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TREATABILITY STUDY EVALUATION REPORT FOR SOLID WASTE MANAGEMENT UNITS
6 AND 7 NS MAYPORT FL
9/1/2006
TETRA TECH NUS

Comprehensive Long-term Environmental Action Navy

CONTRACT NUMBER N62467-94-D-0888



Treatability Study Evaluation Report for Solid Waste Management Units (SWMUs) 6 and 7

Naval Station Mayport
Mayport, Florida

Contract Task Order 0253

September 2006



Southeast

2155 Eagle Drive

North Charleston, South Carolina 29406

**TREATABILITY STUDY EVALUATION REPORT
FOR
SOLID WASTE MANAGEMENT UNITS (SWMUs) 6 AND 7**

**NAVAL STATION MAYPORT
MAYPORT, FLORIDA**

**COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT**

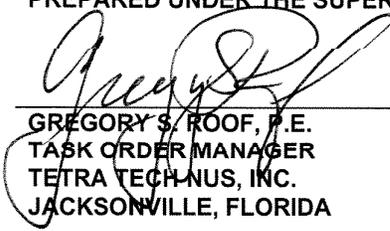
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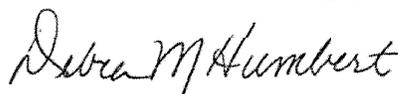
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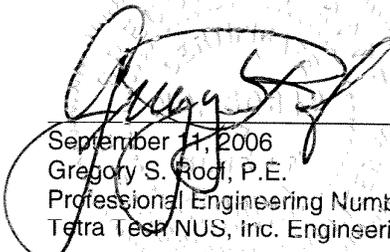
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The professional opinions rendered in this decision document identified as the Treatability Study Evaluation report for Solid Waste Management Units 6 and 7 at Naval Station Mayport, Mayport, Florida were developed in accordance with commonly accepted procedures consistent with applicable standards of practice. This document was prepared under the supervision of the signing engineer and is based on information obtained from others. If conditions are determined to exist differently than those described in this document, then the undersigned professional engineer should be notified to evaluate the effects of any additional information on the project described in this document.



September 11, 2006
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ACRONYMS

ABB-ES	ABB Environmental Services, Inc.
bls	Below Land Surface
BTOC	Below Top of Casing
°C	Degrees Celsius
CAO	Corrective Action Objective
Catalina	Catalina Biosolutions
CMS	Corrective Measure Study
CO ₂	Carbon Dioxide
COC	Contaminant of Concern
CTL	Cleanup Target Level
CTO	Contract Task Order
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
ETI	Enzyme Technologies, Inc.
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
Fe ⁺²	Ferrous Iron
ft	Foot/Feet
FOC	Fractional Organic Carbon
GCTL	Groundwater Cleanup Target Levels
H ₂ S	Hydrogen Sulfide
IM	Interim Measure
LNAPL	Light-Nonaqueous Phase Liquid
LTTD	Low-Temperature Thermal Desorption
µg/L	Micrograms per Liter
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
mS/cm	Millisiemens per Centimeter
NA	Natural Attenuation
NAVSTA	Naval Station
NTU	Nephelometric Turbidity Unit
nM	Nanomolar
ORP	Oxidation-reduction Potential
OWTP	Oily Water Treatment Plant
PAH	Polynuclear Aromatic Hydrocarbon

ACRONYMS (CONTINUED)

RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SCTL	Soil Cleanup Target Level
SOPs	Standard Operating Procedures
STL	Severn Trent Laboratories
SWMU	Solid Waste Management Unit
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbon
TPHCWG	Total Petroleum Hydrocarbon Criteria Working Group
TRPH	Total Recoverable Petroleum Hydrocarbon
TtNUS	Tetra Tech NUS, Inc.
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
WWTP	Waste Water Treatment Plant

EXECUTIVE SUMMARY

Solid Waste Management Unit (SWMU) 6, located directly adjacent to SWMU 7 on Naval Station (NAVSTA) Mayport, Florida, served as a waste oil pit and sludge drying bed prior to the installation of SWMU 7 in 1979. SWMU 7 consists of the Oily Water Treatment Plant (OWTP) sludge drying beds, which are enclosed by earthen berms. The SWMU 7 sludge drying beds received sludge from the OWTP clarifiers and bilge water from receiving tanks. Records indicate that approximately 1,500 gallons of sludge were transferred to the drying beds on the average of twice per week until late 1994. The eastern-most drying bed was excavated in 1989, at which time a lined, diked enclosure and three bilge water receiving tanks were constructed.

A Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) was conducted from 1994 to 1996 [ABB Environmental Services, Inc. (ABB-ES) 1996]. A Corrective Measures Study (CMS) was conducted from 1996 to 2001. Several Interim Measures (IMs) have been conducted at SWMUs 6 and 7 but none have been successful in meeting the cleanup standards set by the Florida Department of Environmental Protection (FDEP).

This treatability study was conducted to determine (1) if an in situ biological method was applicable for contaminated soil treatment; (2) if natural attenuation (NA) was a viable alternative to address dissolved groundwater contamination; (3) to analyze and evaluate contaminated soil under the Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG) at SWMUs 6 and 7; and (4) to determine if passive free-product recovery is feasible. Additionally, free-product monitoring and recovery were conducted to satisfy FDEP requirements.

Results of this treatability study indicated that (1) bioremediation of the soil is feasible. The soil biotreatability vendor recommended ex situ treatment. (2) No groundwater contaminants were detected in excess of FDEP Groundwater Cleanup Target Levels (GCTLs) during this study. Groundwater geochemistry data was collected monthly the first quarter and quarterly for the remaining year. The site geochemistry indicates that conditions are favorable for NA via aerobic degradation processes. The geochemistry data was collected to provide supporting information for use in a revised CMS. (3) TPHCWG data indicated that several of the longer chain carbon groups [total recoverable petroleum hydrocarbons (TRPH) fractions] exceeded default¹ Soil Cleanup Target Levels (SCTLs), but the

¹ The term "default SCTLs" used in this document is the name provided in the *Draft Technical Report: Development of Soil Cleanup Target Levels (SCTLs) for Chapter 62-777, FAC*, dated February 26, 2004. Since they are not included in the regulation, they should be considered as guidance criteria used in site evaluation and are not enforceable.

contamination is limited to the central sludge drying bed. The default SCTLs used in this treatability study for the TRPH fractions are not FDEP regulatory criteria. Chapter 62-777.170, Florida Administrative Code (FAC) allows for the derivation of default SCTLs and uses the methodology presented in the *Draft Technical Report: Development of Soil Cleanup Target Levels (SCTLs) for Chapter 62-777, FAC*, dated February 26, 2004. The Mayport Partnering Team used the default SCTLs for the TRPH fractions found in the Technical Report for comparison purposes only in this treatability study. (4) Minimal free product was recovered from select wells that contained between 0.01 foot (ft) and less than 1 ft of product. Free-product recovery is still being performed at the SWMUs. The groundwater table has dropped and this is believed to have caused the remaining free product to become “smeared” within the vadose zone. It is expected that free product will re-emerge in select isolated wells during seasonal wet periods when the groundwater table rises.

During the March 2004 Mayport Partnering Team meeting, it was decided that enough data had been collected to adequately characterize SWMUs 6 and 7. The Mayport Partnering Team decided an addendum incorporating the remedial options of this Treatability Study Evaluation Report to the CMS (finalized in 1996) was the next course of action for SWMUs 6 and 7.

1.0 INTRODUCTION

1.1 TREATABILITY STUDY OBJECTIVE

The objective of this treatability study was to determine: (1) if an in situ biological method was applicable for contaminated soil treatment; (2) if natural attenuation (NA) was a viable alternative to address dissolved phase groundwater contamination; (3) to analyze and evaluate contaminated soil under the TPHCWG at SWMUs 6 and 7; and (4) to determine if passive free-product recovery is feasible. Additionally, free-product monitoring and recovery were conducted to satisfy FDEP requirements for the abatement of free product. The scope of this treatability study was limited to the documented free product and groundwater, and soil contamination that had been previously identified at the SWMUs.

1.2 DOCUMENT ORGANIZATION

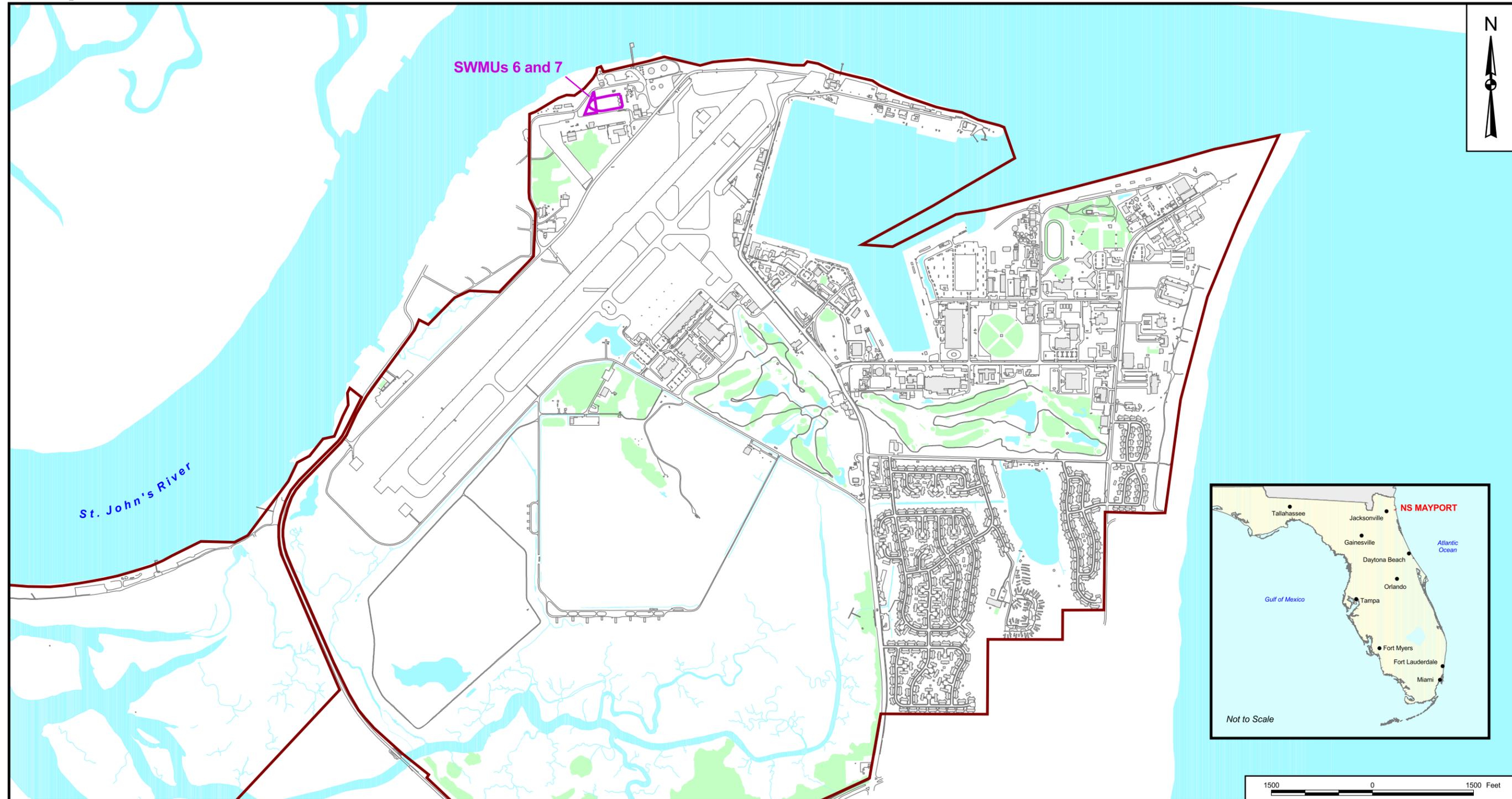
Section 1.0 of this report contains the treatability study objectives; site information; site operations and history, investigative and treatment history; nature and extent of groundwater contamination; a general description of the treatability study, including a summary of field activities performed; and deviations from the original work plan. The soil treatability study results, groundwater sampling data, soil sampling data, and free-product recovery results are described in Section 2.0, the data assessment is provided in Section 3.0, and conclusions are presented in Section 4.0.

1.3 SITE INFORMATION

NAVSTA Mayport is located on a peninsula in northeast Florida and lies approximately 12 miles northeast of Jacksonville. The complex is bounded on the east by the Atlantic Ocean and the north and west by the St. Johns River (Figure 1-1). NAVSTA Mayport, occupying 3,401 acres, has been in service since 1942. Current activities include support services for surface fleet and aircraft, including ship and aircraft repair and maintenance. The general locations of SWMUs 6 and 7 at NAVSTA Mayport are depicted on Figure 1-1.

1.3.1 Site Operations and History

SWMUs 6 and 7 are located just west of the OWTP and about 200 ft south of the St. Johns River. SWMU 6, located directly adjacent to SWMU 7 on the west (Figure 1-2), served as a waste oil pit and sludge drying bed prior to the installation of SWMU 7 in 1979. SWMU 7 is made up of the OWTP sludge drying beds, which are enclosed by earthen berms. The sludge drying beds received sludge from the OWTP clarifiers and bilge water from receiving tanks. The easternmost drying bed was



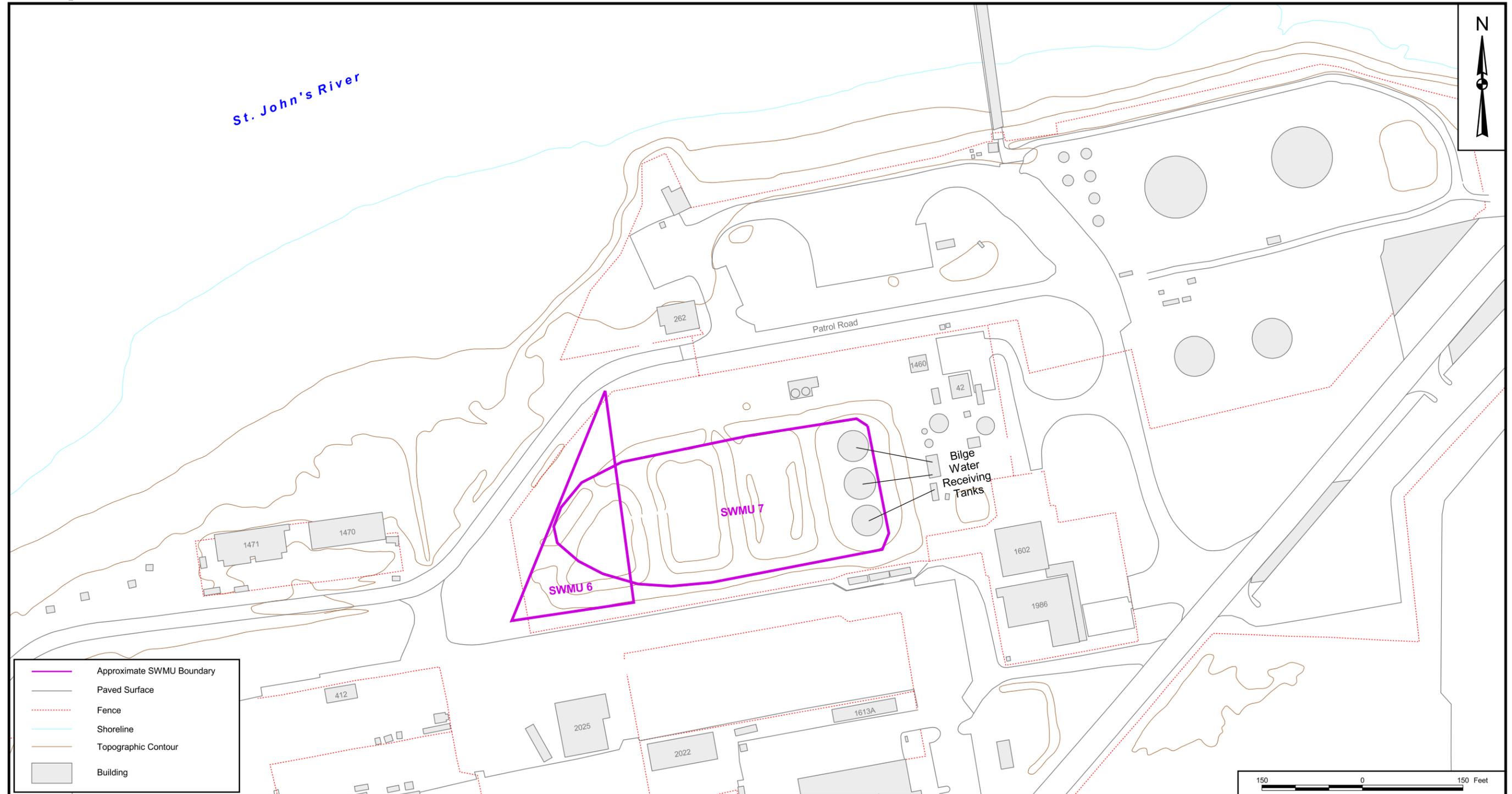
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SITE VICINITY MAP
 TREATABILITY STUDY EVALUATION REPORT
 SWMUs 6 AND 7
 NAVAL STATION MAYPORT
 MAYPORT, FLORIDA

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	Approximate SWMU Boundary
	Paved Surface
	Fence
	Shoreline
	Topographic Contour
	Building

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COST/SCHED-AREA	
SCALE	AS NOTED



SITE LOCATION MAP
TREATABILITY STUDY EVALUATION REPORT
SWMUs 6 AND 7
NAVAL STATION MAYPORT
MAYPORT, FLORIDA

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excavated in 1989, at which time a lined, diked enclosure and three bilge water receiving tanks were constructed [Tetra Tech NUS, Inc. (TtNUS), 2002a]. Records indicate that approximately 1,500 gallons of sludge were transferred to the drying beds on an average of twice per week until late 1994 when operations were discontinued.

1.3.2 Site Investigation and Treatment Summary

Listed below is a chronology of site events since the closing of the sludge bed operations until this treatability study:

1994

- Light-nonaqueous phase Liquid (LNAPL) found in three site wells during RFI field activities.
 - Average fuel thickness found to be 0.50 ft.
- IM Workplan submitted by ABB-ES to mitigate LNAPL migration to St. Johns River.
 - Recommended five sumps with skimmer pumps.

1995

- Sumps and skimmer pumps installed in summer of 1995 as an IM.
 - System was not effective at recovering free product because sumps were located only on the northern boundary (according to Battelle).
 - No LNAPL recovery data is available.

1996

- RFI submitted in January 1996 by ABB-ES .
- Final CMS submitted in December 1996 by ABB-ES.
 - Two Corrective Action Objectives (CAOs).
 1. Remove LNAPL present on water table in excess of 0.1 inch using bioventing/bioslurper system.
 2. Eliminate petroleum-contaminated sludge and soil that contributes to presence of LNAPL and soil/groundwater contamination.
- ABB performed technology evaluation of low-temperature thermal desorption (LTTD) for soil alternative during April and May.
- Two week pilot test of bioventing/bioslurper system conducted in July.

1997

- IM Workplan for bioslurper/bioventing system submitted by Battelle.
- Bioslurper extraction wells and soil-gas monitoring points for the full-scale system were installed at the site in July and August.
- Construction and installation activities completed in late 1997.

1998

- Bioslurper system startup on January 8th.
- Bioventing system installation on January 12th.

- December, aqueous discharge switched from OWTP to Waste Water Treatment Plant (WWTP).

1999

- Oil/Water separators installed.

2000

- Bioslurper/bioventing operation concluded.
- Weekly bailing of free product from wells with product greater than 0.01 ft.
- Beginning of semi-annual (for two years) groundwater sampling by TtNUS.

2001

- Bioslurper system demobilized from site in April.
- Monthly bailing of free product from wells.
- Conclusion of semi-annual groundwater sampling by TtNUS.
 - Free product still present and groundwater contamination present.

A summary explanation of the above referenced historical reports is provided in Appendix A.

1.3.3 Nature and Extent of Contamination

Neither of the above IMs (skimmers or bioslurper/bioventing system) successfully remediated the site. Groundwater monitoring indicated free product was still present and that groundwater contamination was present in excess of FDEP criteria. Soil samples collected within the sludge beds indicated that several carbon chains exceeded default SCTLs following the LTTD (TtNUS, 2002b).

1.3.3.1 Free Product

During previous investigations, free product has been detected at the site on numerous occasions. Monitoring wells with the designation MPT-8, as in MPT-8-MW01S, will be abbreviated as MW01S in this report. Two groundwater monitoring wells have the designation MPT-S (MPT S MW02S and MPT-S-MW03S) and will not be abbreviated in this report. The wells at the site that have historically exhibited a measurable level of free product are as follows: MPT-8-MW01S, MW02S, MW03S, MW04S, MW06S, MW07S, MW11S, and MW15S. Of these wells, MW07S and MW11S were converted to extraction wells for the bioslurper system and MW15S was destroyed and replaced by MW15SR. Locations for these monitoring wells are provided on historical Figure 1-3 (from TtNUS, 2001) in Appendix B.

Historical Figure 4-9 (from Battelle, 2001) in Appendix B presents LNAPL (free product) thickness data collected in July 2000 for SWMUs 6 and 7 following the shut down of the bioslurpers (Battelle, 2001). The figure was created to show the location and thickness of the remaining free product at the site.

1.3.3.2 Extent of Groundwater Contamination

Groundwater samples were collected on a semi-annual basis during 1999 and 2000 (four quarters of groundwater monitoring). Four wells (MW04S, MW09S, MW15S, and MW16S) contained constituents detected at concentrations exceeding FDEP GCTLs (TtNUS, 2001) during these events. [See previous historical Figure 1-3 (TtNUS, 2001) in Appendix B for monitoring well locations.] Analysis of groundwater samples collected from well MW04S during the fourth quarter event (second semi-annual event for 2000) showed concentrations of 1-methylnaphthalene, 2-methylnaphthalene, and TRPH that exceeded GCTLs. The only reported constituent exceeding GCTLs in MW09S was TRPH during the fourth quarter sampling event of 2000. Before MW15S was destroyed, 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene were detected at concentrations exceeding GCTLs. Analysis of groundwater in well MW16S collected during the first quarter 1999 sampling event had concentrations of 1-methylnaphthalene and 2-methylnaphthalene exceeding GCTLs. A summary of the constituents exceeding the FDEP standards during the 1999 and 2000 semi-annual groundwater sampling events is included in Appendix B in historical Table 1.

1.3.3.3 Extent of Soil Contamination

Soil contamination has been documented at the site during many of the above-referenced assessment activities. However, a complete definition of the aerial extent of soil contamination has not been determined. Four soil samples were collected at SWMUs 6 and 7 on March 14, 2002, and analyzed for the TPHCWG parameters. Results and locations of the preliminary soil TPHCWG testing are included in historical Table SWMU 7 (TtNUS, 2002b) and on Figure 2, respectively, in Appendix B. Results of the TPHCWG analysis indicated that several of the carbon ranges exceeded FDEP Chapter 62-777, FAC, Technical Report Cleanup Levels for TRPH criteria.

1.4 TREATABILITY STUDY ACTIVITIES

The following treatability study activities were completed to meet the treatability study objectives:

- (1) Evaluate in situ bioremediation alternative for contaminated soil.
 - A split soil sample was collected and sent to Catalina BioSolutions (Catalina) in Tucson, Arizona and Enzyme Technologies, Inc. (ETI) in Portland, Oregon for bio-treatability tests on June 6, 2003.
 - Catalina tested three different bioremediation products on the soil they received. They sent samples of each product to Severn Trent Laboratories (STL) after 30 days and 60 days of treatment for the Florida TPHCWG analysis. The results of the 30-day and 60-day analyses are provided in Catalina's report that is provided in Appendix C and

titled "Results of Biotreatability for Tetra Tech NUS, Inc.". Further discussion of Catalina's results will be provided in Section 2.1.1 of this report.

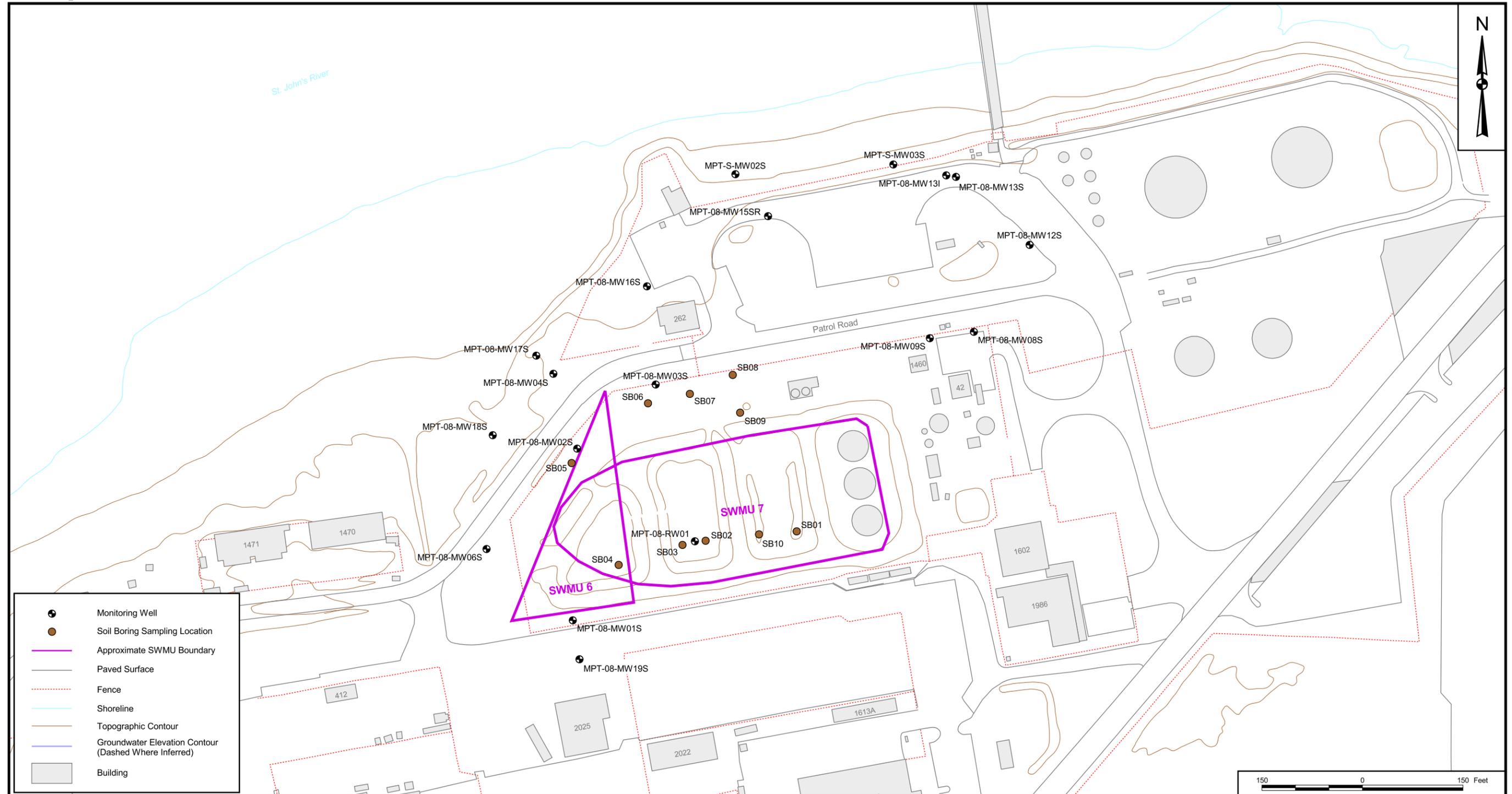
ETI performed a bench-scale treatability test to determine if bioremediation was a remedial option for SWMU 6 and 7. They collected baseline TRPH data (day 0) and proceeded to test each sample group every 7 days until day 35 was reached. They used this data to determine contaminant half-life constants and estimate potential treatment timeframes for the soil. The data collected by ETI is included in their report titled "Soil Treatability Study – Enzyme-Enhanced Bioremediation of Soil Impacted with Heavy Oils", which is provided in Appendix D. Further discussion of ETI's results will be provided in Section 2.1.2 of this report.

- (2) Determine if NA is viable alternative to treat dissolved phase groundwater contamination.
 - Groundwater geochemical parameters were collected.
- (3) Analyze and evaluate contaminated soil using Florida TPHCWG.
 - Ten soil samples were collected from site and analyzed.
- (4) Determine if passive free-product recovery is feasible.
 - A passive skimmer was installed in recovery well RW01.
 - Installed absorbent socks in select wells

1.4.1 Field Operations Summary

The Treatability Study was conducted over four quarters and consisted of the following field activities:

- Four soil borings were collected on March 14, 2002 to provide preliminary TPHCWG data. See previous historical Figure 2 (TtNUS, 2001) in Appendix B for soil sampling locations. On June 7, 2002, TtNUS visited the site to inspect the area and collect groundwater level measurements and free-product thickness measurements. These site activities were conducted to provide information used in the treatability study work plan.
- Field events for the first quarter began in November 2002 with the installation of an upgradient (background) well for NA monitoring activities. On November 13, 2002, TtNUS personnel supervised the installation of a shallow background monitoring well MW19S, just south of SWMUs 6 and 7 (see Figure 1-3).



	Monitoring Well
	Soil Boring Sampling Location
	Approximate SWMU Boundary
	Paved Surface
	Fence
	Shoreline
	Topographic Contour
	Groundwater Elevation Contour (Dashed Where Inferred)
	Building



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COST/SCHED-AREA	
SCALE AS NOTED	



MONITORING WELL AND SOIL BORING LOCATION MAP
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- TtNUS personnel conducted the first quarter (three monthly events) of groundwater sampling in November 2002, December 2002, and January 2003. Baseline sampling (November event) was conducted between November 19 and 22, 2002. Groundwater samples were collected from 10 wells (MW01S, MW06S, MW09S, MW15SR, MW16S, MW17S, MW18S, MW19S, MPT-S-MW02S, and MPT-S-MW03S) and analyzed for volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons (PAHs), TRPH, and geochemical parameters by a fixed-based laboratory. Four additional wells (MW08S, MW12S, MW13S, and MW13I) were sampled during the baseline event for PAHs and VOCs only. Field measured NA parameters were also collected from the 10 selected wells.
- From December 17 to 19, 2002, the second event of the first quarter groundwater sampling was conducted. Groundwater sampling events following the baseline event were for field and laboratory geochemical parameters only. During the first groundwater monitoring event, no COCs were detected. Collection of geochemical parameters was continued to provide groundwater geochemistry data for use in the CMS. Ten groundwater monitoring wells (MW01S, MW03S, MW04S, MW06S, MW09S, MW16S, MW17S, MW18S, MW19S, and MPT-S-MW02S) were sampled for geochemical parameters only.
- From January 13 to 15, 2003, the last (third) event of the first quarter groundwater sampling event was conducted. Ten groundwater monitoring wells (MW01S, MW04S, MW06S, MW09S, MW15SR, MW16S, MW17S, MW18S, MW19S, and MPT-S-MW02S) were sampled for field and laboratory geochemical parameters.
- The second quarter sampling event consisted of sampling groundwater from 10 monitoring wells (MW01S, MW04S, MW06S, MW09S, MW16S, MW17S, MW18S, MW19S, MPT-S-MW02S, and MPT-S-MW03S) analyzing the samples for field and laboratory geochemical parameters from February 10 to 14, 2003. Ten soil samples were collected and sent to a fixed-base laboratory for TPHCWG analysis on February 11, 2003. A 4-inch recovery well (RW01) was installed on February 18, 2003 and a Keck passive skimmer was placed in RW-01 to remove free product from the groundwater surface. The locations of the 10 soil samples and the recovery well RW-01 are provided on Figure 1-3.
- The third quarter sampling event consisted of groundwater sampling and analysis of 10 monitoring wells (MW01S, MW04S, MW06S, MW09S, MW16S, MW17S, MW18S, MW19S, MPT-S-MW02S, and MPT-S-MW03S) for field and laboratory geochemical parameters from May 19 to 21, 2003. A split soil sample was collected near recovery well RW01 (between SB02 and SB03) and sent to ETI in Portland, Oregon and Catalina in Tucson, Arizona for bio-treatability tests on June 6, 2003. On

June 20, 2003, PIG SKIMMER® absorbent socks were placed in groundwater monitoring wells MW02S, MW03S, and four bioslurper wells to remove free product. The free-product recovery progress was checked on a weekly basis.

- From September 3 to 11, 2003, TtNUS conducted the fourth quarter groundwater monitoring event for field and laboratory geochemical parameters. Laboratory samples were collected twice because the first samples arrived at the laboratory above the acceptable temperature range and had to be recollected. Groundwater samples were collected from monitoring wells MW01S, MW04S, MW06S, MW09S, MW16S, MW17S, MW18S, MW19S, MPT-S-MW02S, and MPT-S-MW03S. Free-product recovery was checked weekly in the Keck passive skimmer that was installed in recovery well RW01. The PIG SKIMMER® absorbent socks [installed in MW02S, MW03S, and four bioslurper wells (all containing free product)] were also checked weekly and replaced as needed when they appeared to be saturated with free product. The passive skimmer and absorbent socks were removed on September 26, 2003.
- On February 13, 2004, TtNUS measured free-product levels in the groundwater monitoring wells and bioslurper wells present at SWMUs 6 and 7. The intent of the free-product measurements was to determine if product had re-entered wells that had previously contained absorbent socks. Absorbent socks were placed in eight wells that were found to contain free product. Free-product measurements were between 0.01 ft and 0.08 ft.

A total of four quarterly monitoring reports and an addendum to first quarter report were prepared to document the results of each quarter of sampling during this treatability study. Field collected data along with laboratory data collected during each quarter of sampling was provided in the corresponding quarterly monitoring report.

1.4.2 Summary of Field Sampling Activities

Depths to groundwater and free-product level measurements were recorded during each of the sampling events. Depth to groundwater, top of casing elevations and groundwater elevations are discussed in Section 2.2.1 of this document.

Groundwater and soil samples were collected in general accordance with current FDEP Standard Operating Procedures (SOPs). Sample containers were shipped on ice via Federal Express to the contracted laboratory under proper chain-of-custody protocol.

Groundwater samples were analyzed in the laboratory for the following constituents:

- Alkalinity by United States Environmental Protection Agency (USEPA) Method E310.1
- Biogenic gases (hydrogen, methane, ethane, ethene, oxygen, nitrogen, and carbon dioxide) by Microseeps AMG20GAX
- Ammonia by USEPA Method 350.1
- Cations and anions by USEPA 300 series
- Dissolved Organic Carbon (DOC) by USEPA SW-846 Method 9060
- Fractional Organic Carbon (FOC) by USEPA SW-846 Method 900
- Iron and manganese by USEPA Method SW-846 6010B
- PAHs by USEPA Method 8310 (baseline sampling event only).
- Total Organic Carbon (TOC) by USEPA Method 415.1.
- TRPH by FL-PRO Method (baseline sampling event only).
- VOCs by USEPA Method 8260B (baseline sampling event only).

Groundwater geochemical parameters measured in the field included:

- Specific conductivity, pH, temperature, dissolved oxygen (DO) and oxidation-reduction potential (ORP) were measured with either a Horiba® U-22 or YSI water quality meter and turbidity was measured with a LaMotte 2020 turbidimeter.
- DO by CHEMetrics vacuum ampoules (K7501 and 7512).
- Carbon dioxide (CO₂) by CHEMetrics vacuum ampoules (K1910, K1920, and K1925).
- Hydrogen sulfide (H₂S) by HACH HS-C Method.
- Ferrous iron (Fe⁺²) by HACH DR-890 colorimeter.
- Sulfide by HACH DR-890 colorimeter.

Soil samples were analyzed for the Florida TPHCWG.

1.5 DEVIATIONS FROM WORK PLAN

Passive skimmers could not be installed in any of the site wells containing free product because the wells were not deep enough to accommodate the length of the passive skimmers. Therefore, recovery well RW01 was installed in the area where free-product levels were greatest (between 0.5 and 0.9 ft). The passive skimmer was then installed in RW01.

Carbon dioxide was measured in the field using CHEMetrics vacuum ampoules instead of the HACH kit CA-DT.

2.0 DATA PRESENTATION

Results of the biotreatability tests, groundwater sampling events (November 2002, December 2002, January 2003, February 2003, May 2003, and September 2003), soil sampling (February 2003), and free-product recovery that were performed at SWMUs 6 and 7 are presented in this section.

2.1 SOIL BIOTREATABILITY STUDY

2.1.1 Catalina Biosolutions

Catalina made the following two conclusions:

- (1) Degradation of the contaminated soil from SWMUs 6 and 7 was biologically feasible.
- (2) The rate of degradation was dependent upon the type of biological stimulant added.

Catalina supplied the 30-day and 60-day laboratory TPHCWG analysis along with a short two-page report describing what they did. Catalina used the data from the sample TtNUS collected nearest to the actual treatability test sample as their baseline concentrations for determining the amount of degradation they achieved. They reported that degradation had occurred in their test samples based upon the difference between TtNUS' data and the 30-day and 60-day laboratory results. Copies of laboratory results from the 30-day and 60-day analysis were provided in the appendix of Catalina's report, which is provided as Appendix C of this report. No detailed description of the treatment types was provided except that three different methods were tested. Catalina reported that treatment method # 1 produced the best results. They stated that this result was consistent with other projects they have completed.

