0.012	-0.04
10/2/00 17:56	0.1255	-0.012	-0.04
10/2/00 17:56	0.1328	-0.013	-0.04
10/2/00 17:56	0.1407	-0.015	-0.05
10/2/00 17:56	0.149	-0.016	-0.05
10/2/00 17:56	0.1578	-0.018	-0.05
10/2/00 17:56	0.1672	-0.018	-0.05
10/2/00 17:56	0.177	-0.019	-0.06
10/2/00 17:56	0.1875	-0.021	-0.06
10/2/00 17:56	0.1985	-0.02	-0.06
10/2/00 17:56	0.2102	-0.021	-0.06
10/2/00 17:56	0.2227	-0.021	-0.06
10/2/00 17:56	0.2358	-0.021	-0.06
10/2/00 17:56	0.2498	-0.039	-0.12
10/2/00 17:56	0.2647	-0.038	-0.12
10/2/00 17:56	0.2803	-0.037	-0.11
10/2/00 17:56	0.297	-0.038	-0.12
10/2/00 17:56	0.3147	-0.038	-0.12
10/2/00 17:56	0.3333	-0.039	-0.12
10/2/00 17:56	0.3532	-0.038	-0.12
10/2/00 17:56	0.3742	-0.038	-0.12
10/2/00 17:56	0.3963	-0.038	-0.12
10/2/00 17:56	0.4198	-0.038	-0.12
10/2/00 17:57	0.4447	-0.038	-0.12
10/2/00 17:57	0.4697	-0.038	-0.12
10/2/00 17:57	0.4963	-0.038	-0.12
10/2/00 17:57	0.5247	-0.038	-0.12
10/2/00 17:57	0.5547	-0.038	-0.12
10/2/00 17:57	0.5863	-0.037	-0.11
10/2/00 17:57	0.6213	-0.038	-0.12
10/2/00 17:57	0.658	-0.037	-0.11
10/2/00 17:57	0.6963	-0.037	-0.11
10/2/00 17:57	0.738	-0.037	-0.11
10/2/00 17:57	0.7813	-0.037	-0.11
10/2/00 17:57	0.828	-0.037	-0.11
10/2/00 17:57	0.8763	-0.037	-0.11
10/2/00 17:57	0.928	-0.038	-0.12
10/2/00 17:57	0.983	-0.037	-0.11
10/2/00 17:57	1.0413	-0.037	-0.11
10/2/00 17:57	1.103	-0.037	-0.11

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/2/00 17:57	1.168	-0.037	-0.11
10/2/00 17:57	1.238	-0.037	-0.11
10/2/00 17:57	1.3113	-0.037	-0.11
10/2/00 17:57	1.3897	-0.037	-0.11
10/2/00 17:58	1.473	-0.037	-0.11
10/2/00 17:58	1.5613	-0.038	-0.12
10/2/00 17:58	1.6547	-0.038	-0.12
10/2/00 17:58	1.753	-0.038	-0.12
10/2/00 17:58	1.858	-0.038	-0.12
10/2/00 17:58	1.968	-0.037	-0.11
10/2/00 17:58	2.0847	-0.037	-0.11
10/2/00 17:58	2.2097	-0.037	-0.11
10/2/00 17:58	2.3413	-0.038	-0.12
10/2/00 17:59	2.4813	-0.038	-0.12
10/2/00 17:59	2.6297	-0.037	-0.11
10/2/00 17:59	2.7863	-0.037	-0.11
10/2/00 17:59	2.953	-0.038	-0.12
10/2/00 17:59	3.1297	-0.038	-0.12
10/2/00 17:59	3.3163	-0.037	-0.11
10/2/00 18:00	3.5147	-0.037	-0.11
10/2/00 18:00	3.7247	-0.039	-0.12
10/2/00 18:00	3.9463	-0.037	-0.11
10/2/00 18:00	4.1813	-0.038	-0.12
10/2/00 18:00	4.4297	-0.039	-0.12
10/2/00 18:01	4.693	-0.039	-0.12
10/2/00 18:01	4.973	-0.038	-0.12
10/2/00 18:01	5.2697	-0.038	-0.12
10/2/00 18:02	5.583	-0.037	-0.11
10/2/00 18:02	5.9147	-0.039	-0.12
10/2/00 18:02	6.2663	-0.037	-0.11
10/2/00 18:03	6.6397	-0.037	-0.11
10/2/00 18:03	7.0347	-0.039	-0.12
10/2/00 18:04	7.453	-0.037	-0.11
10/2/00 18:04	7.8963	-0.038	-0.12
10/2/00 18:04	8.3663	-0.037	-0.11
10/2/00 18:05	8.8647	-0.038	-0.12
10/2/00 18:05	9.3913	-0.038	-0.12
10/2/00 18:06	9.9497	-0.038	-0.12
10/2/00 18:07	10.5413	-0.038	-0.12
10/2/00 18:07	11.168	-0.038	-0.12

In-Situ Inc.	Troll
Report generated:	10/23/00 8:37:50
Report from file:	S:\GOODR\CALVER~1\MW07I2R.BIN
DataMgr Version	2.31.0.0
Serial number:	10751
Firmware Version	7.1
Unit name:	Troll 4000
Test name:	FD-MW07-I-2R
Test defined on:	10/2/00 18:09:30
Test started on:	10/2/00 18:09:57
Test stopped on:	10/2/00 18:21:15
Test extracted on:	10/2/00 18:23:36

Data gathered using Logarithmic testing

Maximum time between data points: 1.0000 Minutes.

Number of data samples: 103

TOTAL DATA SAMPLES 103

Channel number [2]

Measurement type:	Pressure/Level	
Channel name:	Pressure	
Sensor Range:	15 PSI.	
Specific gravity:	1	
Mode:	Surface	
User-defined reference:	0	Meters H2O
Referenced on:	channel definition.	
Pressure head at reference:	7.291	Meters H2O

Date	Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/2/00	18:09	0	-0.002	0.01
10/2/00	18:09	0.005	-0.289	0.88
10/2/00	18:09	0.01	-0.34	1.04
10/2/00	18:09	0.015	-0.392	1.19
10/2/00	18:09	0.02	-0.418	1.27
10/2/00	18:09	0.025	-0.38	1.16
10/2/00	18:09	0.03	-0.317	0.97
10/2/00	18:09	0.035	-0.252	0.77
10/2/00	18:09	0.04	-0.195	0.59
10/2/00	18:09	0.045	-0.149	0.45
10/2/00	18:10	0.05	-0.113	0.34
10/2/00	18:10	0.055	-0.085	0.26
10/2/00	18:10	0.06	-0.065	0.20
10/2/00	18:10	0.065	-0.05	0.15

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
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10/2/00 18:10	0.07	-0.039	0.12
10/2/00 18:10	0.075	-0.03	0.09
10/2/00 18:10	0.08	-0.024	0.07
10/2/00 18:10	0.085	-0.02	0.06
10/2/00 18:10	0.09	-0.016	0.05
10/2/00 18:10	0.095	-0.013	0.04
10/2/00 18:10	0.1	-0.011	0.03
10/2/00 18:10	0.1058	-0.009	0.03
10/2/00 18:10	0.112	-0.008	0.02
10/2/00 18:10	0.1185	-0.007	0.02
10/2/00 18:10	0.1255	-0.006	0.02
10/2/00 18:10	0.1328	-0.005	0.02
10/2/00 18:10	0.1407	-0.004	0.01
10/2/00 18:10	0.149	-0.004	0.01
10/2/00 18:10	0.1578	-0.004	0.01
10/2/00 18:10	0.1672	-0.003	0.01
10/2/00 18:10	0.177	-0.002	0.01
10/2/00 18:10	0.1875	-0.002	0.01
10/2/00 18:10	0.1985	-0.002	0.01
10/2/00 18:10	0.2102	-0.002	0.01
10/2/00 18:10	0.2227	-0.001	0.00
10/2/00 18:10	0.2358	-0.001	0.00
10/2/00 18:10	0.2498	-0.019	0.06
10/2/00 18:10	0.2647	-0.019	0.06
10/2/00 18:10	0.2803	-0.018	0.05
10/2/00 18:10	0.297	-0.018	0.05
10/2/00 18:10	0.3147	-0.018	0.05
10/2/00 18:10	0.3333	-0.018	0.05
10/2/00 18:10	0.3532	-0.018	0.05
10/2/00 18:10	0.3742	-0.018	0.05
10/2/00 18:10	0.3963	-0.018	0.05
10/2/00 18:10	0.4198	-0.018	0.05
10/2/00 18:10	0.4447	-0.018	0.05
10/2/00 18:10	0.4697	-0.018	0.05
10/2/00 18:10	0.4963	-0.017	0.05
10/2/00 18:10	0.5247	-0.018	0.05
10/2/00 18:10	0.5547	-0.017	0.05
10/2/00 18:10	0.5863	-0.017	0.05
10/2/00 18:10	0.6213	-0.018	0.05
10/2/00 18:10	0.658	-0.018	0.05
10/2/00 18:10	0.6963	-0.018	0.05
10/2/00 18:10	0.738	-0.017	0.05
10/2/00 18:10	0.7813	-0.017	0.05
10/2/00 18:10	0.828	-0.017	0.05
10/2/00 18:10	0.8763	-0.017	0.05
10/2/00 18:10	0.928	-0.017	0.05
10/2/00 18:10	0.983	-0.017	0.05
10/2/00 18:10	1.0413	-0.017	0.05
10/2/00 18:11	1.103	-0.018	0.05

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/2/00 18:11	1.168	-0.018	0.05
10/2/00 18:11	1.238	-0.018	0.05
10/2/00 18:11	1.3113	-0.018	0.05
10/2/00 18:11	1.3897	-0.018	0.05
10/2/00 18:11	1.473	-0.018	0.05
10/2/00 18:11	1.5613	-0.018	0.05
10/2/00 18:11	1.6547	-0.017	0.05
10/2/00 18:11	1.753	-0.018	0.05
10/2/00 18:11	1.858	-0.018	0.05
10/2/00 18:11	1.968	-0.018	0.05
10/2/00 18:12	2.0847	-0.018	0.05
10/2/00 18:12	2.2097	-0.018	0.05
10/2/00 18:12	2.3413	-0.018	0.05
10/2/00 18:12	2.4813	-0.017	0.05
10/2/00 18:12	2.6297	-0.018	0.05
10/2/00 18:12	2.7863	-0.017	0.05
10/2/00 18:12	2.953	-0.017	0.05
10/2/00 18:13	3.1297	-0.017	0.05
10/2/00 18:13	3.3163	-0.017	0.05
10/2/00 18:13	3.5147	-0.017	0.05
10/2/00 18:13	3.7247	-0.017	0.05
10/2/00 18:13	3.9463	-0.017	0.05
10/2/00 18:14	4.1813	-0.017	0.05
10/2/00 18:14	4.4297	-0.017	0.05
10/2/00 18:14	4.693	-0.017	0.05
10/2/00 18:14	4.973	-0.017	0.05
10/2/00 18:15	5.2697	-0.017	0.05
10/2/00 18:15	5.583	-0.017	0.05
10/2/00 18:15	5.9147	-0.017	0.05
10/2/00 18:16	6.2663	-0.017	0.05
10/2/00 18:16	6.6397	-0.017	0.05
10/2/00 18:16	7.0347	-0.017	0.05
10/2/00 18:17	7.453	-0.018	0.05
10/2/00 18:17	7.8963	-0.017	0.05
10/2/00 18:18	8.3663	-0.017	0.05
10/2/00 18:18	8.8647	-0.017	0.05
10/2/00 18:19	9.3913	-0.017	0.05
10/2/00 18:19	9.9497	-0.017	0.05
10/2/00 18:20	10.5413	-0.017	0.05
10/2/00 18:21	11.168	-0.018	0.05

In-Situ Inc. Troll

Report generated:	10/23/00 8:53:08
Report from file:	S:\GOODR\CALVER~1\MW08S1.BIN
DataMgr Version	2.31.0.0
Serial number:	10751
Firmware Version	7.1
Unit name:	Troll 4000
Test name:	FD-MW08-S-1
Test defined on:	10/2/00 14:49:46
Test started on:	10/2/00 14:50:17
Test stopped on:	10/2/00 15:01:28
Test extracted on:	10/2/00 15:20:43

Data gathered using Logarithmic testing
Maximum time between data points: 1.0000 Minutes.
Number of data samples: 102

TOTAL DATA SAMPLES 102

Channel number [2]

Measurement type:	Pressure/Level
Channel name:	Pressure
Sensor Range:	15 PSI.
Specific gravity:	1
Mode:	Surface
User-defined reference:	0 Meters H2O
Referenced on:	channel definition.
Pressure head at reference:	1.996 Meters H2O

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/2/00 14:50	0	-0.003	0.01
10/2/00 14:50	0.005	-0.003	0.01
10/2/00 14:50	0.01	-0.005	0.02
10/2/00 14:50	0.015	-0.891	2.72
10/2/00 14:50	0.02	-0.262	0.80
10/2/00 14:50	0.025	-0.415	1.26
10/2/00 14:50	0.03	-0.352	1.07
10/2/00 14:50	0.035	-0.317	0.97
10/2/00 14:50	0.04	-0.254	0.77
10/2/00 14:50	0.045	-0.224	0.68
10/2/00 14:50	0.05	-0.193	0.59
10/2/00 14:50	0.055	-0.153	0.47
10/2/00 14:50	0.06	-0.153	0.47
10/2/00 14:50	0.065	-0.122	0.37

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/2/00 14:50	0.07	-0.122	0.37
10/2/00 14:50	0.075	-0.122	0.37
10/2/00 14:50	0.08	-0.098	0.30
10/2/00 14:50	0.085	-0.098	0.30
10/2/00 14:50	0.09	-0.098	0.30
10/2/00 14:50	0.095	-0.098	0.30
10/2/00 14:50	0.1	-0.097	0.30
10/2/00 14:50	0.1058	-0.058	0.18
10/2/00 14:50	0.112	-0.062	0.19
10/2/00 14:50	0.1185	-0.062	0.19
10/2/00 14:50	0.1255	-0.062	0.19
10/2/00 14:50	0.1328	-0.061	0.19
10/2/00 14:50	0.1407	-0.061	0.19
10/2/00 14:50	0.149	-0.061	0.19
10/2/00 14:50	0.1578	-0.061	0.19
10/2/00 14:50	0.1672	-0.061	0.19
10/2/00 14:50	0.177	-0.056	0.17
10/2/00 14:50	0.1875	-0.056	0.17
10/2/00 14:50	0.1985	-0.056	0.17
10/2/00 14:50	0.2102	-0.056	0.17
10/2/00 14:50	0.2227	-0.056	0.17
10/2/00 14:50	0.2358	-0.055	0.17
10/2/00 14:50	0.2498	-0.068	0.21
10/2/00 14:50	0.2647	-0.068	0.21
10/2/00 14:50	0.2803	-0.068	0.21
10/2/00 14:50	0.297	-0.068	0.21
10/2/00 14:50	0.3147	-0.068	0.21
10/2/00 14:50	0.3333	-0.068	0.21
10/2/00 14:50	0.3532	-0.067	0.20
10/2/00 14:50	0.3742	-0.067	0.20
10/2/00 14:50	0.3963	-0.067	0.20
10/2/00 14:50	0.4198	-0.066	0.20
10/2/00 14:50	0.4447	-0.066	0.20
10/2/00 14:50	0.4697	-0.066	0.20
10/2/00 14:50	0.4963	-0.066	0.20
10/2/00 14:50	0.5247	-0.066	0.20
10/2/00 14:50	0.5547	-0.065	0.20
10/2/00 14:50	0.5863	-0.065	0.20
10/2/00 14:50	0.6213	-0.066	0.20
10/2/00 14:50	0.658	-0.065	0.20
10/2/00 14:50	0.6963	-0.065	0.20
10/2/00 14:51	0.738	-0.065	0.20
10/2/00 14:51	0.7813	-0.065	0.20
10/2/00 14:51	0.828	-0.065	0.20
10/2/00 14:51	0.8763	-0.065	0.20
10/2/00 14:51	0.928	-0.065	0.20
10/2/00 14:51	0.983	-0.065	0.20
10/2/00 14:51	1.0413	-0.065	0.20
10/2/00 14:51	1.103	-0.065	0.20