2.1.2 Enzyme Technologies Inc.

ETI reported that TPH constituents were 86 percent degraded after 35 days in the test soil sample to only 46 percent in the control sample. They also reported over 99 percent degradation of PAH constituents over the same time period in the test soil sample as compared to 68 percent in the control sample. Kinetic data related to their tests indicated that a reasonable treatment time estimate for this site would be between 60 to 90 days and that over 99 percent degradation of PAHs should occur. They recommended using an ex situ landfarming application with the specified biological products that were successful in the bench-scale test. Tables showing TRPH and PAH results, a graph showing degradation rates, and the laboratory analysis results are provided in ETI's report (Appendix D).

2.2 GROUNDWATER SAMPLING

2.2.1 Groundwater Elevations and Flow Direction

Depth-to-groundwater was measured in the designated site monitoring wells during each of the sampling events. These measurements and the resulting groundwater elevations are presented in Table 2-1. Figure 2-1 presents groundwater elevations and contours from the fourth quarter groundwater sampling event conducted in September 2003. Groundwater flow on this figure is consistent with what was observed over the course of this treatability study and historically. Groundwater flow at SWMUs 6 and 7 is generally north toward the St. Johns River. The monitoring wells used in the treatability study were screened in the uppermost part of the surficial aquifer and were typically screened in interval from 5.0 to 15.0 ft below land surface (bls). The only exception was MW15SR which had a total depth of 35.5 ft and was presumed to be screened from 30.5 to 35.5 ft bls.

2.2.2 Field Analyzed Geochemical Parameters

Groundwater field parameters were measured by TtNUS personnel prior to collection of samples for the laboratory. Field parameters measured during monitoring well purging included pH, specific conductivity, temperature, turbidity, ORP, and DO. Sulfide, H₂S, Fe⁺², DO, and CO₂ were measured during sample collection. The field measured parameters were collected to evaluate site geochemical conditions. Groundwater level measurement sheets, groundwater sampling logs, low flow purge data sheets, and geochemical parameter analytical log sheets compiled during each site visit were provided in the corresponding quarterly monitoring report. Results of the field measurements are summarized in Table 2-2. A discussion of the field geochemical parameter results is included in Section 3.2 of this report.

2.2.3 Laboratory Analyzed COC and Geochemical Parameters

Groundwater samples were collected and analyzed for PAHs, TRPH, VOCs, and geochemical parameters from 10 monitoring wells during the baseline event. Four additional wells were sampled for PAHs, TRPH and VOCs (site COCs) only, to provide additional horizontal extent of contamination information. Geochemical data from the 10 wells during the subsequent sampling events was collected to provide additional data about the groundwater geochemistry for this site. No PAHs, TRPH, or VOCs constituents were detected at concentrations exceeding FDEP GCTLs in the 14 monitoring wells sampled during the baseline sampling event. Results from the laboratory analyzed geochemical parameters are provided in Table 2-3. A discussion of the laboratory geochemical parameter results is included in Section 3.2 of this report. Validated laboratory reports from each sampling event were provided in the corresponding quarterly monitoring reports.

**TABLE 2-1
SUMMARY OF GROUNDWATER ELEVATIONS - SWMJs 6 AND 7
SEPTEMBER 2003 SAMPLING EVENT**

**TREATABILITY STUDY EVALUATION REPORT
NAVAL STATION MAYPORT
MAYPORT, FLORIDA**

Well Number	Total Depth of Well (ft)	Top of Casing Elevation ¹ (ft)	Depth to Water (ft btoc)						Groundwater Elevation ¹ (ft msl)					
			11/19/02	12/17/02	01/13/03	02/13/03	05/21/03	09/12/03	11/19/02	12/17/02	01/13/03	02/13/03	05/21/03	09/12/03
MPT-8-MW01S	16.30	19.75	8.51	9.10	8.81	9.51	9.21	9.47	11.24	10.65	10.94	10.24	10.54	10.28
MPT-8-MW02S	15.22	NA	FP	FP	FP	FP	FP	11.04	NA	NA	NA	NA	NA	NA
MPT-8-MW03S	15.40	NA	FP	11.48	FP	FP	11.33	10.83	NA	NA	NA	NA	NA	NA
MPT-8-MW04S	15.50	11.90	10.04	10.33	10.14	FP	9.62	8.89	1.86	1.57	1.76	NA	2.28	3.01
MPT-8-MW06S	15.20	NA	7.06	7.53	7.42	8.18	6.99	7.64	NA	NA	NA	NA	NA	NA
MPT-8-MW08S	14.60	NA	9.02	9.64	NM	NM	9.43	7.91	NA	NA	NA	NA	NA	NA
MPT-8-MW09S	14.85	12.55	8.96	9.09	9.03	9.54	8.95	5.90	3.59	3.46	3.52	3.01	3.60	6.65
MPT-8-MW12S	18.10	NA	10.97	11.33	11.25	11.65	10.65	10.15	NA	NA	NA	NA	NA	NA
MPT-8-MW13S	15.25	NA	10.45	10.70	10.55	10.95	10.01	9.03	NA	NA	NA	NA	NA	NA
MPT-8-MW13I	39.45	NA	10.65	10.83	10.55	11.06	10.17	8.74	NA	NA	NA	NA	NA	NA
MPT-8-MW15SR	35.50	NA	10.15	10.61	10.47	10.91	10.12	9.05	NA	NA	NA	NA	NA	NA
MPT-8-MW16S	15.00	NA	8.55	8.77	8.67	9.00	FP	7.32	NA	NA	NA	NA	NA	NA
MPT-8-MW17S	14.89	NA	9.22	9.46	9.26	9.40	FP	7.71	NA	NA	NA	NA	NA	NA
MPT-8-MW18S	15.02	8.80	5.61	6.92	6.86	7.12	6.22	5.86	3.19	1.88	1.94	1.68	2.58	2.94
MPT-8-MW19S	16.30	NA	5.82	5.47	5.26	NM	5.81	6.06	NA	NA	NA	NA	NA	NA
MPT-S-MW02S	15.22	NA	7.85	8.58	8.83	9.98	8.31	7.17	NA	NA	NA	NA	NA	NA
MPT-S-MW03S	15.40	11.90	10.20	10.57	10.43	10.82	NM	9.13	1.70	1.33	1.47	1.08	NM	2.77

Notes:

¹ Based on benchmark elevation of southeast corner of concrete transformer slab assumed to be 30.00 ft.

ft = feet

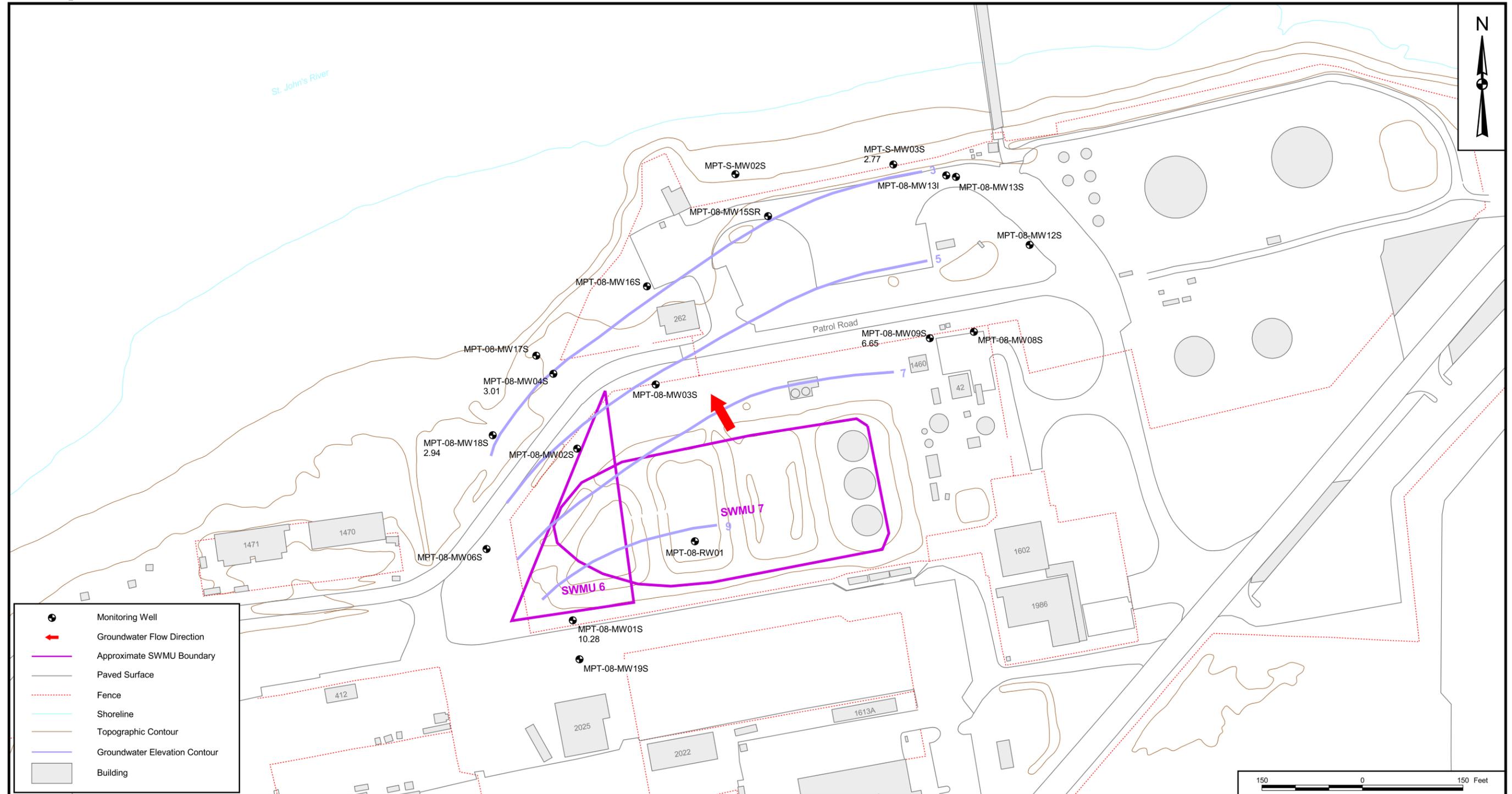
btoc = below top of casing

msl = mean sea level

FP = free-product present so the water level was not measured/collected

NM = not measured

NA = not available



	Monitoring Well
	Groundwater Flow Direction
	Approximate SWMU Boundary
	Paved Surface
	Fence
	Shoreline
	Topographic Contour
	Groundwater Elevation Contour
	Building



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES	DRAWN BY	DATE		CONTRACT NO. 4259		
							A. JANOCHA	2/09/04		APPROVED BY	DATE	
							C. METZ	2/25/04		APPROVED BY	DATE	
										DRAWING NO.	REV.	
								SCALE	GROUNDWATER ELEVATION AND CONTOUR MAP SEPTEMBER 12, 2003 TREATABILITY STUDY EVALUATION REPORT SWMUs 6 AND 7 NAVAL STATION MAYPORT MAYPORT, FLORIDA		FIGURE 2 - 1	0
								AS NOTED				

**TABLE 2-2
SUMMARY OF FIELD SAMPLED NATURAL ATTENUATION PARAMETERS - SWMUs 6 AND 7
SEPTEMBER 2003 SAMPLING EVENT**

**TREATABILITY STUDY EVALUATION REPORT
NAVAL STATION MAYPORT
MAYPORT, FLORIDA
PAGE 1 OF 3**

Sample ID	MPT-8-MW01S						MPT-8-MW04S					
	11/19/02	12/19/02	01/13/03	02/10/03	05/20/03	09/05/03	11/19/02	12/19/02	01/15/03	02/13/03	05/21/03	09/04/03
Temperature (°C)	26.31	22.97	21.21	21.12	23.33	26.88	NS	24.99	22.98	23.25	23.88	26.51
pH (Standard Units)	7.51	11.13	7.54	8.02	7.56	7.55	NS	10.12	6.70	7.22	6.64	6.70
Conductivity (mS/cm)	0.495	0.349	0.342	0.404	0.343	0.339	NS	0.832	0.730	1.030	0.852	0.841
Turbidity (NTU)	2.8	2.6	0	0	0.59	1.3	NS	8.2	0	11.6	0.93	0.3
Redox Potential (Millivolts)	-149	-162	-227	-198	-59.3	-96.3	NS	-175	-181	-129	-59.1	-113.1
Dissolved Oxygen (mg/L)	0.4	0.8	0.6	1.0	0.6	6.0	NS	0.2	0.5	0.3	0.6	3.0
Carbon Dioxide (mg/L)	13	10	<10	<10	<10	<10	NS	90	145	110	170	160
Sulfide (mg/L)	0.06	0.05	0.03	0.19	0.03	0	NS	0.23	0.32	0.15	0.10	0.13
Ferrous Iron (mg/L)	0.05	0.13	0.23	0.12	0.13	0	NS	4.3	6.4	6.0	5.8	5.2
Hydrogen Sulfide (mg/L)	0.1	0.1	0	0.5	0.3	0	NS	2	2.0	2.0	2.0	0.1

Sample ID	MPT-8-MW06S						MPT-8-MW09S					
	11/21/02	12/18/02	01/14/03	02/13/03	05/19/03	09/04/03	11/19/02	12/18/02	01/14/03	02/10/03	05/21/03	09/05/03
Temperature (°C)	25.11	22.42	19.86	19.91	23.05	26.81	25.15	23.45	21.45	20.70	23.67	27.66
pH (Standard Units)	7.54	8.49	7.32	7.88	7.39	7.4	7.22	10.34	6.85	7.20	6.86	7.40
Conductivity (mS/cm)	0.423	0.33	0.294	0.362	0.307	0.303	1.100	1.620	0.768	0.669	0.898	0.500
Turbidity (NTU)	0	0	0	0.2	0	0.2	0	0	0	0.2	0.55	1.7
Redox Potential (Millivolts)	-47	87	74	7	92.1	101.8	-97	-97	-59	-74	35	149.2
Dissolved Oxygen (mg/L)	4.0	5.0	6.0	5.0	4.0	3.0	2.0	1.0	1.0	0.8	1.0	3.0
Carbon Dioxide (mg/L)	<10	<10	10	12	<10	13	25	45	50	29	70	13
Sulfide (mg/L)	0.03	0	0	0	0.01	0.13	0.01	0.01	0	0.01	0.05	0
Ferrous Iron (mg/L)	0.01	0.01	0.01	0.05	0.06	0.09	0	0.98	1.27	1.49	0.4	0
Hydrogen Sulfide (mg/L)	0	0	0	0	0	0	0	0	0.3	0.5	0.3	0

See notes at end of table.

**TABLE 2-2
SUMMARY OF FIELD SAMPLED NATURAL ATTENUATION PARAMETERS - SWMUs 6 AND 7
SEPTEMBER 2003 SAMPLING EVENT**

**TREATABILITY STUDY EVALUATION REPORT
NAVAL STATION MAYPORT
MAYPORT, FLORIDA
PAGE 2 OF 3**

Sample ID	MPT-8-MW015SR						MPT-8-MW016S					
	11/21/02	12/18/02	01/15/03	02/01/03	05/01/03	09/01/03	11/21/02	12/18/02	01/15/03	02/11/03	05/20/03	09/03/03
Temperature (°C)	24.48	NS	22.23	NS	NS	NS	25.90	24.41	22.45	22.50	23.42	26.59
pH (Standard Units)	7.40	NS	7.41	NS	NS	NS	6.84	10.39	6.70	7.30	6.64	6.67
Conductivity (mS/cm)	2.580	NS	2.670	NS	NS	NS	0.908	0.863	1.200	1.180	0.936	0.841
Turbidity (NTU)	>999	NS	277	NS	NS	NS	0	8.4	0	16.9	1.47	2.1
Redox Potential (Millivolts)	-394	NS	-368	NS	NS	NS	-169	-120	-215	-120	-44	-128.2
Dissolved Oxygen (mg/L)	0.3	NS	0.40	NS	NS	NS	0.20	0.8	0.4	1.0	1.0	0.2
Carbon Dioxide (mg/L)	35	NS	50	NS	NS	NS	50	160	70	130	200	225
Sulfide (mg/L)	>0.8	NS	>0.80	NS	NS	NS	0.09	0.06	0.09	0.07	0.03	0.03
Ferrous Iron (mg/L)	1.60	NS	0.1	NS	NS	NS	4.80	4	6	5.6	2.81	5.2
Hydrogen Sulfide (mg/L)	>5	NS	>5.0	NS	NS	NS	0.5	0.1	0.5	0.1	0.5	0.5

Sample ID	MPT-8-MW017S						MPT-8-MW018S					
	11/21/03	12/17/02	01/13/03	02/13/03	05/19/03	09/04/03	11/21/02	12/19/02	01/14/03	02/13/03	05/19/03	09/04/03
Temperature (°C)	25.90	24.09	21.81	22.08	23.07	26.25	26.12	24.10	22.47	21.70	23.24	25.51
pH (Standard Units)	6.84	10.41	6.99	7.59	6.95	6.97	7.16	11.23	7.05	7.63	7.11	7.15
Conductivity (mS/cm)	0.908	0.608	0.512	0.556	0.539	0.547	0.551	0.404	0.334	0.428	0.483	0.440
Turbidity (NTU)	0	0	0	6.7	0.21	0.8	0	0	0	0	0	0.8
Redox Potential (Millivolts)	-169	-182	-132	-128	-52.6	-104.4	-157	-206	-133	-106	-49.1	-92.7
Dissolved Oxygen (mg/L)	0.0	0.4	0.4	1.0	0.1	2.0	0.3	1.0	1.0	1.0	0.6	4.0
Carbon Dioxide (mg/L)	50	30	25	30	35	45	20	28	17	16	20	20
Sulfide (mg/L)	0.09	0.09	0.04	0.08	0.03	0.17	0.01	0.01	0.03	0	0.01	0
Ferrous Iron (mg/L)	4.8	2.61	2.25	1.92	2.64	1.68	0.86	1.17	0.97	0.68	1.76	0.97
Hydrogen Sulfide (mg/L)	0.5	0.5	0	0	0	0	0	NM	0	0	0	0

See notes at end of table.

**TABLE 2-2
SUMMARY OF FIELD SAMPLED NATURAL ATTENUATION PARAMETERS - SWMUs 6 AND 7
SEPTEMBER 2003 SAMPLING EVENT**

**TREATABILITY STUDY EVALUATION REPORT
NAVAL STATION MAYPORT
MAYPORT, FLORIDA
PAGE 3 OF 3**

Sample ID Collect Date	MPT-8-MW019S						MPT-S-MW02S					
	11/20/02	12/18/03	01/14/03	02/11/03	05/20/03	09/04/03	11/20/02	12/17/03	01/15/03	02/11/03	05/20/03	09/03/03
Temperature (°C)	23.63	18.40	16.80	16.44	29.17	32.62	23.52	23.14	21.14	21.38	22.47	26.45
pH (Standard Units)	7.54	8.11	7.54	8.42	7.61	7.58	7.47	10.36	7.29	7.70	7.04	7.04
Conductivity (mS/cm)	0.491	0.345	0.334	0.429	0.337	0.338	2.780	2.780	1.390	1.390	1.034	2.618
Turbidity (NTU)	0	0	0	4.7	0.14	0.7	0	0	0	5.7	0.48	0
Redox Potential (Millivolts)	51	98	75	42	130.5	175.3	-73	-16C	-150	-57	-20.3	83.4
Dissolved Oxygen (mg/L)	3.0	4.0	6.0	6.0	4.0	2.0	1.0	1.0	2.0	3.0	1.0	1.0
Carbon Dioxide (mg/L)	<10	<10	<10	<10	<10	<10	25	25	18	20	20	45
Sulfide (mg/L)	0	0.01	0	0.03	0.01	0	0.03	0.04	0.01	0	0.15	0
Ferrous Iron (mg/L)	0	0.03	0.03	0.01	0.01	0	0.03	0.06	0	0	1.13	0
Hydrogen Sulfide (mg/L)	0	0	0	0	0	0	0	0	0	0	2	0

Sample ID Collect Date	MPT-S-MW03S					
	11/21/03	12/19/02	01/14/03	02/11/03	05/20/03	09/03/03
Temperature (°C)	25.82	NS	NS	21.69	23.60	26.41
pH (Standard Units)	6.93	NS	NS	7.53	7.01	6.93
Conductivity (mS/cm)	0.928	NS	NS	0.740	0.566	0.694
Turbidity (NTU)	2.5	NS	NS	0	1	0
Redox Potential (Millivolts)	-253	NS	NS	-109	-1	-2
Dissolved Oxygen (mg/L)	0.3	NS	NS	1.0	0.4	2.0
Carbon Dioxide (mg/L)	34	NS	NS	35	30	60
Sulfide (mg/L)	0.25	NS	NS	0.01	0.01	0
Ferrous Iron (mg/L)	4.6	NS	NS	2.81	0.87	2.52
Hydrogen Sulfide (mg/L)	5	NS	NS	0	0	0

Notes:

°C = Degrees Celsius
mS/cm = Millisiemens per Centimeter
NTU = Nephelometric Turbidity Unit
NS = Not Sampled

Redox = Oxidation - Reduction
mg/L = Milligrams per Liter
NM = Not measured

**TABLE 2-3
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER - SWMUs 6 AND 7
SEPTEMBER 2003 SAMPLING EVENT**

**TREATABILITY STUDY EVALUATION REPORT
NAVAL STATION MAYPORT
MAYPORT, FLORIDA
PAGE 1 OF 6**

Sample ID		MPT-S-MW02S						MPT-S-MW03S					
Sample Location		S - MW02S						S - MW03S					
Collect Date		11/20/2002	12/17/2002	1/15/2003	2/11/2003	5/20/2003	9/11/2003	11/21/2002	12/17/2002	1/15/2003	2/11/2003	5/20/2003	9/11/2003
	Units												
Metals¹													
Iron	µg/L	85.7	62.3	--	--	1300	1047	3280	NS	NS	4020	920	1900
Manganese	µg/L	14.2	10.7	23.3	3.4	--	47.0	556	NS	NS	190	110	121
Miscellaneous²													
Alkalinity	mg/L	370	330	380	380	350	390	410	NS	NS	370	320	280
Ammonia	mg/L	0.91	0.6	1.2 J	0.78	1.1	1.2	1.2	NS	NS	0.48	0.26	0.33
Chloride	mg/L	420	420	110 J	150	160	340	15 J	NS	NS	14	16	8
Dissolved Organic Carbon	mg/L	12	NA	NA	NA	NA	NA	NA	NS	NS	NA	NA	NA
Fractional Organic Carbon	mg/L	77	NA	NA	NA	NA	NA	NA	NS	NS	NA	NA	NA
Nitrate	mg/L	0.36 J	0.18	0.25 J	0.30 J	0.14	0.6	--	NS	NS	--	0.13	--
Nitrite	mg/L	--	--	--	--	--	--	--	NS	NS	--	--	--
Orthophosphate	mg/L	--	--	--	--	0.2	--	--	NS	NS	--	0.18	--
Sulfate	mg/L	46 J	32	20	25	11	42	50 J	NS	NS	40	31	12
Total Organic Carbon	mg/L	13	13	11	13	20	26	28	NS	NS	2	5	3.7
Biogenic Gases³													
Carbon Dioxide	mg/L	61	51 J	47	52 J	66	63	110	NS	NS	56 J	56	72
Ethane	µg/L	0.29	0.25 J	0.22	0.24 J	0.2	0.230	0.830	NS	NS	0.48 J	1	0.97
Ethene	µg/L	0.003 J	--	--	--	--	--	0.007	NS	NS	--	0.013	--
Hydrogen	nM	2.2	1.1 J	0.71	1.3 J	1.1	1	12	NS	NS	1.8 J	0.48	45
Methane	mg/L	2.3	2.1 J	2.5	2.8 J	3.9	3.5	0.55	NS	NS	0.18	0.056	0.29
Nitrogen	mg/L	14	15 J	14	13 J	13	14	14	NS	NS	16 J	16	16
Oxygen	mg/L	2	2.4 J	4.1	4.5 J	3	2	2.4	NS	NS	2.8 J	4.3	2.6

See notes at end of table

**TABLE 2-3
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER - SWMUs 6 AND 7
SEPTEMBER 2003 SAMPLING EVENT**

**TREATABILITY STUDY EVALUATION REPORT
NAVAL STATION MAYPORT
MAYPORT, FLORIDA
PAGE 2 OF 6**

Sample ID		MPT-8-MW01S						MPT-8-MW03S					
Sample Location		MW01S						MW03S					
Collect Date		11/19/2002	12/19/2002	1/13/2003	2/10/2003	5/20/2003	9/11/2003	11/19/2002	12/19/2003	1/13/2003	2/10/2003	5/20/2003	9/11/2003
	Units												
Metals¹													
Iron	µg/L	815	826	183	--	420	--	NS	486	NS	NS	NS	NS
Manganese	µg/L	34.5	26.6	22.4	23.4	--	4.7	NS	132	NS	NS	NS	NS
Miscellaneous²													
Alkalinity	mg/L	160	170	160 J	170	160	160	NS	510	NS	NS	NS	NS
Ammonia	mg/L	0.17	NA	0.38	0.39	0.26	0.18	NS	NA	NS	NS	NS	NS
Chloride	mg/L	17	16	18	17	13	9	NS	17	NS	NS	NS	NS
Dissolved Organic Carbon	mg/L	4.3	NA	2.7	NA	NA	NA	NS	NA	NS	NS	NS	NS
Fractional Organic Carbon	mg/L	34	NA	46	NA	NA	NA	NS	NA	NS	NS	NS	NS
Nitrate	mg/L	--	--	0.14 J	--	--	--	NS	--	NS	NS	NS	NS
Nitrite	mg/L	--	--	--	--	--	--	NS	--	NS	NS	NS	NS
Orthophosphate	mg/L	--	--	--	--	0.54	--	NS	--	NS	NS	NS	NS
Sulfate	mg/L	39 J	29	31	31	36	37	NS	18	NS	NS	NS	NS
Total Organic Carbon	mg/L	5.3	2.9	2.4	3.1	4.5	3.6	NS	50	NS	NS	NS	NS
Biogenic Gases³													
Carbon Dioxide	mg/L	11	11 J	8.9	6.3 J	7.4	10	NS	160 J	NS	NS	NS	NS
Ethane	µg/L	0.008	0.02 J	0.015	0.012 J	0.013	0.007	NS	0.053 J	NS	NS	NS	NS
Ethene	µg/L	0.009	--	0.006	--	0.005	0.007	NS	--	NS	NS	NS	NS
Hydrogen	nM	2	1.1 J	2.1	2 J	1.4	2.2	NS	3.6 J	NS	NS	NS	NS
Methane	mg/L	0.045	0.12 J	0.087	0.11 J	0.18	0.066	NS	5.2 J	NS	NS	NS	NS
Nitrogen	mg/L	16	18 J	18	17 J	17	18	NS	11 J	NS	NS	NS	NS
Oxygen	mg/L	3.8	1.2 J	1.1	3.4 J	3.5	1.2 J	NS	3.2 J	NS	NS	NS	NS

See notes at end of table.

**TABLE 2-3
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER - SWMUs 6 AND 7
SEPTEMBER 2003 SAMPLING EVENT**

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Sample ID		MPT-8-MW04S						MPT-8-MW-06S					
Sample Location		MW04S						MW06S					
Collect Date		11/21/2002	12/17/2002	1/15/2003	2/13/2004	5/21/2003	9/11/2003	11/21/2002	12/18/2002	1/14/2003	2/13/2003	5/19/2003	9/11/2003
	Units												
Metals¹													
Iron	µg/L	NS	12900	13600	14100	14000	8060	30.1	--	--	--	1600	--
Manganese	µg/L	NS	212	233	226	250	202	6.7	8.0	4.3	40.9	95	21.1
Miscellaneous²													
Alkalinity	mg/L	NS	280	280	500	500	490	180	190	170 J	180	160	180
Ammonia	mg/L	NS	5.3	4.2 J	5	5.1	3.9	0.37	--	--	0.24	--	--
Chloride	mg/L	NS	16	16 J	15	14	15	7.4 J	7.7	6.3	11	8	5
Dissolved Organic Carbon	mg/L	NS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fractional Organic Carbon	mg/L	NS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate	mg/L	NS	--	--	--	--	--	0.98 J	0.44	0.33 J	--	0.88	0.4
Nitrite	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Orthophosphate	mg/L	NS	--	--	--	0.79	--	--	--	--	--	--	--
Sulfate	mg/L	NS	3	4	0.19	--	--	16 J	15	17	14	17	17
Total Organic Carbon	mg/L	NS	30	38	34	35	20	2.1	1.1	1.8	2.9	3	2.6
Biogenic Gases³													
Carbon Dioxide	mg/L	NS	150 J	160	140	190	170	12	9.9 J	8.6	9.5	10 J	15
Ethane	µg/L	NS	0.13 J	0.022	0.01	--	--	--	--	0.001 J	--	0.003 J	0.003 J
Ethene	µg/L	NS	0.01 J	--	--	--	--	0.012	--	0.003 J	--	0.013 J	0.01
Hydrogen	nM	NS	2.2 J	1.8	3	2.5	3.5	1.7	1.2 J	1.4	0.5	0.21 J	1.9
Methane	mg/L	NS	7.5 J	6.7	9.4	10	10	0.00014	0.00008 J	0.00003	0.00006	0.0001 J	0.00066
Nitrogen	mg/L	NS	10 J	9.5	8.2	6.5	7.1	14	17 J	15	16	16 J	17
Oxygen	mg/L	NS	2.1 J	3.5	1.5	1.8	0.85	7	5.4 J	6.6	4.3	5.4 J	3.6

See notes at end of table.

**TABLE 2-3
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER - SWMUs 6 AND 7
SEPTEMBER 2003 SAMPLING EVENT**

**TREATABILITY STUDY EVALUATION REPORT
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Sample ID		MPT-8-MW09S						MPT-8-MW15SR					
Sample Location		MW09S						MW15SR					
Collect Date		11/19/2002	12/18/2002	1/14/2003	2/10/2003	5/21/2003	9/11/2003	11/21/2002	12/18/2002	1/15/2003	2/10/2003	5/21/2003	9/11/2003
	Units												
Metals¹													
Iron	µg/L	--	1200	1580	1650	900	--	14000	NS	4330	NS	NS	NS
Manganese	µg/L	44.0	211	214	231	280	--	118	NS	58.0	NS	NS	NS
Miscellaneous²													
Alkalinity	mg/L	310	370	390 J	330	360	170	310	NS	640	NS	NS	NS
Ammonia	mg/L	0.22	0.24	0.41	3.9	0.66	--	4	NS	--	NS	NS	NS
Chloride	mg/L	140	190	83 J	7	120	25	370 J	NS	400 J	NS	NS	NS
Dissolved Organic Carbon	mg/L	5.3	NA	NA	NA	NA	NA	NA	NS	NA	NS	NS	NS
Fractional Organic Carbon	mg/L	68	NA	NA	NA	NA	NA	NA	NS	NA	NS	NS	NS
Nitrate	mg/L	0.42 J	0.16	0.15 J	--	--	0.5	--	NS	--	NS	NS	NS
Nitrite	mg/L	--	--	--	--	--	--	--	NS	--	NS	NS	NS
Orthophosphate	mg/L	--	--	--	--	0.90	--	2.5	NS	4.6 J	NS	NS	NS
Sulfate	mg/L	33 J	20	11	0.67	10	73	46 J	NS	150	NS	NS	NS
Total Organic Carbon	mg/L	5.5	15	16	35	16	2.9	160	NS	44	NS	NS	NS
Biogenic Gases³													
Carbon Dioxide	mg/L	54	72 J	68	55 J	82	14	60	NS	44	NS	NS	NS
Ethane	µg/L	0.002 J	0.011 J	--	--	--	0.008	0.68	NS	0.55	NS	NS	NS
Ethene	µg/L	0.01	--	--	--	--	--	0.022	NS	0.01	NS	NS	NS
Hydrogen	nM	2	1.6 J	3.4	2.3 J	2.2	1.5	2.8	NS	1.8	NS	NS	NS
Methane	mg/L	0.005	0.340 J	1.1	0.67 J	0.65	0.00007	2.7	NS	2.4	NS	NS	NS
Nitrogen	mg/L	14	17 J	16	16 J	5	16	13	NS	14	NS	NS	NS
Oxygen	mg/L	6.2	2 J	2.2	2.4 J	3.5	5.8	3.4	NS	4.3	NS	NS	NS

See notes at end of table.

**TABLE 2-3
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER - SWMUs 6 AND 7
SEPTEMBER 2003 SAMPLING EVENT**

**TREATABILITY STUDY EVALUATION REPORT
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Sample ID		MPT-8-MW16S						MPT-8-MW17S					
Sample Location		MW16S						MW17S					
Collect Date		11/21/2002	12/18/2002	1/15/2003	2/11/2003	5/20/2003	9/11/2003	11/21/2002	12/17/2002	1/13/2003	2/13/2003	5/19/2003	9/11/2003
	Units												
Metals¹													
Iron	µg/L	NS	5*20	10500	14800	13000	8760	3690	3340	3100	2390	4800	3290
Manganese	µg/L	NS	141	206	270	270	241	133	83.1	99.1	78.8	110	117
Miscellaneous²													
Alkalinity	mg/L	NS	510	140	570	580	540	380	350	320 J	300	320	350
Ammonia	mg/L	NS	2.4	1.4 J	3.9	5.5	5.0	0.91	0.23	0.4	0.25	0.32	0.38
Chloride	mg/L	NS	20	23 J	17	19	13	20 J	13	11	11	11	15
Dissolved Organic Carbon	mg/L	NS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fractional Organic Carbon	mg/L	NS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate	mg/L	NS	0.12	0.22 J	--	2.3 J	--	--	--	--	--	--	--
Nitrite	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Orthophosphate	mg/L	NS	--	--	--	--	--	--	--	--	--	0.12	--
Sulfate	mg/L	NS	14	11	0.67	--	--	11 J	13	15	14	9	13
Total Organic Carbon	mg/L	NS	22	37	35	41	24	10	6.3	2.9	2.9	6	6.3
Biogenic Gases³													
Carbon Dioxide	mg/L	NS	180 J	180	200 J	210	200	100	68 J	61	56	58 J	60
Ethane	µg/L	NS	0.13 J	0.027	0.056 J	--	--	0.009	--	--	--	--	--
Ethene	µg/L	NS	--	--	--	--	--	0.006 J	--	0.004	--	--	--
Hydrogen	nM	NS	3.5 J	1.2	1.9 J	2	12	2.1 J	1.3 J	2.8	1.1	0.37 J	0.94
Methane	mg/L	NS	7.4 J	5.8	3 J	11	10	2	0.610 J	0.310	0.51	0.69 J	0.68
Nitrogen	mg/L	NS	10 J	10	7.8 J	5.1	6.6	14	17 J	17	16	16 J	16
Oxygen	mg/L	NS	0.98 J	3.4	3.1 J	2.9	1.4	2.5	1.4 J	2.5	1.1	2.3 J	0.77

See notes at end of table.