Date	Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
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10/2/00	14:51	1.168	-0.065	0.20
10/2/00	14:51	1.238	-0.064	0.20
10/2/00	14:51	1.3113	-0.065	0.20
10/2/00	14:51	1.3897	-0.063	0.19
10/2/00	14:51	1.473	-0.064	0.20
10/2/00	14:51	1.5613	-0.063	0.19
10/2/00	14:51	1.6547	-0.063	0.19
10/2/00	14:52	1.753	-0.063	0.19
10/2/00	14:52	1.858	-0.063	0.19
10/2/00	14:52	1.968	-0.063	0.19
10/2/00	14:52	2.0847	-0.063	0.19
10/2/00	14:52	2.2097	-0.063	0.19
10/2/00	14:52	2.3413	-0.063	0.19
10/2/00	14:52	2.4813	-0.063	0.19
10/2/00	14:52	2.6297	-0.062	0.19
10/2/00	14:53	2.7863	-0.061	0.19
10/2/00	14:53	2.953	-0.061	0.19
10/2/00	14:53	3.1297	-0.061	0.19
10/2/00	14:53	3.3163	-0.061	0.19
10/2/00	14:53	3.5147	-0.061	0.19
10/2/00	14:54	3.7247	-0.06	0.18
10/2/00	14:54	3.9463	-0.06	0.18
10/2/00	14:54	4.1813	-0.06	0.18
10/2/00	14:54	4.4297	-0.06	0.18
10/2/00	14:54	4.693	-0.06	0.18
10/2/00	14:55	4.973	-0.06	0.18
10/2/00	14:55	5.2697	-0.058	0.18
10/2/00	14:55	5.583	-0.057	0.17
10/2/00	14:56	5.9147	-0.057	0.17
10/2/00	14:56	6.2663	-0.056	0.17
10/2/00	14:56	6.6397	-0.056	0.17
10/2/00	14:57	7.0347	-0.056	0.17
10/2/00	14:57	7.453	-0.055	0.17
10/2/00	14:58	7.8963	-0.055	0.17
10/2/00	14:58	8.3663	-0.054	0.16
10/2/00	14:59	8.8647	-0.053	0.16
10/2/00	14:59	9.3913	-0.053	0.16
10/2/00	15:00	9.9497	-0.052	0.16
10/2/00	15:00	10.5413	-0.051	0.16

In-Situ Inc.	Troll
Report generated:	10/23/00 10:31:03
Report from file:	S:\GOODR\CALVER~1\MW08S2.BIN
DataMgr Version	2.31.0.0
Serial number:	10751
Firmware Version	7.1
Unit name:	Troll 4000
Test name:	FD-MW08-S-2
Test defined on:	10/2/00 15:08:13
Test started on:	10/2/00 15:08:45
Test stopped on:	10/2/00 15:20:32
Test extracted on:	10/2/00 15:21:31

Data gathered using Logarithmic testing
Maximum time between data points: 1.0000 Minutes.
Number of data samples: 103

TOTAL DATA SAMPLES 103

Channel number [2]

Measurement type:	Pressure/Level
Channel name:	Pressure
Sensor Range:	15 PSI.
Specific gravity:	1
Mode:	Surface
User-defined reference:	0 Meters H2O
Referenced on:	channel definition.
Pressure head at reference:	1.996 Meters H2O

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/2/00 15:08	0	-0.001	0.00
10/2/00 15:08	0.005	0	0.00
10/2/00 15:08	0.01	-0.001	0.00
10/2/00 15:08	0.015	-0.212	0.65
10/2/00 15:08	0.02	-0.945	2.88
10/2/00 15:08	0.025	-0.256	0.78
10/2/00 15:08	0.03	-0.366	1.12
10/2/00 15:08	0.035	-0.306	0.93
10/2/00 15:08	0.04	-0.26	0.79
10/2/00 15:08	0.045	-0.222	0.68
10/2/00 15:08	0.05	-0.183	0.56
10/2/00 15:08	0.055	-0.18	0.55
10/2/00 15:08	0.06	-0.138	0.42
10/2/00 15:08	0.065	-0.134	0.41

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
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10/2/00 15:08	0.07	-0.088	0.27
10/2/00 15:08	0.075	-0.074	0.23
10/2/00 15:08	0.08	-0.066	0.20
10/2/00 15:08	0.085	-0.058	0.18
10/2/00 15:08	0.09	-0.054	0.16
10/2/00 15:08	0.095	-0.049	0.15
10/2/00 15:08	0.1	-0.046	0.14
10/2/00 15:08	0.1058	-0.042	0.13
10/2/00 15:08	0.112	-0.039	0.12
10/2/00 15:08	0.1185	-0.036	0.11
10/2/00 15:08	0.1255	-0.034	0.10
10/2/00 15:08	0.1328	-0.032	0.10
10/2/00 15:08	0.1407	-0.029	0.09
10/2/00 15:08	0.149	-0.027	0.08
10/2/00 15:08	0.1578	-0.026	0.08
10/2/00 15:08	0.1672	-0.024	0.07
10/2/00 15:08	0.177	-0.022	0.07
10/2/00 15:08	0.1875	-0.021	0.06
10/2/00 15:08	0.1985	-0.02	0.06
10/2/00 15:08	0.2102	-0.018	0.05
10/2/00 15:08	0.2227	-0.017	0.05
10/2/00 15:08	0.2358	-0.016	0.05
10/2/00 15:08	0.2498	-0.029	0.09
10/2/00 15:09	0.2647	-0.029	0.09
10/2/00 15:09	0.2803	-0.029	0.09
10/2/00 15:09	0.297	-0.027	0.08
10/2/00 15:09	0.3147	-0.027	0.08
10/2/00 15:09	0.3333	-0.027	0.08
10/2/00 15:09	0.3532	-0.026	0.08
10/2/00 15:09	0.3742	-0.026	0.08
10/2/00 15:09	0.3963	-0.026	0.08
10/2/00 15:09	0.4198	-0.026	0.08
10/2/00 15:09	0.4447	-0.025	0.08
10/2/00 15:09	0.4697	-0.025	0.08
10/2/00 15:09	0.4963	-0.025	0.08
10/2/00 15:09	0.5247	-0.025	0.08
10/2/00 15:09	0.5547	-0.025	0.08
10/2/00 15:09	0.5863	-0.025	0.08
10/2/00 15:09	0.6213	-0.024	0.07
10/2/00 15:09	0.658	-0.024	0.07
10/2/00 15:09	0.6963	-0.024	0.07
10/2/00 15:09	0.738	-0.025	0.08
10/2/00 15:09	0.7813	-0.025	0.08
10/2/00 15:09	0.828	-0.024	0.07
10/2/00 15:09	0.8763	-0.024	0.07
10/2/00 15:09	0.928	-0.024	0.07
10/2/00 15:09	0.983	-0.024	0.07
10/2/00 15:09	1.0413	-0.024	0.07
10/2/00 15:09	1.103	-0.024	0.07

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/2/00 15:09	1.168	-0.024	0.07
10/2/00 15:09	1.238	-0.023	0.07
10/2/00 15:10	1.3113	-0.024	0.07
10/2/00 15:10	1.3897	-0.024	0.07
10/2/00 15:10	1.473	-0.025	0.08
10/2/00 15:10	1.5613	-0.025	0.08
10/2/00 15:10	1.6547	-0.024	0.07
10/2/00 15:10	1.753	-0.024	0.07
10/2/00 15:10	1.858	-0.024	0.07
10/2/00 15:10	1.968	-0.024	0.07
10/2/00 15:10	2.0847	-0.023	0.07
10/2/00 15:10	2.2097	-0.024	0.07
10/2/00 15:11	2.3413	-0.023	0.07
10/2/00 15:11	2.4813	-0.025	0.08
10/2/00 15:11	2.6297	-0.024	0.07
10/2/00 15:11	2.7863	-0.024	0.07
10/2/00 15:11	2.953	-0.023	0.07
10/2/00 15:11	3.1297	-0.023	0.07
10/2/00 15:12	3.3163	-0.023	0.07
10/2/00 15:12	3.5147	-0.024	0.07
10/2/00 15:12	3.7247	-0.024	0.07
10/2/00 15:12	3.9463	-0.024	0.07
10/2/00 15:12	4.1813	-0.024	0.07
10/2/00 15:13	4.4297	-0.024	0.07
10/2/00 15:13	4.693	-0.024	0.07
10/2/00 15:13	4.973	-0.024	0.07
10/2/00 15:14	5.2697	-0.024	0.07
10/2/00 15:14	5.583	-0.023	0.07
10/2/00 15:14	5.9147	-0.024	0.07
10/2/00 15:15	6.2663	-0.024	0.07
10/2/00 15:15	6.6397	-0.024	0.07
10/2/00 15:15	7.0347	-0.024	0.07
10/2/00 15:16	7.453	-0.024	0.07
10/2/00 15:16	7.8963	-0.024	0.07
10/2/00 15:17	8.3663	-0.024	0.07
10/2/00 15:17	8.8647	-0.024	0.07
10/2/00 15:18	9.3913	-0.024	0.07
10/2/00 15:18	9.9497	-0.024	0.07
10/2/00 15:19	10.5413	-0.024	0.07
10/2/00 15:19	11.168	-0.025	0.08

In-Situ Inc. Troll

Report generated:	10/23/00	11:05:26
Report from file:	S:\GOODR\CALVER~1\MW09S1.BIN	
DataMgr Version	2.31.0.0	
Serial number:	10751	
Firmware Version	7.1	
Unit name:	Troll 4000	
Test name:		FD-MW09-S-1
Test defined on:	10/2/00	13:23:09
Test started on:	10/2/00	13:23:56
Test stopped on:	10/2/00	13:36:05
Test extracted on:	10/2/00	14:02:59

Data gathered using Logarithmic testing
Maximum time between data points: 3.0000 Minutes.
Number of data samples: 104

TOTAL DATA SAMPLES 104

Channel number [2]

Measurement type:	Pressure/Level	
Channel name:	Pressure	
Sensor Range:	15 PSI.	
Specific gravity:	1	
Mode:	Surface	
User-defined reference:	0	Meters H2O
Referenced on:	channel definition.	
Pressure head at reference:	2.239	Meters H2O

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/2/00 13:23	0	-0.037	0.11
10/2/00 13:23	0.005	-1.045	3.19
10/2/00 13:23	0.01	0.169	-0.52
10/2/00 13:23	0.015	-0.416	1.27
10/2/00 13:23	0.02	-0.379	1.16
10/2/00 13:23	0.025	-0.335	1.02
10/2/00 13:23	0.03	-0.295	0.90
10/2/00 13:23	0.035	-0.266	0.81
10/2/00 13:23	0.04	-0.24	0.73
10/2/00 13:23	0.045	-0.216	0.66
10/2/00 13:23	0.05	-0.193	0.59
10/2/00 13:23	0.055	-0.174	0.53
10/2/00 13:23	0.06	-0.159	0.48
10/2/00 13:23	0.065	-0.143	0.44

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/2/00 13:24	0.07	-0.127	0.39
10/2/00 13:24	0.075	-0.116	0.35
10/2/00 13:24	0.08	-0.105	0.32
10/2/00 13:24	0.085	-0.096	0.29
10/2/00 13:24	0.09	-0.086	0.26
10/2/00 13:24	0.095	-0.079	0.24
10/2/00 13:24	0.1	-0.071	0.22
10/2/00 13:24	0.1058	-0.064	0.20
10/2/00 13:24	0.112	-0.058	0.18
10/2/00 13:24	0.1185	-0.053	0.16
10/2/00 13:24	0.1255	-0.049	0.15
10/2/00 13:24	0.1328	-0.044	0.13
10/2/00 13:24	0.1407	-0.039	0.12
10/2/00 13:24	0.149	-0.034	0.10
10/2/00 13:24	0.1578	-0.03	0.09
10/2/00 13:24	0.1672	-0.027	0.08
10/2/00 13:24	0.177	-0.025	0.08
10/2/00 13:24	0.1875	-0.021	0.06
10/2/00 13:24	0.1985	-0.018	0.05
10/2/00 13:24	0.2102	-0.016	0.05
10/2/00 13:24	0.2227	-0.014	0.04
10/2/00 13:24	0.2358	-0.013	0.04
10/2/00 13:24	0.2498	-0.023	0.07
10/2/00 13:24	0.2647	-0.022	0.07
10/2/00 13:24	0.2803	-0.02	0.06
10/2/00 13:24	0.297	-0.02	0.06
10/2/00 13:24	0.3147	-0.02	0.06
10/2/00 13:24	0.3333	-0.018	0.05
10/2/00 13:24	0.3532	-0.018	0.05
10/2/00 13:24	0.3742	-0.018	0.05
10/2/00 13:24	0.3963	-0.017	0.05
10/2/00 13:24	0.4198	-0.017	0.05
10/2/00 13:24	0.4447	-0.016	0.05
10/2/00 13:24	0.4697	-0.016	0.05
10/2/00 13:24	0.4963	-0.016	0.05
10/2/00 13:24	0.5247	-0.016	0.05
10/2/00 13:24	0.5547	-0.015	0.05
10/2/00 13:24	0.5863	-0.015	0.05
10/2/00 13:24	0.6213	-0.015	0.05
10/2/00 13:24	0.658	-0.015	0.05
10/2/00 13:24	0.6963	-0.015	0.05
10/2/00 13:24	0.738	-0.015	0.05
10/2/00 13:24	0.7813	-0.015	0.05
10/2/00 13:24	0.828	-0.015	0.05
10/2/00 13:24	0.8763	-0.015	0.05
10/2/00 13:24	0.928	-0.015	0.05
10/2/00 13:24	0.983	-0.015	0.05
10/2/00 13:24	1.0413	-0.015	0.05
10/2/00 13:25	1.103	-0.015	0.05

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/2/00 13:25	1.168	-0.017	0.05
10/2/00 13:25	1.238	-0.016	0.05
10/2/00 13:25	1.3113	-0.017	0.05
10/2/00 13:25	1.3897	-0.016	0.05
10/2/00 13:25	1.473	-0.015	0.05
10/2/00 13:25	1.5613	-0.015	0.05
10/2/00 13:25	1.6547	-0.015	0.05
10/2/00 13:25	1.753	-0.015	0.05
10/2/00 13:25	1.858	-0.015	0.05
10/2/00 13:25	1.968	-0.015	0.05
10/2/00 13:26	2.0847	-0.015	0.05
10/2/00 13:26	2.2097	-0.015	0.05
10/2/00 13:26	2.3413	-0.015	0.05
10/2/00 13:26	2.4813	-0.015	0.05
10/2/00 13:26	2.6297	-0.015	0.05
10/2/00 13:26	2.7863	-0.015	0.05
10/2/00 13:26	2.953	-0.015	0.05
10/2/00 13:27	3.1297	-0.015	0.05
10/2/00 13:27	3.3163	-0.015	0.05
10/2/00 13:27	3.5147	-0.016	0.05
10/2/00 13:27	3.7247	-0.015	0.05
10/2/00 13:27	3.9463	-0.015	0.05
10/2/00 13:28	4.1813	-0.015	0.05
10/2/00 13:28	4.4297	-0.015	0.05
10/2/00 13:28	4.693	-0.016	0.05
10/2/00 13:28	4.973	-0.015	0.05
10/2/00 13:29	5.2697	-0.016	0.05
10/2/00 13:29	5.583	-0.015	0.05
10/2/00 13:29	5.9147	-0.015	0.05
10/2/00 13:30	6.2663	-0.015	0.05
10/2/00 13:30	6.6397	-0.015	0.05
10/2/00 13:30	7.0347	-0.015	0.05
10/2/00 13:31	7.453	-0.015	0.05
10/2/00 13:31	7.8963	-0.015	0.05
10/2/00 13:32	8.3663	-0.015	0.05
10/2/00 13:32	8.8647	-0.015	0.05
10/2/00 13:33	9.3913	-0.016	0.05
10/2/00 13:33	9.9497	-0.016	0.05
10/2/00 13:34	10.5413	-0.016	0.05
10/2/00 13:35	11.168	-0.015	0.05
10/2/00 13:35	11.8313	-0.015	0.05

In-Situ Inc. Troll

Report generated:	10/23/00	11:06:16
Report from file:	S:\GOODR\CALVER~1\MW09S2.BIN	
DataMgr Version	2.31.0.0	
Serial number:	10751	
Firmware Version	7.1	
Unit name:	Troll 4000	
Test name:		FD-MW09-S-2
Test defined on:	10/2/00	13:45:04
Test started on:	10/2/00	13:47:55
Test stopped on:	10/2/00	13:59:21
Test extracted on:	10/2/00	14:07:37

Data gathered using Logarithmic testing
Maximum time between data points: 1.0000 Minutes.
Number of data samples: 103

TOTAL DATA SAMPLES 103

Channel number [2]

Measurement type:	Pressure/Level	
Channel name:	Pressure	
Sensor Range:	15 PSI.	
Specific gravity:	1	
Mode:	Surface	
User-defined reference:	0	Meters H2O
Referenced on:	channel definition.	
Pressure head at reference:	2.235	Meters H2O

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/2/00 13:47	0	-0.014	0.04
10/2/00 13:47	0.005	-1.162	3.54
10/2/00 13:47	0.01	-0.057	0.17
10/2/00 13:47	0.015	-0.437	1.33
10/2/00 13:47	0.02	-0.376	1.15
10/2/00 13:47	0.025	-0.345	1.05
10/2/00 13:47	0.03	-0.308	0.94
10/2/00 13:47	0.035	-0.271	0.83
10/2/00 13:47	0.04	-0.243	0.74
10/2/00 13:47	0.045	-0.22	0.67
10/2/00 13:47	0.05	-0.199	0.61
10/2/00 13:47	0.055	-0.18	0.55
10/2/00 13:47	0.06	-0.162	0.49
10/2/00 13:47	0.065	-0.147	0.45

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
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10/2/00 13:47	0.07	-0.133	0.41
10/2/00 13:47	0.075	-0.121	0.37
10/2/00 13:47	0.08	-0.109	0.33
10/2/00 13:48	0.085	-0.102	0.31
10/2/00 13:48	0.09	-0.095	0.29
10/2/00 13:48	0.095	-0.087	0.27
10/2/00 13:48	0.1	-0.081	0.25
10/2/00 13:48	0.1058	-0.075	0.23
10/2/00 13:48	0.112	-0.069	0.21
10/2/00 13:48	0.1185	-0.063	0.19
10/2/00 13:48	0.1255	-0.058	0.18
10/2/00 13:48	0.1328	-0.052	0.16
10/2/00 13:48	0.1407	-0.047	0.14
10/2/00 13:48	0.149	-0.04	0.12
10/2/00 13:48	0.1578	-0.032	0.10
10/2/00 13:48	0.1672	-0.026	0.08
10/2/00 13:48	0.177	-0.021	0.06
10/2/00 13:48	0.1875	-0.017	0.05
10/2/00 13:48	0.1985	-0.014	0.04
10/2/00 13:48	0.2102	-0.011	0.03
10/2/00 13:48	0.2227	-0.009	0.03
10/2/00 13:48	0.2358	-0.007	0.02
10/2/00 13:48	0.2498	-0.018	0.05
10/2/00 13:48	0.2647	-0.017	0.05
10/2/00 13:48	0.2803	-0.017	0.05
10/2/00 13:48	0.297	-0.016	0.05
10/2/00 13:48	0.3147	-0.016	0.05
10/2/00 13:48	0.3333	-0.015	0.05
10/2/00 13:48	0.3532	-0.015	0.05
10/2/00 13:48	0.3742	-0.014	0.04
10/2/00 13:48	0.3963	-0.014	0.04
10/2/00 13:48	0.4198	-0.014	0.04
10/2/00 13:48	0.4447	-0.014	0.04
10/2/00 13:48	0.4697	-0.014	0.04
10/2/00 13:48	0.4963	-0.014	0.04
10/2/00 13:48	0.5247	-0.014	0.04
10/2/00 13:48	0.5547	-0.013	0.04
10/2/00 13:48	0.5863	-0.013	0.04
10/2/00 13:48	0.6213	-0.013	0.04
10/2/00 13:48	0.658	-0.013	0.04
10/2/00 13:48	0.6963	-0.013	0.04
10/2/00 13:48	0.738	-0.013	0.04
10/2/00 13:48	0.7813	-0.013	0.04
10/2/00 13:48	0.828	-0.013	0.04
10/2/00 13:48	0.8763	-0.013	0.04
10/2/00 13:48	0.928	-0.012	0.04
10/2/00 13:48	0.983	-0.013	0.04
10/2/00 13:48	1.0413	-0.013	0.04
10/2/00 13:49	1.103	-0.013	0.04

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/2/00 13:49	1.168	-0.014	0.04
10/2/00 13:49	1.238	-0.013	0.04
10/2/00 13:49	1.3113	-0.014	0.04
10/2/00 13:49	1.3897	-0.014	0.04
10/2/00 13:49	1.473	-0.014	0.04
10/2/00 13:49	1.5613	-0.013	0.04
10/2/00 13:49	1.6547	-0.013	0.04
10/2/00 13:49	1.753	-0.013	0.04
10/2/00 13:49	1.858	-0.013	0.04
10/2/00 13:49	1.968	-0.014	0.04
10/2/00 13:50	2.0847	-0.013	0.04
10/2/00 13:50	2.2097	-0.013	0.04
10/2/00 13:50	2.3413	-0.013	0.04
10/2/00 13:50	2.4813	-0.013	0.04
10/2/00 13:50	2.6297	-0.013	0.04
10/2/00 13:50	2.7863	-0.013	0.04
10/2/00 13:50	2.953	-0.013	0.04
10/2/00 13:51	3.1297	-0.013	0.04
10/2/00 13:51	3.3163	-0.013	0.04
10/2/00 13:51	3.5147	-0.013	0.04
10/2/00 13:51	3.7247	-0.013	0.04
10/2/00 13:51	3.9463	-0.013	0.04
10/2/00 13:52	4.1813	-0.013	0.04
10/2/00 13:52	4.4297	-0.013	0.04
10/2/00 13:52	4.693	-0.014	0.04
10/2/00 13:52	4.973	-0.014	0.04
10/2/00 13:53	5.2697	-0.013	0.04
10/2/00 13:53	5.583	-0.014	0.04
10/2/00 13:53	5.9147	-0.014	0.04
10/2/00 13:54	6.2663	-0.014	0.04
10/2/00 13:54	6.6397	-0.014	0.04
10/2/00 13:54	7.0347	-0.014	0.04
10/2/00 13:55	7.453	-0.014	0.04
10/2/00 13:55	7.8963	-0.014	0.04
10/2/00 13:56	8.3663	-0.014	0.04
10/2/00 13:56	8.8647	-0.014	0.04
10/2/00 13:57	9.3913	-0.014	0.04
10/2/00 13:57	9.9497	-0.014	0.04
10/2/00 13:58	10.5413	-0.014	0.04
10/2/00 13:59	11.168	-0.014	0.04

In-Situ Inc.	Troll
Report generated:	10/23/00 11:07:08
Report from file:	S:\GOODR\CALVER~1\MW10S1.BIN
DataMgr Version	2.31.0.0
Serial number:	10751
Firmware Version	7.1
Unit name:	Troll 4000
Test name:	FD-MW10-S-1
Test defined on:	10/2/00 15:52:27
Test started on:	10/2/00 15:56:25
Test stopped on:	10/2/00 16:07:07
Test extracted on:	10/2/00 16:34:32

Data gathered using Logarithmic testing
Maximum time between data points: 1.0000 Minutes.
Number of data samples: 102

TOTAL DATA SAMPLES 102

Channel number [2]

Measurement type:	Pressure/Level	
Channel name:	Pressure	
Sensor Range:	15 PSI.	
Specific gravity:	1	
Mode:	Surface	
User-defined reference:	0	Meters H2O
Referenced on:	channel definition.	
Pressure head at reference:	1.573	Meters H2O

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H20
10/2/00 15:56	0	0	0.00
10/2/00 15:56	0.005	-0.001	0.00
10/2/00 15:56	0.01	-0.868	2.65
10/2/00 15:56	0.015	-0.267	0.81
10/2/00 15:56	0.02	-0.172	0.52
10/2/00 15:56	0.025	-0.154	0.47
10/2/00 15:56	0.03	-0.129	0.39
10/2/00 15:56	0.035	-0.109	0.33
10/2/00 15:56	0.04	-0.092	0.28
10/2/00 15:56	0.045	-0.078	0.24
10/2/00 15:56	0.05	-0.067	0.20
10/2/00 15:56	0.055	-0.059	0.18
10/2/00 15:56	0.06	-0.05	0.15
10/2/00 15:56	0.065	-0.043	0.13

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H20
-------- --------	------------	---------------	------------
10/2/00 15:56	0.07	-0.037	0.11
10/2/00 15:56	0.075	-0.034	0.10
10/2/00 15:56	0.08	-0.029	0.09
10/2/00 15:56	0.085	-0.026	0.08
10/2/00 15:56	0.09	-0.024	0.07
10/2/00 15:56	0.095	-0.021	0.06
10/2/00 15:56	0.1	-0.02	0.06
10/2/00 15:56	0.1058	-0.017	0.05
10/2/00 15:56	0.112	-0.016	0.05
10/2/00 15:56	0.1185	-0.014	0.04
10/2/00 15:56	0.1255	-0.012	0.04
10/2/00 15:56	0.1328	-0.011	0.03
10/2/00 15:56	0.1407	-0.01	0.03
10/2/00 15:56	0.149	-0.009	0.03
10/2/00 15:56	0.1578	-0.008	0.02
10/2/00 15:56	0.1672	-0.006	0.02
10/2/00 15:56	0.177	-0.006	0.02
10/2/00 15:56	0.1875	-0.005	0.02
10/2/00 15:56	0.1985	-0.005	0.02
10/2/00 15:56	0.2102	-0.004	0.01
10/2/00 15:56	0.2227	-0.004	0.01
10/2/00 15:56	0.2358	-0.003	0.01
10/2/00 15:56	0.2498	-0.002	0.01
10/2/00 15:56	0.2647	-0.014	0.04
10/2/00 15:56	0.2803	-0.014	0.04
10/2/00 15:56	0.297	-0.012	0.04
10/2/00 15:56	0.3147	-0.012	0.04
10/2/00 15:56	0.3333	-0.011	0.03
10/2/00 15:56	0.3532	-0.011	0.03
10/2/00 15:56	0.3742	-0.011	0.03
10/2/00 15:56	0.3963	-0.011	0.03
10/2/00 15:56	0.4198	-0.011	0.03
10/2/00 15:56	0.4447	-0.011	0.03
10/2/00 15:56	0.4697	-0.011	0.03
10/2/00 15:56	0.4963	-0.011	0.03
10/2/00 15:56	0.5247	-0.011	0.03
10/2/00 15:56	0.5547	-0.011	0.03
10/2/00 15:57	0.5863	-0.01	0.03
10/2/00 15:57	0.6213	-0.01	0.03
10/2/00 15:57	0.658	-0.01	0.03
10/2/00 15:57	0.6963	-0.01	0.03
10/2/00 15:57	0.738	-0.011	0.03
10/2/00 15:57	0.7813	-0.01	0.03
10/2/00 15:57	0.828	-0.01	0.03
10/2/00 15:57	0.8763	-0.01	0.03
10/2/00 15:57	0.928	-0.01	0.03
10/2/00 15:57	0.983	-0.01	0.03
10/2/00 15:57	1.0413	-0.009	0.03
10/2/00 15:57	1.103	-0.01	0.03

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H20
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10/2/00 15:57	1.168	-0.009	0.03
10/2/00 15:57	1.238	-0.009	0.03
10/2/00 15:57	1.3113	-0.009	0.03
10/2/00 15:57	1.3897	-0.01	0.03
10/2/00 15:57	1.473	-0.009	0.03
10/2/00 15:57	1.5613	-0.01	0.03
10/2/00 15:58	1.6547	-0.011	0.03
10/2/00 15:58	1.753	-0.011	0.03
10/2/00 15:58	1.858	-0.01	0.03
10/2/00 15:58	1.968	-0.009	0.03
10/2/00 15:58	2.0847	-0.01	0.03
10/2/00 15:58	2.2097	-0.011	0.03
10/2/00 15:58	2.3413	-0.01	0.03
10/2/00 15:58	2.4813	-0.011	0.03
10/2/00 15:59	2.6297	-0.01	0.03
10/2/00 15:59	2.7863	-0.009	0.03
10/2/00 15:59	2.953	-0.009	0.03
10/2/00 15:59	3.1297	-0.009	0.03
10/2/00 15:59	3.3163	-0.009	0.03
10/2/00 15:59	3.5147	-0.009	0.03
10/2/00 16:00	3.7247	-0.01	0.03
10/2/00 16:00	3.9463	-0.01	0.03
10/2/00 16:00	4.1813	-0.01	0.03
10/2/00 16:00	4.4297	-0.009	0.03
10/2/00 16:01	4.693	-0.01	0.03
10/2/00 16:01	4.973	-0.01	0.03
10/2/00 16:01	5.2697	-0.01	0.03
10/2/00 16:01	5.583	-0.009	0.03
10/2/00 16:02	5.9147	-0.01	0.03
10/2/00 16:02	6.2663	-0.01	0.03
10/2/00 16:03	6.6397	-0.01	0.03
10/2/00 16:03	7.0347	-0.009	0.03
10/2/00 16:03	7.453	-0.009	0.03
10/2/00 16:04	7.8963	-0.01	0.03
10/2/00 16:04	8.3663	-0.01	0.03
10/2/00 16:05	8.8647	-0.01	0.03
10/2/00 16:05	9.3913	-0.01	0.03
10/2/00 16:06	9.9497	-0.01	0.03
10/2/00 16:06	10.5413	-0.01	0.03