**TABLE 2-3
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER - SWMUs 5 AND 7
SEPTEMBER 2003 SAMPLING EVENT**

**TREATABILITY STUDY EVALUATION REPORT
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Sample ID		MPT-8-MW18S						MPT-8-MW19S					
Sample Location		MW18S						MW19S					
Collect Date		11/20/2002	12/19/2002	1/14/2003	2/13/2003	5/19/2003	9/11/2003	11/20/2002	12/18/2002	1/14/2003	2/11/2003	5/20/2003	9/11/2003
	Units												
Metals¹													
Iron	µg/L	1250	1280	1410	1300	2100	2000	64.2	--	--	--	--	--
Manganese	µg/L	59.0	77.4	67.5	58.8	95	126	3.7	2.9	2.4	94.4	--	--
Miscellaneous²													
Alkalinity	mg/L	240	230	230 J	220	290	300	160	170	130 J	130	98	140
Ammonia	mg/L	0.22	NA	0.15		0.049	0.08	0.21	--	0.14	--	--	--
Chloride	mg/L	9.9	9.1	7.2 J	6.6	9	10	28	24	21	23	11	9
Dissolved Organic Carbon	mg/L	NA	NA	NA	NA	NA	NA	4.8	5.6	5.7	4.2	7	5.0
Fractional Organic Carbon	mg/L	45	NA	NA	NA	NA	NA	32	31	27	29	NA	NA
Nitrate	mg/L	0.1 J	--	--	--	--	--	1.1 J	1.5	1.3 J	2.0 J	0.78	4.0
Nitrite	mg/L	--	--	--	--	--	--	--	--	--	--	--	--
Orthophosphate	mg/L	--	--	--	--	--	--	--	--	--	--	--	--
Sulfate	mg/L	17 J	15	18	15	3 J	5	33 J	33	34	36	28	32
Total Organic Carbon	mg/L	7.4	3.8	3.5	2.8	5	7.1	5	4.8	6.1	4.6	22	4.8
Biogenic Gases³													
Carbon Dioxide	mg/L	34	13 J	17	23	35 J	32	7.3	4 J	3.3	4 J	7.8	9.2
Ethane	µg/L	0.007	--	0.002	--	0.005 J	0.007	--	--	0.001 J	--	0.002	0.004 J
Ethene	µg/L	0.011	--	--	--	0.008 J	--	0.01	--	0.001 J	--	0.016	0.013
Hydrogen	nM	1.9	1.4 J	1.6 J	2	0.39 J	7	2.5	1 J	1.5	1.1 J	0.3	1.7
Methane	mg/L	0.097	0.068 J	0.100	0.18	0.12 J	0.084	0.00009	0.0002 J	0.00014	0.0004 J	0.00042	0.00028
Nitrogen	mg/L	16	18 J	17	18	17 J	17	13	16 J	16	16 J	15	16
Oxygen	mg/L	2.1	1.5 J	2.5	1.7	2.1 J	1.1	10	5.8 J	5.7	7 J	6.8	5.7

Notes:

¹ SW-846 6010B (Metals)² USEPA 310.1 (Alkalinity); USEPA 350.2 (Ammonia); USEPA 300.0 (Anions); SW-846 9060 (DOC, FOC, TOC)³ AMG20GAX (Biogenic Gases)

-- = Compound not detected

J = Compound detected at an estimated concentration

NA = Not analyzed

NS = Not sampled

NC = No criteria

nM = Nanomolar

mg/L = Milligrams per liter

µg/L = Micrograms per liter

2.3 SOIL SAMPLING

2.3.1 Preliminary Soil Sampling

Laboratory analytical results from the 10 preliminary soil samples analyzed for the Florida TPHCWG are provided in Table 2-4. Several of the aliphatic and aromatic carbon chains (TRPH fractions) in soil boring SB02 exceeded the comparison criteria (default SCTLs) for TRPH fractions. The comparison criteria used for the purpose of this treatability study were selected by the Mayport Partnering Team for the purpose of evaluating soil remediation alternatives and soil characterization. The default SCTLs used in this treatability study for the TRPH fractions are not FDEP regulatory criteria unless added to Chapter 62-777.170, FAC, or otherwise incorporated into a regulation. The Mayport Partnering Team used the default SCTLs for the TRPH fractions found in the *Draft Technical Report: Development of Soil Cleanup Target Levels (SCTLs) for Chapter 62-777, F.A.C.*, dated February 26, 2004, for comparison purposes only in this treatability study. A copy of the pages from the Draft Report relevant to this treatability study is provided in Appendix E. Five carbon chains exceeded the default SCTLs in MPT-8-SB02 and MPT-8-SB02-3; and one carbon chain (C12-C16 Aliphatics) exceeded the criteria in soil boring SB03. Soil sampling locations SB02 and SB03 are both located in the center sludge drying bed. Soil sampling locations are shown on Figure 1-3. The TPHCWG results were used to select the location (between SB02 and SB03) of the soil sample that was used for the soil biotreatability study.

2.4 FREE-PRODUCT MEASUREMENT AND RECOVERY

Free-product levels were measured in the site wells during each of the groundwater sampling events. Table 2-5 provides free-product levels that were measured during the groundwater sampling events. Seven monitoring well were found to contain free product. Five of the wells contained free product during one event only. Monitoring wells MW02S and MW03S were the only wells checked that consistently contained free product. Five bioslurper wells were found to contain free product in February 2003. Bioslurper well VW-136 contained 0.93 ft of free product, which resulted in recovery well RW01 being installed near it. The locations of the bioslurper wells were presented on historical Figure 4-9 in Appendix B. The passive skimmer that was installed in recovery well RW01 was unsuccessful at recovering any free product. To comply with a commitment to FDEP to remove free product when present, the Navy installed absorbent socks in any well where free product was measured. The absorbent socks were changed out when they became saturated with free product. Approximately 30 absorbent socks were used during the period of June through September of 2003.

**TABLE 2-4
SUMMARY OF ANALYTES DETECTED IN SOIL - SWMUs 6 AND 7
FEBRUARY 2003 SAMPLING EVENT (QUARTER 2)**

**TREATABILITY STUDY EVALUATION REPORT
NAVAL STATION MAYPORT
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Sample No.		MPT-8-SB01-3	MPT-8-SB02-3	MPT-8-SB03-3	MPT-8-SB04-2.5	MPT-8-SB05-8	MPT-8-SB06-8.5
Sample Depth (ft bls)		3 ft	3 ft	3 ft	2.5 ft	8 ft	8.5 ft
Collect Date		2/12/2003	2/12/2003	2/12/2003	2/12/2003	2/12/2003	2/12/2003
	Default SCTL ¹ DE1 ² /DE2 ³ /LE ⁴ (mg/kg)						
TPHCWG⁵ (mg/kg)							
C5-C7 Aromatics	340/1800/34	--	--	--	--	--	--
C7-C8 Aromatics	490/3700/59	--	--	--	--	--	--
C8-C10 Aromatics	460/2700/340	--	51	--	--	--	--
C10-C12 Aromatics	900/5900/520	--	600	--	--	100	--
C12-C16 Aromatics	1500/12000/1000	17 J	2000	260	--	800	--
C16-C21 Aromatics	1300/11000/3200	4.1 J	1500	320	--	670	--
C21-C35 Aromatics	2300/40000/25000	--	32 J	5.8 J	1.5J	20 J	--
C6-C8 Aliphatics	8700/46000/1300	--	--	--	--	--	--
C8-C10 Aliphatics	850/4800/7000	--	390	73	--	95	--
C10-C12 Aliphatics	1700/10000/51000	42 J	1900	730	--	500	--
C12-C16 Aliphatics	2900/21000/***	870	4200	3200	--	1900	--
C16-C21 Aliphatics	NL	840	2200	2300	--	1500	--
C21-C35 Aliphatics	NL	26 J	80	91	1.5J	19 J	--
C16-C35 Aliphatics ⁶	4200/280000/***	866 J	2280	2391	1.5J	1519 J	--

See notes at end of table.

TABLE 2-4
SUMMARY OF ANALYTES DETECTED IN SOIL - SWMUs 6 AND 7
FEBRUARY 2003 SAMPLING EVENT (QUARTER 2)

TREATABILITY STUDY EVALUATION REPORT
NAVAL STATION MAYPORT
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Sample No.		MPT-8-SB07-7	MPT-8-SB08-7.5	MPT-8-SB09-6.5	MPT-8-SB010-3	MPT-8-SB010-3 (Duplicate)
Sample Depth (ft bls)		7 ft	7.5 ft	6.5 ft	3 ft	3 ft
Collect Date		2/12/2003	2/12/2003	2/12/2003	2/12/2003	2/12/2003
TPHCWG ⁵ (mg/kg)	Default SCTL ¹					
	DE1 ² /DE2 ³ /LE ⁴ (mg/kg)					
C5-C7 Aromatics	340/1800/34	--	--	--	--	--
C7-C8 Aromatics	490/3700/59	--	--	--	--	--
C8-C10 Aromatics	460/2700/340	--	--	--	--	--
C10-C12 Aromatics	900/5900/520	--	--	23 J	--	--
C12-C16 Aromatics	1500/12000/1000	14 J	15 J	270	16 J	16 J
C16-C21 Aromatics	1300/11000/3200	4.9 J	3.2 J	190	4.6 J	3.4 J
C21-C35 Aromatics	2300/40300/25000	--	--	--	--	--
C6-C8 Aliphatics	8700/46000/1300	--	--	--	--	--
C8-C10 Aliphatics	850/4800/7000	--	17 J	100	--	--
C10-C12 Aliphatics	1700/10000/51000	--	150	780	13 J	23 J
C12-C16 Aliphatics	2900/21000/**	77	370	2700	290	260
C16-C21 Aliphatics	NL	43 J	110	2000	62	48 J
C21-C35 Aliphatics	NL	31 J	12 J	130	--	16 J
C16-C35 Aliphatics ⁶	4200/280000/**	79 J	122 J	2130	62	64 J

Notes:

¹ SCTL = Default Soil Cleanup Target Levels referenced in Chapter 62-777, FAC. These default SCTLs were selected only for comparison purposes of this treatability study.

² DE1 = Direct Exposure Scenario 1 - Residential

³ DE2 = Direct Exposure Scenario 2 - Commercial/Industrial

⁴ LE = Leachability Exposure

⁵ TPHCWG = Total Petroleum Hydrocarbon Criteria Working Group method

⁶ C16-C35 Aliphatics = Sum of C16-C21 + C21-C35 Aliphatics

Notes: mg/kg = milligrams per kilogram
 -- = analyte not detected
 NL = Not Listed
 bold = exceedance of default SCTL

J = compound detected at an estimated concentration
 ft bls = feet below land surface
 ** = not a health risk for this exposure scenario

**TABLE 2-5
FREE-PRODUCT LEVELS
SWMUs 6 AND 7**

**TREATABILITY STUDY EVALUATION REPORT
NAVAL STATION MAYPORT
MAYPORT, FLORIDA**

Measurement Date	June 2002	November 2002	December 2002	January 2003	February 2003	May 2003	September 2003*	February 2004
Free-Product Level	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Location								
MPT-8-MW01S	0.50	--	--	--	--	--	--	--
MPT-8-MW02S	0.05	0.54	0.40	0.45	0.40	0.63	--	0.01
MPT-8-MW03S	0.01	0.01	--	0.02	0.10	--	--	--
MPT-8-MW04S	--	--	--	--	0.02	--	--	--
MPT-8-MW06S	0.30	--	--	--	--	--	--	--
MPT-8-MW16S	--	--	--	--	--	0.01	--	--
MPT-8-MW17S	--	--	--	--	--	0.01	--	--
MPT-8-EW-71	NM	NM	NM	NM	NM	NM	--	0.08
MPT-8-EW-77	NM	NM	NM	NM	NM	NM	--	0.04
MPT-8-EW-78	NM	NM	NM	NM	NM	0.28	--	0.03
MPT-8-VW-99	NM	NM	NM	NM	NM	NM	--	0.01
MPT-8-VW-119	NM	NM	NM	NM	NM	NM	--	0.01
MPT-8-VW-134	NM	NM	NM	NM	NM	NM	--	0.01
MPT-8-VW-120	NM	NM	NM	NM	NM	0.11	--	--
MPT-8-VW-135	NM	NM	NM	NM	NM	0.34	--	--
MPT-8-VW-136	NM	NM	NM	NM	NM	0.93	--	0.01
MPT-8-VW-140	NM	NM	NM	NM	NM	0.03	--	--

Notes:

EW = Extraction well
MPT = Mayport
MW = Monitoring well

NM = Not measured
VW = Venting well
-- = Free-product not detected

*Absorbent socks were installed in wells containing free-product from June until September 2003. This measurement was made within 5 minutes of removing the sock. Therefore, disturbance of the water in the well may have affected the free product thickness.

The site monitoring wells were left untouched from November through January to allow free product to return into the wells. Free product levels were collected from the site groundwater monitoring wells and bioslurper wells on February 13, 2004 to provide additional information for the Mayport Partnering Team meeting. Eight wells were found to contain free product, as provided in Table 2-5. Three bioslurper wells (EW-71, EW-77, and EW-78) contained more than 0.01 ft of product. Absorbent socks were then placed in these eight well to remove the free product. Weekly inspection and changing of the absorbent socks has continued since socks were reinstalled following the February 13, 2004, free product level measurements.

3.0 DATA ASSESSMENT

3.1 SOIL BIOTREATABILITY TESTS

ETI and Catalina were both contracted to evaluate the effectiveness of their soil bioremediation technologies on the soil at SWMUs 6 and 7. An analysis of their results is presented below.

3.1.1 Catalina Biosolutions

The potential for significant error was present in Catalina's tests because they did not perform baseline soil analysis. Without baseline data, it is not possible to determine the percent reduction or rate of reduction that occurred during the life of their test. Without baseline data, it is also impossible to accurately report how efficient Catalina's treatment option was and potentially could be for remediation at this site. For these reasons, TtNUS concluded that Catalina's bench-scale soil tests were inconclusive and may not accurately illustrate the actual degradation trends that could occur within the soil at SWMUs 6 and 7 given a full-scale field application.

3.1.2 Enzyme Technologies, Inc

Based on the results of ETI's bench scale testing it appears that soil remediation using their solution is technically feasible. Their laboratory analytical results indicated that the treatment reduced TRPH and PAHs to less than SCTLs within 90 days.

An objective of the testing was to evaluate whether an in situ method was feasible. ETI's degradation of the contaminated soil was achieved using a mixture of specific enzymes, bacteria, and nutrients in a controlled environment. In situ applications, while available and possible, are more difficult to implement and often times may not be effective at removing all of the contamination. This site has soil contamination from land surface to the water table (approximately 8 ft bls). Remediation is dependent on the vendor mixture coming into contact with the contaminated soil and then maintaining suitable physical conditions for the degradation reactions to occur. These limitations make in situ methods more difficult to implement and less predictable. In evaluating in situ treatment it would be difficult to determine the amount of time it will take for remediation to occur.

3.2 SUMMARY OF GEOCHEMICAL RESULTS

An initial NA score was calculated for each site monitoring well in an addendum to the first quarterly monitoring report for SWMUs 6 and 7. Monitoring wells (MW03S, MW04S, MW16S, and MW17S) that were located within or immediately downgradient to the sludge drying beds (area with known free

product) received NA scores that were reported to indicate adequate evidence of conditions conducive to biodegradation of contaminants. Three more quarters (February, May, and September, 2003) of geochemical sampling were performed to provide additional groundwater chemistry data. Both field and laboratory analyzed geochemical parameters remained generally consistent over the duration of this treatability study.

No dissolved phase groundwater contamination was encountered in the free-product plume wells MW04S and MW16S that are downgradient based on the groundwater flow reported in this document. MW19S is considered an upgradient monitoring well for the purpose of this geochemistry presentation. The following observations were made about the site geochemistry:

- The upgradient well was borderline aerobic, as were the downgradient wells.
- CO₂ was practically non-existent in the upgradient location. Downgradient concentrations of CO₂ ranged from 50 to 225 mg/L.
- The downgradient wells had higher concentrations of ferrous iron than the upgradient well. Ferrous iron is a product of the NA process.
- pH (near 7) and temperature (greater than 20°C) measurements were in the ranges conducive to NA.

3.3 SOIL TPHCWG RESULTS

Ten soil samples were collected in February 2003 and analyzed by the Florida TPHCWG method. Results from this analysis indicate that several of the longer aromatic and aliphatic carbon chains were above default SCTLs. Aromatic carbon chains that were in exceedance were the C10-C12, C12-C16, and C16-C21 chains. Aliphatic carbon chains that were in exceedance were the C10-C12 and C12-C16 chains. The soil samples with TPHCWG values exceeding default SCTLs were collected from the central sludge drying pit. These longer carbon chains are very recalcitrant to degradation, which is why they persist in the environment.

3.4 SUMMARY OF FREE-PRODUCT RECOVERY

According to the manufacturer, one box (30 absorbent socks) of absorbent socks is capable of absorbing up to 4 gallons of free product. Approximately 30 absorbent socks were used over the course of this treatability study. The socks were replaced once they became discolored and smelled of free product. As a conservative assumption, TtNUS estimates that the socks were at 50 percent of saturation capacity when replaced. Therefore, it is estimated that approximately 2 gallons of total free product were removed using the absorbent socks during this treatability study.

The Keck passive skimmer that was installed in recovery well MPT-8-RW01 did not recover measurable quantities of free product. It was checked weekly and was not found to contain free product even though free product was present in the recovery well.

Results of the February 13, 2004, free-product measurements indicate that trace levels of product are still present on the water table at SWMUs 6 and 7. The free product thickness ranged from 0.01 ft to 0.08 ft, with five wells containing 0.01 ft or less. During the study, if free product was measured in a well an absorbent sock was installed. During the time the socks were in place, the free product was reduced to a thickness of less than 0.01 ft. Wells that had previously contained product and had absorbent socks installed in them, no longer contained free product in excess of 0.01 ft.

Monitoring well MW02S was the only well measured during every event of the treatability study that had measurable changes in free product thickness. A comparison of the free product thickness in this well to groundwater elevation changes over the duration of the study indicates that the changes in free product thickness may be due to groundwater fluctuations.

4.0 CONCLUSIONS

This treatability study was conducted to determine (1) if an in situ biological method was applicable for contaminated soil treatment; (2) if NA was a viable alternative to address groundwater contamination; (3) to analyze and evaluate contaminated soil under the TPHCWG at SWMUs 6 and 7; and (4) if a passive skimmer or absorbent socks could remove free product from wells. Additionally, free-product monitoring and recovery was conducted to satisfy FDEP requirements. Conclusions for this treatability study are listed below.

Two separate vendors (ETI and Catalina) conducted soil biotreatability tests on a split sample from the center sludge bed at SWMUs 6 and 7. Both vendors concluded that bioremediation of the soil was possible with the addition of their biological stimulants. They both stated that the more recalcitrant carbon chains (longer aliphatic and aromatic chains) would need specialized microorganisms to effectively and efficiently bioremediate them. ETI estimated that an ex situ landfarming application with their specified biological products could successfully remediate the soil within 60 to 90 days. ETI also predicted that over 99 percent of PAH compounds would be biodegraded during the process.

Based on the information provided by the vendors, TtNUS concludes that ETI's products are likely to reduce the contaminant concentrations in soil from SWMUs 6 and 7. The same conclusion cannot be made regarding the work provided by Catalina due to the lack of baseline analytical data. There are uncertainties associated with both vendors due to sampling and analysis inconsistencies. In situ application of bioremediation chemicals to the soil is rarely effective. Therefore, if this process is considered further, an ex situ landfarming approach is likely the best application alternative.

Baseline groundwater sampling results indicated no COCs were present exceeding FDEP GCTLs in the 14 wells that were sampled. The following general conclusions can be made regarding the site geochemistry.

- The site has borderline aerobic conditions.
- CO₂ is apparent in the downgradient wells at more elevated concentrations than the upgradient and crossgradient wells. This indicates that CO₂ is being produced in the contaminated zone.

Overall, it appears that groundwater in this area provides a slightly aerobic groundwater environment for NA and byproducts of NA are being measured downgradient of the free product; therefore, NA via aerobic degradation appears feasible.

Soil comparison criteria exceedances were detected in two samples collected from the central sludge drying bed. Evaluation of the soil by the TPHCWG indicated that several of the longer aliphatic and aromatic carbon chains are present above comparison criteria. In particular, the C10-C21 range carbon chains were found to be in exceedance. These carbon chains remain persistent in the center sludge drying bed soil because they are very recalcitrant.

A passive skimmer was ineffective at recovering free product because of the viscous nature of the free product.

The following free-product data was not collected as part of the treatability study but rather as information regarding the free-product removal efforts at SWMUs 6 and 7. Free-product measurements collected in February 2004 indicate that three well points contain more than 0.01 ft of free product. The water table was several feet lower than normal during the February 2004 product measurements because of seasonal fluctuations. It is likely that remaining free product is smeared through the soil and may resurface when the water table rebounds. Absorbent socks are currently installed in the eight wells that contained free product during the February 2004 event. The absorbent socks are typically checked weekly and replaced as needed.

Additional free product measurements will be collected once seasonal conditions allow the water table to rebound. This will provide additional data on whether free product is trapped in the smear zone and reemerges during seasonal wet periods. This additional free product data will be presented to the Mayport Partnering Team for use in the CMS that is planned for SWMUs 6 and 7. A CMS addendum was decided as the next logical step in the remediation of SWMUs 6 and 7 by the Mayport Partnering Team during their March 2004 meeting.

REFERENCES

ABB-ES (ABB Environmental Services, Inc.), 1994. *Interim Measures Workplan SWMUs 6 and 7, Sludge Drying Beds Area.*

ABB-ES, 1996a. *Resource Conservation and Recovery Act Facility Investigation, Group II SWMUs, NAVSTA Mayport, Mayport, Florida.* January.

ABB-ES, 1996b. *Draft Corrective Measures Study, Group II SWMUs.*

ABB-ES, 1998. *Technology Evaluation Report NELP Technology Demonstration for Thermal Desorption of Petroleum Impacted Soil at SWMUs 6 and 7.*

Battelle, 2001. *Final Project Report for Free-Product Source Removal via Bioslurping at Naval Station Mayport, Mayport, Florida.* November.

Harding Lawson Associates (HLA), 1998. *Interim Measure Monitoring Plan for Bioventing and Bioslurping at Solid Waste Management Units 6 & 7.* June.

TtNUS (Tetra Tech NUS, Inc.), 2001. *Annual Monitoring Report for Solid Waste Management Units 6 and 7.* May.

TtNUS, 2002a. *Treatability Study Work Plan for SWMUs 6 & 7.* September.

TtNUS, 2002b. *Letter Report, Massachusetts EPH & VPH Analytical Results for NS Mayport SWMU 6 & 7 soil as compared to FDEP Chapter 62-777, F.A.C. Technical Report Cleanup Target Levels for TRPH.* April.

TtNUS, 2003a. *First Quarter Monitoring Report for Solid Waste Management Units (SWMUs) 6 & 7 Treatability Study.* July.

TtNUS, 2003b. *First Quarter Monitoring Report Addendum for Solid Waste Management Units (SWMUs) 6 & 7 Treatability Study.* October.

TtNUS, 2003c. *Second Quarter Monitoring Report for Solid Waste Management Units (SWMUs) 6 & 7 Treatability Study.* October.

REFERENCES (Continued)

TtNUS, 2004a. *Third Quarter Monitoring Letter Report for Solid Waste Management Units (SWMUs) 6 & 7 Treatability Study*. February.

TtNUS, 2004b. *Fourth Quarter Monitoring Letter Report for Solid Waste Management Units (SWMUs) 6 & 7 Treatability Study*. February.

APPENDIX A

HISTORICAL REPORTS SUMMARY

Summary of Historical Reports

- Interim Measures Workplan SWMUs 6 and 7 Sludge Drying Beds Area [ABB Environmental Services, Inc. (ABB-ES), 1994].
 - During the initial phases of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) free-product was discovered in three wells at the site. It was deemed necessary to attempt to recover the product during the continuation of the investigation to minimize the threat of a release of light nonaqueous phase liquid (LNAPL) to the St. Johns River. An Interim Measure (IM) to recover LNAPL was designed.
 - The work plan included the design of five 36-inch diameter sumps with surface skimming pumps to recover both groundwater and LNAPL. The recovered oily water was to be sent to the OWTP process for proper treatment and disposal.
- RFI, Group II SWMUs, NAVSTA, Mayport, Florida (ABB-ES, 1996a).
 - An extensive investigation was initiated in 1992 to determine the extent of contamination at SWMUs 6 and 7. The presence of LNAPL at SWMUs 6 and 7 is documented in the report dated January 1996. A recommendation for conducting an IM to recover the LNAPL was presented in the RFI report. A previous IM (implemented in 1995 following completion of the RFI field activities) to recover LNAPL with skimmer pumps had been unsuccessful.
- Corrective Measure Study (CMS), Group II SWMUs (ABB-ES, 1996b).
 - A corrective action objective (CAO) to remove LNAPL in excess of 0.01 foot (ft) in the vicinity of SWMUs 6 and 7 was presented in the draft CMS. The sump recovery system was to be replaced with a bioslurping and bioventing system that relied on the physical removal of LNAPL and groundwater. Enhanced biodegradation by the introduction of air, which increases the percentage of oxygen in subsurface soil, was considered an additional benefit of the bioslurping system.
 - In addition to the bioventing/bioslurping system, the draft CMS also identified a CAO to eliminate petroleum-impacted soil at the site. During the selection of corrective action alternatives for the draft CMS, a Navy Environmental Leadership Program (NELP) technology demonstration of low-temperature thermal desorption (LTTD) was considered.

- IM Monitoring Plan for Bioventing and Bioslurping at SWMUs 6 and 7 [Harding Lawson Associates, Inc. (HLA), 1998].
 - This IM was to address the presence of LNAPL at the site per the CMS recommendation for the installation of a bioventing and bioslurping system. The IM included the design, procedures, and goals for site characterization and LNAPL recovery.
 - The design was implemented in 1998.
- Technology Evaluation Report NELP Technology Demonstration for Thermal Desorption of Petroleum-Impacted Soil at SWMUs 6 and 7 (ABB-ES, 1998).
 - Southwest Soil Remediation, Inc. (SSR) conducted a technology demonstration under NELP to demonstrate the effectiveness of thermal desorption of petroleum-impacted soil and related organic compounds at the site. ABB-ES collected baseline and performance evaluation soil samples to evaluate the effectiveness of the technology demonstration.
 - Results of the LTTD demonstration appeared to have been effective. However, there was some uncertainty as to whether or not some of the soil piles were retreated to meet requirements.
- Annual Monitoring Report for SWMUs 6 and 7 (TtNUS, 2001).
 - The Annual Monitoring Report provided a summary of the four quarterly monitoring events of 2000/2001. The report included groundwater flow data, sampling results, free-product thickness measurements, and a historical comparison.
 - The following are the results of groundwater sampling during the fourth quarter:
 - Seven volatile organic compounds (VOCs) were detected in the groundwater samples collected from SWMUs 6 and 7. There were no VOCs detected at concentrations exceeding FDEP Groundwater Cleanup Target Levels (GCTLs).
 - Five polynuclear aromatic hydrocarbons (PAHs) were detected in the groundwater samples collected from SWMUs 6 and 7. Two PAHs were detected in the groundwater samples at concentrations that exceeded FDEP GCTLs.

1-Methylnaphthalene and 2-methylnaphthalene were detected at 89 and 88 micrograms per liter ($\mu\text{g/L}$), respectively, exceeding their FDEP GCTLs of 20 $\mu\text{g/L}$.

- Total recoverable petroleum hydrocarbons (TRPH) concentrations exceeded the FDEP GCTLs of 5,000 $\mu\text{g/L}$ in the groundwater samples collected from monitoring wells MPT-8-MW04 (14,000 $\mu\text{g/L}$) and MPT-8-MW09 (9,300 $\mu\text{g/L}$).
- Project Report For Free-Product Source Removal Via Bioslurping At Naval Station Mayport (Batelle, 2001).
 - This report summarized the activities of the bioslurping and bioventing IM. The system was shut down as recovery rates had dropped to less than 0.1 gallons per month. The system was found to be effective while in operation. A total of 1,420 gallons of free-product were recovered during the 31 months of operation.
 - After deactivation of the system, free-product thickness was measured on a monthly basis for nine months and bailing was used to recover any free-product. A total of 137 gallons of free-product were recovered during these events. During the last two events, free-product recovery fell to less than 0.1 gallons per month and the monitoring was discontinued.
- Letter Report, Massachusetts EPH and VPH Analytical Results for NS Mayport SWMUs 6 and 7 soil as compared to FDEP Chapter 62-777, Florida Administrative Code (FAC), Technical Report Cleanup Target Levels for TRPH (TtNUS, 2002a).
 - This letter report was prepared as a handout for the NAVSTA Mayport Partnering Team in April 2002. The letter report presented the results of 4 soil samples collected at SWMUs 6 and 7 on March 14, 2002, and analyzed for the TPHCWG. The letter report also summarized the results of soil samples collected and analyzed in 2000, for the Massachusetts Extractable Petroleum Hydrocarbon and Volatile Petroleum Hydrocarbon methods. The soil results were compared to the FDEP Chapter 62-777, FAC, Technical Report Cleanup Target Levels for TRPH. Results of the comparison indicated that many of the carbon ranges did not exceed TRPH criteria, and that further soil analysis under the TPHCWG may provide additional information on petroleum characterization.

APPENDIX B

HISTORICAL DOCUMENTS

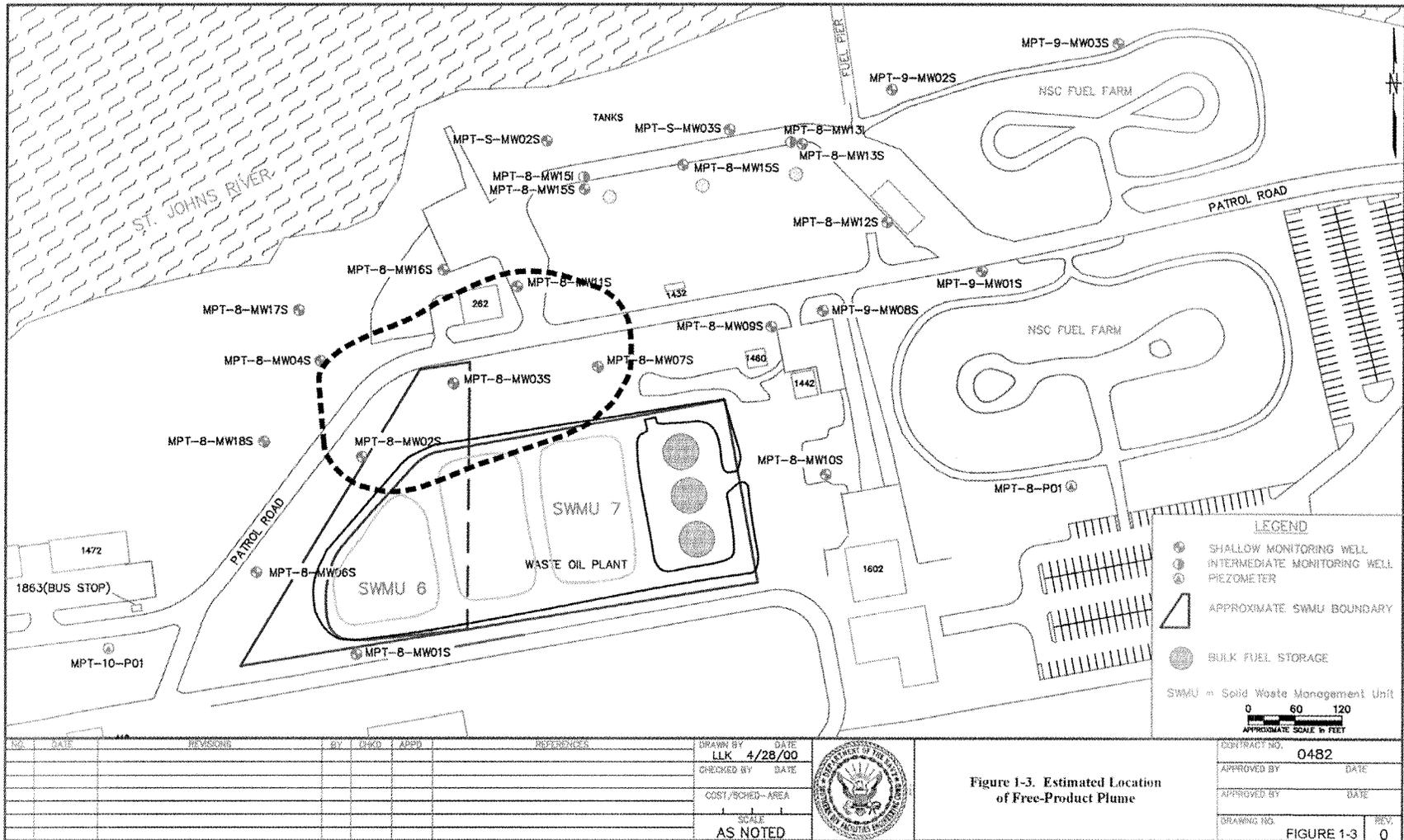


Figure 1-3. Estimated Location of Free-Product Plume

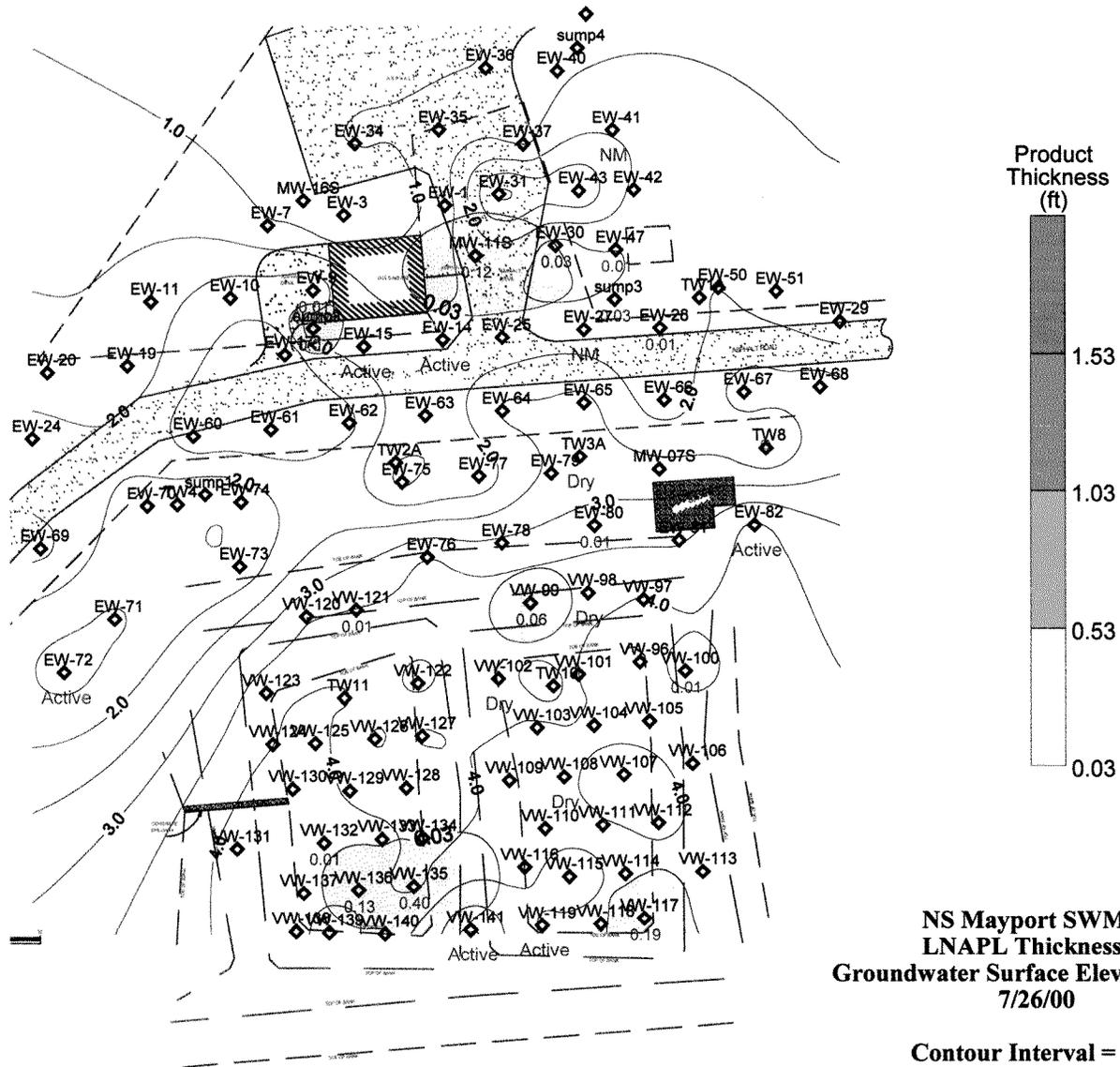


Figure 4-9. LNAPL Thickness Data, July 2000

Table 1
Summary of Chemicals and Analytes in Groundwater

Annual Monitoring Report for SWMUs 6 and 7
 Naval Station Mayport
 Mayport, Florida

Sample No. Quarter Collection Date	Groundwater Cleanup Criteria ¹ (ug/L)	MPT-S-MW01S				MPT-S-MW02S			
		Q2	Q4	Q2	Q4	Q2	Q4	Q2	Q4
		Mar-99	Sep-99	Jun-00	Dec-00	Mar-99	Sep-99	Jun-00	Dec-00
Volatile² (ug/L)									
1,1-Dichloroethane	70								
1,1-Dichloroethene	7								
1,2-Dichloroethene, total	63								
2-Butanone	4,200								
Acetone	700			2.9J				2.1J	
Benzene	1								
cis-1,2-Dichloroethene	70								
Chloroform	5.7								
Chloromethane	2.7			0.12J				0.35J	
Ethylbenzene	700								
Isobutyl Alcohol	2,100								
Methyl tert-Butyl Ether	50								
Methylene Chloride	5							0.15J	
Toluene	40								
Polycyclic Aromatic Hydrocarbons³ (ug/L)									
1-Methylnaphthalene	20								3.8
2-Methylnaphthalene	20								
Acenaphthene	20								
Anthracene	2,100								
Fluorene	280								
Naphthalene	20								
Phenathrene	210								
Total Petroleum Hydrocarbons⁴ (ug/L)	5,000							740	1,500
See notes at end of table									

Table 1
Summary of Chemicals and Analytes in Groundwater

Annual Monitoring Report for SWMUs 6 and 7
 Naval Station Mayport
 Mayport, Florida

Sample No. Quarter Collection Date	Groundwater Cleanup Criteria ¹ (ug/L)	MPT-8-MW04S				MPT-8-MW09S			
		Q2	Q4	Q2	Q4	Q2	Q4	Q2	Q4
		Mar-99	Sep-99	Jun-00	Dec-00	Mar-99	Sep-99	Jun-00	Dec-00
Volatile² (ug/L)									
1,1-Dichloroethane	70								
1,1-Dichloroethene	7								
1,2-Dichloroethene, total	63								
2-Butanone	4,200								
Acetone	700			4.8J			1.1J		
Benzene	1			0.21J	0.37J				
cis-1,2-Dichloroethene	70				0.11J				
Chloroform	5.7								
Chloromethane	2.7			0.16J					
Ethylbenzene	700			0.075J					
Isobutyl Alcohol	2,100						4.5		
Methyl tert-Butyl Ether	50								
Methylene Chloride	5				0.74J				0.34J
Toluene	40			0.15J	0.34J				
Polycyclic Aromatic Hydrocarbons³ (ug/L)									
1-Methylnaphthalene	20	140	61		89	0.85			
2-Methylnaphthalene	20	120	43		88	0.81			
Acenaphthene	20		6	2.4J	1.8J				
Anthracene	2,100		0.6						
Fluorene	280	17	6.4		17				
Naphthalene	20								
Phenathrene	210				22				
Total Petroleum Hydrocarbons⁴ (ug/L)	5,000	1,300	1,400	5,200	14,000				9,300
See notes at end of table									