In-Situ Inc. Troll

Report generated:	10/23/00	11:08:01
Report from file:	S:\GOODR\CALVER~1\MW10S2.BIN	
DataMgr Version	2.31.0.0	
Serial number:	10751	
Firmware Version	7.1	
Unit name:	Troll 4000	
Test name:		FD-MW10-S-2
Test defined on:	10/2/00	16:21:33
Test started on:	10/2/00	16:22:56
Test stopped on:	10/2/00	16:34:04
Test extracted on:	10/2/00	16:35:19

Data gathered using Logarithmic testing
  Maximum time between data points: 1.0000 Minutes.
  Number of data samples: 102

TOTAL DATA SAMPLES 102

Channel number [2]

Measurement type:	Pressure/Level	
Channel name:	Pressure	
Sensor Range:	15 PSI.	
Specific gravity:	1	
Mode:	Surface	
User-defined reference:	0	Meters H2O
Referenced on:	channel definition.	
Pressure head at reference:	1.574	Meters H2O

Date	Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/2/00	16:22	0	-0.009	0.03
10/2/00	16:22	0.005	-0.713	2.17
10/2/00	16:22	0.01	-0.31	0.94
10/2/00	16:22	0.015	-0.187	0.57
10/2/00	16:22	0.02	-0.163	0.50
10/2/00	16:22	0.025	-0.137	0.42
10/2/00	16:22	0.03	-0.117	0.36
10/2/00	16:22	0.035	-0.099	0.30
10/2/00	16:22	0.04	-0.083	0.25
10/2/00	16:22	0.045	-0.071	0.22
10/2/00	16:22	0.05	-0.061	0.19
10/2/00	16:22	0.055	-0.054	0.16
10/2/00	16:22	0.06	-0.046	0.14
10/2/00	16:22	0.065	-0.042	0.13

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
10/2/00 16:23	0.07	-0.037	0.11
10/2/00 16:23	0.075	-0.033	0.10
10/2/00 16:23	0.08	-0.029	0.09
10/2/00 16:23	0.085	-0.026	0.08
10/2/00 16:23	0.09	-0.024	0.07
10/2/00 16:23	0.095	-0.021	0.06
10/2/00 16:23	0.1	-0.021	0.06
10/2/00 16:23	0.1058	-0.018	0.05
10/2/00 16:23	0.112	-0.017	0.05
10/2/00 16:23	0.1185	-0.015	0.05
10/2/00 16:23	0.1255	-0.014	0.04
10/2/00 16:23	0.1328	-0.012	0.04
10/2/00 16:23	0.1407	-0.011	0.03
10/2/00 16:23	0.149	-0.01	0.03
10/2/00 16:23	0.1578	-0.01	0.03
10/2/00 16:23	0.1672	-0.009	0.03
10/2/00 16:23	0.177	-0.007	0.02
10/2/00 16:23	0.1875	-0.007	0.02
10/2/00 16:23	0.1985	-0.007	0.02
10/2/00 16:23	0.2102	-0.007	0.02
10/2/00 16:23	0.2227	-0.004	0.01
10/2/00 16:23	0.2358	-0.004	0.01
10/2/00 16:23	0.2498	-0.015	0.05
10/2/00 16:23	0.2647	-0.015	0.05
10/2/00 16:23	0.2803	-0.015	0.05
10/2/00 16:23	0.297	-0.014	0.04
10/2/00 16:23	0.3147	-0.014	0.04
10/2/00 16:23	0.3333	-0.014	0.04
10/2/00 16:23	0.3532	-0.014	0.04
10/2/00 16:23	0.3742	-0.013	0.04
10/2/00 16:23	0.3963	-0.013	0.04
10/2/00 16:23	0.4198	-0.012	0.04
10/2/00 16:23	0.4447	-0.012	0.04
10/2/00 16:23	0.4697	-0.012	0.04
10/2/00 16:23	0.4963	-0.012	0.04
10/2/00 16:23	0.5247	-0.012	0.04
10/2/00 16:23	0.5547	-0.011	0.03
10/2/00 16:23	0.5863	-0.011	0.03
10/2/00 16:23	0.6213	-0.012	0.04
10/2/00 16:23	0.658	-0.011	0.03
10/2/00 16:23	0.6963	-0.012	0.04
10/2/00 16:23	0.738	-0.012	0.04
10/2/00 16:23	0.7813	-0.011	0.03
10/2/00 16:23	0.828	-0.012	0.04
10/2/00 16:23	0.8763	-0.011	0.03
10/2/00 16:23	0.928	-0.011	0.03
10/2/00 16:23	0.983	-0.011	0.03
10/2/00 16:23	1.0413	-0.011	0.03
10/2/00 16:24	1.103	-0.012	0.04

Date Time	ET (min)	Chan[2] Meters H2O	Drawdown Feet H2O
-------- --------	------------	---------------	------------
10/2/00 16:24	1.168	-0.011	0.03
10/2/00 16:24	1.238	-0.012	0.04
10/2/00 16:24	1.3113	-0.011	0.03
10/2/00 16:24	1.3897	-0.011	0.03
10/2/00 16:24	1.473	-0.011	0.03
10/2/00 16:24	1.5613	-0.011	0.03
10/2/00 16:24	1.6547	-0.011	0.03
10/2/00 16:24	1.753	-0.011	0.03
10/2/00 16:24	1.858	-0.011	0.03
10/2/00 16:24	1.968	-0.011	0.03
10/2/00 16:25	2.0847	-0.011	0.03
10/2/00 16:25	2.2097	-0.011	0.03
10/2/00 16:25	2.3413	-0.011	0.03
10/2/00 16:25	2.4813	-0.011	0.03
10/2/00 16:25	2.6297	-0.011	0.03
10/2/00 16:25	2.7863	-0.011	0.03
10/2/00 16:25	2.953	-0.011	0.03
10/2/00 16:26	3.1297	-0.012	0.04
10/2/00 16:26	3.3163	-0.011	0.03
10/2/00 16:26	3.5147	-0.011	0.03
10/2/00 16:26	3.7247	-0.011	0.03
10/2/00 16:26	3.9463	-0.011	0.03
10/2/00 16:27	4.1813	-0.011	0.03
10/2/00 16:27	4.4297	-0.011	0.03
10/2/00 16:27	4.693	-0.011	0.03
10/2/00 16:27	4.973	-0.011	0.03
10/2/00 16:28	5.2697	-0.011	0.03
10/2/00 16:28	5.583	-0.011	0.03
10/2/00 16:28	5.9147	-0.011	0.03
10/2/00 16:29	6.2663	-0.011	0.03
10/2/00 16:29	6.6397	-0.011	0.03
10/2/00 16:29	7.0347	-0.011	0.03
10/2/00 16:30	7.453	-0.011	0.03
10/2/00 16:30	7.8963	-0.011	0.03
10/2/00 16:31	8.3663	-0.011	0.03
10/2/00 16:31	8.8647	-0.011	0.03
10/2/00 16:32	9.3913	-0.011	0.03
10/2/00 16:32	9.9497	-0.011	0.03
10/2/00 16:33	10.5413	-0.011	0.03

	Y_o	T_o	Y_t	T_t	
04 S1	1.0 ft	1.5 sec	0.1 ft	5.4 sec	SAME
04 S2	1.0 ft	1.5 sec	0.1 ft	5.4 sec	
05 S1	~~0.44~~ 0.20 ft	1.5 sec	0.008 ft	5.4 sec	
05 S2	~~0.44~~ 0.20 ft	1.8 sec	0.009 ft	5.4 sec	
06 S1	0.4 ft	1.8 sec	0.04 ft	7.8 sec	
06 S2	0.6 ft	0.6 sec	0.05 ft	7.2 sec	
07I 1F	0.4 ft	2.4 sec	0.01 ft	7.8 sec	
07I 1R	0.6 ft	2.4 sec	0.008 ft.	7.2 sec	
07I 2F	Not Analyzed				
07I 2R	1.0 ft	1.8 sec	0.008 ft.	7.2 sec	
08 S1	0.8 ft	2.4 sec	0.09 ft.	6.6 sec	
08 S2	0.8 ft	2.4 sec	~~0.09~~ 0.09 ft	6.0 sec	
09 S1	1.0 ft	1.5 sec	0.2 ft	6.0 sec	
09 S2	1.0 ft	1.5 sec	0.06 ft.	9.6 sec.	
10 S1	0.4 ft	1.8 sec	0.02 ft	7.5 sec	~~SAME~~
10 S2	0.4 ft	1.5 sec	0.02 ft	7.2 sec	

10/02/00	18:10:07	0.1672	-0.003
10/02/00	18:10:07	0.1770	-0.002
10/02/00	18:10:08	0.1875	-0.002
10/02/00	18:10:08	0.1985	-0.002
10/02/00	18:10:09	0.2102	-0.002
10/02/00	18:10:10	0.2227	-0.001
10/02/00	18:10:11	0.2358	-0.001
10/02/00	18:10:11	0.2498	-0.019
10/02/00	18:10:12	0.2647	-0.019
10/02/00	18:10:13	0.2803	-0.018
10/02/00	18:10:14	0.2970	-0.018
10/02/00	18:10:15	0.3147	-0.018
10/02/00	18:10:17	0.3333	-0.018
10/02/00	18:10:18	0.3532	-0.018
10/02/00	18:10:19	0.3742	-0.018
10/02/00	18:10:20	0.3963	-0.018
10/02/00	18:10:22	0.4198	-0.018
10/02/00	18:10:23	0.4447	-0.018
10/02/00	18:10:25	0.4697	-0.018
10/02/00	18:10:26	0.4963	-0.017
10/02/00	18:10:28	0.5247	-0.018
10/02/00	18:10:30	0.5547	-0.017
10/02/00	18:10:32	0.5863	-0.017
10/02/00	18:10:34	0.6213	-0.018
10/02/00	18:10:36	0.6580	-0.018
10/02/00	18:10:38	0.6963	-0.018
10/02/00	18:10:41	0.7380	-0.017
10/02/00	18:10:43	0.7813	-0.017
10/02/00	18:10:46	0.8280	-0.017
10/02/00	18:10:49	0.8763	-0.017
10/02/00	18:10:52	0.9280	-0.017
10/02/00	18:10:55	0.9830	-0.017
10/02/00	18:10:59	1.0413	-0.017
10/02/00	18:11:03	1.1030	-0.018
10/02/00	18:11:07	1.1680	-0.018
10/02/00	18:11:11	1.2380	-0.018
10/02/00	18:11:15	1.3113	-0.018
10/02/00	18:11:20	1.3897	-0.018
10/02/00	18:11:25	1.4730	-0.018
10/02/00	18:11:30	1.5613	-0.018
10/02/00	18:11:36	1.6547	-0.017
10/02/00	18:11:42	1.7530	-0.018
10/02/00	18:11:48	1.8580	-0.018
10/02/00	18:11:55	1.9680	-0.018
10/02/00	18:12:02	2.0847	-0.018
10/02/00	18:12:09	2.2097	-0.018
10/02/00	18:12:17	2.3413	-0.018
10/02/00	18:12:25	2.4813	-0.017
10/02/00	18:12:34	2.6297	-0.018
10/02/00	18:12:44	2.7863	-0.017
10/02/00	18:12:54	2.9530	-0.017
10/02/00	18:13:04	3.1297	-0.017
10/02/00	18:13:15	3.3163	-0.017
10/02/00	18:13:27	3.5147	-0.017
10/02/00	18:13:40	3.7247	-0.017
10/02/00	18:13:53	3.9463	-0.017
10/02/00	18:14:07	4.1813	-0.017
10/02/00	18:14:22	4.4297	-0.017
10/02/00	18:14:38	4.6930	-0.017
10/02/00	18:14:55	4.9730	-0.017
10/02/00	18:15:13	5.2697	-0.017
10/02/00	18:15:31	5.5830	-0.017
10/02/00	18:15:51	5.9147	-0.017
10/02/00	18:16:12	6.2663	-0.017
10/02/00	18:16:35	6.6397	-0.017
10/02/00	18:16:59	7.0347	-0.017
10/02/00	18:17:24	7.4530	-0.018

Job # 3853

NWIRP CALVERTON SLUG TEST, FUEL DEPOT AREA

Well No.	Total Depth (ft. TOC)	Depth to Water (ft TOC)	L_w	L_e	r_c	r_w	Top of Screen (ft. TOC)	Screen Length (ft)
04 S	26.08	18.62	7.46'	7.46'	0.167'	0.417'	16.0	10
05 S	25.92	17.50	8.42'	8.42'			16.0	
06 S	25.95	17.42	8.53'	8.53'			16.0	
07 I	44.05	15.37	28.68'	10.00'			34.05	
08 S	22.55	15.70	6.85'	6.85'			12.55	
09 S	22.75	15.18	7.57'	7.57'			12.75	
10 S	22.85	17.23	5.62'	5.62'			12.85	

Avg. Aquifer Thickness = H or D =

{True confining layer @ appx. 1100 ft. Local aquitards at appx 60 to 80 ft (minus ~15' depth to water). Use average estimated aquifer thickness value of 55'.}

ATTACHMENT I

ANALYTICAL RESULTS

INITIAL GROUNDWATER ANALYTICAL DATA

CTO189 - NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA001

SAMPLE NUMBER:	FD-GWGR19-00			FD-GWGR24-00			FD-GWGR4-00			FD-GWGRD-00		
SAMPLE DATE:	03/01/00			03/01/00			02/29/00			02/28/00		
LABORATORY ID:	C0C020132009			C0C020132007			C0C020132002			C0B290180001		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
PETROLEUM HYDROCARBONS												
DIESEL RANGE ORGANICS	2100			1100			3400			1200		
GASOLINE RANGE ORGANICS	1200			1700			5800			290		

CTO189 - NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA001

SAMPLE NUMBER:	GWFD-030200											
SAMPLE DATE:	03/02/00			/ /			/ /			/ /		
LABORATORY ID:	C0C030123002											
QC_TYPE:	NORMAL											
% SOLIDS:	0.0 %			100.0 %			100.0 %			100.0 %		
UNITS:	UG/L											
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
PETROLEUM HYDROCARBONS												
DIESEL RANGE ORGANICS	570											
GASOLINE RANGE ORGANICS	100	U										

CTO189 - NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA001

SAMPLE NUMBER:	FD-GW01S-00			FD-GW03S-00			FD-GW04S-00			FD-GW05S-00		
SAMPLE DATE:	03/01/00			03/01/00			02/29/00			02/29/00		
LABORATORY ID:	C0C020132010			C0C020132008			C0C020132005			C0C020132003		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
1,1,1-TRICHLOROETHANE	10	U		10	U		50	U		10	U	
1,1,2,2-TETRACHLOROETHANE	10	U		10	U		50	U		10	U	
1,1,2-TRICHLOROETHANE	10	U		10	U		50	U		10	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	10	UJ	C	10	UJ	C	50	UJ	C	10	UJ	C
1,1-DICHLOROETHANE	10	U		10	U		50	U		10	U	
1,1-DICHLOROETHENE	10	UJ	C	10	UJ	C	50	UJ	C	10	UJ	C
1,2-DICHLOROETHANE	10	U		10	U		50	U		10	U	
1,2-DICHLOROETHENE (TOTAL)	10	U		10	U		50	U		10	U	
1,2-DICHLOROPROPANE	10	U		10	U		50	U		10	U	
2-BUTANONE	10	UJ	C	10	UJ	C	50	UJ	C	10	UJ	C
2-HEXANONE	10	U		10	U		50	U		10	U	
4-METHYL-2-PENTANONE	10	U		10	U		50	U		10	U	
ACETONE	10	UJ	C	10	UJ	C	50	UJ	C	10	UJ	C
BENZENE	10	U		10	U		50	U		10	U	
BROMODICHLOROMETHANE	10	U		10	U		50	U		10	U	
BROMOFORM	10	U		10	U		50	U		10	U	
BROMOMETHANE	10	U		10	U		50	U		10	U	
CARBON DISULFIDE	10	U		10	U		50	U		10	U	
CARBON TETRACHLORIDE	10	U		10	U		50	U		10	U	
CHLOROBENZENE	10	U		10	U		50	U		10	U	
CHLOROETHANE	10	UJ	C	10	UJ	C	50	UJ	C	10	UJ	C
CHLOROFORM	10	U		10	U		50	U		10	U	
CHLOROMETHANE	10	U		10	U		50	U		10	U	
CIS-1,3-DICHLOROPROPENE	10	U		10	U		50	U		10	U	
DIBROMOCHLOROMETHANE	10	U		10	U		50	U		10	U	
DIFLUORODICHLOROMETHANE	10	UJ	C	10	UJ	C	50	UJ	C	10	UJ	C
ETHYLBENZENE	10	U		10	U		120			110		
METHYL TERT-BUTYL ETHER	10	U		10	U		50	U		10	U	
METHYLENE CHLORIDE	10	U		10	U		50	U		10	U	
STYRENE	10	U		10	U		50	U		10	U	
TETRACHLOROETHENE	10	U		10	U		50	U		10	U	
TOLUENE	10	U		10	U		5.2	J	P	10	U	

CTO189 - NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA001

SAMPLE NUMBER:	FD-GW01S-00			FD-GW03S-00			FD-GW04S-00			FD-GW05S-00		
SAMPLE DATE:	03/01/00			03/01/00			02/29/00			02/29/00		
LABORATORY ID:	C0C020132010			C0C020132008			C0C020132005			C0C020132003		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
TRICHLOROFLUOROMETHANE	10	U		10	U		50	U		10	U	
VINYL CHLORIDE	10	UJ	C	10	UJ	C	50	UJ	C	10	UJ	C
XYLENES, TOTAL	10	U		2.2	J	P	1100			460		

CTO189 - NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA001

SAMPLE NUMBER:	FD-GW06S-00			FD-GW07S-00			FD-GWGR11-00			FD-GWGR16-00		
SAMPLE DATE:	02/29/00			03/02/00			02/28/00			02/29/00		
LABORATORY ID:	C0C020132001			C0C030123001			C0B290180002			C0C020132004		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
1,1,1-TRICHLOROETHANE	10	U		10	U		33	U		10	U	
1,1,2,2-TETRACHLOROETHANE	10	U		10	U		33	U		10	U	
1,1,2-TRICHLOROETHANE	10	U		10	U		33	U		10	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	10	UJ	C	10	U		33	U		13	J	C
1,1-DICHLOROETHANE	10	U		10	U		33	U		10	U	
1,1-DICHLOROETHENE	10	UJ	C	10	U		33	U		10	UJ	C
1,2-DICHLOROETHANE	10	U		10	U		33	U		10	U	
1,2-DICHLOROETHENE (TOTAL)	10	U		10	U		33	U		10	U	
1,2-DICHLOROPROPANE	10	U		10	U		33	U		10	U	
2-BUTANONE	10	UJ	C	10	U		33	UJ	C	10	UJ	C
2-HEXANONE	10	U		10	UJ	C	33	U		10	U	
4-METHYL-2-PENTANONE	10	U		10	UJ	C	33	U		10	U	
ACETONE	10	UJ	C	10	U		33	UJ	C	10	UJ	C
BENZENE	10	U		10	U		6	J	P	10	U	
BROMODICHLOROMETHANE	10	U		10	U		33	U		10	U	
BROMOFORM	10	U		10	U		33	U		10	U	
BROMOMETHANE	10	U		10	U		33	U		10	U	
CARBON DISULFIDE	10	U		10	U		33	U		10	U	
CARBON TETRACHLORIDE	10	U		10	U		33	U		10	U	
CHLOROBENZENE	10	U		10	U		33	U		10	U	
CHLOROETHANE	10	UJ	C	10	UJ	C	33	UJ	C	10	UJ	C
CHLOROFORM	10	U		10	U		33	U		10	U	
CHLOROMETHANE	10	U		10	U		33	U		10	U	
CIS-1,3-DICHLOROPROPENE	10	U		10	U		33	U		10	U	
DIBROMOCHLOROMETHANE	10	U		10	U		33	U		10	U	
DIFLUORODICHLOROMETHANE	10	UJ	C	10	UJ	C	33	U		10	UJ	C
ETHYLBENZENE	28			10	U		220			3.7	J	P
METHYL TERT-BUTYL ETHER	10	U		10	U		33	U		10	UJ	C
METHYLENE CHLORIDE	10	U		10	U		33	U		10	U	
STYRENE	10	U		10	U		33	U		10	U	
TETRACHLOROETHENE	10	U		10	U		33	U		10	U	
TOLUENE	10	U		10	U		550			1.2	J	P
TRANS-1,3-DICHLOROPROPENE	10	U		10	U		33	U		10	U	

CTO189 - NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA001

SAMPLE NUMBER:	FD-GW06S-00			FD-GW07S-00			FD-GWGR11-00			FD-GWGR16-00		
SAMPLE DATE:	02/29/00			03/02/00			02/28/00			02/29/00		
LABORATORY ID:	C0C020132001			C0C030123001			C0B290180002			C0C020132004		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
TRICHLOROFLUOROMETHANE	10	U		10	U		33	UJ	C	10	U	
VINYL CHLORIDE	10	UJ	C	10	U		33	U		10	UJ	C
XYLENES, TOTAL	170			10	U		1100			24		

CTO189 - NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA001

SAMPLE NUMBER:	FD-GWGR19-00			FD-GWGR24-00			FD-GWGR4-00			FD-GWGRD-00		
SAMPLE DATE:	03/01/00			03/01/00			02/29/00			02/28/00		
LABORATORY ID:	C0C020132009			C0C020132007			C0C020132002			C0B290180001		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
1,1,1-TRICHLOROETHANE	10	U		20	U		100	U		10	U	
1,1,2,2-TETRACHLOROETHANE	10	U		20	U		100	U		10	U	
1,1,2-TRICHLOROETHANE	10	U		20	U		100	U		10	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	10	U		20	UJ	C	100	UJ	C	10	U	
1,1-DICHLOROETHANE	10	U		20	U		100	U		10	U	
1,1-DICHLOROETHENE	10	U		20	UJ	C	100	UJ	C	10	U	
1,2-DICHLOROETHANE	10	U		20	U		100	U		10	U	
1,2-DICHLOROETHENE (TOTAL)	10	U		20	U		100	U		10	U	
1,2-DICHLOROPROPANE	10	U		20	U		100	U		10	U	
2-BUTANONE	10	U		20	UJ	C	100	UJ	C	10	UJ	C
2-HEXANONE	10	UJ	C	20	U		100	U		10	U	
4-METHYL-2-PENTANONE	10	UJ	C	20	U		100	U		10	U	
ACETONE	10	U		20	UJ	C	100	UJ	C	10	U	B
BENZENE	10	U		8.8	J	P	100	U		10	U	
BROMODICHLOROMETHANE	10	U		20	U		100	U		10	U	
BROMOFORM	10	U		20	U		100	U		10	U	
BROMOMETHANE	10	U		20	U		100	U		10	U	
CARBON DISULFIDE	10	U		20	U		100	U		10	U	
CARBON TETRACHLORIDE	10	U		20	U		100	U		10	U	
CHLOROBENZENE	10	U		20	U		100	U		10	U	
CHLOROETHANE	10	U		20	UJ	C	100	UJ	C	10	UJ	C
CHLOROFORM	10	U		20	U		100	U		10	U	
CHLOROMETHANE	10	UJ	C	20	U		100	U		10	U	
CIS-1,3-DICHLOROPROPENE	10	U		20	U		100	U		10	U	
DIBROMOCHLOROMETHANE	10	U		20	U		100	U		10	U	
DIFLUORODICHLOROMETHANE	10	UJ	C	20	UJ	C	100	UJ	C	10	U	
ETHYLBENZENE	10	U		83			290			10	U	
METHYL TERT-BUTYL ETHER	10	U		20	U		100	U		10	U	
METHYLENE CHLORIDE	10	U		20	U		100	U		10	U	
STYRENE	10	U		20	U		100	U		10	U	
TETRACHLOROETHENE	10	U		20	U		100	U		10	U	
TOLUENE	10	U		28			140			10	U	
TRANS-1,3-DICHLOROPROPENE	10	U		20	U		100	U		10	U	

CTO189 - NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA001

SAMPLE NUMBER:	FD-GWGR19-00			FD-GWGR24-00			FD-GWGR4-00			FD-GWGRD-00		
SAMPLE DATE:	03/01/00			03/01/00			02/29/00			02/28/00		
LABORATORY ID:	C0C020132009			C0C020132007			C0C020132002			C0B290180001		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**
VOLATILES												
TRICHLOROFLUOROMETHANE	10	U		20	U		100	U		10	U	
VINYL CHLORIDE	10	U		20	UJ	C	100	UJ	C	10	U	
XYLENES, TOTAL	10	U		390			2300			3.9	J	P

CTO189 - NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA001

SAMPLE NUMBER:	GWFD-030200			GWTB-022800			GWTB-022900			GWTB-030100		
SAMPLE DATE:	03/02/00			02/28/00			02/29/00			03/01/00		
LABORATORY ID:	C0C030123002			C0B290180003			C0C020132006			C0C020132011		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
1,1,1-TRICHLOROETHANE	10	U		10	U		10	U		10	U	
1,1,2,2-TETRACHLOROETHANE	10	U		10	U		10	U		10	U	
1,1,2-TRICHLOROETHANE	10	U		10	U		10	U		10	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	10	U		10	U		10	UJ	C	10	UJ	C
1,1-DICHLOROETHANE	10	U		10	U		10	U		10	UJ	C
1,1-DICHLOROETHENE	10	U		10	U		10	UJ	C	10	UJ	C
1,2-DICHLOROETHANE	10	U		10	U		10	U		10	U	
1,2-DICHLOROETHENE (TOTAL)	10	U		10	U		10	U		10	U	
1,2-DICHLOROPROPANE	10	U		10	U		10	U		10	U	
2-BUTANONE	10	U		10	UJ	C	10	UJ	C	10	UJ	C
2-HEXANONE	10	UJ	C	10	U		10	U		10	U	
4-METHYL-2-PENTANONE	10	UJ	C	10	U		10	U		10	U	
ACETONE	10	U	B	10	U		1.3	J	CP	2.4	J	CP
BENZENE	10	U		10	U		10	U		10	U	
BROMODICHLOROMETHANE	10	U		10	U		10	U		10	U	
BROMOFORM	10	U		10	U		10	U		10	U	
BROMOMETHANE	10	U		10	U		10	U		10	U	
CARBON DISULFIDE	10	U		10	U		10	U		10	U	
CARBON TETRACHLORIDE	10	U		10	U		10	U		10	U	
CHLOROBENZENE	10	U		10	U		10	U		10	U	
CHLOROETHANE	10	U		10	UJ	C	10	UJ	C	10	UJ	C
CHLOROFORM	10	U		10	U		10	U		10	U	
CHLOROMETHANE	10	UJ	C	10	U		10	U		10	U	
CIS-1,3-DICHLOROPROPENE	10	U		10	U		10	U		10	U	
DIBROMOCHLOROMETHANE	10	U		10	U		10	U		10	U	
DIFLUORODICHLOROMETHANE	10	UJ	C	10	U		10	UJ	C	10	UJ	C
ETHYLBENZENE	10	U		10	U		10	U		10	U	
METHYL TERT-BUTYL ETHER	10	U		10	U		10	U		10	U	
METHYLENE CHLORIDE	10	U		10	U		10	U		10	U	
STYRENE	10	U		10	U		10	U		10	U	
TETRACHLOROETHENE	10	U		10	U		10	U		10	U	
TOLUENE	10	U		10	U		10	U		10	U	
TRANS-1,3-DICHLOROPROPENE	10	U		10	U		10	U		10	U	

CTO189 - NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA001

SAMPLE NUMBER:	GWFD-030200			GWTB-022800			GWTB-022900			GWTB-030100		
SAMPLE DATE:	03/02/00			02/28/00			02/29/00			03/01/00		
LABORATORY ID:	C0C030123002			C0B290180003			C0C020132006			C0C020132011		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
TRICHLOROFLUOROMETHANE	10	U		10	UJ	C	10	U		10	U	
VINYL CHLORIDE	10	U		10	U		10	UJ	C	10	UJ	C
XYLENES, TOTAL	10	U		10	U		10	U		10	U	