Table 1
Summary of Chemicals and Analytes in Groundwater
 Annual Monitoring Report for SWMUs 6 and 7
 Naval Station Mayport
 Mayport, Florida

Sample No. Quarter Collection Date	Groundwater Cleanup Criteria ¹ (ug/L)	MPT-S-MW03S				MPT-8-MW01S			
		Q2 Mar-99	Q4 Sep-99	Q2 Jun-00	Q4 Dec-00	Q2 Mar-99	Q4 Sep-99	Q2 Jun-00	Q4 Dec-00
<u>Volatile² (ug/L)</u>									
1,1-Dichloroethane	70								
1,1-Dichloroethene	7								
1,2-Dichloroethene, total	63								
2-Butanone	4,200								
Acetone	700			1.5J				1.6J	
Benzene	1								
cis-1,2-Dichloroethene	70								
Chloroform	5.7								
Chloromethane	2.7								
Ethylbenzene	700								
Isobutyl Alcohol	2,100								
Methyl tert-Butyl Ether	50								
Methylene Chloride	5			0.14J	0.29 ^J			0.16J	
Toluene	40								
<u>Polycyclic Aromatic Hydrocarbons³ (ug/L)</u>									
1-Methylnaphthalene	20								
2-Methylnaphthalene	20								
Acenaphthene	20								
Anthracene	2,100								
Fluorene	280								
Naphthalene	20								
Phenathrene	210					0.05J			
Total Petroleum Hydrocarbons⁴ (ug/L)	5,000								

See notes at end of table

Table 1
Summary of Chemicals and Analytes in Groundwater
 Annual Monitoring Report for SWMUs 6 and 7
 Naval Station Mayport
 Mayport, Florida

Sample No. Quarter Collection Date	Groundwater Cleanup Criteria ¹ (ug/L)	MPT-8-MW10S				MPT-8-MW13S			
		Q2 Mar-99	Q4 Sep-99	Q2 Jun-00	Q4 Dec-00	Q2 Mar-99	Q4 Sep-99	Q2 Jun-00	Q4 Dec-00
<u>Volatile² (ug/L)</u>									
1,1-Dichloroethane	70								
1,1-Dichloroethene	7			0.15J					
1,2-Dichloroethene, total	63								
2-Butanone	4,200								
Acetone	700			3J			1.8J		
Benzene	1								
cis-1,2-Dichloroethene	70							0.19J	
Chloroform	5.7			0.15J				0.36J	
Chloromethane	2.7								
Ethylbenzene	700							23J	
Isobutyl Alcohol	2,100								
Methyl tert-Butyl Ether	50								
Methylene Chloride	5			0.16J					0.39J
Toluene	40								
<u>Polycyclic Aromatic Hydrocarbons³ (ug/L)</u>									
1-Methylnaphthalene	20								
2-Methylnaphthalene	20								
Acenaphthene	20								
Anthracene	2,100								
Fluorene	280								
Naphthalene	20								
Phenathrene	210								
Total Petroleum Hydrocarbons⁴ (ug/L)									
	5,000								

See notes at end of table

Table 1
Summary of Chemicals and Analytes in Groundwater

Annual Monitoring Report for SWMUs 6 and 7
Naval Station Mayport
Mayport, Florida

Sample No. Quarter Collection Date	Groundwater Cleanup Criteria ¹ (ug/L)	MPT-8-MW13I				MPT-8-MW15S			
		Q2 Mar-99	Q4 Sep-99	Q2 Jun-00	Q4 Dec-00	Q2 Mar-99	Q4 Sep-99	Q2 Jun-00	Q4 Dec-00
Volatile ² (ug/L)									
1,1-Dichloroethane	70			0.14J	0.13J				
1,1-Dichloroethene	7			0.15J	0.14J			0.12J	
1,2-Dichloroethene, total	63								
2-Butanone	4,200							0.8J	
Acetone	700			2.4J				6.1J	
Benzene	1								
cis-1,2-Dichloroethene	70				0.14J				
Chloroform	5.7								
Chloromethane	2.7			0.28J				0.29J	
Ethylbenzene	700								
Isobutyl Alcohol	2,100								
Methyl tert-Butyl Ether	50				0.14J				
Methylene Chloride	5			0.13J					
Toluene	40								
Polycyclic Aromatic Hydrocarbons ³ (ug/L)									
1-Methylnaphthalene	20					26			
2-Methylnaphthalene	20					20			
Acenaphthene	20								
Anthracene	2,100								
Fluorene	280					3.6			
Naphthalene	20					14			
Phenathrene	210					1.5			
Total Petroleum Hydrocarbons ⁴ (ug/L)									
	5,000			390J	280J				

See notes at end of table

Table 1
Summary of Chemicals and Analytes in Groundwater

Annual Monitoring Report for SWMUs 6 and 7
 Naval Station Mayport
 Mayport, Florida

Sample No. Quarter Collection Date	Groundwater Cleanup Criteria ¹ (ug/L)	MPT-8-MW15I				MPT-8-MW17S			
		Q2 Mar-99	Q4 Sep-99	Q2 Jun-00	Q4 Dec-00	Q2 Mar-99	Q4 Sep-99	Q2 Jun-00	Q4 Dec-00
<u>Volatile</u>² (ug/L)									
1,1-Dichloroethane	70			0.12J					
1,1-Dichloroethene	7			0.31J					
1,2-Dichloroethene, total	63			0.13J					
2-Butanone	4,200								
Acetone	700			3.8J					
Benzene	1								
cis-1,2-Dichloroethene	70								
Chloroform	5.7								
Chloromethane	2.7								
Ethylbenzene	700								
Isobutyl Alcohol	2,100								
Methyl tert-Butyl Ether	50								
Methylene Chloride	5			0.06J					
Toluene	40								
<u>Polycyclic Aromatic Hydrocarbons</u>³ (ug/L)									
1-Methylnaphthalene	20	2.5							
2-Methylnaphthalene	20	1.3							
Acenaphthene	20								
Anthracene	2,100								
Fluorene	280								
Naphthalene	20								
Phenathrene	210								
Total Petroleum Hydrocarbons ⁴ (ug/L)	5,000		1700						

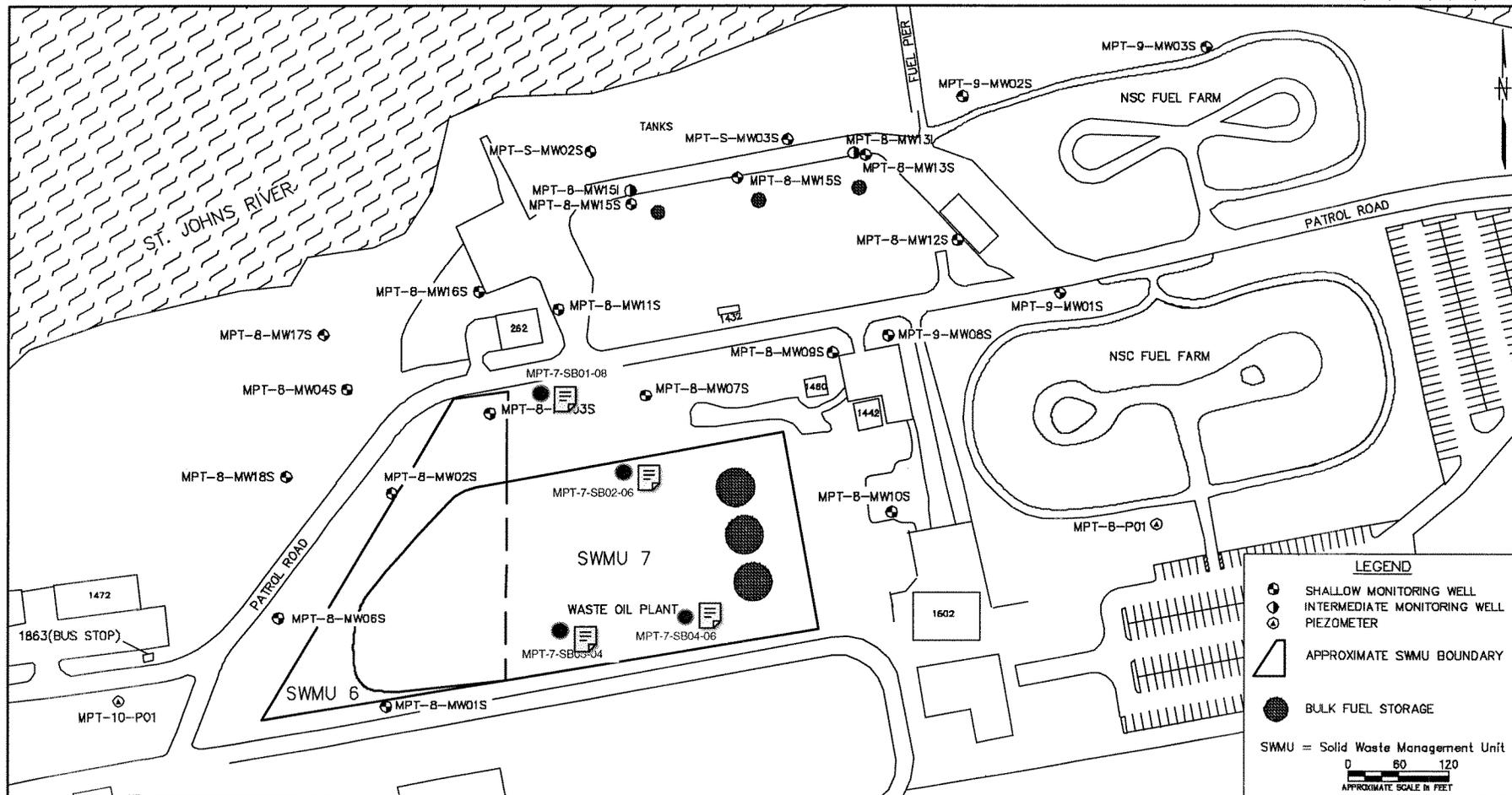
Notes:
¹ Groundwater Clean-up Criteria as provided in Chapter 62-777, F.A.C.
² SW-846 8260B, ³ SW-846 8310, ⁴ FDEP FL-PRO
⁵ indicates the presence of a chemical at an estimated concentration.
 * = monitoring well was destroyed
 NA = not analyzed
 Analytical results that were below laboratory detection limits are left blank
Bold indicates an exceedance of FDEP GCTLs

SMWU 7
 TRPH Working Group Analytical Results
 Naval Station Mayport
 Mayport, Florida

Fraction	MPT-7-SB01-8	MPT-7-SB02-6	MPT-7-SB03-4	MPT-7-SB04-6
Aliphatics (mg/kg)				
>=C6-C8	<50	<50	<50	<50
>C8-C10	650	<50	<50	<50
>C10-C12	2,300	560	180	420
>C12-C16	4,800	1,300	880	990
>C16-C21	800	200	150	150
Aromatics (mg/kg)				
>C5-C7	<50	<50	<50	<50
>C7-C8	<50	<50	<50	<50
>C8-C10	<50	<50	<50	<50
>C10-C12	230	<50	450	67
>C12-C16	890	230	3,800	240
>C16-C21	240	<50	1,900	<50
>C21-C35	<50	<50	130	<50

Notes:

Highest concentrations in C12-C16 chain in every case. In all samples except SB03, higher concentrations were present in the aliphatic fraction. The only obvious difference was that SB03 was collected at four bls versus depths of six to eight feet for the other samples.



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

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 DATE: 4/28/00
 CHECKED BY: []
 DATE: []
 COST/SCHED-AREA: []
 SCALE: AS NOTED

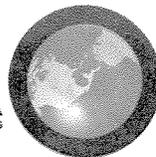


MONITORING WELL LOCATIONS
 SWMUs 6 AND 7
 U.S. NAVAL STATION
 MAYPORT, FLORIDA

CONTRACT NO.	0482
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	FIGURE 2
REV.	0

APPENDIX C

**CATALINA BIOSOLUTIONS
SOIL BIOTREATABILITY STUDY**



January 22, 2004

RESULTS OF BIOTREATABILITY FOR TETRA TECH NUS, INC.

PURCHASE ORDER NUMBER: N4259-P333 (SS)
PROJECT NUMBER: N4259 CTO #253- PM TERRY HANSEN
JOBSITE: NAVAL STATION MAYPORT, JACKSONVILLE, and FL CTO #253

BACKGROUND INFORMATION:

Catalina Biosolutions was hired to do two tests; the first to determine the biological feasibility of effectively treating and degrading samples of contaminant provided by Tetra Tech; and second to evaluate three different bioremediation products to determine which was the most effective in remediating contaminated soil provided by Tetra Tech.

We would apply three different bioremediation products to three split samples of contaminated soil provided by Tetra Tech. Three samples at day 30 and three samples at day 60 would be sent to a lab designated by Tetra Tech for analysis. Positive degradation results would answer the first question. And different degradation results would answer the second.

EVALUATION METHOD:

A 5gallon plastic pail of contaminated soil was received from Tetra Tech in June 2003 from Tetra Tech. Base line samples identified as MPT-8-SBO1-3; MPT-SB-O2-3; and MBT-SB-O1-3 were provided by Tetra Tech. These analysis are attached as Exhibit 1.

A portion of the contaminant was placed into each of three new plastic buckets labeled #1, #2, and #3, to a level of 8 inches from the bottom of each bucket.

BUCKET #1

In bucket #1, our Bio Prep was added in a solution of chlorine free water and mixed with the contaminated soil and allowed to stand for 36 hours. At that time, a solution of our Microbial Blend "A" was added with our Biobooster nutrient, mixed and allowed to stand for 30 days with occasional mixing throughout the time period. Chlorine free water was added to maintain a moisture level of 20%. The temperature range was from 75 degrees F to 90 degrees F. The bucket was uncovered and located inside, and not exposed to direct sunlight.

Page 2.

After 30 days, a sample was gathered and sent to STL laboratory for analysis, and is identified in their report dated 07/30/2003 which is attached as Exhibit #2.

After 60 days another sample was collected and sent to STL laboratory for analysis and is identified in their report dated 10/27/03 which is attached as Exhibit #3. (Of note, the original 60-day sample was destroyed in shipping so the treatability study had to be repeated.)

BUCKET #2

The process for bucket # 2 was the same as Bucket # 1 with the exception that our BioPrep treatment was eliminated. Samples were gathered after 30 days, and again after 60 days and sent to STL. See Exhibit #2 for the 30 day results and Exhibit #3 for the 60 day results.

BUCKET #3

Our Microbial blend "B" and our Biobooster nutrient was applied in a similar manner and samples were gathered and sent after 30 days, and again after 60 days. See Exhibit 2 for the 30-day results and Exhibit #3 for the 60-day results.

RESULTS:

The attached laboratory analysis for the 30-day time period and the 60-day period show significant declines in the contaminant levels with a few exceptions. The site is definitely appropriate for bioremediation.

The products used in bucket #1 produced lower levels of contamination in both 30 days and 60 days than did those used in buckets #2 and #3.

The exceptions are:

C16-C21 Aliphatics, sample #1 went from 1400 ppm at the 30 day period to 2100 ppm at the 60 day period.

C16-C21 Aromatics, sample # 3 went from 390 ppm at the 30-day period to 880 ppm at the 60-day period.

Page 3.

Frequently these types of “spikes” occur but not always. Explanations can be varied but usually the “spike” is temporary and normal degradation occurs over time.

Treatment method #1 produced the best result with the exception noted. We find this consistent with other projects we have completed.

This method consisted of an application of our Bio Prep for a period of 36 hours followed by a treatment using our microbial blend “A”.

If there are any questions regarding these findings, please contact Jerry Coon at 520.299.9808.

PROJ_NO: 4259

SDG: C302250 MEDIA: SOIL DATA FRACTION: P

nsample MPT-8-SB01-3
samp_date 2/12/2003
lab_id C302250*1
qc_type NM
units MG/KG
Pct_Solids 90
DUP_OF:

Parameter	Result	Val Qual	Qual Code
C10-C12 ALIPHATICS	42	J	P
C10-C12 AROMATICS	50	U	
C12-C16 ALIPHATICS	870		
C12-C16 AROMATICS	17	J	P
C16-C21 ALIPHATICS	840		
C16-C21 AROMATICS	4.1	J	P
C21-C35 ALIPHATICS	26	J	P
C21-C35 AROMATICS	50	U	
C5-C7 AROMATICS	34	U	
C6-C8 ALIPHATICS	55	U	
C7-C8 AROMATICS	50	U	
C8-C10 ALIPHATICS	55	U	
C8-C10 AROMATICS	50	U	

nsample MPT-8-SB02-3
samp_date 2/12/2003
lab_id C302250*2
qc_type NM
units MG/KG
Pct_Solids 90
DUP_OF:

Parameter	Result	Val Qual	Qual Code
C10-C12 ALIPHATICS	1900		
C10-C12 AROMATICS	600		
C12-C16 ALIPHATICS	4200		
C12-C16 AROMATICS	2000		
C16-C21 ALIPHATICS	2200		
C16-C21 AROMATICS	1500		
C21-C35 ALIPHATICS	80		
C21-C35 AROMATICS	32	J	P
C5-C7 AROMATICS	34	U	
C6-C8 ALIPHATICS	55	U	
C7-C8 AROMATICS	50	U	
C8-C10 ALIPHATICS	390		
C8-C10 AROMATICS	51		

nsample MPT-8-SB03-3
samp_date 2/12/2003
lab_id C302250*3
qc_type NM
units MG/KG
Pct_Solids 88
DUP_OF:

Parameter	Result	Val Qual	Qual Code
C10-C12 ALIPHATICS	730		
C10-C12 AROMATICS	50	U	
C12-C16 ALIPHATICS	3200		
C12-C16 AROMATICS	260		
C16-C21 ALIPHATICS	2300		
C16-C21 AROMATICS	320		
C21-C35 ALIPHATICS	91		
C21-C35 AROMATICS	5.8	J	P
C5-C7 AROMATICS	34	U	
C6-C8 ALIPHATICS	55	U	
C7-C8 AROMATICS	50	U	
C8-C10 ALIPHATICS	73		
C8-C10 AROMATICS	50	U	

Exhibit 1

Analytical Report

For: Ms. Amy Thomson
Tetra Tech NUS, Inc.
661 Anderson Drive
Pittsburgh, PA 15220

CC:

Order Number: C307559
SDG Number:
Client Project ID: SWMU7
Project: NS MAYPORT
Report Date: 07/30/2003
Sampled By: Client
Sample Received Date: 07/23/2003
Requisition Number: CTO 253
Purchase Order:



Lance Larson, Project Manager
llarson@stl-inc.com
12/31/2003

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in this report. Pursuant to NELAP, this report may not be reproduced, except in full, without the written approval of the laboratory.

2-10-11-13

Sample Summary

Order: C307559
Date Received: 07/23/2003

Client: Tetra Tech NUS, Inc.
Project: NS MAYPORT

Client Sample ID	Lab Sample ID	Matrix	Date Sampled
JAR 1 (SAMPLE #1)	C307559*1	Solid	07/21/2003 00:00
JAR 2 (SAMPLE #2)	C307559*2	Solid	07/21/2003 00:00
JAR 3 (SAMPLE #3)	C307559*3	Solid	07/21/2003 00:00

Exhibit 2

Analytical Data Report

Lab Sample ID	Description	Matrix	Date Received	Date Sampled	SDG#
07559-1	JAR 1 (SAMPLE #1)	Solid	07/23/03	07/21/03 00:00	
07559-2	JAR 2 (SAMPLE #2)	Solid	07/23/03	07/21/03 00:00	
07559-3	JAR 3 (SAMPLE #3)	Solid	07/23/03	07/21/03 00:00	

Parameter	Units	Lab Sample IDs		
		07559-1	07559-2	07559-3

TPH-WG-ALI (TPHCWG)

>/= C6-C8 Aliphatics	mg/kg dw	<60	<70	<65
>C8-C10 Aliphatics	mg/kg dw	61	<70	<65
>C10-C12 Aliphatics	mg/kg dw	300	410	360
>C12-C16 Aliphatics	mg/kg dw	1300	3600	1800
>C16-C21 Aliphatics	mg/kg dw	1400	2900	1500
>C21-C35 Aliphatics	mg/kg dw	180	480	590
Percent Solids		85	74	77
Dilution Factor		1	1	1
Prep Date		07/24/03	07/24/03	07/24/03
Analysis Date		07/29/03	07/29/03	07/29/03
Batch ID		GES364	GES364	GES364
Prep Method		TPHCWG	TPHCWG	TPHCWG
Analyst		IE	IE	IE
Quantitation Factor		1.2	1.4	1.3

TPH-WG-ARO (TPHCWG)

>C5-C7 Aromatics	mg/kg dw	<41	<48	<44
>C7-C8 Aromatics	mg/kg dw	<60	<70	<65
>C8-C10 Aromatics	mg/kg dw	<60	<70	<65
>C10-C12 Aromatics	mg/kg dw	<60	84	<65
>C12-C16 Aromatics	mg/kg dw	420	1300	470
>C16-C21 Aromatics	mg/kg dw	390	1200	390
>C21-C35 Aromatics	mg/kg dw	<60	<70	<65
Percent Solids		85	74	77
Dilution Factor		1	1	1
Prep Date		07/24/03	07/24/03	07/24/03
Analysis Date		07/29/03	07/29/03	07/29/03
Batch ID		GES364	GES364	GES364
Prep Method		TPHCWG	TPHCWG	TPHCWG
Analyst		IE	IE	IE
Quantitation Factor		1.2	1.4	1.3

2 xhibit 2

Analytical Data Report

Lab Sample ID	Description	Matrix	Date Received	Date Sampled	SDG#
07559-4	Method Blank	Solid	07/23/03		
07559-5	LCS True Value	Solid	07/23/03		
07559-6	LCS Result	Solid	07/23/03		
07559-7	LCS % Recovery	Solid	07/23/03		
07559-8	LCS Accuracy Control Limit (%R)	Solid	07/23/03		

Parameter	Units	Lab Sample IDs				
		07559-4	07559-5	07559-6	07559-7	07559-8

Total TPH at >= C6-C35 (TPHCWG)

Total TPH at >= C6-C35	mg/kg dw	<50	850	568	67 %	60-140
Dilution Factor		1		1		
Prep Date		07/24/03		07/24/03		
Analysis Date		07/28/03		07/28/03		
Batch ID		GES364	GES364	GES364	GES364	
Prep Method		TPHCWG		TPHCWG		
Analyst		IE		IE		
Quantitation Factor		1.0		1.0		

Exhibit 2

Analytical Data Report

Lab Sample ID	Description	Matrix	Date Received	Date Sampled	SDG#
07559-9	MS True Value	Solid	07/23/03		
07559-10	Matrix Spike Result	Solid	07/23/03		
07559-11	Matrix Spike % Recovery	Solid	07/23/03		
07559-12	MSD True Value	Solid	07/23/03		
07559-13	MSD Result	Solid	07/23/03		

Parameter	Units	Lab Sample IDs				
		07559-9	07559-10	07559-11	07559-12	07559-13

Total TPH at >= C6-C35 (TPHCWG)

Total TPH at >= C6-C35	mg/kg dw	850	N/C	N/C	850	N/C
Dilution Factor			1			1
Prep Date			07/24/03			07/24/03
Analysis Date			07/28/03			07/28/03
Batch ID		GES364	GES364	GES364	GES364	GES364
Prep Method			TPHCWG			TPHCWG
Analyst			IE			IE
Quantitation Factor			1.0			1.0

Exhibit 2

Analytical Data Report

Lab Sample ID	Description	Matrix	Date Received	Date Sampled	SDG#
07559-14	MSD % Recovery	Solid	07/23/03		
07559-15	MS Accuracy Advisory Limit (%R)	Solid	07/23/03		
07559-16	Precision (%RPD) MS/MSD	Solid	07/23/03		
07559-17	MS Precision Advisory Limit (%RPD)	Solid	07/23/03		

Parameter	Units	Lab Sample IDs			
		07559-14	07559-15	07559-16	07559-17

Total TPH at >= C6-C35 (TPHCWG)

Total TPH at >= C6-C35	mg/kg dw	N/C	60-140	N/C	50
Batch ID		GES364		GES364	

Exhibit 2

Analytical Data Report

Lab Sample ID	Description	Matrix	Date Received	Date Sampled	SDG#
07559-18	Method Detection Limit (MDL)	Solid	07/23/03		
07559-19	Reporting Limit (RL)	Solid	07/23/03		

Parameter	Units	Lab Sample IDs	
		07559-18	07559-19
TPH-WG-ALI (TPHCWG)			
>= C6-C8 Aliphatics	mg/kg dw	0.62	50
>C8-C10 Aliphatics	mg/kg dw	0.62	50
>C10-C12 Aliphatics	mg/kg dw	0.62	50
>C12-C16 Aliphatics	mg/kg dw	0.62	50
>C16-C21 Aliphatics	mg/kg dw	0.62	50
>C21-C35 Aliphatics	mg/kg dw	0.62	50
TPH-WG-ARO (TPHCWG)			
>C5-C7 Aromatics	mg/kg dw	0.62	34
>C7-C8 Aromatics	mg/kg dw	0.62	50
>C8-C10 Aromatics	mg/kg dw	0.62	50
>C10-C12 Aromatics	mg/kg dw	0.62	50
>C12-C16 Aromatics	mg/kg dw	0.62	50
>C16-C21 Aromatics	mg/kg dw	0.62	50
>C21-C35 Aromatics	mg/kg dw	0.62	50
Total TPH at >= C6-C35 (TPHCWG)			
Total TPH at >= C6-C35	mg/kg dw	0.62	50

Exhibit 2

These test results meet all the requirements of NELAC. All questions regarding this test report should be directed to the STL Project Manager who signed this test report.

Exhibit 2

Analytical Report

For: Ms. Amy Thomson
Tetra Tech NUS, Inc.
661 Anderson Drive
Pittsburgh, PA 15220

CC:

Order Number: C310475
SDG Number:
Client Project ID: SWMU7
Project: NS MAYPORT
Report Date: 10/27/2003
Sampled By: Client
Sample Received Date: 10/16/2003
Requisition Number: CTO 253
Purchase Order:



Lance Larson, Project Manager
llarson@stl-inc.com
12/31/2003

Exhibit 3

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in this report. Pursuant to NELAP, this report may not be reproduced, except in full, without the written approval of the laboratory.

Sample Summary

Order: C310475
Date Received: 10/16/2003

Client: Tetra Tech NUS, Inc.
Project: NS MAYPORT

Client Sample ID	Lab Sample ID	Matrix	Date Sampled
JAR 1 (SAMPLE #1)	C310475*1	Solid	10/16/2003
JAR 2 (SAMPLE #2)	C310475*2	Solid	10/16/2003
JAR 3 (SAMPLE #3)	C310475*3	Solid	10/16/2003

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W

Analytical Data Report

Lab Sample ID	Description	Matrix	Date Received	Date Sampled	SDG#
10475-1	JAR 1 (SAMPLE #1)	Solid	10/16/03	10/16/03	
10475-2	JAR 2 (SAMPLE #2)	Solid	10/16/03	10/16/03	
10475-3	JAR 3 (SAMPLE #3)	Solid	10/16/03	10/16/03	

Parameter	Units	Lab Sample IDs		
		10475-1	10475-2	10475-3

TPH-WG-ALI (TPHCWG)

>/= C6-C8 Aliphatics	mg/kg dw	<60	<55	<55
>C8-C10 Aliphatics	mg/kg dw	<60	<55	<55
>C10-C12 Aliphatics	mg/kg dw	<60	400	240
>C12-C16 Aliphatics	mg/kg dw	670	2600	2100
>C16-C21 Aliphatics	mg/kg dw	1200	1800	1400
>C21-C35 Aliphatics	mg/kg dw	<60	130	<55
Percent Solids		86	92	91
Dilution Factor		1	1	1
Prep Date		10/20/03	10/20/03	10/20/03
Analysis Date		10/23/03	10/23/03	10/23/03
Batch ID		GES004	GES004	GES004
Prep Method		TPHCWG	TPHCWG	TPHCWG
Analyst		IE	IE	IE
Quantitation Factor		1.2	1.1	1.1

TPH-WG-ARO (TPHCWG)

>C5-C7 Aromatics	mg/kg dw	<34	<34	<34
>C7-C8 Aromatics	mg/kg dw	<60	<55	<55
>C8-C10 Aromatics	mg/kg dw	<60	<55	<55
>C10-C12 Aromatics	mg/kg dw	<60	<55	<55
>C12-C16 Aromatics	mg/kg dw	310	860	470
>C16-C21 Aromatics	mg/kg dw	380	1300	880
>C21-C35 Aromatics	mg/kg dw	<60	370	190
Percent Solids		86	92	91
Dilution Factor		1	1	1
Prep Date		10/20/03	10/20/03	10/20/03
Analysis Date		10/23/03	10/23/03	10/23/03
Batch ID		GES004	GES004	GES004
Prep Method		TPHCWG	TPHCWG	TPHCWG
Analyst		IE	IE	IE
Quantitation Factor		1.2	1.1	1.1

Exhibit B

Analytical Data Report

Lab Sample ID	Description	Matrix	Date Received	Date Sampled	SDG#
10475-4	Method Blank	Solid	10/16/03		
10475-5	LCS True Value	Solid	10/16/03		
10475-6	LCS Result	Solid	10/16/03		
10475-7	LCS % Recovery	Solid	10/16/03		
10475-8	LCS Accuracy Control Limit (%R)	Solid	10/16/03		

Parameter	Units	Lab Sample IDs				
		10475-4	10475-5	10475-6	10475-7	10475-8

Total TPH at >= C6-C35 (TPHCWG)

Total TPH at >= C6-C35	mg/kg dw	50	850	716	84 %	60-140
Dilution Factor		1		1		
Prep Date		10/20/03		10/20/03		
Analysis Date		10/21/03		10/21/03		
Batch ID		GES004	GES004	GES004	GES004	
Prep Method		TPHCWG		TPHCWG		
Analyst		IE		IE		
Quantitation Factor		1		1		

Exhibit B

Analytical Data Report

Lab Sample ID	Description	Matrix	Date Received	Date Sampled	SDG#
10475-9	MS True Value	Solid	10/16/03		
10475-10	Matrix Spike Result	Solid	10/16/03		
10475-11	Matrix Spike % Recovery	Solid	10/16/03		
10475-12	MSD True Value	Solid	10/16/03		
10475-13	MSD Result	Solid	10/16/03		

Parameter	Units	Lab Sample IDs				
		10475-9	10475-10	10475-11	10475-12	10475-13

Total TPH at >= C6-C35 (TPHCWG)

Total TPH at >= C6-C35	mg/kg dw	N/C	N/C	N/C	N/C	N/C
Prep Method			TPHCWG			TPHCWG

2 Exhibit 3

Analytical Data Report

Lab Sample ID	Description	Matrix	Date Received	Date Sampled	SDG#
10475-14	MSD % Recovery	Solid	10/16/03		
10475-15	MS Accuracy Advisory Limit (%R)	Solid	10/16/03		
10475-16	Precision (%RPD) MS/MSD	Solid	10/16/03		
10475-17	MS Precision Advisory Limit (%RPD)	Solid	10/16/03		

Parameter	Units	Lab Sample IDs			
		10475-14	10475-15	10475-16	10475-17

Total TPH at >= C6-C35 (TPHCWG)

Total TPH at >= C6-C35	mg/kg dw	N/C	N/C	N/C	N/C
------------------------	----------	-----	-----	-----	-----

Exhibit 3

Analytical Data Report

Lab Sample ID	Description	Matrix	Date Received	Date Sampled	SDG#
10475-18	Method Detection Limit (MDL)	Solid	10/16/03		
10475-19	Reporting Limit (RL)	Solid	10/16/03		

Parameter	Units	Lab Sample IDs	
		10475-18	10475-19
TPH-WG-ALI (TPHCWG)			
>/= C6-C8 Aliphatics	mg/kg dw	0.62	50
>C8-C10 Aliphatics	mg/kg dw	0.62	50
>C10-C12 Aliphatics	mg/kg dw	0.62	50
>C12-C16 Aliphatics	mg/kg dw	0.62	50
>C16-C21 Aliphatics	mg/kg dw	0.62	50
>C21-C35 Aliphatics	mg/kg dw	0.62	50
TPH-WG-ARO (TPHCWG)			
>C5-C7 Aromatics	mg/kg dw	0.62	34
>C7-C8 Aromatics	mg/kg dw	0.62	50
>C8-C10 Aromatics	mg/kg dw	0.62	50
>C10-C12 Aromatics	mg/kg dw	0.62	50
>C12-C16 Aromatics	mg/kg dw	0.62	50
>C16-C21 Aromatics	mg/kg dw	0.62	50
>C21-C35 Aromatics	mg/kg dw	0.62	50
Total TPH at >/= C6-C35 (TPHCWG)			
Total TPH at >/= C6-C35	mg/kg dw	0.62	50

Exhibit B

These test results meet all the requirements of NELAC. All questions regarding this test report should be directed to the STL Project Manager who signed this test report.

Exhibit 3

APPENDIX D

**ENZYME TECHNOLOGIES, INC.
SOIL TREATABILITY STUDY**



SOIL TREATABILITY STUDY

**Enzyme-Enhanced Bioremediation of
Soil Impacted with Heavy Oils**

Performed for:

TetraTech NUS, Inc.

Performed by:

**ENZYME TECHNOLOGIES, INC.
5228 NE 158th Ave.
Portland, Oregon 97230
(503) 254-4331**

June 10th – July 15th, 2003

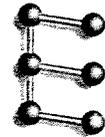


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APPENDIX A

- Table – Complete Analytical Data
- Table – VOC Analytical Data
- Table – Kinetics Calculations
- Graph – Estimated Oil-Range TPH Reductions using Kinetic Calculations

APPENDIX B

- Nutrient Recipe
- Analytical Laboratory Data



1.0 INTRODUCTION

As outlined in our proposal, Enzyme Technologies, Inc. (ETEC) was contracted to perform a treatability study for TetraTech NUS, Inc. (TTNUS) on an impacted soil sample to determine the potential effectiveness of bioremediation as a remedial option. This report summarizes the results of our bench-scale treatability test. Tables and graphs of the laboratory data and our kinetic calculations are included throughout this report and in Appendix A. In addition, we have included all raw analytical laboratory data in Appendix B.

1.1 BACKGROUND INFORMATION

Based on the information provided to us via phone, fax, and mail transmittals, we understand that oil-range petroleum contaminant releases, possibly bilge oils, impacted subsurface soils at a Naval facility (Bayport Naval Station). We also understand that soil concentrations range as high as 20,000 mg/kg (and possibly higher) in some areas. TPH and PAHs are assumed to be the probable regulatory drivers for soil cleanup. However, we are currently unaware of the precise regulatory cleanup goals for this soil.

1.2 OBJECTIVES OF TREATABILITY STUDY

The primary objective of the bench scale treatability study was to encourage biological degradation of the existing oil-range petroleum hydrocarbons within the soil sample, and to measure the percent degradation of total petroleum hydrocarbons (TPH) degradation over a 35-day period. Additionally, poly-aromatic hydrocarbon (PAH) constituents were also measured at test start-up and completion to determine if reductions of these potential regulatory drivers could be achieved.

Results of the bench scale treatability study were used to verify contaminant degradation, and also to estimate potential treatment timeframes for this soil. Using data collected during the test, ETEC performed some basic microbial kinetic calculations to determine contaminant half-life constants and soil degradation rates. It was the intent of the study to evaluate the applicability of bioremediation for this soil as well as any potential benefits derived from this remedial approach.



2.0 TREATABILITY TEST PROCEDURES

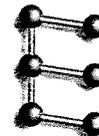
2.1 TEST AND CONTROL PROCEDURES

ETEC received one sealed 5-gallon plastic bucket from TTNUS on the afternoon of June 9th, 2003. Based on the accompanying Chain of Custody, the soil in the bucket was a grab sample collected from 2 to 3 feet bgs at the project site. This bucket was immediately placed in a refrigeration unit at 40 degrees Fahrenheit. On June 10th, 2003, the soil from the 5-gallon plastic bucket was removed and homogenized (mixed) in a large plastic pan. The soil consisted primarily of medium sand with some fines, was brown-gray in color, and included numerous large and small marine seashell fragments. The largest seashell fragments were physically removed from the homogenized soil. The homogenized soil was then measured for pH; a baseline pH of approximately 8.5 to 8.6 was recorded.

After pH measurement, a baseline soil sample was collected and designated as sample TTNUS-Day00-TC (see Sample Designations summary below). After collection of the baseline sample, the remaining soil was then split into a Test pan and a Control pan; approximately 10 kilograms (~ 22 lbs.) of soil was placed in each stainless steel pan. Biological products were then added to the Test pan only; products included 50 milliliters (ml.) of Multi-Enzyme Complexes (MZC), 50 ml. of Enzyme Accelerator (EA), 150 ml. of TPH bacterial Consortium (A2), and 100 ml. of Nutrient solution (NUT). See Appendix B for the Nutrient recipe used for this treatability test. To ensure that the Control pan contained the same moisture level at start-up, 350 ml. of de-ionized water was added to the Control pan.