CTO189 - NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA001

SAMPLE NUMBER:	GWTB-030200											
SAMPLE DATE:	03/02/00			/ /			/ /			/ /		
LABORATORY ID:	C0C030123003											
QC_TYPE:	NORMAL											
% SOLIDS:	0.0 %			100.0 %			100.0 %			100.0 %		
UNITS:	UG/L											
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
1,1,1-TRICHLOROETHANE	10	U										
1,1,2,2-TETRACHLOROETHANE	10	U										
1,1,2-TRICHLOROETHANE	10	U										
1,1,2-TRICHLOROTRIFLUOROETHANE	10	U										
1,1-DICHLOROETHANE	10	U										
1,1-DICHLOROETHENE	10	U										
1,2-DICHLOROETHANE	10	U										
1,2-DICHLOROETHENE (TOTAL)	10	U										
1,2-DICHLOROPROPANE	10	U										
2-BUTANONE	10	U										
2-HEXANONE	10	UJ	C									
4-METHYL-2-PENTANONE	10	UJ	C									
ACETONE	10	U										
BENZENE	10	U										
BROMODICHLOROMETHANE	10	U										
BROMOFORM	10	U										
BROMOMETHANE	10	U										
CARBON DISULFIDE	10	U										
CARBON TETRACHLORIDE	10	U										
CHLOROBENZENE	10	U										
CHLOROETHANE	10	U										
CHLOROFORM	10	U										
CHLOROMETHANE	10	UJ	C									
CIS-1,3-DICHLOROPROPENE	10	U										
DIBROMOCHLOROMETHANE	10	U										
DIFLUORODICHLOROMETHANE	10	UJ	C									
ETHYLBENZENE	10	U										
METHYL TERT-BUTYL ETHER	10	U										
METHYLENE CHLORIDE	10	U										
STYRENE	10	U										
TETRACHLOROETHENE	10	U										
TOLUENE	10	U										
TRANS-1,3-DICHLOROPROPENE	10	U										

CTO189 - NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA001

SAMPLE NUMBER:	GWTB-030200											
SAMPLE DATE:	03/02/00			/ /			/ /			/ /		
LABORATORY ID:	C0C030123003											
QC_TYPE:	NORMAL											
% SOLIDS:	0.0 %			100.0 %			100.0 %			100.0 %		
UNITS:	UG/L											
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
TRICHLOROFLUOROMETHANE	10	U										
VINYL CHLORIDE	10	U										
XYLENES, TOTAL	10	U										

CTO189 - NWIRP CALVERTON

WATER DATA
QUANTERRA
SDG: CA001

SAMPLE NUMBER:	FD-GW01S-00			FD-GW03S-00			FD-GW04S-00			FD-GW05S-00		
SAMPLE DATE:	03/01/00			03/01/00			02/29/00			02/29/00		
LABORATORY ID:	C0C020132010			C0C020132008			C0C020132005			C0C020132003		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**
PETROLEUM HYDROCARBONS												
DIESEL RANGE ORGANICS	150			470			850			1000		
GASOLINE RANGE ORGANICS	100	U		100	U		2800			1700		

CTO189 - NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA001

SAMPLE NUMBER:	FD-GW06S-00			FD-GW07S-00			FD-GWGR11-00			FD-GWGR16-00		
SAMPLE DATE:	02/29/00			03/02/00			02/28/00			02/29/00		
LABORATORY ID:	C0C020132001			C0C030123001			C0B290180002			C0C020132004		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
PETROLEUM HYDROCARBONS												
DIESEL RANGE ORGANICS	3000			560			39000			250		
GASOLINE RANGE ORGANICS	4000			100	U		11000			100	U	

MONITORED NATURAL ATTENUATION ANALYTICAL DATA

CTO1 NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA003

SAMPLE NUMBER:	FD-GW07S-00			FD-GW10S-00			TB071700					
SAMPLE DATE:	07/17/00			07/17/00			07/17/00			/ /		
LABORATORY ID:	C0G180124002			C0G180124003			C0G180124001					
QC_TYPE:	NORMAL			NORMAL			NORMAL					
% SOLIDS:	0.0 %			0.0 %			0.0 %			100.0 %		
UNITS:	UG/L			UG/L			UG/L					
FIELD DUPLICATE OF:												
	RESULT	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**
VOLATILES												
1,1,1-TRICHLOROETHANE	10	U		10	U		10	U				
1,1,2,2-TETRACHLOROETHANE	10	U		10	U		10	U				
1,1,2-TRICHLOROETHANE	10	U		10	U		10	U				
1,1,2-TRICHLOROTRIFLUOROETHANE	10	U		10	U		10	U				
1,1-DICHLOROETHANE	10	U		10	U		10	U				
1,1-DICHLOROETHENE	10	U		10	U		10	U				
1,2-DICHLOROETHANE	10	U		10	U		10	U				
1,2-DICHLOROETHENE (TOTAL)	10	U		10	U		10	U				
1,2-DICHLOROPROPANE	10	U		10	U		10	U				
2-BUTANONE	10	U		10	U		10	U				
2-HEXANONE	10	U		10	U		10	U				
4-METHYL-2-PENTANONE	10	U		10	U		10	U				
ACETONE	10	U		10	U		10	U				
BENZENE	10	U		1.3	J	P	10	U				
BROMODICHLOROMETHANE	10	U		10	U		10	U				
BROMOFORM	10	U		10	U		10	U				
BROMOMETHANE	10	UJ	C	10	UJ	C	10	UJ	C			
CARBON DISULFIDE	10	U		10	U		10	U				
CARBON TETRACHLORIDE	10	U		10	U		10	U				
CHLOROBENZENE	10	U		10	U		10	U				
CHLOROETHANE	10	UJ	C	10	UJ	C	10	UJ	C			
CHLOROFORM	10	U		10	U		10	U				
CHLOROMETHANE	10	U		10	U		10	U				
CIS-1,3-DICHLOROPROPENE	10	U		10	U		10	U				
DIBROMOCHLOROMETHANE	10	U		10	U		10	U				
DICHLORODIFLUOROMETHANE	10	U		10	U		10	U				
ETHYLBENZENE	10	U		28			10	U				
METHYL TERT-BUTYL ETHER	10	U		10	U		10	U				
METHYLENE CHLORIDE	10	U		10	U		10	U				
STYRENE	10	U		10	U		10	U				
TETRACHLOROETHENE	10	U		10	U		10	U				
TOLUENE	10	U		3.2	J	P	10	U				

CTO189-NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA003

SAMPLE NUMBER:	FD-GW07S-00			FD-GW10S-00			TB071700					
SAMPLE DATE:	07/17/00			07/17/00			07/17/00			/ /		
LABORATORY ID:	C0G180124002			C0G180124003			C0G180124001					
QC_TYPE:	NORMAL			NORMAL			NORMAL					
% SOLIDS:	0.0 %			0.0 %			0.0 %			100.0 %		
UNITS:	UG/L			UG/L			UG/L					
FIELD DUPLICATE OF:												
	RESULT	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**
VOLATILES												
TRICHLOROETHENE	10	U		10	U		10	U				
TRICHLOROFLUOROMETHANE	10	UJ	C	10	UJ	C	10	UJ	C			
VINYL CHLORIDE	10	U		10	U		10	U				
XYLENES, TOTAL	10	U		84			10	U				

CTO1 NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA004

SAMPLE NUMBER:	FD-GW07I-00	FD-GW08S-00	FD-GW09S-00	TB-071800
SAMPLE DATE:	07/18/00	07/18/00	07/18/00	07/18/00
LABORATORY ID:	C0G190132002	C0G190132003	C0G190132004	C0G190132001
QC_TYPE:	NORMAL	NORMAL	NORMAL	NORMAL
% SOLIDS:	0.0 %	0.0 %	0.0 %	0.0 %
UNITS:	UG/L	UG/L	UG/L	UG/L
FIELD DUPLICATE OF:				

	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
1,1,1-TRICHLOROETHANE	10	U		10	U		10	U		10	U	
1,1,2,2-TETRACHLOROETHANE	10	U		10	U		10	U		10	U	
1,1,2-TRICHLOROETHANE	10	U		10	U		10	U		10	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	17			10	U		10	U		10	U	
1,1-DICHLOROETHANE	10	U		10	U		10	U		10	U	
1,1-DICHLOROETHENE	10	U		10	U		10	U		10	U	
1,2-DICHLOROETHANE	10	U		10	U		10	U		10	U	
1,2-DICHLOROETHENE (TOTAL)	10	U		10	U		10	U		10	U	
1,2-DICHLOROPROPANE	10	U		10	U		10	U		10	U	
2-BUTANONE	10	U		10	U		10	U		10	U	
2-HEXANONE	10	U		10	U		10	U		10	U	
4-METHYL-2-PENTANONE	10	U		10	U		10	U		10	U	
ACETONE	2.8	J	P	10	U		10	U		10	U	
BENZENE	10	U		10	U		10	U		10	U	
BROMODICHLOROMETHANE	10	U		10	U		10	U		10	U	
BROMOFORM	10	U		10	U		10	U		10	U	
BROMOMETHANE	10	UJ	C	10	UJ	C	10	UJ	C	10	UJ	C
CARBON DISULFIDE	10	U		10	U		10	U		10	U	
CARBON TETRACHLORIDE	10	U		10	U		10	U		10	U	
CHLOROBENZENE	10	U		10	U		10	U		10	U	
CHLOROETHANE	10	UJ	C	10	UJ	C	10	UJ	C	10	UJ	C
CHLOROFORM	10	U		10	U		10	U		10	U	
CHLOROMETHANE	10	U		10	U		10	U		10	U	
CIS-1,3-DICHLOROPROPENE	10	U		10	U		10	U		10	U	
DIBROMOCHLOROMETHANE	10	U		10	U		10	U		10	U	
DICHLORODIFLUOROMETHANE	10	U		10	U		10	U		10	U	
ETHYLBENZENE	10	U		10	U		10	U		10	U	
METHYL TERT-BUTYL ETHER	10	U		10	U		10	U		10	U	
METHYLENE CHLORIDE	10	U		10	U		10	U		10	U	
STYRENE	10	U		10	U		10	U		10	U	
TETRACHLOROETHENE	10	U		10	U		10	U		10	U	
TOLUENE	10	U		10	U		10	U		10	U	
[illegible]	10	U		10	U		10	U		10	U	

CTO189-NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA004

SAMPLE NUMBER:	FD-GW07I-00			FD-GW08S-00			FD-GW09S-00			TB-071800		
SAMPLE DATE:	07/18/00			07/18/00			07/18/00			07/18/00		
LABORATORY ID:	C0G190132002			C0G190132003			C0G190132004			C0G190132001		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
TRICHLOROETHENE	10	U		10	U		10	U		10	U	
TRICHLOROFLUOROMETHANE	10	UJ	C	10	UJ	C	10	UJ	C	10	UJ	C
VINYL CHLORIDE	10	U		10	U		10	U		10	U	
XYLENES, TOTAL	2.1	J	P	10	U		10	U		10	U	

CTO NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA006

SAMPLE NUMBER:	FB-071900-DI			FB-071900-POT			FD-GW03S-00			FD-GW04S-00		
SAMPLE DATE:	07/19/00			07/19/00			07/19/00			07/19/00		
LABORATORY ID:	C0G210192003			C0G210192002			C0G210192004			C0G210192005		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
1,1,1-TRICHLOROETHANE	10	U		10	U		10	U		100	U	
1,1,2,2-TETRACHLOROETHANE	10	U		10	U		10	U		100	U	
1,1,2-TRICHLOROETHANE	10	U		10	U		10	U		100	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	10	U		10	U		10	U		100	U	
1,1-DICHLOROETHANE	10	U		10	U		10	U		100	U	
1,1-DICHLOROETHENE	10	U		10	U		10	U		100	U	
1,2-DICHLOROETHANE	10	U		10	U		10	U		100	U	
1,2-DICHLOROETHENE (TOTAL)	10	U		10	U		10	U		100	U	
1,2-DICHLOROPROPANE	10	U		10	U		10	U		100	U	
2-BUTANONE	10	UJ	C	10	UJ	C	10	UJ	C	100	UJ	C
2-HEXANONE	10	U		10	U		10	U		100	U	
4-METHYL-2-PENTANONE	10	U		10	U		10	U		100	U	
ACETONE	10	UJ	C	10	UJ	C	2.2	J	CP	100	UJ	C
BENZENE	10	U		10	U		10	U		100	U	
BROMODICHLOROMETHANE	10	U		1.9	J	P	10	U		100	U	
BROMOFORM	10	U		10	U		10	U		100	U	
BROMOMETHANE	10	U		10	U		10	U		100	U	
CARBON DISULFIDE	10	U		10	U		10	U		100	U	
CARBON TETRACHLORIDE	10	U		10	U		10	U		100	U	
CHLOROBENZENE	10	U		10	U		10	U		100	U	
CHLOROETHANE	10	U		10	U		10	U		100	U	
CHLOROFORM	10	U		1.8	J	P	10	U		100	U	
CHLOROMETHANE	10	U		10	U		10	U		100	U	
CIS-1,3-DICHLOROPROPENE	10	U		10	U		10	U		100	U	
DIBROMOCHLOROMETHANE	10	U		10	U		10	U		100	U	
DICHLORODIFLUOROMETHANE	10	UJ	C	10	UJ	C	10	UJ	C	100	UJ	C
ETHYLBENZENE	10	U		10	U		10	U		500		
METHYL TERT-BUTYL ETHER	10	U		10	U		10	U		100	U	
METHYLENE CHLORIDE	10	U		10	U		10	U		100	U	
STYRENE	10	U		10	U		10	U		100	U	
TETRACHLOROETHENE	10	U		10	U		10	U		100	U	
TOLUENE	10	U		10	U		10	U		14	J	P
TRANS-1,3-DICHLOROPROPENE	10	U		10	U		10	U		100	U	

CTO189-NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA006

SAMPLE NUMBER:	FB-071900-DI			FB-071900-POT			FD-GW03S-00			FD-GW04S-00		
SAMPLE DATE:	07/19/00			07/19/00			07/19/00			07/19/00		
LABORATORY ID:	C0G210192003			C0G210192002			C0G210192004			C0G210192005		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
TRICHLOROETHENE	10	U		10	U		10	U		100	U	
TRICHLOROFLUOROMETHANE	10	UJ	C	10	UJ	C	10	UJ	C	100	UJ	C
VINYL CHLORIDE	10	U		10	U		10	U		100	U	
XYLENES, TOTAL	10	U		10	U		10	U		4800		

CTO1 NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA006

SAMPLE NUMBER:	FD-GWFD-071900			FD-MWERMIBN			RB-071900			TB-071900		
SAMPLE DATE:	07/19/00			07/19/00			07/19/00			07/14/00		
LABORATORY ID:	C0G210192007			C0G210192006			C0G210192011			C0G210192001		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:	FD-MWERM1BN											
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
1,1,1-TRICHLOROETHANE	50	U		10	U		10	U		10	U	
1,1,2,2-TETRACHLOROETHANE	50	U		10	U		10	U		10	U	
1,1,2-TRICHLOROETHANE	50	U		10	U		10	U		10	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	50	U		10	U		10	U		10	U	
1,1-DICHLOROETHANE	50	U		10	U		10	U		10	U	
1,1-DICHLOROETHENE	50	U		10	U		10	U		10	U	
1,2-DICHLOROETHANE	50	U		10	U		10	U		10	U	
1,2-DICHLOROETHENE (TOTAL)	50	U		10	U		10	U		10	U	
1,2-DICHLOROPROPANE	50	U		10	U		10	U		10	U	
2-BUTANONE	50	UJ	C	3.1	J	PC	5.3	J	PC	10	UJ	C
2-HEXANONE	50	U		10	U		10	U		10	U	
4-METHYL-2-PENTANONE	50	U		10	U		10	U		10	U	
ACETONE	100	J	C	70	J	C	17	J	C	10	UJ	C
BENZENE	50	U		10	U		10	U		10	U	
BROMODICHLOROMETHANE	50	U		10	U		10	U		10	U	
BROMOFORM	50	U		10	U		10	U		10	U	
BROMOMETHANE	50	U		10	U		10	U		10	U	
CARBON DISULFIDE	50	U		10	U		10	U		10	U	
CARBON TETRACHLORIDE	50	U		10	U		10	U		10	U	
CHLOROBENZENE	50	U		10	U		10	U		10	U	
CHLOROETHANE	50	U		10	U		10	U		10	U	
CHLOROFORM	50	U		10	U		10	U		10	U	
CHLOROMETHANE	50	U		10	U		10	U		10	U	
CIS-1,3-DICHLOROPROPENE	50	U		10	U		10	U		10	U	
DIBROMOCHLOROMETHANE	50	UJ	C	10	UJ	C	10	UJ	C	10	UJ	C
DICHLORODIFLUOROMETHANE	50	U		10	U		10	U		10	U	
ETHYLBENZENE	190			33			10	U		10	U	
METHYL TERT-BUTYL ETHER	50	U		10	U		10	U		10	U	
METHYLENE CHLORIDE	50	U		10	U		10	U		10	U	
STYRENE	50	U		10	U		10	U		10	U	
TETRACHLOROETHENE	50	U		10	U		10	U		10	U	
TOLUENE	490			75			10	U		10	U	
TRANS-1,3-DICHLOROPROPENE	50	U		10	U		10	U		10	U	

CTO189-NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA006

SAMPLE NUMBER:	FD-GWFD-071900			FD-MWERMIBN			RB-071900			TB-071900		
SAMPLE DATE:	07/19/00			07/19/00			07/19/00			07/14/00		
LABORATORY ID:	C0G210192007			C0G210192006			C0G210192011			C0G210192001		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:	FD-MWERM1BN											
	RESULT	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**
VOLATILES												
TRICHLOROETHENE	50	U		10	U		10	U		10	U	
TRICHLOROFLUOROMETHANE	50	UJ	C	10	UJ	C	10	UJ	C	10	UJ	C
VINYL CHLORIDE	50	U		10	U		10	U		10	U	
XYLENES, TOTAL	930			170			10	U		10	U	

CTO1[illegible] NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA007

SAMPLE NUMBER:	FC-GW01S-00	FC-GW02S-11-6-00-REP	FC-GW02S-11.6-00	FC-GW03S-11-6-00-REP
SAMPLE DATE:	07/31/00	08/01/00	08/01/00	08/01/00
LABORATORY ID:	C0H010196002	C0H020129008	C0H020129005	C0H020129009
QC_TYPE:	NORMAL	NORMAL	NORMAL	NORMAL
% SOLIDS:	0.0 %	0.0 %	0.0 %	0.0 %
UNITS:	UG/L	UG/L	UG/L	UG/L
FIELD DUPLICATE OF:				

	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
1,1,1-TRICHLOROETHANE	10	U		2000			1900			1.7	J	P
1,1,2,2-TETRACHLOROETHANE	10	U		200	U		200	U		10	U	
1,1,2-TRICHLOROETHANE	10	U		200	U		200	U		10	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	10	UJ	C	200	UJ	C	200	UJ	C	10	U	
1,1-DICHLOROETHANE	10	U		3400			3300			2.6	J	P
1,1-DICHLOROETHENE	10	U		30	J	P	25	J	P	10	U	
1,2-DICHLOROETHANE	10	U		200	U		200	U		10	U	
1,2-DICHLOROETHENE (TOTAL)	10	U		200	U		200	U		10	U	
1,2-DICHLOROPROPANE	10	U		200	U		200	U		10	U	
2-BUTANONE	10	UJ	C	200	UJ	C	200	UJ	C	10	U	
2-HEXANONE	10	U		200	U		200	U		10	U	
4-METHYL-2-PENTANONE	10	U		200	U		200	U		10	U	
ACETONE	10	U		200	U		200	U		10	U	
BENZENE	10	U		200	U		200	U		10	U	
BROMODICHLOROMETHANE	10	U		200	U		200	U		10	U	
BROMOFORM	10	U		200	U		200	U		10	U	
BROMOMETHANE	10	UJ	C	200	UJ	C	200	UJ	C	10	UJ	C
CARBON DISULFIDE	10	U		200	U		200	U		10	U	
CARBON TETRACHLORIDE	10	U		200	U		200	U		10	U	
CHLOROBENZENE	10	U		200	U		200	U		10	U	
CHLOROETHANE	10	U		200	U		200	U		10	U	
CHLOROFORM	10	U		200	U		200	U		10	U	
CHLOROMETHANE	10	U		200	U		200	U		10	U	
CIS-1,3-DICHLOROPROPENE	10	U		200	U		200	U		10	U	
DIBROMOCHLOROMETHANE	10	U		200	U		200	U		10	U	
DICHLORODIFLUOROMETHANE	10	U		200	U		200	U		10	U	
ETHYLBENZENE	10	U		29	J	P	46	J	P	10	U	
METHYL TERT-BUTYL ETHER	10	UJ	C	200	UJ	C	200	UJ	C	10	U	
METHYLENE CHLORIDE	10	U		200	U		200	U		10	U	
STYRENE	10	U		200	U		200	U		10	U	
TETRACHLOROETHENE	10	U		200	U		200	U		10	U	
TOLUENE	10	U		110	J	P	140	J	P	10	U	
[illegible]	[illegible]	[illegible]		200	U		200	U		10	U	

CTO189-NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA007

SAMPLE NUMBER:	FC-GW01S-00			FC-GW02S-11-6-00-REP			FC-GW02S-11.6-00			FC-GW03S-11-6-00-REP		
SAMPLE DATE:	07/31/00			08/01/00			08/01/00			08/01/00		
LABORATORY ID:	C0H010196002			C0H020129008			C0H020129005			C0H020129009		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
TRICHLOROETHENE	10	U		200	U		200	U		10	U	
TRICHLOROFLUOROMETHANE	10	U		200	U		200	U		10	U	
VINYL CHLORIDE	10	U		200	U		200	U		10	U	
XYLENES, TOTAL	10	U		330			510			10	U	

CTO NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA007

SAMPLE NUMBER:	FC-GW03S-11.6-00			GW-FB-080100-DI			GW-FB-080100-POT			GW-FD-080100		
SAMPLE DATE:	08/01/00			08/01/00			08/01/00			08/01/00		
LABORATORY ID:	C0H020129006			C0H020129003			C0H020129004			C0H020129007		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
1,1,1-TRICHLOROETHANE	10	U		10	U		10	U		10	U	
1,1,2,2-TETRACHLOROETHANE	10	U		10	U		10	U		10	U	
1,1,2-TRICHLOROETHANE	10	U		10	U		10	U		10	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	10	U		10	U		10	U		10	U	
1,1-DICHLOROETHANE	10	U		10	U		10	U		10	U	
1,1-DICHLOROETHENE	10	U		10	U		10	U		10	U	
1,2-DICHLOROETHANE	10	U		10	U		10	U		10	U	
1,2-DICHLOROETHENE (TOTAL)	10	U		10	U		10	U		10	U	
1,2-DICHLOROPROPANE	10	U		10	U		10	U		10	U	
2-BUTANONE	10	U		4.9	J	PC	10	U		10	U	
2-HEXANONE	10	U		10	U		10	U		10	U	
4-METHYL-2-PENTANONE	10	U		10	U		10	U		10	U	
ACETONE	10	U		11			10	U		10	U	
BENZENE	10	U		10	U		10	U		10	U	
BROMODICHLOROMETHANE	10	U		10	U		6.4	J	P	10	U	
BROMOFORM	10	U		10	U		1.5	J	P	10	U	
BROMOMETHANE	10	UJ	C	10	UJ	C	10	UJ	C	10	UJ	C
CARBON DISULFIDE	10	U		10	U		10	U		10	U	
CARBON TETRACHLORIDE	10	U		10	U		10	U		10	U	
CHLOROBENZENE	10	U		10	U		10	U		10	U	
CHLOROETHANE	10	U		10	U		10	U		10	U	
CHLOROFORM	10	U		10	U		6.6	J	P	10	U	
CHLOROMETHANE	10	U		10	U		10	U		10	U	
CIS-1,3-DICHLOROPROPENE	10	U		10	U		10	U		10	U	
DIBROMOCHLOROMETHANE	10	U		10	U		10	U		10	U	
DICHLORODIFLUOROMETHANE	10	U		10	U		10	U		10	U	
ETHYLBENZENE	10	U		10	U		10	U		10	U	
METHYL TERT-BUTYL ETHER	10	U		10	U		10	U		10	U	
METHYLENE CHLORIDE	10	U		2.8	J	P	10	U		10	U	
STYRENE	10	U		10	U		10	U		10	U	
TETRACHLOROETHENE	10	U		10	U		10	U		10	U	
TOLUENE	10	U		10	U		10	U		10	U	
TRANS-1,3-DICHLOROPROPENE	10	U		10	U		10	U		10	U	

CTO189-NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA007

SAMPLE NUMBER:	FC-GW03S-11.6-00			GW-FB-080100-DI			GW-FB-080100-POT			GW-FD-080100		
SAMPLE DATE:	08/01/00			08/01/00			08/01/00			08/01/00		
LABORATORY ID:	C0H020129006			C0H020129003			C0H020129004			C0H020129007		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
TRICHLOROETHENE	10	U		10	U		10	U		10	U	
TRICHLOROFLUOROMETHANE	10	U		10	U		10	U		10	U	
VINYL CHLORIDE	10	U		10	U		10	U		10	U	
XYLENES, TOTAL	10	U		10	U		10	U		10	U	

CTO NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA007

SAMPLE NUMBER:	GW-RB-080100	GW-TB-080100	GW-TB-080200	SA-PZ101-I-47-00
SAMPLE DATE:	08/01/00	08/01/00	08/02/00	08/02/00
LABORATORY ID:	C0H020129002	C0H020129001	C0H030222001	C0H030222002
QC_TYPE:	NORMAL	NORMAL	NORMAL	NORMAL
% SOLIDS:	0.0 %	0.0 %	0.0 %	0.0 %
UNITS:	UG/L	UG/L	UG/L	UG/L
FIELD DUPLICATE OF:				

	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
1,1,1-TRICHLOROETHANE	10	U		10	U		10	U		8.1	J	P
1,1,2,2-TETRACHLOROETHANE	10	U		10	U		10	U		10	U	
1,1,2-TRICHLOROETHANE	10	U		10	U		10	U		10	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	10	U		10	U		10	U		10	U	
1,1-DICHLOROETHANE	3.7	J	P	10	U		10	U		170		
1,1-DICHLOROETHENE	1.4	J	P	10	U		10	U		18		
1,2-DICHLOROETHANE	10	U		10	U		10	U		10	U	
1,2-DICHLOROETHENE (TOTAL)	10	U		10	U		10	U		10	U	
1,2-DICHLOROPROPANE	10	U		10	U		10	U		10	U	
2-BUTANONE	4.8	J	CP	10	U		10	U		10	U	
2-HEXANONE	10	U		10	U		10	U		10	U	
4-METHYL-2-PENTANONE	10	U		10	U		10	U		10	U	
ACETONE	10	U		10	U		10	U		10	U	
BENZENE	1.1	J	P	10	U		10	U		10	U	
BROMODICHLOROMETHANE	10	U		10	U		10	U		10	U	
BROMOFORM	10	U		10	U		10	U		10	U	
BROMOMETHANE	10	UJ	C	10	UJ	C	10	UJ	C	10	UJ	C
CARBON DISULFIDE	10	U		10	U		10	U		10	U	
CARBON TETRACHLORIDE	10	U		10	U		10	U		10	U	
CHLOROBENZENE	1.1	J	P	10	U		10	U		10	U	
CHLOROETHANE	10	U		10	U		10	U		9.1	J	P
CHLOROFORM	10	U		10	U		10	U		10	U	
CHLOROMETHANE	10	U		10	U		10	U		10	U	
CIS-1,3-DICHLOROPROPENE	10	U		10	U		10	U		10	U	
DIBROMOCHLOROMETHANE	10	U		10	U		10	U		10	U	
DICHLORODIFLUOROMETHANE	10	U		10	U		10	U		10	U	
ETHYLBENZENE	10	U		10	U		10	U		10	U	
METHYL TERT-BUTYL ETHER	10	U		10	U		10	U		10	U	
METHYLENE CHLORIDE	2.7	J	P	10	U		5.2	J	P	10	U	
STYRENE	10	U		10	U		10	U		10	U	
TETRACHLOROETHENE	10	U		10	U		10	U		10	U	
TOLUENE	1.2	J	P	10	U		10	U		10	U	
TRANS-1,3-DICHLOROPROPENE	10	U		10	U		10	U		10	U	

CTO189-NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA007

SAMPLE NUMBER:	GW-RB-080100			GW-TB-080100			GW-TB-080200			SA-PZ101-I-47-00		
SAMPLE DATE:	08/01/00			08/01/00			08/02/00			08/02/00		
LABORATORY ID:	C0H020129002			C0H020129001			C0H030222001			C0H030222002		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
TRICHLOROETHENE	1.1	J	P	10	U		10	U		10	U	
TRICHLOROFLUOROMETHANE	10	U		10	U		10	U		10	U	
VINYL CHLORIDE	10	U		10	U		10	U		10	U	
XYLENES, TOTAL	10	U		10	U		10	U		10	U	

SAMPLE NUMBER:	SA-PZ104-S-10.5-00			TB-073100								
SAMPLE DATE:	08/02/00			07/31/00			/ /			/ /		
LABORATORY ID:	C0H030222003			C0H010196001								
QC_TYPE:	NORMAL			NORMAL								
% SOLIDS:	0.0 %			0.0 %			100.0 %			100.0 %		
UNITS:	UG/L			UG/L								
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
1,1,1-TRICHLOROETHANE	10	U		10	U							
1,1,2,2-TETRACHLOROETHANE	10	U		10	U							
1,1,2-TRICHLOROETHANE	10	U		10	U							
1,1,2-TRICHLOROTRIFLUOROETHANE	10	U		10	U							
1,1-DICHLOROETHANE	10	U		10	U							
1,1-DICHLOROETHENE	10	U		10	U							
1,2-DICHLOROETHANE	10	U		10	U							
1,2-DICHLOROETHENE (TOTAL)	10	U		10	U							
1,2-DICHLOROPROPANE	10	U		10	U							
2-BUTANONE	10	U		10	U							
2-HEXANONE	10	U		10	U							
4-METHYL-2-PENTANONE	10	U		10	U							
ACETONE	10	U		10	U							
BENZENE	10	U		10	U							
BROMODICHLOROMETHANE	10	U		10	U							
BROMOFORM	10	U		10	U							
BROMOMETHANE	10	UJ	C	10	UJ	C						
CARBON DISULFIDE	10	U		10	U							
CARBON TETRACHLORIDE	10	U		10	U							
CHLOROBENZENE	10	U		10	U							
CHLOROETHANE	10	U		10	U							
CHLOROFORM	10	U		10	U							
CHLOROMETHANE	10	U		10	U							
CIS-1,3-DICHLOROPROPENE	10	U		10	U							
DIBROMOCHLOROMETHANE	10	U		10	U							
DICHLORODIFLUOROMETHANE	10	U		10	U							
ETHYLBENZENE	10	U		10	U							
METHYL TERT-BUTYL ETHER	10	U		10	U							
METHYLENE CHLORIDE	10	U		10	U							
STYRENE	10	U		10	U							
TETRACHLOROETHENE	10	U		10	U							
TOLUENE	10	U		10	U							