After product addition to the Test pan, the soil pH was measured at 8.85 in the Test pan. Due to the overall elevated pH in the soil for this test, the pH for the Test and Control pans was adjusted to try and get it within the 6 to 8 pH range that is preferred for biological degradation. First, 1 ml of 0.1M HCL was applied to each pan; the soil was then tilled using dedicated soil mixers. The pH was relatively unchanged after this addition. Therefore, 15 grams of aluminum sulfate was added to the Test and Control pans. The resulting pH was between 7.8 and 7.9. This was judged sufficient, and no further pH adjustments were performed. The pans were then covered with a plastic wrap to limit volatilization and to prevent any cross-contamination between the Test and Control pans.

For daily maintenance, the soil in the Test and Control pans was mixed/tilled 2-3 times daily. Moisture levels were maintained weekly through application of deionized water to the Control pan and nutrient addition to the Test pan. Samples were collected every 7 days for TPH analysis (FLPRO Method).



2.2 SAMPLE DESIGNATIONS

For clarification in this report, standard sample identifications or designations were used for the Test and Control samples. Each sample ID included the characters TTNUS to designate the name of the test, followed by the term Day and a two-digit suffix to indicate the day sampled within the test period (i.e. Day00, Day07, Day14, etc.), followed by a suffix T for Test or C for Control. Some examples and descriptions of these designations are included below.

TTNUS-Day00-TC	<i>This baseline sample was collected from the TTNUS soil sample on the first day of the test prior to splitting it into Control and Test pans.</i>
TTNUS-Day07-T	<i>This sample was collected from the Test pan on the 7th day of the test to determine degradation progress during this timeframe.</i>
TTNUS-Day35-C	<i>This sample was collected from the Control pan on the 35th day of the test to determine final degradation results.</i>

2.3 SAMPLE COLLECTION DETAILS

As previously described, ETEC collected a baseline sample as well as interim samples every 7 days to determine TPH reductions. Note that interim soil samples were only collected from the Test pan. Final samples were collected from the Test and Control pans on Day 35. Both baseline and final (Day35) soil samples were analyzed for the following constituents:

- TPH by Method FLPRO
- TPH by Method TPH-CWG
- VOCs by Method EPA8260
- PAHs by Method EPA8270SIM (modified)
- Metals by Method RCRA 8
- Hydrocarbon-Degrading Plate Counts (standard methodology)
- Inorganic Nutrient Parameters (by appropriate methods – see Appendix B)

Interim soil samples (Day07, Day14, Day21, Day28) were analyzed for the following constituents:

- TPH by Method FLPRO
- Hydrocarbon-Degrading Plate Counts (standard methodology)
- Inorganic Nutrient Parameters (by appropriate methods – see Appendix B)

For each sampling event, a soil sample with approximately 8 ounces of soil was collected in a sterile, sealed glass jar and delivered to Specialty Analytical for laboratory analysis. Specialty Analytical performed all FLPRO, TPH-CWG, EPA8260, EPA8270SIM, and RCRA 8 analyses.



3.0 TREATABILITY TEST RESULTS

3.1 BASELINE SAMPLE RESULTS

Baseline results for PAHs and TPH are shown in the following table. These concentrations reflect the starting contaminant levels prior to product inoculation and treatment. As the baseline results show, the initial TPH concentration was 18,700 mg/Kg (carbon range C6 to C38), and significant PAH compounds were present in the soil. No significant VOC detections were found in the baseline sample, so this data is not included in the table below. Refer to Appendix A for the VOC results.

TABLE 1: BASELINE PAH & TPH RESULTS

	Units	Baseline
Total Petroleum Hydrocarbons		
TPH-FLPRO	mg/Kg	18,700
TPH-CWG	mg/Kg	13,000
PAHs		
Acenaphthene	ug/Kg	901
Acenaphthylene	ug/Kg	167
Anthracene	ug/Kg	426
Benzo(a)anthracene	ug/Kg	62.7
Benzo(a)pyrene	ug/Kg	12
Benzo(b)fluoranthene	ug/Kg	32.7
Benzo(g,h,i)perylene	ug/Kg	9.33
Benzo(k)fluoranthene	ug/Kg	ND
Chrysene	ug/Kg	69.3
Dibenzo(a,h)anthracene	ug/Kg	ND
Fluoranthene	ug/Kg	54.7
Fluorene	ug/Kg	1200
Indeno(1,2,3-cd)pyrene	ug/Kg	ND
Naphthalene	ug/Kg	965
Phenanthrene	ug/Kg	3460
Pyrene	ug/Kg	893

3.2 TPH SAMPLE RESULTS

TPH results showing baseline, interim, and final results for the Test pan are included in the following table.

TABLE 2: TPH DATA TABLE

		Baseline	Test						Control	
	Units	Day 0	Day 7	Day 14	Day 21	Day 28	Day 35	Final 1	Day 35	Final 2
FLPRO	mg/Kg	18,700	11,600	10,900	11,400	7,360	10,100	2,060	2,640	7,070
CWG	mg/Kg	13,000	--	--	--	--	7,100	--	2,000	--



As the concentrations indicate, significant ongoing contaminant degradation was recorded from test initiation through Day 35. Based on the Method FLPRO results, approximately 30% reductions were achieved by Day 7, 50% reductions by Day 14, and 65% reductions by Day 28. Please note that the Test pan Day 35 results showed a significant increase in TPH (to 10,100 mg/Kg) when compared to the previous Day 28 and Day 21 results, while the Control pan showed unexpected reductions (down to 2,640 mg/Kg). Not only did the Test and Control data not correlate, but comparison of the PAH reductions (discussed below) also did not make sense. Specifically, the Test pan showed 99% total PAH reduction, while the Control pan showed only 46% reductions. From a biological standpoint, the more recalcitrant PAHs would not degrade quicker than the TPH, but would degrade at a rate equal to or slower than the TPH. Because of this, we speculated that the TPH samples may have been inadvertently switched in the laboratory during analyses. This was discussed with the laboratory, and while they agreed that the results didn't seem right, they could not confirm an analytical error one way or the other. To verify that an error had occurred, a final sample from the Test pan soil (designated TTNUS-Final1) and a final sample from the Control pan (designated TTNUS-Final2) was delivered to the laboratory for TPH analysis on separate days. The results indicated that some laboratory error had indeed occurred – the Test sample was 2,060 mg/Kg, while the Control sample was 7,070 mg/Kg. These concentrations not only fit with the trend that was observed in the Test pan prior to Day 35, but the two concentrations were similar to the Day 35 concentrations, only reversed. Table 3 below reflects the adjusted data that we used for our kinetic calculations.

TABLE 3: ADJUSTED TPH DATA TABLE

		Baseline	Test						Control	
	Units	Day 0	Day 7	Day 14	Day 21	Day 28	Day 35	Final 1	Day 35	Final 2
FLPRO	mg/Kg	18,700	11,600	10,900	11,400	7,360	2,640	2,060	10,100	7,070
CWG	mg/Kg	13,000	--	--	--	--	2,000	--	7,100	--

3.3 PAH SAMPLE RESULTS

As discussed above, significant degradation of TPH constituents (86% reductions) within the Test pan occurred over the course of the treatability test. Perhaps more importantly, the data indicates that a 99% reduction in total PAH constituents occurred within the Test pan, with most PAH compounds being degraded to non-detect levels (see Table 4). The only PAH constituents remaining at Day 35 in the Test pan were the following: benzo(a)pyrene with 39% reduction (from 12 ppb to 7.3 ppb), acenaphthalene with 70% reduction (167 ppb to 50.7 ppb), and fluorene with 97% reduction (1,200 ppb to 40 ppb).



These results are indicative of the highly active biological conditions that were supported within the Test pan.

TABLE 4: PAH SAMPLE RESULTS

	Units	Test		Control	
		Day 0	Day 35	Day 0	Day 35
PAHs					
Acenaphthene	ug/Kg	901	ND	901	707
Acenaphthylene	ug/Kg	167	50.7	167	100
Anthracene	ug/Kg	426	ND	426	273
Benzo(a)anthracene	ug/Kg	62.7	ND	62.7	64.7
Benzo(a)pyrene	ug/Kg	12	7.33	12	7.33
Benzo(b)fluoranthene	ug/Kg	32.7	ND	32.7	16.7
Benzo(g,h,i)perylene	ug/Kg	9.33	ND	9.33	ND
Benzo(k)fluoranthene	ug/Kg	ND	ND	ND	ND
Chrysene	ug/Kg	69.3	ND	69.3	44.7
Dibenzo(a,h)anthracene	ug/Kg	ND	ND	ND	ND
Fluoranthene	ug/Kg	54.7	ND	54.7	200
Fluorene	ug/Kg	1200	40	1200	493
Indeno(1,2,3-cd)pyrene	ug/Kg	ND	ND	ND	ND
Naphthalene	ug/Kg	965	ND	965	ND
Phenanthrene	ug/Kg	3460	ND	3460	760
Pyrene	ug/Kg	893	ND	893	350

The Control Pan showed a 46% reduction in TPH constituents over the course of the treatability test, and PAH degradation was significantly decreased in the Control pan, with only 63% degradation of total PAHs. Only two PAH constituents (naphthalene and benzo(g,h,i)perylene) were degraded to non-detect levels. Overall, the carcinogenic PAH constituents received the lowest degree of degradation within the Control pan.

3.4 NUTRIENT AND PLATE COUNT RESULTS

Although not part of our original proposal, in order to track biological activity within the Test and Control pans, plate count and nutrient parameters were analyzed during the test. The collected data is shown in Table 5 below.

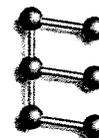


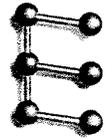
TABLE 5: NUTRIENT & PLATE COUNT RESULTS

		Test						Control
	Units	Day 0	Day 7	Day 14	Day 21	Day 28	Day 35	Day 35
Plate Count								
H-C Degrading	CFU/g	8.9E+05	1.0E+08	9.4E+07	2.1E+07	1.0E+08	2.6E+08	3.0E+07
Nutrients								
Ammonia	mg/kg	ND	3	ND	120	30	30	ND
Nitrite	mg/kg	ND	ND	ND	20	ND	ND	ND
Nitrate	mg/kg	ND	ND	ND	43	ND	ND	ND
Phosphate	mg/kg	ND	NA	ND	20	20	ND	ND
Sulfate	mg/kg	7	1100	1200	1100	1000	830	780
Manganese	mg/kg	50	ND	20	30	30	30	20
Potassium	mg/kg	40	70	80	150	180	180	43
Iron	mg/kg	670	610	620	780	690	670	680

No detectable nitrogen or phosphorous species were measured in the baseline soil sample. However, adequate levels of potassium, iron, manganese, and sulfate were present. Supplemental nutrient additions to the Test pan throughout the study increased the nitrogen and phosphorous levels. Maximum levels of ammonia, nitrite, nitrate, and phosphorous were recorded on Day 21. Elevated sulfate levels observed were a result of aluminum sulfate additions during pH adjustment.

The baseline plate count results revealed a native population of 10^5 CFU/g. Bioaugmentation of the Test pan resulted in a maximum microbial population of 10^8 CFU/g. This plate count was maintained throughout the treatment process. The microbial population measured in the Control pan on Day 35 was 10^7 CFU/g.

The TPH, PAH, Nutrient and Plate Count results indicate that significant biological degradation of petroleum constituents in this soil is possible, and that bioremediation is an applicable and potentially effective treatment option for this soil. The data also indicates that degradation of both TPH and PAH constituents can be achieved using an enzyme-enhanced bioremediation process.



4.0 KINETICS

In order to provide some information on the potential timeframes involved with degradation of the TPH and PAH constituents in the soil, ETEC performed some basic kinetic calculations to determine first order reaction rate constants. ETEC measured the kinetics of the degradation process using a first order reaction as follows:

$$\frac{dx}{dt} = -KX \quad \text{or} \quad X_t = X_0 e^{-KT}$$

where dx = change in concentration of target compound
 dt = elapsed treatment time
 T = treatment time
 X_t = concentration of target compound at time t
 X_0 = initial concentration of the target compound
 K = first order degradation rate

Taking the natural logarithm of both sides of the equation yields:

$$\ln X_t = \ln X_0 - KT$$

Using the least squares method, the constants $\ln X_0$ and $-K$ will be determined using the following equation:

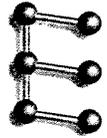
$$\ln X_0 = \frac{(\sum \ln X_t)(\sum T^2) - (\sum T)(\sum T \ln X_t)}{N \sum T^2 - (\sum T)^2}$$

and

$$-K = \frac{N \sum T \ln X_t - (\sum T)(\sum \ln X_t)}{N \sum T^2 - (\sum T)^2}$$

Once these constants are determined, the estimated treatment time for TPH can be calculated as follows:

$$\text{est } T_f = \frac{\ln X_{\text{goal}} - \ln X_0}{-K}$$

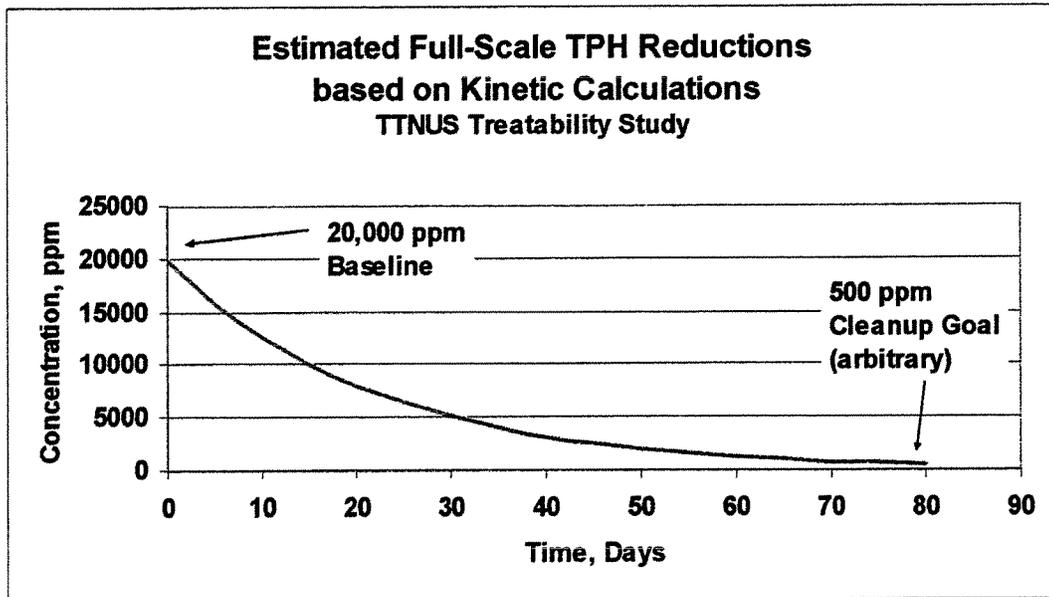


where $estT_f$ = estimated final time to meet the site goal for each target compound; and
 lnX_{goal} = natural logarithm of site goal concentration for each target compound

A summary of the kinetic calculations using the collected data is included in Appendix A. The calculated kinetic constants were as follows:

K (degradation rate constant): -0.00189 per hour
 $ln X_0$ (baseline constant): 9.896

We utilized the degradation rate constant K to calculate treatment times for soils from a starting concentration of 20,000 mg/Kg to an arbitrary treatment goal of 500 mg/Kg; the calculated treatment time was 80 days (see graph below and in Appendix A).



This remediation timeframe estimate is based on the contaminant reductions measured from our Test pan, and would be most directly applicable to ex situ bioremediation methods, such as landfarm soil treatment.



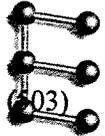
5.0 DISCUSSION AND CONCLUSIONS

Upon review of the data generated from this treatability study, several conclusions can be made concerning the feasibility of biological treatment of the test soil, as summarized in the following list.

- The treatability results indicate that the TPH and PAH soil constituents can effectively be treated to the required levels using enzyme-enhanced bioremediation.
- The treatability results showed a significant disparity between the Test and Control pans, indicating the effectiveness of biological enhancements for TPH and PAH reductions. It cannot be overstated that the petroleum compounds in the soil are very recalcitrant, and complete microbial degradation of these heavy-end hydrocarbons will undoubtedly require specialized biological products/enhancements.
- The results indicate that full-scale soil treatment could be achieved within a 60 to 90-day timeframe, depending upon the type of bioremediation process selected.

The specific biological products used for the Test pan, our A2 bacterial consortium and EA enzyme enhancement, were able to increase contaminant bioavailability and catalyze oxidation/reduction reactions that maximized breakdown and mineralization of the TPH compounds as well as the full range of PAH constituents, including the carcinogenic 5- and 6-ring PAH compounds. The Test pan achieved over 86% degradation of TPH constituents and over 99% degradation of PAH constituents by Day 35. Comparatively, the Control pan showed only 46% TPH degradation, and only 68% PAH degradation by Day 35. The baseline plate count data indicated that hydrocarbon degraders were present in the native soils. However, the Control pan demonstrated that these bacteria are not capable of complete degradation of the PAH compounds, and that degradation of the TPH compounds was significantly slower than in the augmented Test pan. We have successfully treated soil with similar oil-range compounds (primarily ex situ) on a full-scale basis, and this data is further evidence of the efficacy of this bioremediation technology as a fast, cost-effective remedial option for petroleum-impacted soil cleanup.

Based on the kinetic data related to the treatability study, it can be concluded that a reasonable treatment time estimate for full-scale soil treatment would approach 60 to 90 days using an ex situ landfarming application and the specified biological products. The data further suggests that over 99% degradation of the PAH compounds within the soil would also occur within this 60 to 90-day timeframe.

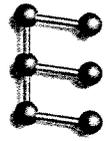


If you have any questions or comments regarding the data presented in this report, please call me at (503) 546-3621. We appreciate the opportunity to perform this treatability study for TetraTech NUS, Inc. and their client, and we look forward to further collaboration on this and other projects.

Respectfully,

ENZYME TECHNOLOGIES, INC.

David Laughlin
Environmental Services Director
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503-546-3621 (direct)



Appendix A

Tables and Graphs

COMPLETE ANALYTICAL DATA
TTNUS Treatability Study

	Units	Test						Control	
		Day 0	Day 7	Day 14	Day 21	Day 28	Day 35*	Day 0	Day 35*
Total Petroleum Hydrocarbons									
TPH-FLPRO	mg/Kg	18,700	11,600	10,900	11,400	7,360	2,640	18,700	10,100
TPH-CWG	mg/Kg	13,000					2,000	13,000	7,100
PAHs									
Acenaphthene	ug/Kg	901					ND	901	707
Acenaphthylene	ug/Kg	167					50.7	167	100
Anthracene	ug/Kg	426					ND	426	273
Benzo(a)anthracene	ug/Kg	62.7					ND	62.7	64.7
Benzo(a)pyrene	ug/Kg	12					7.33	12	7.33
Benzo(b)fluoranthene	ug/Kg	32.7					ND	32.7	16.7
Benzo(g,h,i)perylene	ug/Kg	9.33					ND	9.33	ND
Benzo(k)fluoranthene	ug/Kg	ND					ND	ND	ND
Chrysene	ug/Kg	69.3					ND	69.3	44.7
Dibenzo(a,h)anthracene	ug/Kg	ND					ND	ND	ND
Fluoranthene	ug/Kg	54.7					ND	54.7	200
Fluorene	ug/Kg	1200					40	1200	493
Indeno(1,2,3-cd)pyrene	ug/Kg	ND					ND	ND	ND
Naphthalene	ug/Kg	965					ND	965	ND
Phenanthrene	ug/Kg	3460					ND	3460	760
Pyrene	ug/Kg	893					ND	893	350
Total Metals									
Arsenic	mg/Kg	ND					ND	ND	ND
Barium	mg/Kg	5.09					6.36	5.09	5.21
Cadmium	mg/Kg	ND					ND	ND	ND
Chromium	mg/Kg	2.69					5.82	2.69	5.6
Lead	mg/Kg	ND					ND	ND	ND
Selenium	mg/Kg	ND					ND	ND	ND
Silver	mg/Kg	ND					ND	ND	ND
Mercury	mg/Kg	ND					ND	ND	ND
Plate Count									
H-C Degrading	CFU/g	8.9E+05	1.0E+08	9.4E+07	2.1E+07	1.0E+08	2.6E+08	8.9E+05	3.0E+07
Nutrients									
Ammonia	mg/kg	ND	3	ND	120	30	30	ND	ND
Nitrite	mg/kg	ND	ND	ND	20	ND	ND	ND	ND
Nitrate	mg/kg	ND	ND	ND	43	ND	ND	ND	ND
Phosphate	mg/kg	ND	NA	ND	20	20	ND	ND	ND
Sulfate	mg/kg	7	1100	1200	1100	1000	830	7	780
Manganese	mg/kg	50	ND	20	30	30	30	50	20
Potassium	mg/kg	40	70	80	150	180	180	40	43
Iron	mg/kg	670	610	620	780	690	670	670	680

NOTES:

- H-C: Hydrocarbon-Degrading
- ND: Not detected at specified detection limit
- TPH: Total Petroleum Hydrocarbons
- PAHs: Poly-Aromatic Hydrocarbons
- mg/Kg: milligrams of compound per kilogram of soil
- NA: Not available
- * See discussion on page 6

VOC ANALYTICAL DATA
TTNUS Treatability Study

	Units	Test					Control		
		Baseline	Day 7	Day 14	Day 21	Day 28	Day 35	Baseline	Day 35
Volatiles by GC/MS									
1,1,1,2-Tetrachloroethane	ug/Kg	ND					ND	ND	ND
1,1,1-Trichloroethane	ug/Kg	ND					ND	ND	ND
1,1,2,2-Tetrachloroethane	ug/Kg	ND					ND	ND	ND
1,1,2-Trichloroethane	ug/Kg	ND					ND	ND	ND
1,1-Dichloroethane	ug/Kg	ND					ND	ND	ND
1,1-Dichloroethane	ug/Kg	ND					ND	ND	ND
1,1-Dichloropropene	ug/Kg	ND					ND	ND	ND
1,2,3-Trichlorobenzene	ug/Kg	ND					ND	ND	ND
1,2,3-Trichloropropene	ug/Kg	ND					ND	ND	ND
1,2,4-Trichlorobenzene	ug/Kg	ND					ND	ND	ND
1,2,4-Trimethylbenzene	ug/Kg	101					101	101	101
1,2-Dibromo-3-chloropropane	ug/Kg	ND					ND	ND	ND
1,2-Dibromoethane	ug/Kg	ND					ND	ND	ND
1,2-Dichlorobenzene	ug/Kg	ND					ND	ND	ND
1,2-Dichloroethane	ug/Kg	ND					ND	ND	ND
1,2-Dichloropropene	ug/Kg	ND					ND	ND	ND
1,3,5-Trimethylbenzene	ug/Kg	36.5					ND	36.5	ND
1,3-Dichlorobenzene	ug/Kg	ND					ND	ND	ND
1,3-Dichloropropene	ug/Kg	ND					ND	ND	ND
1,4-Dichlorobenzene	ug/Kg	ND					ND	ND	ND
2,2-Dichloropropene	ug/Kg	ND					ND	ND	ND
2-Butanone	ug/Kg	ND					ND	ND	ND
2-Chlorotoluene	ug/Kg	ND					ND	ND	ND
2-Hexanone	ug/Kg	31.4					ND	31.4	ND
4-Chlorotoluene	ug/Kg	ND					ND	ND	ND
4-Isopropyltoluene	ug/Kg	105					ND	105	ND
4-Methyl-2-pentanone	ug/Kg	ND					ND	ND	ND
Acetone	ug/Kg	ND					ND	ND	ND
Benzene	ug/Kg	ND					ND	ND	ND
Bromobenzene	ug/Kg	ND					ND	ND	ND
Bromochloromethane	ug/Kg	ND					ND	ND	ND
Bromodichloromethane	ug/Kg	ND					ND	ND	ND
Bromoform	ug/Kg	ND					ND	ND	ND
Bromomethane	ug/Kg	ND					ND	ND	ND
Carbon Disulfide	ug/Kg	ND					ND	ND	ND
Carbon Tetrachloride	ug/Kg	ND					ND	ND	ND
Chlorobenzene	ug/Kg	ND					ND	ND	ND
chloroethane	ug/Kg	ND					ND	ND	ND
Chloroform	ug/Kg	ND					ND	ND	ND
Chloromethane	ug/Kg	ND					ND	ND	ND
cis-1,2-Dichloroethene	ug/Kg	ND					ND	ND	ND
cis-1,3-Dichloropropene	ug/Kg	ND					ND	ND	ND
Dibromochloromethane	ug/Kg	ND					ND	ND	ND
Dibromomethane	ug/Kg	ND					ND	ND	ND
Dichlorodifluoromethane	ug/Kg	ND					ND	ND	ND
Ethylbenzene	ug/Kg	ND					ND	ND	ND
Hexachlorobutadiene	ug/Kg	ND					ND	ND	ND
Isopropylbenzene	ug/Kg	ND					ND	ND	ND
m,p-Xylene	ug/Kg	ND					ND	ND	ND
Methyl tert-butyl ether	ug/Kg	ND					ND	ND	ND
Methylene chloride	ug/Kg	ND					ND	ND	ND
n-Butylbenzene	ug/Kg	ND					ND	ND	ND
n-Propylbenzene	ug/Kg	ND					ND	ND	ND
Naphthalene	ug/Kg	176					27.9	176	51.1
o-Xylene	ug/Kg	ND					ND	ND	ND
sec-Butylbenzene	ug/Kg	ND					ND	ND	ND
Styrene	ug/Kg	ND					ND	ND	ND
tert-Butylbenzene	ug/Kg	11.9					ND	11.9	ND
Tetrachloroethane	ug/Kg	ND					ND	ND	ND
Toluene	ug/Kg	ND					ND	ND	ND
trans-1,2-Dichloroethene	ug/Kg	ND					ND	ND	ND
trans-1,3-Dichloropropene	ug/Kg	ND					ND	ND	ND
Trichloroethene	ug/Kg	ND					ND	ND	ND
Trichlorofluoromethane	ug/Kg	ND					ND	ND	ND
Vinyl chloride	ug/Kg	ND					ND	ND	ND

NOTES:

- H-C: Hydrocarbon-Degrading
- ND: Not detected at specified detection limit
- TPH: Total Petroleum Hydrocarbons
- PAHs: Poly-Aromatic Hydrocarbons
- mg/Kg: milligrams of compound per kilogram of soil
- NA: Not available

KINETIC CALCULATIONS
TTNUS Treatability Study

COMPOUND	Concentration (mg/Kg) at Time t (hours)						Calculations										
	0	168	336	504	672	840	Sum [ln(Xt)]	Sum [T2], hours	Sum [T]	Sum [T*ln(Xt)]	N*Sum [T2]	(SumT)2	ln(Xo)	-K	Xgoal (ppm)	est(Tf), hours	Estimated Time to Goal, Days
TPH-Dx	18,700	11,600	10,900	11,400	7,360	2,640	54.62	1552320	2520	22005.28	9313920	6350400	9.896025	-0.00189	1,000	1,582	66

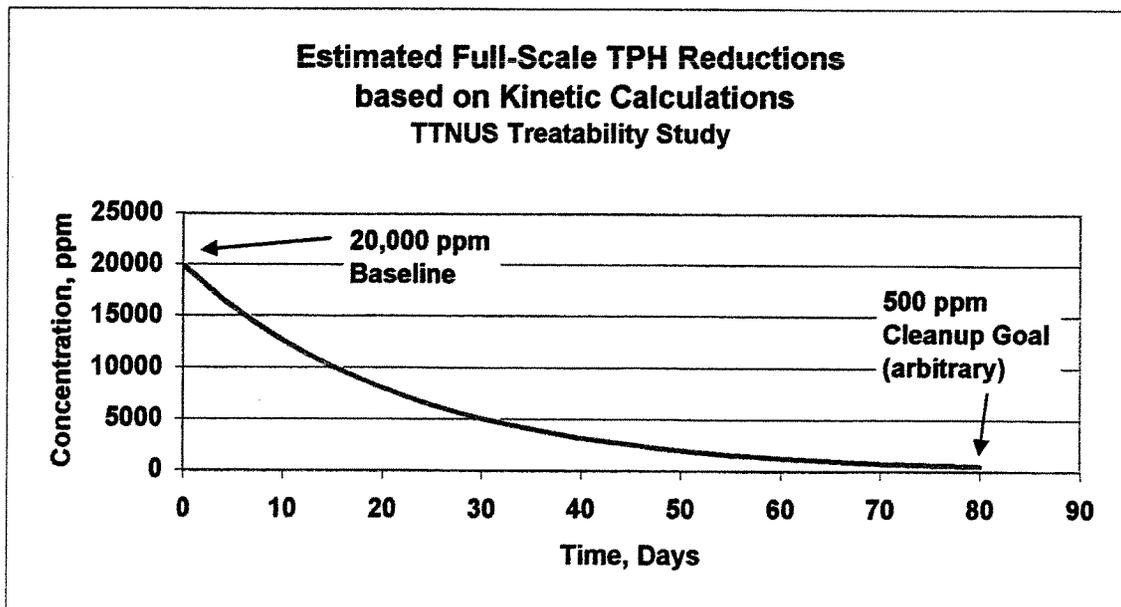
Days: 0 7 14 21 28 35

Estimated Oil-range TPH Reductions (using kinetic constants)

Assumed starting concentration (Xo) 20,000 mg/Kg
 Cleanup goal (Xt) 500 mg/Kg
 Assumed -K -0.00189
 Time = 1953 hours
 81 days

(with ex situ landfarm)

	TPH t, days	Xt
Based on the kinetic constants calculated from this treatability study, full-scale treatment of soil containing 20,000 ppm TPH could be completed within 80 days to a final concentration of less than 500 ppm.	0	20000
	5	15943
	10	12709
	15	10131
	20	8076
	25	6438
	30	5132
	35	4091
	40	3261
	45	2600
Based on the treatability study, 99% reduction of PAH constituents would also be achieved during this treatment timeframe.	50	2072
	55	1652
	60	1317
	65	1050
	70	837
	75	667
	80	532





Appendix B

Analytical Laboratory Data

Nutrient Recipe

To 500 ml of tap water,

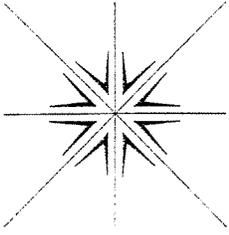
2.44 g Na_2HPO_4

1.52 g KH_2PO_4

0.50 g $(\text{NH}_4)_2\text{SO}_4$

0.20g $\text{MgSO}_4 \times 7\text{H}_2\text{O}$

0.05g $\text{CaCl}_2 \times 2 \text{H}_2\text{O}$



Specialty Analytical

19761 S.W. 95th Place
Tualatin, OR 97062
(503) 612-9007
Fax (503) 612-8572
1 (877) 612-9007

July 29, 2003

Randy Mueller
Enzyme Technologies
5228 NE 158th Avenue
Portland, OR 97230

TEL: (503) 254-4331
FAX (503) 254-1722

RE: TTNUS Treatability

Dear Randy Mueller:

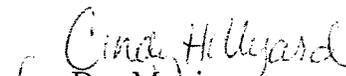
Order No.: 0306059

Specialty Analytical received 1 sample on 6/10/2003 for the analyses presented in the following report.

There were no problems with the analysis and all data for associated QC met EPA or laboratory specifications except where noted in the Case Narrative, or as qualified with flags. Results apply only to the samples analyzed. Without approval of the laboratory, the reproduction of this report is only permitted in its entirety.

If you have any questions regarding these tests, please feel free to call.

Sincerely,


Dan Marrin
Project Manager


Technical Review

Specialty Analytical

Date: 29-Jul-03

CLIENT: Enzyme Technologies
 Lab Order: 0306059
 Project: TTNUS Treatability
 Lab ID: 0306059-01

Client Sample ID: TTNUS-Day00-TC
 Collection Date: 6/10/2003 9:00:00 AM

Matrix: SOIL

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PETROLEUM HYDROCARBONS-FLPRO		FLPRO_S				Analyst: btf
Diesel	18700	150		mg/Kg	10	7/17/2003
Surr: o-terphenyl	749	50-150	S,D	%REC	10	7/17/2003
TOTAL PETROLEUM HYDROCARBONS-CWG		CWG_S				Analyst: btf
Diesel	13000	150		mg/Kg	10	7/17/2003
Surr: o-terphenyl	749	50-150	S,D	%REC	10	7/17/2003
TOTAL METALS BY ICP		E6010				Analyst: das
Arsenic	ND	2.00		mg/Kg	1	7/1/2003
Barium	5.09	1.00		mg/Kg	1	7/1/2003
Cadmium	ND	0.100		mg/Kg	1	7/1/2003
Chromium	2.69	0.500		mg/Kg	1	7/1/2003
Lead	ND	2.00		mg/Kg	1	7/1/2003
Selenium	ND	2.00		mg/Kg	1	7/1/2003
Silver	ND	2.00		mg/Kg	1	7/1/2003
MERCURY, TOTAL		SW7471				Analyst: das
Mercury	ND	0.0167		mg/Kg	1	7/3/2003
PAH'S BY GC/MS-OARSIM		8270SIM				Analyst: bda
Acenaphthene	901	6.67		µg/Kg	1	6/30/2003 12:33:00 PM
Acenaphthylene	167	6.67		µg/Kg	1	6/28/2003 10:20:00 PM
Anthracene	426	6.67		µg/Kg	1	6/28/2003 10:20:00 PM
Benz(a)anthracene	62.7	6.67		µg/Kg	1	6/30/2003 12:33:00 PM
Benzo(a)pyrene	12.0	6.67		µg/Kg	1	6/30/2003 12:33:00 PM
Benzo(b)fluoranthene	32.7	6.67		µg/Kg	1	6/30/2003 12:33:00 PM
Benzo(g,h,i)perylene	9.33	6.67		µg/Kg	1	6/30/2003 12:33:00 PM
Benzo(k)fluoranthene	ND	6.67		µg/Kg	1	6/30/2003 12:33:00 PM
Chrysene	69.3	6.67		µg/Kg	1	6/30/2003 12:33:00 PM
Dibenz(a,h)anthracene	ND	6.67		µg/Kg	1	6/30/2003 12:33:00 PM
Fluoranthene	54.7	6.67		µg/Kg	1	6/28/2003 10:20:00 PM
Fluorene	1200	6.67		µg/Kg	1	6/28/2003 10:20:00 PM
Indeno(1,2,3-cd)pyrene	ND	6.67		µg/Kg	1	6/30/2003 12:33:00 PM
Naphthalene	965	6.67		µg/Kg	1	6/28/2003 10:20:00 PM
Phenanthrene	3460	33.3		µg/Kg	5	6/30/2003 1:37:00 PM
Pyrene	893	6.67		µg/Kg	1	6/30/2003 12:33:00 PM
Surr: 2-Fluorobiphenyl	4590	42.6-128	S	%REC	1	6/30/2003 12:33:00 PM
Surr: 2-Fluorobiphenyl	82.3	42.6-128		%REC	1	6/28/2003 10:20:00 PM
Surr: Nitrobenzene-d5	186	21.7-155	S,E,MI	%REC	1	6/28/2003 10:20:00 PM
Surr: Nitrobenzene-d5	10700	21.7-155	S,E,MI	%REC	1	6/30/2003 12:33:00 PM
Surr: p-Terphenyl-d14	6250	44.9-155	S	%REC	1	6/30/2003 12:33:00 PM
Surr: p-Terphenyl-d14	108	44.9-155	MI	%REC	1	6/28/2003 10:20:00 PM

Specialty Analytical

Date: 29-Jul-03

CLIENT: Enzyme Technologies
 Lab Order: 0306059
 Project: TTNUS Treatability
 Lab ID: 0306059-01

Client Sample ID: TTNUS-Day00-TC
 Collection Date: 6/10/2003 9:00:00 AM
 Matrix: SOIL

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
VOLATILES BY GC/MS		SW8260B				Analyst: skc
1,1,1,2-Tetrachloroethane	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
1,1,1-Trichloroethane	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
1,1,2,2-Tetrachloroethane	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
1,1,2-Trichloroethane	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
1,1-Dichloroethane	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
1,1-Dichloroethene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
1,1-Dichloropropene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
1,2,3-Trichlorobenzene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
1,2,3-Trichloropropane	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
1,2,4-Trichlorobenzene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
1,2,4-Trimethylbenzene	101	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
1,2-Dibromo-3-chloropropane	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
1,2-Dibromoethane	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
1,2-Dichlorobenzene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
1,2-Dichloroethane	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
1,2-Dichloropropane	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
1,3,5-Trimethylbenzene	36.5	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
1,3-Dichlorobenzene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
1,3-Dichloropropane	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
1,4-Dichlorobenzene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
2,2-Dichloropropane	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
2-Butanone	ND	40.0		µg/Kg	1	6/25/2003 4:49:00 PM
2-Chlorotoluene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
2-Hexanone	31.4	20.0		µg/Kg	1	6/25/2003 4:49:00 PM
4-Chlorotoluene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
4-Isopropyltoluene	105	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
4-Methyl-2-pentanone	ND	40.0		µg/Kg	1	6/25/2003 4:49:00 PM
Acetone	ND	100		µg/Kg	1	6/25/2003 4:49:00 PM
Benzene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Bromobenzene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Bromochloromethane	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Bromodichloromethane	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Bromoform	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Bromomethane	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Carbon disulfide	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Carbon tetrachloride	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Chlorobenzene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Chloroethane	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Chloroform	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Chloromethane	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
cis-1,2-Dichloroethene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM

Specialty Analytical

Date: 29-Jul-03

CLIENT: Enzyme Technologies
 Lab Order: 0306059
 Project: TTNUS Treatability
 Lab ID: 0306059-01

Client Sample ID: TTNUS-Day00-TC
 Collection Date: 6/10/2003 9:00:00 AM
 Matrix: SOIL

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
VOLATILES BY GC/MS		SW8260B				Analyst: skc
cis-1,3-Dichloropropene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Dibromochloromethane	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Dibromomethane	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Dichlorodifluoromethane	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Ethylbenzene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Hexachlorobutadiene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Isopropylbenzene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
m,p-Xylene	ND	20.0		µg/Kg	1	6/25/2003 4:49:00 PM
Methyl tert-butyl ether	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Methylene chloride	ND	50.0		µg/Kg	1	6/25/2003 4:49:00 PM
n-Butylbenzene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
n-Propylbenzene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Naphthalene	176	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
o-Xylene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
sec-Butylbenzene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Styrene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
tert-Butylbenzene	11.9	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Tetrachloroethene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Toluene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
trans-1,2-Dichloroethene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
trans-1,3-Dichloropropene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Trichloroethene	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Trichlorofluoromethane	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Vinyl chloride	ND	10.0		µg/Kg	1	6/25/2003 4:49:00 PM
Surr: 1,2-Dichloroethane-d4	105	71.5-112		%REC	1	6/25/2003 4:49:00 PM
Surr: 4-Bromofluorobenzene	167	75.7-122	S,MI	%REC	1	6/25/2003 4:49:00 PM
Surr: Dibromofluoromethane	118	64.3-124		%REC	1	6/25/2003 4:49:00 PM
Surr: Toluene-d8	113	74.9-120		%REC	1	6/25/2003 4:49:00 PM

Specialty Analytical

Date: 29-Jul-03

CLIENT: Enzyme Technologies
 Work Order: 0306059
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: 6010_S

Sample ID	MB-8956	SampType: MBLK	TestCode: 6010_S	Units: mg/Kg	Prep Date: 6/26/2003	Run ID: TJA IRIS_030701H					
Client ID:	ZZZZZ	Batch ID: 8956	TestNo: E6010		Analysis Date: 7/1/2003	SeqNo: 196825					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	ND	2.00									
Arsenic	1.45	2.00									J
Barium	0.2	1.00									J
Cadmium	ND	0.100									
Chromium	ND	0.500									
Copper	0.37	1.00									J
Lead	ND	2.00									
Nickel	ND	0.500									
Selenium	ND	2.00									
Silver	ND	2.00									
Zinc	0.9	1.00									J

Sample ID	LCS-8956	SampType: LCS	TestCode: 6010_S	Units: mg/Kg	Prep Date: 6/26/2003	Run ID: TJA IRIS_030701H					
Client ID:	ZZZZZ	Batch ID: 8956	TestNo: E6010		Analysis Date: 7/1/2003	SeqNo: 196824					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	51.77	2.00	50	0	104	86.7	111	0	0		
Arsenic	104	2.00	100	1.45	103	87.6	110	0	0		
Barium	54.97	1.00	50	0.2	110	92.7	109	0	0		S
Cadmium	5.23	0.100	5	0	105	90.8	109	0	0		
Chromium	27.31	0.500	25	0	109	91.7	114	0	0		
Copper	51.32	1.00	50	0.37	102	91.3	111	0	0		
Lead	108.3	2.00	100	0	108	92.9	109	0	0		
Nickel	27.05	0.500	25	0	108	91.8	109	0	0		
Selenium	106.8	2.00	100	0	107	90.2	112	0	0		
Silver	49.1	2.00	50	0	98.2	85.1	108	0	0		
Zinc	53.59	1.00	50	0.9	105	88.1	111	0	0		

Qualifiers: ND - Not Detected at the Reporting Limit S - Spike Recovery outside accepted recovery limits B - Analyte detected in the associated Method Blank
 J - Analyte detected below quantitation limits R - RPD outside accepted recovery limits

CLIENT: Enzyme Technologies
 Work Order: 0306059
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: 6010_S

Sample ID: 0306133-12BMS	SampType: MS	TestCode: 6010_S	Units: mg/Kg	Prep Date: 6/26/2003	Run ID: TJA IRIS_030701H
Client ID: ZZZZZ	Batch ID: 8956	TestNo: E6010		Analysis Date: 7/1/2003	SeqNo: 196819

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	30.99	2.00	50	3.22	55.5	75	125	0	0		S
Arsenic	105.4	2.00	100	0.65	105	86.1	109	0	0		
Barium	133.4	1.00	50	0	267	75	125	0	0		SE
Cadmium	5.29	0.100	5	0	106	86.4	113	0	0		
Chromium	44.39	0.500	25	16.55	111	75	121	0	0		
Copper	60.96	1.00	50	8.48	105	75.1	126	0	0		
Lead	108.3	2.00	100	0	108	92.1	104	0	0		S
Nickel	48.12	0.500	25	21.11	108	89.3	105	0	0		S
Selenium	107.9	2.00	100	0	108	77.7	116	0	0		
Silver	48.85	2.00	50	0	97.7	75	123	0	0		
Zinc	106.8	1.00	50	49.39	115	86.2	113	0	0		SE

Sample ID: 0306133-12BMSD	SampType: MSD	TestCode: 6010_S	Units: mg/Kg	Prep Date: 6/26/2003	Run ID: TJA IRIS_030701H
Client ID: ZZZZZ	Batch ID: 8956	TestNo: E6010		Analysis Date: 7/1/2003	SeqNo: 196820

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	32.79	2.00	50	3.22	59.1	75	125	30.99	5.64	20	S
Arsenic	106.2	2.00	100	0.65	106	86.1	109	105.4	0.756	20	
Barium	155	1.00	50	0	310	75	125	133.4	15.0	20	SE
Cadmium	5.27	0.100	5	0	105	86.4	113	5.29	0.379	20	
Chromium	44.88	0.500	25	16.55	113	75	121	44.39	1.10	20	
Copper	60.71	1.00	50	8.48	104	75.1	126	60.96	0.411	20	
Lead	109.4	2.00	100	0	109	92.1	104	108.3	1.01	20	S
Nickel	49.53	0.500	25	21.11	114	89.3	105	48.12	2.89	20	S
Selenium	107.3	2.00	100	0	107	77.7	116	107.9	0.558	20	
Silver	49.19	2.00	50	0	98.4	75	123	48.85	0.694	20	
Zinc	106.7	1.00	50	49.39	115	86.2	113	106.8	0.0937	20	SE

Qualifiers: ND - Not Detected at the Reporting Limit S - Spike Recovery outside accepted recovery limits B - Analyte detected in the associated Method Blank
 J - Analyte detected below quantitation limits R - RPD outside accepted recovery limits

CLIENT: Enzyme Technologies
 Work Order: 0306059
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: 6010_S

Sample ID 0306133-12BDUP		SampType: DUP		TestCode: 6010_S		Units: mg/Kg		Prep Date: 6/26/2003		Run ID: TJA IRIS_030701H		
Client ID: ZZZZZ		Batch ID: 8956		TestNo: E6010				Analysis Date: 7/1/2003		SeqNo: 196818		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual	
Antimony	3.84	2.00	0	0	0	0	0	3.22	17.6	20		
Arsenic	1.03	2.00	0	0	0	0	0	0.65	0	20	J	
Cadmium	ND	0.100	0	0	0	0	0	0	0	20		
Chromium	20.05	0.500	0	0	0	0	0	16.55	19.1	20		
Copper	11.41	1.00	0	0	0	0	0	8.48	29.5	20	R	
Lead	ND	2.00	0	0	0	0	0	0	0	20		
Nickel	20.54	0.500	0	0	0	0	0	21.11	2.74	20		
Zinc	52.74	1.00	0	0	0	0	0	49.39	6.56	20		

Sample ID CCV		SampType: CCV		TestCode: 6010_S		Units: mg/Kg		Prep Date:		Run ID: TJA IRIS_030701H		
Client ID: ZZZZZ		Batch ID: 8956		TestNo: E6010				Analysis Date: 7/1/2003		SeqNo: 196827		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual	
Antimony	50.86	2.00	50	0	102	90	110	0	0			
Arsenic	102.6	2.00	100	0	103	90	110	0	0			
Barium	53.71	1.00	50	0	107	90	110	0	0			
Cadmium	5.28	0.100	5	0	106	90	110	0	0			
Chromium	26.85	0.500	25	0	107	90	110	0	0			
Copper	50.25	1.00	50	0	101	90	110	0	0			
Lead	105.2	2.00	100	0	105	90	110	0	0			
Nickel	26.6	0.500	25	0	106	90	110	0	0			
Selenium	106	2.00	100	0	106	90	110	0	0			
Silver	50.5	2.00	50	0	101	90	110	0	0			
Zinc	53.29	1.00	50	0	107	90	110	0	0			

Sample ID ICV		SampType: ICV		TestCode: 6010_S		Units: mg/Kg		Prep Date:		Run ID: TJA IRIS_030701H		
Client ID: ZZZZZ		Batch ID: 8956		TestNo: E6010				Analysis Date: 7/1/2003		SeqNo: 196826		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual	
Antimony	50.78	2.00	50	0	102	90	110	0	0			
Arsenic	100.4	2.00	100	0	100	90	110	0	0			

Qualifiers: ND - Not Detected at the Reporting Limit
 J - Analyte detected below quantitation limits

S - Spike Recovery outside accepted recovery limits
 R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

CLIENT: Enzyme Technologies
Work Order: 0306059
Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: 6010_S

Sample ID	ICV	SampType: ICV	TestCode: 6010_S	Units: mg/Kg	Prep Date:	Run ID: TJA IRIS_030701H					
Client ID:	ZZZZZ	Batch ID: 8956	TestNo: E6010		Analysis Date: 7/1/2003	SeqNo: 196826					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Barium	52.42	1.00	50	0	105	90	110	0	0		
Cadmium	5.16	0.100	5	0	103	90	110	0	0		
Chromium	26.39	0.500	25	0	106	90	110	0	0		
Copper	49.68	1.00	50	0	99.4	90	110	0	0		
Lead	103.6	2.00	100	0	104	90	110	0	0		
Nickel	25.83	0.500	25	0	103	90	110	0	0		
Selenium	103.1	2.00	100	0	103	90	110	0	0		
Silver	49.94	2.00	50	0	99.9	90	110	0	0		
Zinc	52.43	1.00	50	0	105	90	110	0	0		

Qualifiers: ND - Not Detected at the Reporting Limit S - Spike Recovery outside accepted recovery limits B - Analyte detected in the associated Method Blank
 J - Analyte detected below quantitation limits R - RPD outside accepted recovery limits

CLIENT: Enzyme Technologies
Work Order: 0306059
Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260_S

Sample ID MB	SampType: MBLK	TestCode: 8260_S	Units: µg/Kg	Prep Date: 6/25/2003	Run ID: 5973L_030625B
Client ID: ZZZZZ	Batch ID: 8957	TestNo: SW8260B		Analysis Date: 6/25/2003	SeqNo: 195331

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1,1,2-Tetrachloroethane	ND	10.0									
1,1,1-Trichloroethane	ND	10.0									
1,1,2,2-Tetrachloroethane	ND	10.0									
1,1,2-Trichloroethane	ND	10.0									
1,1-Dichloroethane	ND	10.0									
1,1-Dichloroethene	ND	10.0									
1,1-Dichloropropene	ND	10.0									
1,2,3-Trichlorobenzene	2.09	10.0									
1,2,3-Trichloropropane	ND	10.0									J
1,2,4-Trichlorobenzene	1.48	10.0									
1,2,4-Trimethylbenzene	ND	10.0									J
1,2-Dibromo-3-chloropropane	ND	10.0									
1,2-Dibromoethane	ND	10.0									
1,2-Dichlorobenzene	ND	10.0									
1,2-Dichloroethane	ND	10.0									
1,2-Dichloropropane	ND	10.0									
1,3,5-Trimethylbenzene	ND	10.0									
1,3-Dichlorobenzene	ND	10.0									
1,3-Dichloropropane	ND	10.0									
1,4-Dichlorobenzene	ND	10.0									
2,2-Dichloropropane	ND	10.0									
2-Butanone	ND	40.0									
2-Chlorotoluene	ND	10.0									
2-Hexanone	ND	20.0									
4-Chlorotoluene	ND	10.0									
4-Isopropyltoluene	ND	10.0									
4-Methyl-2-pentanone	ND	40.0									
Acetone	ND	100									
Benzene	ND	10.0									
Bromobenzene	ND	10.0									
Bromochloromethane	ND	10.0									

Qualifiers: ND - Not Detected at the Reporting Limit
 J - Analyte detected below quantitation limits

S - Spike Recovery outside accepted recovery limits
 R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

CLIENT: Enzyme Technologies
Work Order: 0306059
Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260_S

Sample ID MB	SampType: MBLK	TestCode: 8260_S	Units: µg/Kg	Prep Date: 6/25/2003	Run ID: 5973L_030625B
Client ID: ZZZZZ	Batch ID: 8957	TestNo: SW8260B		Analysis Date: 6/25/2003	SeqNo: 195331

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Bromodichloromethane	ND	10.0									
Bromoform	ND	10.0									
Bromomethane	4.15	10.0									
Carbon disulfide	ND	10.0									J
Carbon tetrachloride	ND	10.0									
Chlorobenzene	ND	10.0									
Chloroethane	ND	10.0									
Chloroform	ND	10.0									
Chloromethane	1.07	10.0									
cis-1,2-Dichloroethene	ND	10.0									J
cis-1,3-Dichloropropene	ND	10.0									
Dibromochloromethane	ND	10.0									
Dibromomethane	ND	10.0									
Dichlorodifluoromethane	ND	10.0									
Ethylbenzene	ND	10.0									
Hexachlorobutadiene	ND	10.0									
Isopropylbenzene	ND	10.0									
m,p-Xylene	ND	20.0									
Methyl tert-butyl ether	ND	10.0									
Methylene chloride	21.18	50.0									
n-Butylbenzene	ND	10.0									J
n-Propylbenzene	ND	10.0									
Naphthalene	8.1	10.0									
o-Xylene	ND	10.0									J
sec-Butylbenzene	ND	10.0									
Styrene	ND	10.0									
tert-Butylbenzene	ND	10.0									
Tetrachloroethene	ND	10.0									
Toluene	ND	10.0									
trans-1,2-Dichloroethene	ND	10.0									
trans-1,3-Dichloropropene	ND	10.0									

Qualifiers: ND - Not Detected at the Reporting Limit
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 R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

CLIENT: Enzyme Technologies
Work Order: 0306059
Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260_S

Sample ID	SampType	TestCode	Units	Prep Date	Run ID
MB	MBLK	8260_S	µg/Kg	6/25/2003	5973L_030625B
Client ID: ZZZZZ	Batch ID: 8957	TestNo: SW8260B		Analysis Date: 6/25/2003	SeqNo: 195331

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Trichloroethene	ND	10.0									
Trichlorofluoromethane	ND	10.0									
Vinyl chloride	ND	10.0									
Surr: 1,2-Dichloroethane-d4	104.6	1.00	100	0	105	71.5	112	0	0		
Surr: 4-Bromofluorobenzene	102.5	1.00	100	0	103	75.7	122	0	0		
Surr: Dibromofluoromethane	119.2	1.00	100	0	119	64.3	124	0	0		
Surr: Toluene-d8	102.3	1.00	100	0	102	74.9	120	0	0		

Sample ID	SampType	TestCode	Units	Prep Date	Run ID
LCS	LCS	8260_S	µg/Kg	6/25/2003	5973L_030625B
Client ID: ZZZZZ	Batch ID: 8957	TestNo: SW8260B		Analysis Date: 6/25/2003	SeqNo: 195330

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	64.27	10.0	80	0	80.3	65.4	133	0	0		
Benzene	70.78	10.0	80	0	88.5	78	123	0	0		
Chlorobenzene	76.03	10.0	80	0	95	79.5	125	0	0		
Toluene	69.61	10.0	80	0	87	77.5	132	0	0		
Trichloroethene	81.95	10.0	80	0	102	72.4	124	0	0		

Sample ID	SampType	TestCode	Units	Prep Date	Run ID
0306141-01BMS	MS	8260_S	µg/Kg	6/25/2003	5973L_030625B
Client ID: ZZZZZ	Batch ID: 8957	TestNo: SW8260B		Analysis Date: 6/25/2003	SeqNo: 195335

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	35.29	10.0	40	0	88.2	69.2	158	0	0		
Benzene	37.22	10.0	40	0	93	71.7	147	0	0		
Chlorobenzene	40.58	10.0	40	0	101	85.6	148	0	0		
Toluene	44.02	10.0	40	1.86	105	75.8	153	0	0		
Trichloroethene	40.31	10.0	40	0	101	77.1	138	0	0		

Qualifiers:
 ND - Not Detected at the Reporting Limit
 J - Analyte detected below quantitation limits

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 R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

CLIENT: Enzyme Technologies
 Work Order: 0306059
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260_S

Sample ID 0306141-01BMSD	SampType: MSD	TestCode: 8260_S	Units: µg/Kg	Prep Date: 6/25/2003	Run ID: 5973L_030625B						
Client ID: ZZZZZ	Batch ID: 8957	TestNo: SW8260B		Analysis Date: 6/25/2003	SeqNo: 195336						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	36.05	10.0	40	0	90.1	69.2	158	35.29	2.13	20	
Benzene	38.73	10.0	40	0	96.8	71.7	147	37.22	3.98	20	
Chlorobenzene	42.13	10.0	40	0	105	85.6	148	40.58	3.75	20	
Toluene	41.97	10.0	40	1.86	100	75.8	153	44.02	4.77	20	
Trichloroethene	34.6	10.0	40	0	86.5	77.1	138	40.31	15.2	20	

Sample ID CCV	SampType: CCV	TestCode: 8260_S	Units: µg/Kg	Prep Date: 6/25/2003	Run ID: 5973L_030625B						
Client ID: ZZZZZ	Batch ID: 8957	TestNo: SW8260B		Analysis Date: 6/25/2003	SeqNo: 195329						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	16.46	10.0	20	0	82.3	80	120	0	0		
1,2-Dichloropropane	20.87	10.0	20	0	104	80	120	0	0		
Chloroform	20.85	10.0	20	0	104	80	120	0	0		
Ethylbenzene	20.8	10.0	20	0	104	80	120	0	0		
Toluene	20.01	10.0	20	0	100	80	120	0	0		
Vinyl chloride	16.99	10.0	20	0	85	80	120	0	0		

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CLIENT: Enzyme Technologies
Work Order: 0306059
Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: FLPRO_S

Sample ID	SampType	TestCode	Units	Prep Date	Run ID						
MBLK	MBLK	FLPRO_S	mg/Kg		GC-O_030717A						
Client ID: ZZZZZ	Batch ID: R25715	TestNo: FLPRO_S		Analysis Date: 7/17/2003	SeqNo: 201333						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel	ND	15.0									
Surr: o-terphenyl	30.1	0	33.33	0	90.3	50	150	0	0		
Sample ID LCS	SampType: LCS	TestCode: FLPRO_S	Units: mg/Kg	Prep Date:	Run ID: GC-O_030717A						
Client ID: ZZZZZ	Batch ID: R25715	TestNo: FLPRO_S		Analysis Date: 7/17/2003	SeqNo: 201334						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel	366.7	15.0	333.3	0	110	75	125	0	0		
Sample ID 0307059-01BDUP	SampType: DUP	TestCode: FLPRO_S	Units: mg/Kg	Prep Date:	Run ID: GC-O_030717A						
Client ID: ZZZZZ	Batch ID: R25715	TestNo: FLPRO_S		Analysis Date: 7/17/2003	SeqNo: 201342						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel	12620	150	0	0	0	0	0	18660	38.7	20	R
Sample ID CCV	SampType: CCV	TestCode: FLPRO_S	Units: mg/Kg	Prep Date:	Run ID: GC-O_030717A						
Client ID: ZZZZZ	Batch ID: R25715	TestNo: FLPRO_S		Analysis Date: 7/17/2003	SeqNo: 201343						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel	339	15.0	335.3	0	101	85	115	0	0		

Qualifiers: ND - Not Detected at the Reporting Limit
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B - Analyte detected in the associated Method Blank

CLIENT: Enzyme Technologies
Work Order: 0306059
Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: HG_CTS

Sample ID: MB-9012	SampType: MBLK	TestCode: HG_CTS	Units: mg/Kg	Prep Date: 7/2/2003	Run ID: CVAA_030703A
Client ID: ZZZZZ	Batch ID: 9012	TestNo: SW7471		Analysis Date: 7/3/2003	SeqNo: 196944
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC LowLimit HighLimit RPD Ref Val %RPD RPDLimit Qual
Mercury	ND	0.0167			

Sample ID: LCS-9012	SampType: LCS	TestCode: HG_CTS	Units: mg/Kg	Prep Date: 7/2/2003	Run ID: CVAA_030703A
Client ID: ZZZZZ	Batch ID: 9012	TestNo: SW7471		Analysis Date: 7/3/2003	SeqNo: 196943
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC LowLimit HighLimit RPD Ref Val %RPD RPDLimit Qual
Mercury	0.2252	0.0167	0.208	0	108 88.2 113 0 0

Sample ID: 0306059-01BMS	SampType: MS	TestCode: HG_CTS	Units: mg/Kg	Prep Date: 7/2/2003	Run ID: CVAA_030703A
Client ID: TTNUS-Day00-TC	Batch ID: 9012	TestNo: SW7471		Analysis Date: 7/3/2003	SeqNo: 196937
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC LowLimit HighLimit RPD Ref Val %RPD RPDLimit Qual
Mercury	0.233	0.0157	0.195	0	119 78.1 125 0 0

Sample ID: 0306059-01BMSD	SampType: MSD	TestCode: HG_CTS	Units: mg/Kg	Prep Date: 7/2/2003	Run ID: CVAA_030703A
Client ID: TTNUS-Day00-TC	Batch ID: 9012	TestNo: SW7471		Analysis Date: 7/3/2003	SeqNo: 196938
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC LowLimit HighLimit RPD Ref Val %RPD RPDLimit Qual
Mercury	0.2503	0.0167	0.208	0	120 78.1 125 0.233 7.19 20

Sample ID: 0306059-01BDUP	SampType: DUP	TestCode: HG_CTS	Units: mg/Kg	Prep Date: 7/2/2003	Run ID: CVAA_030703A
Client ID: TTNUS-Day00-TC	Batch ID: 9012	TestNo: SW7471		Analysis Date: 7/3/2003	SeqNo: 196936
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC LowLimit HighLimit RPD Ref Val %RPD RPDLimit Qual
Mercury	ND	0.0157	0	0	0 0 0 0 0 0 20

Sample ID: CCV-9012	SampType: CCV	TestCode: HG_CTS	Units: mg/Kg	Prep Date: 7/2/2003	Run ID: CVAA_030703A
Client ID: ZZZZZ	Batch ID: 9012	TestNo: SW7471		Analysis Date: 7/3/2003	SeqNo: 196942
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC LowLimit HighLimit RPD Ref Val %RPD RPDLimit Qual
Mercury					

Qualifiers: ND - Not Detected at the Reporting Limit
 J - Analyte detected below quantitation limits

S - Spike Recovery outside accepted recovery limits
 R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

CLIENT: Enzyme Technologies
Work Order: 0306059
Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: HG_CTS

Sample ID	CCV-9012	SampType: CCV	TestCode: HG_CTS	Units: mg/Kg	Prep Date: 7/2/2003	Run ID: CVAA_030703A					
Client ID:	ZZZZZ	Batch ID: 9012	TestNo: SW7471		Analysis Date: 7/3/2003	SeqNo: 196942					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	0.2277	0.0167	0.208	0	109	90	110	0	0		

Qualifiers: ND - Not Detected at the Reporting Limit
 J - Analyte detected below quantitation limits

S - Spike Recovery outside accepted recovery limits
 R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

CLIENT: Enzyme Technologies
 Work Order: 0306059
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: PAHLL_S

Sample ID: MB-8970	SampType: MBLK	TestCode: PAHLL_S	Units: µg/Kg	Prep Date: 6/28/2003	Run ID: 5973G_030628A
Client ID: ZZZZZ	Batch ID: 8970	TestNo: 8270SIM		Analysis Date: 6/28/2003	SeqNo: 195995

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Acenaphthene	ND	6.67									
Acenaphthylene	ND	6.67									
Anthracene	ND	6.67									
Benz(a)anthracene	ND	6.67									
Benzo(a)pyrene	ND	6.67									
Benzo(b)fluoranthene	ND	6.67									
Benzo(g,h,i)perylene	ND	6.67									
Benzo(k)fluoranthene	ND	6.67									
Chrysene	ND	6.67									
Dibenz(a,h)anthracene	ND	6.67									
Fluoranthene	ND	6.67									
Fluorene	ND	6.67									
Indeno(1,2,3-cd)pyrene	ND	6.67									
Naphthalene	ND	6.67									
Phenanthrene	ND	6.67									
Pyrene	ND	6.67									
Surr: 2-Fluorobiphenyl	5100	0	6667	0	76.5	42.6	128	0	0		
Surr: Nitrobenzene-d5	5819	0	6667	0	87.3	21.7	155	0	0		
Surr: p-Terphenyl-d14	6397	0	6667	0	95.9	44.9	155	0	0		

Sample ID: LCS-8970	SampType: LCS	TestCode: PAHLL_S	Units: µg/Kg	Prep Date: 6/28/2003	Run ID: 5973G_030628A
Client ID: ZZZZZ	Batch ID: 8970	TestNo: 8270SIM		Analysis Date: 6/28/2003	SeqNo: 195996

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Acenaphthene	123.3	6.67	166.7	0	74	40.4	107	0	0		
Benzo(g,h,i)perylene	128	6.67	166.7	0	76.8	44.6	125	0	0		
Chrysene	137.3	6.67	166.7	0	82.4	59.9	121	0	0		
Naphthalene	122.7	6.67	166.7	0	73.6	33.5	96.1	0	0		
Phenanthrene	132.7	6.67	166.7	0	79.6	52.2	108	0	0		
Pyrene	138.7	6.67	166.7	0	83.2	53.8	120	0	0		

Qualifiers: ND - Not Detected at the Reporting Limit S - Spike Recovery outside accepted recovery limits B - Analyte detected in the associated Method Blank
 J - Analyte detected below quantitation limits R - RPD outside accepted recovery limits

CLIENT: Enzyme Technologies
Work Order: 0306059
Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: PAHLL_S

Sample ID 0306168-03BMS	SampType: MS	TestCode: PAHLL_S	Units: µg/Kg	Prep Date: 6/28/2003	Run ID: 5973G_030628A
Client ID: ZZZZZ	Batch ID: 8970	TestNo: 8270SIM		Analysis Date: 6/28/2003	SeqNo: 195997

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Acenaphthene	120.7	6.67	166.7	0	72.4	33.7	107	0	0		
Benzo(g,h,i)perylene	126.7	6.67	166.7	0	76	15	128	0	0		
Chrysene	137.3	6.67	166.7	0	82.4	37.5	125	0	0		
Naphthalene	110.7	6.67	166.7	0	66.4	27.7	108	0	0		
Phenanthrene	130	6.67	166.7	8.667	72.8	20.2	139	0	0		
Pyrene	135.3	6.67	166.7	4.667	78.4	26.8	134	0	0		

Sample ID 0306168-03BMSD	SampType: MSD	TestCode: PAHLL_S	Units: µg/Kg	Prep Date: 6/28/2003	Run ID: 5973G_030628A
Client ID: ZZZZZ	Batch ID: 8970	TestNo: 8270SIM		Analysis Date: 6/28/2003	SeqNo: 195998

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Acenaphthene	116.7	6.67	166.7	0	70	33.7	107	120.7	3.37	20	
Benzo(g,h,i)perylene	124	6.67	166.7	0	74.4	15	128	126.7	2.13	20	
Chrysene	131.3	6.67	166.7	0	78.8	37.5	125	137.3	4.47	20	
Naphthalene	104	6.67	166.7	0	62.4	27.7	108	110.7	6.21	20	
Phenanthrene	127.3	6.67	166.7	8.667	71.2	20.2	139	130	2.07	20	
Pyrene	134.7	6.67	166.7	4.667	78	26.8	134	135.3	0.494	20	

Sample ID CCV-8970	SampType: CCV	TestCode: PAHLL_S	Units: µg/Kg	Prep Date:	Run ID: 5973G_030628A
Client ID: ZZZZZ	Batch ID: 8970	TestNo: 8270SIM		Analysis Date: 6/28/2003	SeqNo: 195994

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Acenaphthene	69.33	6.67	66.67	0	104	70	130	0	0		
Acenaphthylene	62.67	6.67	66.67	0	94	70	130	0	0		
Anthracene	71.33	6.67	66.67	0	107	70	130	0	0		
Benz(a)anthracene	71.33	6.67	66.67	0	107	70	130	0	0		
Benzo(a)pyrene	70.67	6.67	66.67	0	106	70	130	0	0		
Benzo(b)fluoranthene	76.67	6.67	66.67	0	115	70	130	0	0		
Benzo(g,h,i)perylene	68.67	6.67	66.67	0	103	70	130	0	0		
Benzo(k)fluoranthene	70	6.67	66.67	0	105	70	130	0	0		
Chrysene	70.67	6.67	66.67	0	106	70	130	0	0		

Qualifiers: ND - Not Detected at the Reporting Limit S - Spike Recovery outside accepted recovery limits B - Analyte detected in the associated Method Blank
 J - Analyte detected below quantitation limits R - RPD outside accepted recovery limits

CLIENT: Enzyme Technologies
Work Order: 0306059
Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: PAHLL_S

Sample ID	CCV-8970	SampType:	CCV	TestCode:	PAHLL_S	Units:	µg/Kg	Prep Date:		Run ID:	5973G_030628A
Client ID:	ZZZZZ	Batch ID:	8970	TestNo:	8270SIM	Analysis Date:	6/28/2003	SeqNo:	195994		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Dibenz(a,h)anthracene	66	6.67	66.67	0	99	70	130	0	0		
Fluoranthene	68	6.67	66.67	0	102	70	130	0	0		
Fluorene	66.67	6.67	66.67	0	100	70	130	0	0		
Indeno(1,2,3-cd)pyrene	67.33	6.67	66.67	0	101	70	130	0	0		
Naphthalene	70	6.67	66.67	0	105	70	130	0	0		
Phenanthrene	71.33	6.67	66.67	0	107	70	130	0	0		
Pyrene	72.67	6.67	66.67	0	109	70	130	0	0		

Qualifiers: ND - Not Detected at the Reporting Limit S - Spike Recovery outside accepted recovery limits B - Analyte detected in the associated Method Blank
 J - Analyte detected below quantitation limits R - RPD outside accepted recovery limits

CLIENT: Enzyme Technologies
 Work Order: 0306059
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: TPH_CWG

Sample ID	SampType:	TestCode:	Units:	Prep Date:	Run ID:						
Client ID:	Batch ID:	TestNo:				SeqNo:					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
MBLK	MBLK	TPH_CWG	mg/Kg		GC-O_030717B						
ZZZZZ	R25752	CWG_S				201352					
Diesel	ND	15									
Surr: o-terphenyl	30.1	0	33.33	0	90.3	50	150	0	0		
LCS	LCS	TPH_CWG	mg/Kg		GC-O_030717B						
ZZZZZ	R25752	CWG_S				201353					
Diesel	157.9	15	166.6	0	94.7	75	125	0	0		
0307059-01BDUP	DUP	TPH_CWG	mg/Kg		GC-O_030717B						
ZZZZZ	R25752	CWG_S				201358					
Diesel	8935	150	0	0	0	0	0	12670	34.5	20	R
CCV	CCV	TPH_CWG	mg/Kg		GC-O_030717B						
ZZZZZ	R25752	CWG_S				201354					
Diesel	339	15	335.3	0	101	85	115	0	0		

Qualifiers: ND - Not Detected at the Reporting Limit
 J - Analyte detected below quantitation limits

S - Spike Recovery outside accepted recovery limits
 R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

KEY TO FLAGS

- A. This sample contains a Gasoline Range Organic not identified as a specific hydrocarbon product. The result was quantified against gasoline calibration standards.
- A1. This sample contains a Diesel Range Organic not identified as a specific hydrocarbon product. The result was quantified against diesel calibration standards.
- A2. This sample contains a Lube Oil Range Organic not identified as a specific hydrocarbon product. The result was quantified against lube oil calibration standards.
- A3. Results determined to be non detect based on hydrocarbon pattern recognition. The product was carry-over from another hydrocarbon type.
- B. The blank exhibited a positive result greater than the reporting limit for this compound.
- C. The result confirmed by secondary column or GC/MS analysis.
- CN. See case narrative.
- CR. Result for this analyte maybe biased due to interferences. Confirmation by GC/MS or other technique is recommended.
- D. Surrogate was diluted outside reporting range.
- E. Result exceeds the calibration range for the compound. The result should be considered an estimate.
- F. The positive result for this hydrocarbon is due to single component contamination. The product does not match any hydrocarbon in the fuels library.
- G. Result may be biased high due to biogenic interferences. Silica gel clean-up recommended.
- H. Sample was analyzed outside recommended holding times.
- HT. At clients request, sample was analyzed outside method recommended holding time.
- J. The result for this analyte is between the MDL and the PQL, and should be considered an estimated concentration.
- K. Diesel result is biased high due to amount of oil contained in the sample.
- L. Diesel result is biased high due to amount of gasoline contained in the sample.
- M. Oil result is biased high due to amount of diesel contained in the sample.
- MC. Sample concentration is greater than 4x the spiked value; the spiked value is considered insignificant.
- MI. Outside control limits due to Matrix Interference.
- MSA. Value determined by Method of Standard Addition.
- N. Sample appears to contain biogenic material biasing quantification.
- O. Laboratory Control Standard (LCS) exceeded laboratory control limits, meets CCV criteria. Data meets EPA requirements.
- P. Detected levels of Methylene Chloride may be due to laboratory contamination, due to previous analysis or background levels.
- Q. Detection limits elevated due to sample matrix.
- R. RPD control limits were exceeded.
- RF. Duplicate failed, due to result being at or near method reporting limit.
- RP. Matrix spike values exceed established QC limits, post digestion spike is in control.
- S. Recovery outside control limits.
- *. The result for this parameter was greater than the maximum contaminant level or the TCLP regulatory limit.

SPECIALTY ANALYTICAL.

0306059

ENZYME TECHNOLOGIES, INC.
 5228 NE 158th Ave.
 Portland, OR 97230
 Phone: 503-254-4331
 Fax: 503-254-1722

Chain of Custody Record Laboratory Analysis

Special Instructions

Turnaround

N - Normal:
 R - Rush:
 O - Other:

Project Information

Project Name: TTNUS Treatability
 Project #:
 P.O.#:
 Sampler's Name:
 Signature:

ETEC Contact:

Phone Number: Randy Mueller
503-546-3617
 Comments:

Remarks:

Analyses

Sample Identification	Date	Time	Matrix (S or W)	# of Containers	HC-Degrading Plate Count	Heterotrophic Plate Count	Analyses					Remarks
							EPA Method 8260	EPA Method 8270 Modified Sim	RCRAB	FL-PEO/NUTPH-Dx	TPH-CWG-	
1 TTNUS - Day 00 - TC	6/10/03	0900	S	1			X	X	X	X	X	
2												
3												
4												
5												
6												
7												
8												

~~Relinquished~~

Signature _____ Date _____
 Print Name _____ Time _____
 Company _____

Received

Signature Randy Mueller Date _____
 Print Name Randy Mueller Time _____
 Company ETEC

~~Relinquished~~

Signature Dawn [Signature] Date 6/10/03
 Print Name Dawn [Signature] Time 12:45
 Company ETEC

Received

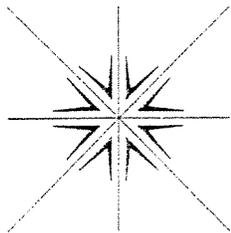
Signature Cindy Hillgard Date 6/10/03
 Print Name Cindy Hillgard Time 12:45
 Company Specialty

~~Relinquished~~

Signature _____ Date _____
 Print Name _____ Time _____
 Company _____

Received

Signature _____ Date _____
 Print Name _____ Time _____
 Company _____



Specialty Analytical

19761 S.W. 95th Place
Tualatin, OR 97062
(503) 612-9007
Fax (503) 612-8572
1 (877) 612-9007

July 29, 2003

Randy Mueller
Enzyme Technologies
5228 NE 158th Avenue
Portland, OR 97230

TEL: (503) 254-4331

FAX (503) 254-1722

RE: TTNUS Treatability

Dear Randy Mueller:

Order No.: 0306104

Specialty Analytical received 1 sample on 6/17/2003 for the analyses presented in the following report.

There were no problems with the analysis and all data for associated QC met EPA or laboratory specifications except where noted in the Case Narrative, or as qualified with flags. Results apply only to the samples analyzed. Without approval of the laboratory, the reproduction of this report is only permitted in its entirety.

If you have any questions regarding these tests, please feel free to call.