CTO189-NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA007

SAMPLE NUMBER:	SA-PZ104-S-10.5-00			TB-073100								
SAMPLE DATE:	08/02/00			07/31/00			/ /			/ /		
LABORATORY ID:	C0H030222003			C0H010196001								
QC_TYPE:	NORMAL			NORMAL								
% SOLIDS:	0.0 %			0.0 %			100.0 %			100.0 %		
UNITS:	UG/L			UG/L								
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
TRICHLOROETHENE	10	U		10	U							
TRICHLOROFLUOROMETHANE	10	U		10	U							
VINYL CHLORIDE	10	U		10	U							
XYLENES, TOTAL	10	U		10	U							

CTO1.. NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA003

SAMPLE NUMBER:	FD-GW07S-00			FD-GW10S-00								
SAMPLE DATE:	07/17/00			07/17/00			/ /			/ /		
LABORATORY ID:	C0G180124002			C0G180124003								
QC_TYPE:	NORMAL			NORMAL								
% SOLIDS:	0.0 %			0.0 %			100.0 %			100.0 %		
UNITS:	UG/L			UG/L								
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
PETROLEUM HYDROCARBONS												
DIESEL RANGE ORGANICS	100	U		2100								
GASOLINE RANGE ORGANICS	100	UR	R	830								

CTO189-NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA004

SAMPLE NUMBER:	FD-GW07I-00			FD-GW08S-00			FD-GW09S-00					
SAMPLE DATE:	07/18/00			07/18/00			07/18/00			/ /		
LABORATORY ID:	C0G190132002			C0G190132003			C0G190132004					
QC_TYPE:	NORMAL			NORMAL			NORMAL					
% SOLIDS:	0.0 %			0.0 %			0.0 %			100.0 %		
UNITS:	UG/L			UG/L			UG/L					
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
PETROLEUM HYDROCARBONS												
DIESEL RANGE ORGANICS	380			140			160					
GASOLINE RANGE ORGANICS	100	UR	R	100	UR	R	100	UR	R			

NWIR. ALVERTON
WATER DATA
QUANTERRA
SDG: CA006

SAMPLE NUMBER:	FD-GW03S-00			FD-GW04S-00			FD-GWFD-071900			FD-MWERMIBN		
SAMPLE DATE:	07/19/00			07/19/00			07/19/00			07/19/00		
LABORATORY ID:	C0G210192004			C0G210192005			C0G210192007			C0G210192006		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**
PETROLEUM HYDROCARBONS												
DIESEL RANGE ORGANICS	100	U		990			28000			27000		
GASOLINE RANGE ORGANICS	100	U		4800			8300			5700		

CTO189-NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA003

SAMPLE NUMBER:	FD-GW07S-00			FD-GW10S-00								
SAMPLE DATE:	07/17/00			07/17/00			/ /			/ /		
LABORATORY ID:	C0G180124002			C0G180124003								
QC_TYPE:	NORMAL			NORMAL								
% SOLIDS:	0.0 %			0.0 %			100.0 %			100.0 %		
FIELD DUPLICATE OF:												
	RESULT	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**
MISCELLANEOUS PARAMETERS												
BIOCHEMICAL OXYGEN DEMAND(MG/L)	2	U		4.6								
CHEMICAL OXYGEN DEMAND(MG/L)	10	U		33.9								
CHLORIDE(MG/L)	5.4			3.1								
NITRATE(MG/L)	0.10	U		0.1	U							
NITRITE(MG/L)	0.1	U		0.1	U							
ORTHOPHOSPHATE(MG/L)	0.50	U		0.5								
SULFATE(MG/L)	8.7			3.6								
SULFIDE(MG/L)	1	U		1	U							
TOTAL ALKALINITY(MG/L)	8.7			72.2								
TOTAL ORGANIC CARBON(MG/L)	1.1			9.2								

CTO -NWIRP CALVERTON

WATER DATA
QUANTERRA
SDG: CA004

SAMPLE NUMBER:	FD-GW07I-00											
SAMPLE DATE:	07/18/00			/ /			/ /			/ /		
LABORATORY ID:	C0G190132002											
QC_TYPE:	NORMAL											
% SOLIDS:	0.0 %			100.0 %			100.0 %			100.0 %		
UNITS:	MG/L											
FIELD DUPLICATE OF:												
	RESULT	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**
MISCELLANEOUS PARAMETERS												
BIOCHEMICAL OXYGEN DEMAND	3.9											
CHEMICAL OXYGEN DEMAND	10	U										
CHLORIDE	8.2											
NITRATE	0.3											
NITRITE	0.1	U										
ORTHOPHOSPHATE	0.5	U										
SULFATE	19.8											
SULFIDE	1	U										
TOTAL ALKALINITY	21.2											
TOTAL ORGANIC CARBON	1.4											

CTO189-NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA005

SAMPLE NUMBER:	FD-GW03S-00			FD-GW04S-00			FD-GWFD-071900			FD-MWERM1BN		
SAMPLE DATE:	07/19/00			07/19/00			07/19/00			07/19/00		
LABORATORY ID:	C0G200134001			C0G200134002			C0G200134004			C0G200134003		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
MISCELLANEOUS PARAMETERS												
BIOCHEMICAL OXYGEN DEMAND(MG/L)	2	U		3	U		42.5			42.6		
CHLORIDE(MG/L)	2.8			4.4			3.4			3.2		
NITRATE(MG/L)	2.8			0.37			0.1	U		0.1	U	
NITRITE(MG/L)	0.1	U		0.1	U		0.1	U		0.1	U	
ORTHOPHOSPHATE(MG/L)	0.5	U		0.50	U		0.5	U		0.5	U	
SULFATE(MG/L)	5			2.2			2.6			2.4		
TOTAL ALKALINITY(MG/L)	30.8			49.5			230			222		

NWIR CALVERTON
WATER DATA
QUANTERRA
SDG: CA006

SAMPLE NUMBER:	FD-GW03S-00			FD-GW04S-00			FD-GWFD-071900			FD-MWERMIBN		
SAMPLE DATE:	07/19/00			07/19/00			07/19/00			07/19/00		
LABORATORY ID:	C0G210192004			C0G210192005			C0G210192007			C0G210192006		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
MISCELLANEOUS PARAMETERS												
CHEMICAL OXYGEN DEMAND(MG/L)	10	U		10	U		323			327		
SULFIDE(MG/L)	1	U		1	U		4.6			4.2		
TOTAL ORGANIC CARBON(MG/L)	1.0	U		1.6			100	U		100	U	

CTO189-NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA006

SAMPLE NUMBER:	FD-GW03S-00			FD-GW04S-00			FD-GWFD-071900			FD-MWERMIBN		
SAMPLE DATE:	07/19/00			07/19/00			07/19/00			07/19/00		
LABORATORY ID:	C0G210192004			C0G210192005			C0G210192007			C0G210192006		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	MG/L			MG/L			MG/L			MG/L		
FIELD DUPLICATE OF:							FD-MWERM1BN					
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
MISCELLANEOUS PARAMETERS												
CHEMICAL OXYGEN DEMAND	10	U		10	U		323			327		
SULFIDE	1	U		1	U		4.6			4.2		
TOTAL ORGANIC CARBON	1.0	U		1.6			100	U		100	U	

NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA007

SAMPLE NUMBER:	FC-GW01S-00			FC-GW02S-11.6-00			FC-GW03S-11.6-00			GW-FD-080100		
SAMPLE DATE:	07/31/00			08/01/00			08/01/00			08/01/00		
LABORATORY ID:	C0H010196002			C0H020129005			C0H020129006			C0H020129007		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
FIELD DUPLICATE OF:												
	RESULT	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**
MISCELLANEOUS PARAMETERS												
BIOCHEMICAL OXYGEN DEMAND(MG/L)	3.6			23			2	U		2	U	
CHEMICAL OXYGEN DEMAND(MG/L)	15.2			84.1			10	U		10	U	
CHLORIDE(MG/L)	2.2			2.3			1.0	U		1.0	U	
NITRATE(MG/L)	0.14	J	H	0.1	U		0.1	U		0.1	U	
NITRITE(MG/L)	0.5	UJ	H	0.5	U		0.5	U		0.5	U	
ORTHOPHOSPHATE(MG/L)	0.2	UJ	H	0.5	U		0.5	U		0.5	U	
SULFATE(MG/L)	4			1.0	U		2			2		
SULFIDE(MG/L)	1	U		3			1	U		1	U	
TOTAL ORGANIC CARBON(MG/L)	7.8			1.0	U		1.3			1.1		

NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA007

SAMPLE NUMBER:	SA-PZ101-I-47-00	SA-PZ104-S-10.5-00		
SAMPLE DATE:	08/02/00	08/02/00	/ /	/ /
LABORATORY ID:	C0H030222002	C0H030222003		
QC_TYPE:	NORMAL	NORMAL		
% SOLIDS:	0.0 %	0.0 %	100.0 %	100.0 %
FIELD DUPLICATE OF:				

	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
MISCELLANEOUS PARAMETERS												
BIOCHEMICAL OXYGEN DEMAND(MG/L)	3.5			7.8								
CHEMICAL OXYGEN DEMAND(MG/L)	10	U		28.3								
CHLORIDE(MG/L)	6.3			6.8								
NITRATE(MG/L)	0.1	U		0.1	U							
NITRITE(MG/L)	0.5	U		0.50	U							
ORTHOPHOSPHATE(MG/L)	0.5	U		0.5	U							
SULFATE(MG/L)	14.2			3.2								
SULFIDE(MG/L)	1			2.2								
TOTAL ORGANIC CARBON(MG/L)	1.3			11.3								

CTO1 NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA003

SAMPLE NUMBER:	FD-GW03S-00			FD-GW04S-00			FD-GW07I-00			FD-GW07S-00		
SAMPLE DATE:	07/19/00			07/19/00			07/18/00			07/17/00		
LABORATORY ID:	424749			424750			424581			424569		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
DISSOLVED METHANE												
CARBON DIOXIDE	350	U		2200			350	U		350	U	
ETHANE	4	U		4	U		4	U		4	U	
ETHENE	3	U		3	U		3	U		3	U	
METHANE	2	U		190			87			32		

CTO189-NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA003

SAMPLE NUMBER:	FD-GW10S-00	FD-GWFD-071900	FD-MWERMIBN	
SAMPLE DATE:	07/17/00	07/19/00	07/19/00	/ /
LABORATORY ID:	424570	424751	424752	
QC_TYPE:	NORMAL	NORMAL	NORMAL	
% SOLIDS:	0.0 %	0.0 %	0.0 %	100.0 %
UNITS:	UG/L	UG/L	UG/L	
FIELD DUPLICATE OF:				

	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
DISSOLVED METHANE												
CARBON DIOXIDE	350	U		17000			16000					
ETHANE	8	U		4	U		4	U				
ETHENE	6	U		3	U		3	U				
METHANE	1600			1200			1000					

NWIR ALVERTON
WATER DATA
STL
SDG: CA007

SAMPLE NUMBER:	FC-GW01S-00			FC-GW02S-11.6-00			FC-GW03S-11.6-00			GW-FD-080100		
SAMPLE DATE:	07/31/00			08/01/00			08/01/00			08/01/00		
LABORATORY ID:	426361			426358			426359			426360		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**
DISSOLVED METHANE												
CARBON DIOXIDE	4300			350	U		350	U		350	U	
ETHANE	4	U		4	U		4	U		4	U	
ETHENE	3	U		3	U		3	U		3	U	
METHANE	2600			890			62			6.7		

NWIRP CALVERTON
WATER DATA
STL
SDG: CA007

SAMPLE NUMBER:	SA-PZ101-I-47-00			SA-PZ104-S-10.5-00								
SAMPLE DATE:	08/02/00			08/02/00			/ /			/ /		
LABORATORY ID:	426490			426489								
QC_TYPE:	NORMAL			NORMAL								
% SOLIDS:	0.0 %			0.0 %			100.0 %			100.0 %		
UNITS:	UG/L			UG/L								
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
DISSOLVED METHANE												
CARBON DIOXIDE	630			9100								
ETHANE	4	U		4	U							
ETHENE	3	U		3	U							
METHANE	850			3800								

CTO1[illegible]-NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA006

SAMPLE NUMBER:	FB-072000-FILT			FD-GW010S-00			FD-GW03S-00			FD-GW04S-00		
SAMPLE DATE:	07/20/00			07/17/00			07/19/00			07/19/00		
LABORATORY ID:	C0G210192012			C0G210192009			C0G210192004			C0G210192005		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**
INORGANICS												
IRON	32.1	U	A	8630			22.3	U	A	3750		
MANGANESE	0.67	U		173			3.3	U	A	33.0		

CTO189-NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA006

SAMPLE NUMBER:	FD-GW07I-00			FD-GW07S-00			FD-GWFD-071900			FD-MWERMIBN		
SAMPLE DATE:	07/18/00			07/17/00			07/19/00			07/19/00		
LABORATORY ID:	C0G210192010			C0G210192008			C0G210192007			C0G210192006		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:							FD-MWERM1BN					
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
INORGANICS												
IRON	42.8	U	A	3780			7200			7080		
MANGANESE	339			138			87.5			85.6		

NWI. CALVERTON
WATER DATA
QUANTERRA
SDG: CA007

SAMPLE NUMBER:	FC-GW01S-00			FC-GW02S-11.6-00			FC-GW03S-11.6-00			GW-FD-080100		
SAMPLE DATE:	07/31/00			08/01/00			08/01/00			08/01/00		
LABORATORY ID:	C0H010196002			C0H020129005			C0H020129006			C0H020129007		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	0.0 %			0.0 %			0.0 %			0.0 %		
UNITS:	UG/L			UG/L			UG/L			UG/L		
FIELD DUPLICATE OF:												
	RESULT	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**
INORGANICS												
IRON	7740			12100			63.6	U	A	63.1	U	A
MANGANESE	202			50			1.2	U	A	1.7	U	A

NWIRP CALVERTON
WATER DATA
QUANTERRA
SDG: CA007

SAMPLE NUMBER:	SA-PZ101-I-47-00			SA-PZ104-S-10.5-00							
SAMPLE DATE:	08/02/00			08/02/00			/ /			/ /		
LABORATORY ID:	C0H030222002			C0H030222003								
QC_TYPE:	NORMAL			NORMAL								
% SOLIDS:	0.0 %			0.0 %			100.0 %			100.0 %		
UNITS:	UG/L			UG/L								
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
INORGANICS												
IRON	753			19100								
MANGANESE	814			622								