Sincerely,

Cindy Hillyard
for Dan Marrin
Project Manager

[Handwritten Signature]
Technical Review

Specialty Analytical

Date: 29-Jul-03

CLIENT: Enzyme Technologies
Project: TTNUS Treatability

Lab Order: 0306104

Lab ID: 0306104-01

Collection Date: 6/17/2003 11:08:00 AM

Client Sample ID: TTNUS-Day 7-T

Matrix: SOIL

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PETROLEUM HYDROCARBONS-FLPRO		FLPRO_S				Analyst: btf
Diesel	11600	150		mg/Kg	10	7/17/2003
Surr: o-terphenyl	626	50-150	S,D	%REC	10	7/17/2003

CLIENT: Enzyme Technologies
 Work Order: 0306104
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: FLPRO_S

Sample ID	MBLK	SampType:	MBLK	TestCode:	FLPRO_S	Units:	mg/Kg	Prep Date:		Run ID:	GC-O_030717A			
Client ID:	ZZZZZ	Batch ID:	R25715	TestNo:	FLPRO_S			Analysis Date:	7/17/2003	SeqNo:	201333			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Diesel		ND		15.0										
Surr: o-terphenyl		30.1		0	33.33	0		90.3	50	150	0		0	

Sample ID	LCS	SampType:	LCS	TestCode:	FLPRO_S	Units:	mg/Kg	Prep Date:		Run ID:	GC-O_030717A			
Client ID:	ZZZZZ	Batch ID:	R25715	TestNo:	FLPRO_S			Analysis Date:	7/17/2003	SeqNo:	201334			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Diesel		366.7		15.0	333.3	0		110	75	125	0		0	
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Sample ID	0307059-01BDUP	SampType:	DUP	TestCode:	FLPRO_S	Units:	mg/Kg	Prep Date:		Run ID:	GC-O_030717A			
Client ID:	ZZZZZ	Batch ID:	R25715	TestNo:	FLPRO_S			Analysis Date:	7/17/2003	SeqNo:	201342			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Diesel		12620		150	0	0		0	0	0	18660		38.7	20	R
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Sample ID	CCV	SampType:	CCV	TestCode:	FLPRO_S	Units:	mg/Kg	Prep Date:		Run ID:	GC-O_030717A			
Client ID:	ZZZZZ	Batch ID:	R25715	TestNo:	FLPRO_S			Analysis Date:	7/17/2003	SeqNo:	201343			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Diesel		339		15.0	335.3	0		101	85	115	0		0	
--------	--	-----	--	------	-------	---	--	-----	----	-----	---	--	---	--

Qualifiers: ND - Not Detected at the Reporting Limit
 J - Analyte detected below quantitation limits

S - Spike Recovery outside accepted recovery limits
 R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

KEY TO FLAGS

- A. This sample contains a Gasoline Range Organic not identified as a specific hydrocarbon product. The result was quantified against gasoline calibration standards.
- A1. This sample contains a Diesel Range Organic not identified as a specific hydrocarbon product. The result was quantified against diesel calibration standards.
- A2. This sample contains a Lube Oil Range Organic not identified as a specific hydrocarbon product. The result was quantified against lube oil calibration standards.
- A3. Results determined to be non detect based on hydrocarbon pattern recognition. The product was carry-over from another hydrocarbon type.
- B. The blank exhibited a positive result greater than the reporting limit for this compound.
- C. The result confirmed by secondary column or GC/MS analysis.
- CN. See case narrative.
- CR. Result for this analyte maybe biased due to interferences. Confirmation by GC/MS or other technique is recommended.
- D. Surrogate was diluted outside reporting range.
- E. Result exceeds the calibration range for the compound. The result should be considered an estimate.
- F. The positive result for this hydrocarbon is due to single component contamination. The product does not match any hydrocarbon in the fuels library.
- G. Result may be biased high due to biogenic interferences. Silica gel clean-up recommended.
- H. Sample was analyzed outside recommended holding times.
- HT. At clients request, sample was analyzed outside method recommended holding time.
- J. The result for this analyte is between the MDL and the PQL, and should be considered an estimated concentration.
- K. Diesel result is biased high due to amount of oil contained in the sample.
- L. Diesel result is biased high due to amount of gasoline contained in the sample.
- M. Oil result is biased high due to amount of diesel contained in the sample.
- MC. Sample concentration is greater than 4x the spiked value; the spiked value is considered insignificant.
- MI. Outside control limits due to Matrix Interference.
- MSA. Value determined by Method of Standard Addition.
- N. Sample appears to contain biogenic material biasing quantification.
- O. Laboratory Control Standard (LCS) exceeded laboratory control limits, meets CCV criteria. Data meets EPA requirements.
- P. Detected levels of Methylene Chloride may be due to laboratory contamination, due to previous analysis or background levels.
- Q. Detection limits elevated due to sample matrix.
- R. RPD control limits were exceeded.
- RF. Duplicate failed, due to result being at or near method reporting limit.
- RP. Matrix spike values exceed established QC limits, post digestion spike is in control.
- S. Recovery outside control limits.
- *. The result for this parameter was greater than the maximum contaminant level or the TCLP regulatory limit.

Lab #

0306104

Specialty

ENZYME TECHNOLOGIES, INC.
 5228 NE 158th Ave.
 Portland, OR 97230
 Phone: 503-254-4331
 Fax: 503-254-1722

Chain of Custody Record Laboratory Analysis

Special Instructions
 Attn: Marty French

Turnaround		Project Information			
N - Normal:	✓	Project Name:	TTNUS		ETEC Contact:
R - Rush:		Project #:		Phone Number:	Randy Mueller
O - Other:		P.O.#:		Comments:	503-546-3617
		Sampler's Name:			
		Signature:			

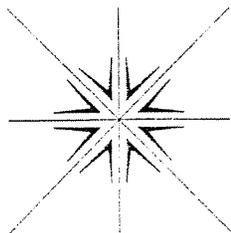
Remarks:

Sample Identification	Date	Time	Matrix (S or W)	# of Containers	Analyses							FL-PRO/MWTEH-Dx	Remarks
					HC-Degrading Plate Count	Heterotrophic Plate Count	Iron-Degrading Plate Count	Complete Nutrient Suite	Limited Nutrient Suite	pH			
1 TTNUS-Day 7-T	6/17/03	11:08 AM	S	1									
2													
3													
4													
5													
6													
7													
8													

Relinquished	
Signature <i>Randy Mueller</i>	Date 6/17/03
Print Name <i>Randy Mueller</i>	Time <i>NOON</i>
Company <i>EETC</i>	
Received	
Signature <i>Dan Marin</i>	Date 6/17/03
Print Name <i>D. Marin</i>	Time <i>1:25</i>
Company <i>SA</i>	

Relinquished	
Signature	Date
Print Name	Time
Company	
Received	
Signature	Date
Print Name	Time
Company	

Relinquished	
Signature	Date
Print Name	Time
Company	
Received	
Signature	Date
Print Name	Time
Company	



Specialty Analytical

19761 S.W. 95th Place
Tualatin, OR 97062
(503) 612-9007
Fax (503) 612-8572
1 (877) 612-9007

July 29, 2003

Randy Mueller
Enzyme Technologies
5228 NE 158th Avenue
Portland, OR 97230

TEL: (503) 254-4331
FAX (503) 254-1722

RE: TTNUS Treatability

Dear Randy Mueller:

Order No.: 0306141

Specialty Analytical received 1 sample on 6/24/2003 for the analyses presented in the following report.

There were no problems with the analysis and all data for associated QC met EPA or laboratory specifications except where noted in the Case Narrative, or as qualified with flags. Results apply only to the samples analyzed. Without approval of the laboratory, the reproduction of this report is only permitted in its entirety.

If you have any questions regarding these tests, please feel free to call.

Sincerely,

Cindy Klippard
for Dan Marrin
Project Manager

[Signature]
Technical Review

Specialty Analytical

Date: 29-Jul-03

CLIENT: Enzyme Technologies
Project: TTNUS Treatability

Lab Order: 0306141

Lab ID: 0306141-01

Collection Date: 6/24/2003 9:45:00 AM

Client Sample ID: TTNUS-Day 14-T

Matrix: SOIL

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PETROLEUM HYDROCARBONS-FLPRO						
Diesel	10900	FLPRO_S 150		mg/Kg	10	Analyst: btf 7/17/2003
Surr: o-terphenyl	522	50-150	S,D	%REC	10	7/17/2003

Specialty Analytical

Date: 29-Jul-03

CLIENT: Enzyme Technologies
 Work Order: 0306141
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: FLPRO_S

Sample ID	MBLK	SampType:	MBLK	TestCode:	FLPRO_S	Units:	mg/Kg	Prep Date:		Run ID:	GC-O_030717A			
Client ID:	ZZZZZ	Batch ID:	R25715	TestNo:	FLPRO_S			Analysis Date:	7/17/2003	SeqNo:	201333			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel		ND		15.0										
Surr: o-terphenyl		30.1		0	33.33	0		90.3	50	150	0		0	

Sample ID	LCS	SampType:	LCS	TestCode:	FLPRO_S	Units:	mg/Kg	Prep Date:		Run ID:	GC-O_030717A			
Client ID:	ZZZZZ	Batch ID:	R25715	TestNo:	FLPRO_S			Analysis Date:	7/17/2003	SeqNo:	201334			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel		366.7		15.0	333.3	0		110	75	125	0		0	

Sample ID	0307059-01BDUP	SampType:	DUP	TestCode:	FLPRO_S	Units:	mg/Kg	Prep Date:		Run ID:	GC-O_030717A			
Client ID:	ZZZZZ	Batch ID:	R25715	TestNo:	FLPRO_S			Analysis Date:	7/17/2003	SeqNo:	201342			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel		12620		150	0	0		0	0	0	18660	38.7	20	R

Sample ID	CCV	SampType:	CCV	TestCode:	FLPRO_S	Units:	mg/Kg	Prep Date:		Run ID:	GC-O_030717A			
Client ID:	ZZZZZ	Batch ID:	R25715	TestNo:	FLPRO_S			Analysis Date:	7/17/2003	SeqNo:	201343			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel		339		15.0	335.3	0		101	85	115	0		0	

Qualifiers: ND - Not Detected at the Reporting Limit
 J - Analyte detected below quantitation limits

S - Spike Recovery outside accepted recovery limits
 R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

KEY TO FLAGS

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- A1. This sample contains a Diesel Range Organic not identified as a specific hydrocarbon product. The result was quantified against diesel calibration standards.
- A2. This sample contains a Lube Oil Range Organic not identified as a specific hydrocarbon product. The result was quantified against lube oil calibration standards.
- A3. Results determined to be non detect based on hydrocarbon pattern recognition. The product was carry-over from another hydrocarbon type.
- B. The blank exhibited a positive result greater than the reporting limit for this compound.
- C. The result confirmed by secondary column or GC/MS analysis.
- CN. See case narrative.
- CR. Result for this analyte maybe biased due to interferences. Confirmation by GC/MS or other technique is recommended.
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- F. The positive result for this hydrocarbon is due to single component contamination. The product does not match any hydrocarbon in the fuels library.
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- H. Sample was analyzed outside recommended holding times.
- HT. At clients request, sample was analyzed outside method recommended holding time.
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- L. Diesel result is biased high due to amount of gasoline contained in the sample.
- M. Oil result is biased high due to amount of diesel contained in the sample.
- MC. Sample concentration is greater than 4x the spiked value; the spiked value is considered insignificant.
- MI. Outside control limits due to Matrix Interference.
- MSA. Value determined by Method of Standard Addition.
- N. Sample appears to contain biogenic material biasing quantification.
- O. Laboratory Control Standard (LCS) exceeded laboratory control limits, meets CCV criteria. Data meets EPA requirements.
- P. Detected levels of Methylene Chloride may be due to laboratory contamination, due to previous analysis or background levels.
- Q. Detection limits elevated due to sample matrix.
- R. RPD control limits were exceeded.
- RF. Duplicate failed, due to result being at or near method reporting limit.
- RP. Matrix spike values exceed established QC limits, post digestion spike is in control.
- S. Recovery outside control limits.
- *. The result for this parameter was greater than the maximum contaminant level or the TCLP regulatory limit.

0306141

Specialty

ENZYME TECHNOLOGIES, INC. 5228 NE 158 th Ave. Portland, OR 97230 Phone: 503-254-4331 Fax: 503-254-1722	<h2 style="margin: 0;">Chain of Custody Record Laboratory Analysis</h2>	Special Instructions Attn: Murby French
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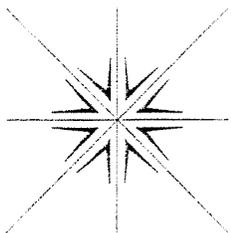
Turnaround		Project Information			
N - Normal:	✓	Project Name:	TTNUS	ETEC Contact:	Randy Mueller
R - Rush :		Project #:		Phone Number:	503-546-3617
O - Other:		P.O.#:		Comments:	
		Sampler's Name:			
		Signature:			

Remarks:				Analyses										Remarks
				Matrix (S or W)	# of Containers	HC-Degrading Plate Count	Heterotrophic Plate Count	Iron-Degrading Plate Count	Complete Nutrient Suite	Limited Nutrient Suite	pH	FL-PRO / NWTPH-0x		
Sample Identification		Date	Time											
1	TTNUS - Day 14 - T	6/24/03	9:45 AM	S	1								X	
2														
3														
4														
5														
6														
7														
8														

Relinquished			
Signature	Randy Mueller	Date	6/24/03
Print Name	Randy Mueller	Time	9:45 AM
Company	ETEC		
Received			
Signature	Cindy Hilliard	Date	6/24/03
Print Name	Cindy Hilliard	Time	11:20
Company	Specialty		

Relinquished			
Signature		Date	
Print Name		Time	
Company			
Received			
Signature		Date	
Print Name		Time	
Company			

Relinquished			
Signature		Date	
Print Name		Time	
Company			
Received			
Signature		Date	
Print Name		Time	
Company			



Specialty Analytical

19761 S.W. 95th Place
Tualatin, OR 97062
(503) 612-9007
Fax (503) 612-8572
1 (877) 612-9007

July 29, 2003

Randy Mueller
Enzyme Technologies
5228 NE 158th Avenue
Portland, OR 97230

TEL: (503) 254-4331
FAX (503) 254-1722

RE: TTNUS Treatability

Dear Randy Mueller:

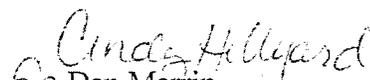
Order No.: 0307010

Specialty Analytical received 1 sample on 7/2/2003 for the analyses presented in the following report.

There were no problems with the analysis and all data for associated QC met EPA or laboratory specifications except where noted in the Case Narrative, or as qualified with flags. Results apply only to the samples analyzed. Without approval of the laboratory, the reproduction of this report is only permitted in its entirety.

If you have any questions regarding these tests, please feel free to call.

Sincerely,


Cindy Hillgard
Dan Marin
Project Manager


Technical Review

Specialty Analytical

Date: 29-Jul-03

CLIENT: Enzyme Technologies
Project: TTNUS Treatability

Lab Order: 0307010

Lab ID: 0307010-01

Collection Date: 7/1/2003 9:30:00 AM

Client Sample ID: TTNUS-Day 21-T

Matrix: SOIL

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PETROLEUM HYDROCARBONS-FLPRO						
Diesel	11400	150		mg/Kg	10	7/17/2003
Surr: o-terphenyl	544	50-150	S,D	%REC	10	7/17/2003

Analyst: btf

Specialty Analytical

Date: 29-Jul-03

CLIENT: Enzyme Technologies
 Work Order: 0307010
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: FLPRO_S

Sample ID	MBLK	SampType:	MBLK	TestCode:	FLPRO_S	Units:	mg/Kg	Prep Date:		Run ID:	GC-O_030717A			
Client ID:	ZZZZZ	Batch ID:	R25715	TestNo:	FLPRO_S			Analysis Date:	7/17/2003	SeqNo:	201333			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Diesel		ND		15.0										
Surr: o-terphenyl		30.1		0	33.33	0		90.3	50	150	0		0	

Sample ID	LCS	SampType:	LCS	TestCode:	FLPRO_S	Units:	mg/Kg	Prep Date:		Run ID:	GC-O_030717A			
Client ID:	ZZZZZ	Batch ID:	R25715	TestNo:	FLPRO_S			Analysis Date:	7/17/2003	SeqNo:	201334			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Diesel		366.7		15.0	333.3	0		110	75	125	0		0	
--------	--	-------	--	------	-------	---	--	-----	----	-----	---	--	---	--

Sample ID	0307059-01BDUP	SampType:	DUP	TestCode:	FLPRO_S	Units:	mg/Kg	Prep Date:		Run ID:	GC-O_030717A			
Client ID:	ZZZZZ	Batch ID:	R25715	TestNo:	FLPRO_S			Analysis Date:	7/17/2003	SeqNo:	201342			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Diesel		12620		150	0	0		0	0	0	18660		38.7	20	R
--------	--	-------	--	-----	---	---	--	---	---	---	-------	--	------	----	---

Sample ID	CCV	SampType:	CCV	TestCode:	FLPRO_S	Units:	mg/Kg	Prep Date:		Run ID:	GC-O_030717A			
Client ID:	ZZZZZ	Batch ID:	R25715	TestNo:	FLPRO_S			Analysis Date:	7/17/2003	SeqNo:	201343			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Diesel		339		15.0	335.3	0		101	85	115	0		0	
--------	--	-----	--	------	-------	---	--	-----	----	-----	---	--	---	--

Qualifiers: ND - Not Detected at the Reporting Limit S - Spike Recovery outside accepted recovery limits B - Analyte detected in the associated Method Blank
 J - Analyte detected below quantitation limits R - RPD outside accepted recovery limits

KEY TO FLAGS

- A. This sample contains a Gasoline Range Organic not identified as a specific hydrocarbon product. The result was quantified against gasoline calibration standards.
- A1. This sample contains a Diesel Range Organic not identified as a specific hydrocarbon product. The result was quantified against diesel calibration standards.
- A2. This sample contains a Lube Oil Range Organic not identified as a specific hydrocarbon product. The result was quantified against lube oil calibration standards.
- A3. Results determined to be non detect based on hydrocarbon pattern recognition. The product was carry-over from another hydrocarbon type.
- B. The blank exhibited a positive result greater than the reporting limit for this compound.
- C. The result confirmed by secondary column or GC/MS analysis.
- CN. See case narrative.
- CR. Result for this analyte maybe biased due to interferences. Confirmation by GC/MS or other technique is recommended.
- D. Surrogate was diluted outside reporting range.
- E. Result exceeds the calibration range for the compound. The result should be considered an estimate.
- F. The positive result for this hydrocarbon is due to single component contamination. The product does not match any hydrocarbon in the fuels library.
- G. Result may be biased high due to biogenic interferences. Silica gel clean-up recommended.
- H. Sample was analyzed outside recommended holding times.
- HT. At clients request, sample was analyzed outside method recommended holding time.
- J. The result for this analyte is between the MDL and the PQL, and should be considered an estimated concentration.
- K. Diesel result is biased high due to amount of oil contained in the sample.
- L. Diesel result is biased high due to amount of gasoline contained in the sample.
- M. Oil result is biased high due to amount of diesel contained in the sample.
- MC. Sample concentration is greater than 4x the spiked value; the spiked value is considered insignificant.
- MI. Outside control limits due to Matrix Interference.
- MSA. Value determined by Method of Standard Addition.
- N. Sample appears to contain biogenic material biasing quantification.
- O. Laboratory Control Standard (LCS) exceeded laboratory control limits, meets CCV criteria. Data meets EPA requirements.
- P. Detected levels of Methylene Chloride may be due to laboratory contamination, due to previous analysis or background levels.
- Q. Detection limits elevated due to sample matrix.
- R. RPD control limits were exceeded.
- RF. Duplicate failed, due to result being at or near method reporting limit.
- RP. Matrix spike values exceed established QC limits, post digestion spike is in control.
- S. Recovery outside control limits.
- *. The result for this parameter was greater than the maximum contaminant level or the TCLP regulatory limit.

Specialty

ENZYME TECHNOLOGIES, INC. 5228 NE 158 th Ave. Portland, OR 97230 Phone: 503-254-4331 Fax: 503-254-1722	<h2 style="margin: 0;">Chain of Custody Record</h2> <h2 style="margin: 0;">Laboratory Analysis</h2>	Special Instructions
--	---	----------------------

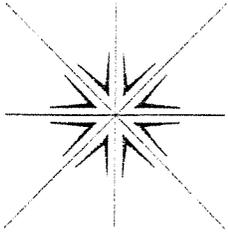
Turnaround		Project Information			
N - Normal:	✓	Project Name:	TTNUS	ETEC Contact:	Randy Mueller
R - Rush:		Project #:		Phone Number:	503-546-3617
O - Other:		P.O.#:		Comments:	
		Sampler's Name:			
		Signature:			

Remarks:				Analyses										Remarks
Sample Identification	Date	Time	Matrix (S or W)	# of Containers	HC-Degrading Plate Count	Heterotrophic Plate Count	Iron-Degrading Plate Count	Complete Nutrient Suite	Limited Nutrient Suite	pH	FL-PRO/ NWTPH-DX			
1	TTNUS - Day 21 - T	7/1/03	9:30 AM	S	1							X		
2														
3														
4														
5														
6														
7														
8														

Relinquished	
Signature <i>Randy Mueller</i>	Date 7/1/03
Print Name <i>Randy Mueller</i>	Time 9:30 AM
Company <i>ETEC</i>	
Received	
Signature <i>[Signature]</i>	Date 7/2/03
Print Name <i>[Name]</i>	Time <i>[Time]</i>
Company <i>SPECIALTY</i>	

Relinquished	
Signature	Date
Print Name	Time
Company	
Received	
Signature	Date
Print Name	Time
Company	

Relinquished	
Signature	Date
Print Name	Time
Company	
Received	
Signature	Date
Print Name	Time
Company	



Specialty Analytical

19761 S.W. 95th Place
Tualatin, OR 97062
(503) 612-9007
Fax (503) 612-8572
1 (877) 612-9007

July 29, 2003

Randy Mueller
Enzyme Technologies
5228 NE 158th Avenue
Portland, OR 97230

TEL: (503) 254-4331
FAX (503) 254-1722

RE: TTNUS Treatability

Dear Randy Mueller:

Order No.: 0307037

Specialty Analytical received 1 sample on 7/9/2003 for the analyses presented in the following report.

There were no problems with the analysis and all data for associated QC met EPA or laboratory specifications except where noted in the Case Narrative, or as qualified with flags. Results apply only to the samples analyzed. Without approval of the laboratory, the reproduction of this report is only permitted in its entirety.

If you have any questions regarding these tests, please feel free to call.

Sincerely,

DM
Dan Marrin
Project Manager

Technical Review

Specialty Analytical

Date: 29-Jul-03

CLIENT: Enzyme Technologies
Project: TTNUS Treatability

Lab Order: 0307037

Lab ID: 0307037-01

Collection Date: 7/8/2003 9:30:00 AM

Client Sample ID: TTNUS-Day 28-T

Matrix: SOIL

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
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PETROLEUM HYDROCARBONS-FLPRO

FLPRO_S

Analyst: btf

Diesel

7360

150

mg/Kg

10

7/17/2003

Surr: o-terphenyl

434

50-150

S,D

%REC

10

7/17/2003

Specialty Analytical

Date: 29-Jul-03

CLIENT: Enzyme Technologies
 Work Order: 0307037
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: FLPRO_S

Sample ID	MBLK	SampType:	MBLK	TestCode:	FLPRO_S	Units:	mg/Kg	Prep Date:		Run ID:	GC-O_030717A			
Client ID:	ZZZZZ	Batch ID:	R25715	TestNo:	FLPRO_S			Analysis Date:	7/17/2003	SeqNo:	201333			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel		ND		15.0										
Surr: o-terphenyl		30.1		0	33.33	0		90.3	50	150	0		0	

Sample ID	LCS	SampType:	LCS	TestCode:	FLPRO_S	Units:	mg/Kg	Prep Date:		Run ID:	GC-O_030717A			
Client ID:	ZZZZZ	Batch ID:	R25715	TestNo:	FLPRO_S			Analysis Date:	7/17/2003	SeqNo:	201334			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel		366.7		15.0	333.3	0		110	75	125	0		0	

Sample ID	0307059-01BDUP	SampType:	DUP	TestCode:	FLPRO_S	Units:	mg/Kg	Prep Date:		Run ID:	GC-O_030717A			
Client ID:	ZZZZZ	Batch ID:	R25715	TestNo:	FLPRO_S			Analysis Date:	7/17/2003	SeqNo:	201342			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel		12620		150	0	0		0	0	0	18660	38.7	20	R

Sample ID	CCV	SampType:	CCV	TestCode:	FLPRO_S	Units:	mg/Kg	Prep Date:		Run ID:	GC-O_030717A			
Client ID:	ZZZZZ	Batch ID:	R25715	TestNo:	FLPRO_S			Analysis Date:	7/17/2003	SeqNo:	201343			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel		339		15.0	335.3	0		101	85	115	0		0	

Qualifiers: ND - Not Detected at the Reporting Limit S - Spike Recovery outside accepted recovery limits B - Analyte detected in the associated Method Blank
 J - Analyte detected below quantitation limits R - RPD outside accepted recovery limits

KEY TO FLAGS

- A. This sample contains a Gasoline Range Organic not identified as a specific hydrocarbon product. The result was quantified against gasoline calibration standards.
- A1. This sample contains a Diesel Range Organic not identified as a specific hydrocarbon product. The result was quantified against diesel calibration standards.
- A2. This sample contains a Lube Oil Range Organic not identified as a specific hydrocarbon product. The result was quantified against lube oil calibration standards.
- A3. Results determined to be non detect based on hydrocarbon pattern recognition. The product was carry-over from another hydrocarbon type.
- B. The blank exhibited a positive result greater than the reporting limit for this compound.
- C. The result confirmed by secondary column or GC/MS analysis.
- CN. See case narrative.
- CR. Result for this analyte maybe biased due to interferences. Confirmation by GC/MS or other technique is recommended.
- D. Surrogate was diluted outside reporting range.
- E. Result exceeds the calibration range for the compound. The result should be considered an estimate.
- F. The positive result for this hydrocarbon is due to single component contamination. The product does not match any hydrocarbon in the fuels library.
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- M. Oil result is biased high due to amount of diesel contained in the sample.
- MC. Sample concentration is greater than 4x the spiked value; the spiked value is considered insignificant.
- MI. Outside control limits due to Matrix Interference.
- MSA. Value determined by Method of Standard Addition.
- N. Sample appears to contain biogenic material biasing quantification.
- O. Laboratory Control Standard (LCS) exceeded laboratory control limits, meets CCV criteria. Data meets EPA requirements.
- P. Detected levels of Methylene Chloride may be due to laboratory contamination, due to previous analysis or background levels.
- Q. Detection limits elevated due to sample matrix.
- R. RPD control limits were exceeded.
- RF. Duplicate failed, due to result being at or near method reporting limit.
- RP. Matrix spike values exceed established QC limits, post digestion spike is in control.
- S. Recovery outside control limits.
- *. The result for this parameter was greater than the maximum contaminant level or the TCLP regulatory limit.

0307037

Specialty

ENZYME TECHNOLOGIES, INC.
 5228 NE 158th Ave.
 Portland, OR 97230
 Phone: 503-254-4331
 Fax: 503-254-1722

Chain of Custody Record Laboratory Analysis

Special Instructions

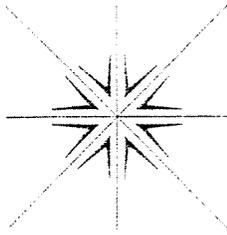
Turnaround		Project Information			
N - Normal:	✓	Project Name:	TTNUS		ETEC Contact:
R - Rush:		Project #:		Phone Number:	Randy Mueller
O - Other:		P.O.#:		Comments:	503-546-3617
		Sampler's Name:			
		Signature:			

Remarks:				Analyses								Remarks
				Matrix (S or W)	# of Containers	HC-Degrading Plate Count	Heterotrophic Plate Count	Iron-Degrading Plate Count	Complete Nutrient Suite	Limited Nutrient Suite	PH	
Sample Identification	Date	Time	Matrix (S or W)	# of Containers	HC-Degrading Plate Count	Heterotrophic Plate Count	Iron-Degrading Plate Count	Complete Nutrient Suite	Limited Nutrient Suite	PH	FL-PRO/ NUTPH-dx	Remarks
1	TTNUS - Day 28 - T	7/8/03	S	1							X	
2												
3												
4												
5												
6												
7												
8												

Relinquished	
Signature <i>Randy Mueller</i>	Date <i>7/8/03</i>
Print Name <i>Randy Mueller</i>	Time <i>9:30 AM</i>
Company <i>ETEC</i>	
Received	
Signature <i>Cindy Hillgard</i>	Date <i>7/9/03</i>
Print Name <i>Cindy Hillgard</i>	Time <i>8:50</i>
Company <i>Specialty Analytical</i>	

Relinquished	
Signature	Date
Print Name	Time
Company	
Received	
Signature	Date
Print Name	Time
Company	

Relinquished	
Signature	Date
Print Name	Time
Company	
Received	
Signature	Date
Print Name	Time
Company	



Specialty Analytical

19761 S.W. 95th Place
Tualatin, OR 97062
(503) 612-9007
Fax (503) 612-8572
1 (877) 612-9007

July 29, 2003

Randy Mueller
Enzyme Technologies
5228 NE 158th Avenue
Portland, OR 97230

TEL: (503) 254-4331

FAX (503) 254-1722

RE: TTNUS Treatability

Dear Randy Mueller:

Order No.: 0307085

Specialty Analytical received 2 samples on 7/16/2003 for the analyses presented in the following report.

There were no problems with the analysis and all data for associated QC met EPA or laboratory specifications except where noted in the Case Narrative, or as qualified with flags. Results apply only to the samples analyzed. Without approval of the laboratory, the reproduction of this report is only permitted in its entirety.

If you have any questions regarding these tests, please feel free to call.

Sincerely,

for *Andi Helligard*
Dan Marrin
Project Manager

[Signature]
Technical Review

Specialty Analytical

Date: 29-Jul-03

CLIENT: Enzyme Technologies
 Lab Order: 0307085
 Project: TTNUS Treatability
 Lab ID: 0307085-01

Client Sample ID: TTNUS-Day35-T
 Collection Date: 7/15/2003 10:00:00 AM

Matrix: SOIL

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PETROLEUM HYDROCARBONS-FLPRO						
		FLPRO_S				Analyst: btf
Diesel	10100	150		mg/Kg	10	7/17/2003
Surr: o-terphenyl	634	50-150	S,D	%REC	10	7/17/2003
TOTAL PETROLEUM HYDROCARBONS-CWG						
		CWG_S				Analyst: btf
Diesel	7100	150		mg/Kg	10	7/17/2003
Surr: o-terphenyl	634	50-150	S,D	%REC	10	7/17/2003
TOTAL METALS BY ICP						
		E6010				Analyst: tif
Arsenic	ND	1.85		mg/Kg	1	7/18/2003 5:03:00 AM
Barium	6.36	0.926		mg/Kg	1	7/20/2003 9:35:30 PM
Cadmium	ND	0.0926		mg/Kg	1	7/20/2003 9:35:30 PM
Chromium	5.82	0.463		mg/Kg	1	7/20/2003 9:35:30 PM
Lead	ND	1.85		mg/Kg	1	7/18/2003 5:03:00 AM
Selenium	ND	1.85		mg/Kg	1	7/18/2003 5:03:00 AM
Silver	ND	1.85		mg/Kg	1	7/18/2003 5:03:00 AM
MERCURY, TOTAL						
		SW7471				Analyst: das
Mercury	ND	0.0167		mg/Kg	1	7/17/2003
PAH'S BY GC/MS-OARSIM						
		8270SIM				Analyst: bda
Acenaphthene	ND	6.67		µg/Kg	1	7/23/2003 7:00:00 PM
Acenaphthylene	50.7	6.67		µg/Kg	1	7/23/2003 7:00:00 PM
Anthracene	ND	6.67		µg/Kg	1	7/23/2003 7:00:00 PM
Benz(a)anthracene	ND	6.67		µg/Kg	1	7/23/2003 7:00:00 PM
Benzo(a)pyrene	7.33	6.67		µg/Kg	1	7/23/2003 7:00:00 PM
Benzo(b)fluoranthene	ND	6.67		µg/Kg	1	7/23/2003 7:00:00 PM
Benzo(g,h,i)perylene	ND	6.67		µg/Kg	1	7/23/2003 7:00:00 PM
Benzo(k)fluoranthene	ND	6.67		µg/Kg	1	7/23/2003 7:00:00 PM
Chrysene	ND	6.67		µg/Kg	1	7/23/2003 7:00:00 PM
Dibenz(a,h)anthracene	ND	6.67		µg/Kg	1	7/23/2003 7:00:00 PM
Fluoranthene	ND	6.67		µg/Kg	1	7/23/2003 7:00:00 PM
Fluorene	40.0	6.67		µg/Kg	1	7/23/2003 7:00:00 PM
Indeno(1,2,3-cd)pyrene	ND	6.67		µg/Kg	1	7/23/2003 7:00:00 PM
Naphthalene	ND	6.67		µg/Kg	1	7/23/2003 7:00:00 PM
Phenanthrene	ND	6.67		µg/Kg	1	7/23/2003 7:00:00 PM
Pyrene	ND	6.67		µg/Kg	1	7/23/2003 7:00:00 PM
Surr: 2-Fluorobiphenyl	104	42.6-128		%REC	1	7/23/2003 7:00:00 PM
Surr: Nitrobenzene-d5	108	21.7-155		%REC	1	7/23/2003 7:00:00 PM
Surr: p-Terphenyl-d14	70.8	44.9-155		%REC	1	7/23/2003 7:00:00 PM
VOLATILES BY GC/MS						
		SW8260B				Analyst: skc
1,1,1,2-Tetrachloroethane	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
1,1,1-Trichloroethane	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM

Specialty Analytical

Date: 29-Jul-03

CLIENT: Enzyme Technologies
 Lab Order: 0307085
 Project: TTNUS Treatability
 Lab ID: 0307085-01

Client Sample ID: TTNUS-Day35-T
 Collection Date: 7/15/2003 10:00:00 AM

Matrix: SOIL

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
VOLATILES BY GC/MS		SW8260B		Analyst: skc		
1,1,2,2-Tetrachloroethane	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
1,1,2-Trichloroethane	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
1,1-Dichloroethane	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
1,1-Dichloroethene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
1,1-Dichloropropene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
1,2,3-Trichlorobenzene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
1,2,3-Trichloropropane	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
1,2,4-Trichlorobenzene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
1,2,4-Trimethylbenzene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
1,2-Dibromo-3-chloropropane	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
1,2-Dibromoethane	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
1,2-Dichlorobenzene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
1,2-Dichloroethane	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
1,2-Dichloropropane	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
1,3,5-Trimethylbenzene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
1,3-Dichlorobenzene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
1,3-Dichloropropane	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
1,4-Dichlorobenzene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
2,2-Dichloropropane	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
2-Butanone	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
2-Chlorotoluene	ND	40.0		µg/Kg	1	7/17/2003 4:10:00 PM
2-Hexanone	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
4-Chlorotoluene	ND	20.0		µg/Kg	1	7/17/2003 4:10:00 PM
4-Isopropyltoluene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
4-Methyl-2-pentanone	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Acetone	ND	40.0		µg/Kg	1	7/17/2003 4:10:00 PM
Benzene	ND	100		µg/Kg	1	7/17/2003 4:10:00 PM
Bromobenzene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Bromochloromethane	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Bromodichloromethane	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Bromoform	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Bromomethane	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Carbon disulfide	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Carbon tetrachloride	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Chlorobenzene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Chloroethane	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Chloroform	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Chloromethane	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
cis-1,2-Dichloroethene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
cis-1,3-Dichloropropene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Dibromochloromethane	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM

Specialty Analytical

Date: 29-Jul-03

CLIENT: Enzyme Technologies
 Lab Order: 0307085
 Project: TTNUS Treatability
 Lab ID: 0307085-01

Client Sample ID: TTNUS-Day35-T
 Collection Date: 7/15/2003 10:00:00 AM
 Matrix: SOIL

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
VOLATILES BY GC/MS		SW8260B		Analyst: skc		
Dibromomethane	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Dichlorodifluoromethane	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Ethylbenzene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Hexachlorobutadiene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Isopropylbenzene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
m,p-Xylene	ND	20.0		µg/Kg	1	7/17/2003 4:10:00 PM
Methyl tert-butyl ether	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Methylene chloride	ND	50.0		µg/Kg	1	7/17/2003 4:10:00 PM
n-Butylbenzene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
n-Propylbenzene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Naphthalene	27.9	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
o-Xylene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
sec-Butylbenzene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Styrene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
tert-Butylbenzene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Tetrachloroethene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Toluene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
trans-1,2-Dichloroethene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
trans-1,3-Dichloropropene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Trichloroethene	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Trichlorofluoromethane	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Vinyl chloride	ND	10.0		µg/Kg	1	7/17/2003 4:10:00 PM
Surr: 1,2-Dichloroethane-d4	92.2	71.5-112		%REC	1	7/17/2003 4:10:00 PM
Surr: 4-Bromofluorobenzene	96.4	75.7-122		%REC	1	7/17/2003 4:10:00 PM
Surr: Dibromofluoromethane	92.7	64.3-124		%REC	1	7/17/2003 4:10:00 PM
Surr: Toluene-d8	110	74.9-120		%REC	1	7/17/2003 4:10:00 PM

Specialty Analytical

Date: 29-Jul-03

CLIENT: Enzyme Technologies
 Lab Order: 0307085
 Project: TTNUS Treatability
 Lab ID: 0307085-02

Client Sample ID: TTNUS-Day35-C
 Collection Date: 7/15/2003 10:30:00 AM
 Matrix: SOIL

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PETROLEUM HYDROCARBONS-FLPRO Analyst: btf						
Diesel	2640	150		mg/Kg	10	7/17/2003
Surr: o-terphenyl	420	50-150	S,D	%REC	10	7/17/2003
TOTAL PETROLEUM HYDROCARBONS-CWG Analyst: btf						
Diesel	2000	150		mg/Kg	10	7/17/2003
Surr: o-terphenyl	420	50-150	S,D	%REC	10	7/17/2003
TOTAL METALS BY ICP Analyst: tif						
Arsenic	ND	2.00		mg/Kg	1	7/18/2003 5:08:31 AM
Barium	5.21	1.00		mg/Kg	1	7/20/2003 9:41:01 PM
Cadmium	ND	0.100		mg/Kg	1	7/20/2003 9:41:01 PM
Chromium	5.60	0.500		mg/Kg	1	7/20/2003 9:41:01 PM
Lead	ND	2.00		mg/Kg	1	7/18/2003 5:08:31 AM
Selenium	ND	2.00		mg/Kg	1	7/18/2003 5:08:31 AM
Silver	ND	2.00		mg/Kg	1	7/18/2003 5:08:31 AM
MERCURY, TOTAL Analyst: das						
Mercury	ND	0.0157		mg/Kg	1	7/17/2003
PAH'S BY GC/MS-OARSIM Analyst: bda						
Acenaphthene	707	66.7		µg/Kg	10	7/23/2003 7:30:00 PM
Acenaphthylene	100	66.7		µg/Kg	10	7/23/2003 7:30:00 PM
Anthracene	273	66.7		µg/Kg	10	7/23/2003 7:30:00 PM
Benz(a)anthracene	64.7	6.67		µg/Kg	1	7/23/2003 8:00:00 PM
Benzo(a)pyrene	7.33	6.67		µg/Kg	1	7/23/2003 8:00:00 PM
Benzo(b)fluoranthene	16.7	6.67		µg/Kg	1	7/23/2003 8:00:00 PM
Benzo(g,h,i)perylene	ND	6.67		µg/Kg	1	7/23/2003 8:00:00 PM
Benzo(k)fluoranthene	ND	6.67		µg/Kg	1	7/23/2003 8:00:00 PM
Chrysene	44.7	6.67		µg/Kg	1	7/23/2003 8:00:00 PM
Dibenz(a,h)anthracene	ND	6.67		µg/Kg	1	7/23/2003 8:00:00 PM
Fluoranthene	200	66.7		µg/Kg	10	7/23/2003 7:30:00 PM
Fluorene	493	66.7		µg/Kg	10	7/23/2003 7:30:00 PM
Indeno(1,2,3-cd)pyrene	ND	6.67		µg/Kg	1	7/23/2003 8:00:00 PM
Naphthalene	ND	66.7	Q	µg/Kg	10	7/23/2003 7:30:00 PM
Phenanthrene	760	66.7		µg/Kg	10	7/23/2003 7:30:00 PM
Pyrene	350	6.67		µg/Kg	1	7/23/2003 8:00:00 PM
Surr: 2-Fluorobiphenyl	0	42.6-128	S,MI	%REC	1	7/23/2003 8:00:00 PM
Surr: Nitrobenzene-d5	151	21.7-155	E,MI	%REC	1	7/23/2003 8:00:00 PM
Surr: p-Terphenyl-d14	43.6	44.9-155	S,MI	%REC	1	7/23/2003 8:00:00 PM
VOLATILES BY GC/MS Analyst: skc						
1,1,1,2-Tetrachloroethane	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
1,1,1-Trichloroethane	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM

Specialty Analytical

Date: 29-Jul-03

CLIENT: Enzyme Technologies
 Lab Order: 0307085
 Project: TTNUS Treatability
 Lab ID: 0307085-02

Client Sample ID: TTNUS-Day35-C
 Collection Date: 7/15/2003 10:30:00 AM
 Matrix: SOIL

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
VOLATILES BY GC/MS		SW8260B		Analyst: skc		
1,1,2,2-Tetrachloroethane	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
1,1,2-Trichloroethane	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
1,1-Dichloroethane	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
1,1-Dichloroethene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
1,1-Dichloropropene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
1,2,3-Trichlorobenzene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
1,2,3-Trichloropropane	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
1,2,4-Trichlorobenzene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
1,2,4-Trimethylbenzene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
1,2-Dibromo-3-chloropropane	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
1,2-Dibromoethane	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
1,2-Dichlorobenzene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
1,2-Dichloroethane	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
1,2-Dichloropropane	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
1,3,5-Trimethylbenzene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
1,3-Dichlorobenzene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
1,3-Dichloropropane	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
1,4-Dichlorobenzene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
2,2-Dichloropropane	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
2-Butanone	ND	40.0		µg/Kg	1	7/17/2003 4:48:00 PM
2-Chlorotoluene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
2-Hexanone	ND	20.0		µg/Kg	1	7/17/2003 4:48:00 PM
4-Chlorotoluene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
4-Isopropyltoluene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
4-Methyl-2-pentanone	ND	40.0		µg/Kg	1	7/17/2003 4:48:00 PM
Acetone	ND	100		µg/Kg	1	7/17/2003 4:48:00 PM
Benzene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Bromobenzene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Bromochloromethane	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Bromodichloromethane	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Bromoform	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Bromomethane	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Carbon disulfide	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Carbon tetrachloride	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Chlorobenzene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Chloroethane	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Chloroform	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Chloromethane	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
cis-1,2-Dichloroethene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
cis-1,3-Dichloropropene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Dibromochloromethane	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM

Specialty Analytical

Date: 29-Jul-03

CLIENT: Enzyme Technologies
 Lab Order: 0307085
 Project: TTNUS Treatability
 Lab ID: 0307085-02

Client Sample ID: TTNUS-Day35-C
 Collection Date: 7/15/2003 10:30:00 AM
 Matrix: SOIL

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
VOLATILES BY GC/MS		SW8260B				Analyst: skc
Dibromomethane	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Dichlorodifluoromethane	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Ethylbenzene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Hexachlorobutadiene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Isopropylbenzene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
m,p-Xylene	ND	20.0		µg/Kg	1	7/17/2003 4:48:00 PM
Methyl tert-butyl ether	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Methylene chloride	ND	50.0		µg/Kg	1	7/17/2003 4:48:00 PM
n-Butylbenzene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
n-Propylbenzene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Naphthalene	51.1	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
o-Xylene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
sec-Butylbenzene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Styrene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
tert-Butylbenzene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Tetrachloroethene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Toluene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
trans-1,2-Dichloroethene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
trans-1,3-Dichloropropene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Trichloroethene	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Trichlorofluoromethane	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Vinyl chloride	ND	10.0		µg/Kg	1	7/17/2003 4:48:00 PM
Surr: 1,2-Dichloroethane-d4	99.2	71.5-112		%REC	1	7/17/2003 4:48:00 PM
Surr: 4-Bromofluorobenzene	95.9	75.7-122		%REC	1	7/17/2003 4:48:00 PM
Surr: Dibromofluoromethane	97.9	64.3-124		%REC	1	7/17/2003 4:48:00 PM
Surr: Toluene-d8	104	74.9-120		%REC	1	7/17/2003 4:48:00 PM

CLIENT: Enzyme Technologies
 Work Order: 0307085
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: 6010_S

Sample ID	MBLK-9082	SampType:	MBLK	TestCode:	6010_S	Units:	mg/Kg	Prep Date:	7/16/2003	Run ID:	TJA IRIS_030717E			
Client ID:	ZZZZZ	Batch ID:	9082	TestNo:	E6010			Analysis Date:	7/18/2003	SeqNo:	199649			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Arsenic		1.07		2.00										J
Copper		1.45		1.00										
Lead		1.23		2.00										J
Selenium		ND		2.00										
Silver		ND		2.00										
Sodium		7.37		10.0										J

Sample ID	MBLK-9082	SampType:	MBLK	TestCode:	6010_S	Units:	mg/Kg	Prep Date:	7/16/2003	Run ID:	TJA IRIS_030720D			
Client ID:	ZZZZZ	Batch ID:	9082	TestNo:	E6010			Analysis Date:	7/20/2003	SeqNo:	199980			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Barium		ND		1.00										
Cadmium		ND		0.100										
Chromium		ND		0.500										
Copper		2.13		1.00										
Lead		ND		2.00										

Sample ID	LCS-9082	SampType:	LCS	TestCode:	6010_S	Units:	mg/Kg	Prep Date:	7/16/2003	Run ID:	TJA IRIS_030717E			
Client ID:	ZZZZZ	Batch ID:	9082	TestNo:	E6010			Analysis Date:	7/18/2003	SeqNo:	199650			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Arsenic		96.09		2.00	100	1.07		95	87.6	110	0	0		
Lead		102.9		2.00	100	1.23		102	92.9	109	0	0		
Selenium		100.4		2.00	100	0		100	90.2	112	0	0		
Silver		50.88		2.00	50	0		102	85.1	108	0	0		

Qualifiers: ND - Not Detected at the Reporting Limit S - Spike Recovery outside accepted recovery limits B - Analyte detected in the associated Method Blank
 J - Analyte detected below quantitation limits R - RPD outside accepted recovery limits

CLIENT: Enzyme Technologies
 Work Order: 0307085
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: 6010_S

Sample ID LCS-9082		SampType: LCS		TestCode: 6010_S		Units: mg/Kg		Prep Date: 7/16/2003		Run ID: TJA IRIS_030720D	
Client ID: ZZZZZ		Batch ID: 9082		TestNo: E6010				Analysis Date: 7/20/2003		SeqNo: 199981	
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Barium	53.81	1.00	50	0	108	92.7	109	0	0		
Cadmium	5.4	0.100	5	0	108	90.8	109	0	0		
Chromium	27.63	0.500	25	0	111	91.7	114	0	0		
Copper	56.58	1.00	50	2.13	109	91.3	111	0	0		B
Lead	107.4	2.00	100	0	107	92.9	109	0	0		

Sample ID 0307078-01BMS		SampType: MS		TestCode: 6010_S		Units: mg/Kg		Prep Date: 7/16/2003		Run ID: TJA IRIS_030717E	
Client ID: ZZZZZ		Batch ID: 9082		TestNo: E6010				Analysis Date: 7/18/2003		SeqNo: 199653	
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Arsenic	85.63	1.85	92.59	0	92.5	86.1	109	0	0		
Lead	88.42	1.85	92.59	0.8462	94.6	92.1	104	0	0		
Selenium	96.48	1.85	92.59	0.8462	103	77.7	116	0	0		
Silver	19.06	1.85	46.3	0	41.2	75	123	0	0		S

Sample ID 0307078-01BMS		SampType: MS		TestCode: 6010_S		Units: mg/Kg		Prep Date: 7/16/2003		Run ID: TJA IRIS_030720D	
Client ID: ZZZZZ		Batch ID: 9082		TestNo: E6010				Analysis Date: 7/20/2003		SeqNo: 199984	
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Barium	49.13	0.926	46.3	0.8365	104	75	125	0	0		
Cadmium	5.13	0.0926	4.63	0.1442	108	86.4	113	0	0		
Chromium	25.02	0.463	23.15	0.9135	104	75	121	0	0		
Copper	67.22	0.926	46.3	1.452	142	75.1	126	0	0		BS
Lead	96.85	1.85	92.59	0	105	92.1	104	0	0		S

Sample ID 0307078-01BMSD		SampType: MSD		TestCode: 6010_S		Units: mg/Kg		Prep Date: 7/16/2003		Run ID: TJA IRIS_030717E	
Client ID: ZZZZZ		Batch ID: 9082		TestNo: E6010				Analysis Date: 7/18/2003		SeqNo: 199654	
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Arsenic	91.22	2.00	100	0	91.2	86.1	109	85.63	6.32	20	
Lead	91.96	2.00	100	0.8462	91.1	92.1	104	88.42	3.93	20	S

Qualifiers: ND - Not Detected at the Reporting Limit S - Spike Recovery outside accepted recovery limits B - Analyte detected in the associated Method Blank
 J - Analyte detected below quantitation limits R - RPD outside accepted recovery limits

CLIENT: Enzyme Technologies
 Work Order: 0307085
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: 6010_S

Sample ID	0307078-01BMSD	SampType: MSD	TestCode: 6010_S	Units: mg/Kg	Prep Date: 7/16/2003	Run ID: TJA IRIS_030717E					
Client ID:	ZZZZZ	Batch ID: 9082	TestNo: E6010		Analysis Date: 7/18/2003	SeqNo: 199654					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Selenium	102.5	2.00	100	0.8462	102	77.7	116	96.48	6.05	20	
Silver	14.11	2.00	50	0	28.2	75	123	19.06	29.8	20	S,R

Sample ID	0307078-01BMSD	SampType: MSD	TestCode: 6010_S	Units: mg/Kg	Prep Date: 7/16/2003	Run ID: TJA IRIS_030720D					
Client ID:	ZZZZZ	Batch ID: 9082	TestNo: E6010		Analysis Date: 7/20/2003	SeqNo: 199985					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Barium	50.39	1.00	50	0.8365	99.1	75	125	49.13	2.53	20	
Cadmium	5.3	0.100	5	0.1442	103	86.4	113	5.13	3.27	20	
Chromium	26.02	0.500	25	0.9135	100	75	121	25.02	3.92	20	
Copper	59.42	1.00	50	1.452	116	75.1	126	67.22	12.3	20	B
Lead	100	2.00	100	0	100	92.1	104	96.85	3.20	20	

Sample ID	0307078-01BDUP	SampType: DUP	TestCode: 6010_S	Units: mg/Kg	Prep Date: 7/16/2003	Run ID: TJA IRIS_030717E					
Client ID:	ZZZZZ	Batch ID: 9082	TestNo: E6010		Analysis Date: 7/18/2003	SeqNo: 199652					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Arsenic	ND	1.92	0	0	0	0	0	0	0	20	
Lead	2.288	1.92	0	0	0	0	0	0.8462	92.0	20	R
Selenium	0.9712	1.92	0	0	0	0	0	0.8462	0	20	J
Silver	ND	1.92	0	0	0	0	0	0	0	20	

Sample ID	0307078-01BDUP	SampType: DUP	TestCode: 6010_S	Units: mg/Kg	Prep Date: 7/16/2003	Run ID: TJA IRIS_030720D					
Client ID:	ZZZZZ	Batch ID: 9082	TestNo: E6010		Analysis Date: 7/20/2003	SeqNo: 199983					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Barium	0.2788	0.962	0	0	0	0	0	0.8365	0	20	J
Cadmium	ND	0.0962	0	0	0	0	0	0.1442	0	20	
Chromium	0.7404	0.481	0	0	0	0	0	0.9135	20.9	20	RF
Copper	1.231	0.962	0	0	0	0	0	1.452	16.5	20	B
Lead	ND	1.92	0	0	0	0	0	0	0	20	

Qualifiers: ND - Not Detected at the Reporting Limit
 J - Analyte detected below quantitation limits

S - Spike Recovery outside accepted recovery limits
 R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

CLIENT: Enzyme Technologies
 Work Order: 0307085
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: 6010_S

Sample ID	CCV	SampType: CCV	TestCode: 6010_S	Units: mg/Kg	Prep Date: 7/16/2003	Run ID: TJA IRIS_030717E					
Client ID:	ZZZZZ	Batch ID: 9082	TestNo: E6010		Analysis Date: 7/18/2003	SeqNo: 199648					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Arsenic	95.46	2.00	100	0	95.5	90	110	0	0		
Lead	102.5	2.00	100	0	103	90	110	0	0		
Selenium	96.96	2.00	100	0	97	90	110	0	0		
Silver	50.51	2.00	50	0	101	90	110	0	0		

Sample ID	CCV	SampType: CCV	TestCode: 6010_S	Units: mg/Kg	Prep Date: 7/16/2003	Run ID: TJA IRIS_030717E					
Client ID:	ZZZZZ	Batch ID: 9082	TestNo: E6010		Analysis Date: 7/18/2003	SeqNo: 199658					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Arsenic	96.36	2.00	100	0	96.4	90	110	0	0		
Lead	102	2.00	100	0	102	90	110	0	0		
Selenium	98.42	2.00	100	0	98.4	90	110	0	0		
Silver	51.64	2.00	50	0	103	90	110	0	0		

Sample ID	CCV	SampType: CCV	TestCode: 6010_S	Units: mg/Kg	Prep Date: 7/16/2003	Run ID: TJA IRIS_030717E					
Client ID:	ZZZZZ	Batch ID: 9082	TestNo: E6010		Analysis Date: 7/18/2003	SeqNo: 199663					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Arsenic	97.33	2.00	100	0	97.3	90	110	0	0		
Lead	104.7	2.00	100	0	105	90	110	0	0		
Selenium	99.41	2.00	100	0	99.4	90	110	0	0		
Silver	51.53	2.00	50	0	103	90	110	0	0		

Sample ID	CCV	SampType: CCV	TestCode: 6010_S	Units: mg/Kg	Prep Date: 7/16/2003	Run ID: TJA IRIS_030720D					
Client ID:	ZZZZZ	Batch ID: 9082	TestNo: E6010		Analysis Date: 7/20/2003	SeqNo: 199979					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Barium	49.74	1.00	50	0	99.5	90	110	0	0		
Cadmium	4.9	0.100	5	0	98	90	110	0	0		
Chromium	24.63	0.500	25	0	98.5	90	110	0	0		
Copper	50.18	1.00	50	0	100	90	110	0	0		B

Qualifiers: ND - Not Detected at the Reporting Limit
 J - Analyte detected below quantitation limits

S - Spike Recovery outside accepted recovery limits
 R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

CLIENT: Enzyme Technologies
Work Order: 0307085
Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: 6010_S

Sample ID	CCV	SampType:	CCV	TestCode:	6010_S	Units:	mg/Kg	Prep Date:	7/16/2003	Run ID:	TJA IRIS_030720D			
Client ID:	ZZZZZ	Batch ID:	9082	TestNo:	E6010			Analysis Date:	7/20/2003	SeqNo:	199979			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Lead		97.91		2.00	100	0		97.9	90	110	0	0		
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Sample ID	CCV	SampType:	CCV	TestCode:	6010_S	Units:	mg/Kg	Prep Date:	7/16/2003	Run ID:	TJA IRIS_030720D			
Client ID:	ZZZZZ	Batch ID:	9082	TestNo:	E6010			Analysis Date:	7/20/2003	SeqNo:	199987			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Barium		48.7		1.00	50	0		97.4	90	110	0	0		
Cadmium		4.85		0.100	5	0		97	90	110	0	0		
Chromium		24.04		0.500	25	0		96.2	90	110	0	0		
Copper		50.59		1.00	50	0		101	90	110	0	0		B
Lead		97.64		2.00	100	0		97.6	90	110	0	0		

Sample ID	CCV	SampType:	CCV	TestCode:	6010_S	Units:	mg/Kg	Prep Date:	7/16/2003	Run ID:	TJA IRIS_030720D			
Client ID:	ZZZZZ	Batch ID:	9082	TestNo:	E6010			Analysis Date:	7/20/2003	SeqNo:	199995			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Barium		48.97		1.00	50	0		97.9	90	110	0	0		
Cadmium		4.88		0.100	5	0		97.6	90	110	0	0		
Chromium		24.3		0.500	25	0		97.2	90	110	0	0		
Copper		49.7		1.00	50	0		99.4	90	110	0	0		B
Lead		96.1		2.00	100	0		96.1	90	110	0	0		

Sample ID	ICV	SampType:	ICV	TestCode:	6010_S	Units:	mg/Kg	Prep Date:	7/16/2003	Run ID:	TJA IRIS_030717E			
Client ID:	ZZZZZ	Batch ID:	9082	TestNo:	E6010			Analysis Date:	7/17/2003	SeqNo:	199647			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Arsenic		95.27		2.00	100	0		95.3	90	110	0	0		
Lead		91.95		2.00	100	0		92	90	110	0	0		
Selenium		99.13		2.00	100	0		99.1	90	110	0	0		
Silver		48.6		2.00	50	0		97.2	90	110	0	0		

Qualifiers: ND - Not Detected at the Reporting Limit
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 R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

CLIENT: Enzyme Technologies
Work Order: 0307085
Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: 6010_S

Sample ID	ICV	SampType: ICV	TestCode: 6010_S	Units: mg/Kg	Prep Date: 7/16/2003	Run ID: TJA IRIS_030720D					
Client ID: ZZZZZ	Batch ID: 9082	TestNo: E6010	Analysis Date: 7/20/2003	SeqNo: 199978							
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Barium	48.39	1.00	50	0	96.8	90	110	0	0		
Cadmium	4.82	0.100	5	0	96.4	90	110	0	0		
Chromium	23.42	0.500	25	0	93.7	90	110	0	0		
Copper	49.38	1.00	50	0	98.8	90	110	0	0		B
Lead	94.81	2.00	100	0	94.8	90	110	0	0		

Qualifiers: ND - Not Detected at the Reporting Limit
 J - Analyte detected below quantitation limits

S - Spike Recovery outside accepted recovery limits
 R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

CLIENT: Enzyme Technologies
 Work Order: 0307085
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260_S

Sample ID	MB	SampType: MBLK	TestCode: 8260_S	Units: µg/Kg	Prep Date: 7/16/2003	Run ID: 5973J_030716C
Client ID:	ZZZZZ	Batch ID: 9090	TestNo: SW8260B		Analysis Date: 7/16/2003	SeqNo: 199715

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1,1,2-Tetrachloroethane	ND	10.0									
1,1,1-Trichloroethane	ND	10.0									
1,1,2,2-Tetrachloroethane	ND	10.0									
1,1,2-Trichloroethane	ND	10.0									
1,1-Dichloroethane	ND	10.0									
1,1-Dichloroethene	ND	10.0									
1,1-Dichloropropene	ND	10.0									
1,2,3-Trichlorobenzene	ND	10.0									
1,2,3-Trichloropropane	ND	10.0									
1,2,4-Trichlorobenzene	ND	10.0									
1,2,4-Trimethylbenzene	ND	10.0									
1,2-Dibromo-3-chloropropane	ND	10.0									
1,2-Dibromoethane	ND	10.0									
1,2-Dichlorobenzene	ND	10.0									
1,2-Dichloroethane	ND	10.0									
1,2-Dichloropropane	ND	10.0									
1,3,5-Trimethylbenzene	ND	10.0									
1,3-Dichlorobenzene	ND	10.0									
1,3-Dichloropropane	ND	10.0									
1,4-Dichlorobenzene	ND	10.0									
2,2-Dichloropropane	ND	10.0									
2-Butanone	ND	40.0									
2-Chlorotoluene	ND	10.0									
2-Hexanone	ND	20.0									
4-Chlorotoluene	ND	10.0									
4-Isopropyltoluene	ND	10.0									
4-Methyl-2-pentanone	ND	40.0									
Acetone	ND	100									
Benzene	ND	10.0									
Bromobenzene	ND	10.0									
Bromochloromethane	ND	10.0									

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CLIENT: Enzyme Technologies
Work Order: 0307085
Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260_S

Sample ID	MB	SampType: MBLK	TestCode: 8260_S	Units: µg/Kg	Prep Date: 7/16/2003	Run ID: 5973J_030716C
Client ID:	ZZZZZ	Batch ID: 9090	TestNo: SW8260B		Analysis Date: 7/16/2003	SeqNo: 199715

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Bromodichloromethane	ND	10.0									
Bromoform	ND	10.0									
Bromomethane	ND	10.0									
Carbon disulfide	ND	10.0									
Carbon tetrachloride	ND	10.0									
Chlorobenzene	ND	10.0									
Chloroethane	ND	10.0									
Chloroform	ND	10.0									
Chloromethane	ND	10.0									
cis-1,2-Dichloroethene	ND	10.0									
cis-1,3-Dichloropropene	ND	10.0									
Dibromochloromethane	ND	10.0									
Dibromomethane	ND	10.0									
Dichlorodifluoromethane	ND	10.0									
Ethylbenzene	ND	10.0									
Hexachlorobutadiene	ND	10.0									
Isopropylbenzene	ND	10.0									
m,p-Xylene	ND	20.0									
Methyl tert-butyl ether	ND	10.0									
Methylene chloride	ND	50.0									
n-Butylbenzene	ND	10.0									
n-Propylbenzene	ND	10.0									
Naphthalene	ND	10.0									
o-Xylene	ND	10.0									
sec-Butylbenzene	ND	10.0									
Styrene	ND	10.0									
tert-Butylbenzene	ND	10.0									
Tetrachloroethene	ND	10.0									
Toluene	ND	10.0									
trans-1,2-Dichloroethene	ND	10.0									
trans-1,3-Dichloropropene	ND	10.0									

Qualifiers: ND - Not Detected at the Reporting Limit
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CLIENT: Enzyme Technologies
 Work Order: 0307085
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260_S

Sample ID	SampType	TestCode	Units	Prep Date	Run ID						
MB	MBLK	8260_S	µg/Kg	7/16/2003	5973J_030716C						
Client ID: ZZZZZ	Batch ID: 9090	TestNo: SW8260B		Analysis Date: 7/16/2003	SeqNo: 199715						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Trichloroethene	ND	10.0									
Trichlorofluoromethane	ND	10.0									
Vinyl chloride	ND	10.0									
Surr: 1,2-Dichloroethane-d4	102.8	1.00	100	0	103	71.5	112	0	0		
Surr: 4-Bromofluorobenzene	97.95	1.00	100	0	98	75.7	122	0	0		
Surr: Dibromofluoromethane	99.24	1.00	100	0	99.2	64.3	124	0	0		
Surr: Toluene-d8	104.2	1.00	100	0	104	74.9	120	0	0		

Sample ID	SampType	TestCode	Units	Prep Date	Run ID						
LCS	LCS	8260_S	µg/Kg	7/16/2003	5973J_030716C						
Client ID: ZZZZZ	Batch ID: 9090	TestNo: SW8260B		Analysis Date: 7/16/2003	SeqNo: 199714						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	51.32	10.0	40	0	128	65.4	133	0	0		
Benzene	48.3	10.0	40	0	121	78	123	0	0		
Chlorobenzene	45.41	10.0	40	0	114	79.5	125	0	0		
Toluene	47.57	10.0	40	0	119	77.5	132	0	0		
Trichloroethene	44.18	10.0	40	0	110	72.4	124	0	0		

Sample ID	SampType	TestCode	Units	Prep Date	Run ID						
A0307071-06BMS	MS	8260_S	µg/Kg	7/16/2003	5973J_030716C						
Client ID: ZZZZZ	Batch ID: 9090	TestNo: SW8260B		Analysis Date: 7/17/2003	SeqNo: 199719						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	14.12	10.0	20	0	70.6	69.2	158	0	0		
Benzene	19.15	10.0	20	0	95.8	71.7	147	0	0		
Chlorobenzene	19.89	10.0	20	0	99.4	85.6	148	0	0		
Toluene	20.79	10.0	20	0	104	75.8	153	0	0		
Trichloroethene	16.57	10.0	20	0	82.8	77.1	138	0	0		

Qualifiers: ND - Not Detected at the Reporting Limit
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 R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

CLIENT: Enzyme Technologies
 Work Order: 0307085
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260_S

Sample ID	SampType	TestCode	Units	Prep Date	Run ID						
A0307071-06BMSD	MSD	8260_S	µg/Kg	7/16/2003	5973J_030716C						
Client ID: ZZZZ	Batch ID: 9090	TestNo: SW8260B		Analysis Date: 7/17/2003	SeqNo: 199720						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	20.9	10.0	20	0	104	69.2	158	14.12	38.7	20	R
Benzene	21.13	10.0	20	0	106	71.7	147	19.15	9.83	20	
Chlorobenzene	21.59	10.0	20	0	108	85.6	148	19.89	8.20	20	
Toluene	22.89	10.0	20	0	114	75.8	153	20.79	9.62	20	
Trichloroethene	19.97	10.0	20	0	99.8	77.1	138	16.57	18.6	20	

Sample ID	SampType	TestCode	Units	Prep Date	Run ID						
CCV	CCV	8260_S	µg/Kg	7/16/2003	5973J_030716C						
Client ID: ZZZZ	Batch ID: 9090	TestNo: SW8260B		Analysis Date: 7/16/2003	SeqNo: 199713						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	47.81	10.0	50	0	95.6	80	120	0	0		
1,2-Dichloropropane	47.59	10.0	50	0	95.2	80	120	0	0		
Chloroform	44.48	10.0	50	0	89	80	120	0	0		
Ethylbenzene	49.96	10.0	50	0	99.9	80	120	0	0		
Toluene	51.85	10.0	50	0	104	80	120	0	0		
Vinyl chloride	53.22	10.0	50	0	106	80	120	0	0		

Sample ID	SampType	TestCode	Units	Prep Date	Run ID						
CCV	CCV	8260_S	µg/Kg	7/16/2003	5973J_030716C						
Client ID: ZZZZ	Batch ID: 9090	TestNo: SW8260B		Analysis Date: 7/17/2003	SeqNo: 199717						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	77.54	10.0	80	0	96.9	80	120	0	0		
1,2-Dichloropropane	82.5	10.0	80	0	103	80	120	0	0		
Chloroform	73.36	10.0	80	0	91.7	80	120	0	0		
Ethylbenzene	81.43	10.0	80	0	102	80	120	0	0		
Toluene	84.83	10.0	80	0	106	80	120	0	0		
Vinyl chloride	90.19	10.0	80	0	113	80	120	0	0		

Qualifiers: ND - Not Detected at the Reporting Limit
 J - Analyte detected below quantitation limits

S - Spike Recovery outside accepted recovery limits
 R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

CLIENT: Enzyme Technologies
Work Order: 0307085
Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260_S

Sample ID	CCV	SampType:	CCV	TestCode:	8260_S	Units:	µg/Kg	Prep Date:	7/16/2003	Run ID:	5973J_030716C
Client ID:	ZZZZZ	Batch ID:	9090	TestNo:	SW8260B	Analysis Date:	7/18/2003	SeqNo:	199730		

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	40.01	10.0	50	0	80	80	120	0	0		
1,2-Dichloropropane	53.52	10.0	50	0	107	80	120	0	0		
Chloroform	46.21	10.0	50	0	92.4	80	120	0	0		
Ethylbenzene	56.61	10.0	50	0	113	80	120	0	0		
Toluene	58.22	10.0	50	0	116	80	120	0	0		
Vinyl chloride	42.92	10.0	50	0	85.8	80	120	0	0		

Qualifiers: ND - Not Detected at the Reporting Limit
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 R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

CLIENT: Enzyme Technologies
Work Order: 0307085
Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: FLPRO_S

Sample ID MBLK	SampType: MBLK	TestCode: FLPRO_S	Units: mg/Kg	Prep Date:	Run ID: GC-O_030717A						
Client ID: ZZZZZ	Batch ID: R25715	TestNo: FLPRO_S		Analysis Date: 7/17/2003	SeqNo: 201333						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Diesel	ND	15.0									
Surr: o-terphenyl	30.1	0	33.33	0	90.3	50	150	0	0		

Sample ID LCS	SampType: LCS	TestCode: FLPRO_S	Units: mg/Kg	Prep Date:	Run ID: GC-O_030717A						
Client ID: ZZZZZ	Batch ID: R25715	TestNo: FLPRO_S		Analysis Date: 7/17/2003	SeqNo: 201334						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Diesel	366.7	15.0	333.3	0	110	75	125	0	0		
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Sample ID 0307059-01BDUP	SampType: DUP	TestCode: FLPRO_S	Units: mg/Kg	Prep Date:	Run ID: GC-O_030717A						
Client ID: ZZZZZ	Batch ID: R25715	TestNo: FLPRO_S		Analysis Date: 7/17/2003	SeqNo: 201342						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Diesel	12620	150	0	0	0	0	0	18660	38.7	20	R
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Sample ID CCV	SampType: CCV	TestCode: FLPRO_S	Units: mg/Kg	Prep Date:	Run ID: GC-O_030717A						
Client ID: ZZZZZ	Batch ID: R25715	TestNo: FLPRO_S		Analysis Date: 7/17/2003	SeqNo: 201343						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Diesel	339	15.0	335.3	0	101	85	115	0	0		
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Qualifiers: ND - Not Detected at the Reporting Limit S - Spike Recovery outside accepted recovery limits B - Analyte detected in the associated Method Blank
 J - Analyte detected below quantitation limits R - RPD outside accepted recovery limits

CLIENT: Enzyme Technologies
Work Order: 0307085
Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: HG_CTS

Sample ID	SampType	TestCode	Units	Prep Date	Run ID	Client ID	Batch ID	TestNo	Analysis Date	SeqNo	Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual		
MB-9083	MBLK	HG_CTS	mg/Kg	7/16/2003	CVAA_030717B	ZZZZZ	9083	SW7471	7/17/2003	200035	Mercury	ND	0.0167											
LCS-9083	LCS	HG_CTS	mg/Kg	7/16/2003	CVAA_030717B	ZZZZZ	9083	SW7471	7/17/2003	200034	Mercury	0.2068	0.0167	0.208	0	99.4	88.2	113	0	0				
0307078-01BMS	MS	HG_CTS	mg/Kg	7/16/2003	CVAA_030717B	ZZZZZ	9083	SW7471	7/17/2003	200029	Mercury	0.1778	0.0157	0.195	0	91.2	78.1	125	0	0				
0307078-01BMSD	MSD	HG_CTS	mg/Kg	7/16/2003	CVAA_030717B	ZZZZZ	9083	SW7471	7/17/2003	200030	Mercury	0.1828	0.0167	0.208	0	87.9	78.1	125	0.1778	2.74	20			
0307078-01BDUP	DUP	HG_CTS	mg/Kg	7/16/2003	CVAA_030717B	ZZZZZ	9083	SW7471	7/17/2003	200028	Mercury	ND	0.0157	0	0	0	0	0	0	0	0	20		
CCV-9083	CCV	HG_CTS	mg/Kg	7/16/2003	CVAA_030717B	ZZZZZ	9083	SW7471	7/17/2003	200036	Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual		

Qualifiers: ND - Not Detected at the Reporting Limit S - Spike Recovery outside accepted recovery limits B - Analyte detected in the associated Method Blank
 J - Analyte detected below quantitation limits R - RPD outside accepted recovery limits

CLIENT: Enzyme Technologies
Work Order: 0307085
Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: HG_CTS

Sample ID	CCV-9083	SampType:	CCV	TestCode:	HG_CTS	Units:	mg/Kg	Prep Date:	7/16/2003	Run ID:	CVAA_030717B	
Client ID:	ZZZZZ	Batch ID:	9083	TestNo:	SW7471			Analysis Date:	7/17/2003	SeqNo:	200036	
Analyte		Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury		0.2102	0.0167	0.208	0	101	90	110	0	0		

Qualifiers: ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits

S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

CLIENT: Enzyme Technologies
 Work Order: 0307085
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: PAHLL_S

Sample ID MB-9085	SampType: MBLK	TestCode: PAHLL_S	Units: µg/Kg	Prep Date: 7/16/2003	Run ID: 5972N_030723B						
Client ID: ZZZZZ	Batch ID: 9085	TestNo: 8270SIM		Analysis Date: 7/23/2003	SeqNo: 200913						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Acenaphthene	ND	6.67									
Acenaphthylene	ND	6.67									
Anthracene	ND	6.67									
Benz(a)anthracene	ND	6.67									
Benzo(a)pyrene	ND	6.67									
Benzo(b)fluoranthene	ND	6.67									
Benzo(g,h,i)perylene	ND	6.67									
Benzo(k)fluoranthene	ND	6.67									
Chrysene	ND	6.67									
Dibenz(a,h)anthracene	ND	6.67									
Fluoranthene	ND	6.67									
Fluorene	ND	6.67									
Indeno(1,2,3-cd)pyrene	ND	6.67									
Naphthalene	ND	6.67									
Phenanthrene	ND	6.67									
Pyrene	ND	6.67									
Surr: 2-Fluorobiphenyl	4854	0	6667	0	72.8	42.6	128	0	0		
Surr: Nitrobenzene-d5	6746	0	6667	0	101	21.7	155	0	0		
Surr: p-Terphenyl-d14	4809	0	6667	0	72.1	44.9	155	0	0		

Sample ID LCS-9085	SampType: LCS	TestCode: PAHLL_S	Units: µg/Kg	Prep Date: 7/16/2003	Run ID: 5972N_030723B						
Client ID: ZZZZZ	Batch ID: 9085	TestNo: 8270SIM		Analysis Date: 7/23/2003	SeqNo: 200912						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Acenaphthene	86	6.67	166.7	0	51.6	40.4	107	0	0		
Benzo(g,h,i)perylene	216	6.67	166.7	0	130	44.6	125	0	0		S
Chrysene	108	6.67	166.7	0	64.8	59.9	121	0	0		
Naphthalene	83.33	6.67	166.7	0	50	33.5	96.1	0	0		
Phenanthrene	126	6.67	166.7	0	75.6	52.2	108	0	0		
Pyrene	121.3	6.67	166.7	0	72.8	53.8	120	0	0		

Qualifiers: ND - Not Detected at the Reporting Limit S - Spike Recovery outside accepted recovery limits B - Analyte detected in the associated Method Blank
 J - Analyte detected below quantitation limits R - RPD outside accepted recovery limits

CLIENT: Enzyme Technologies
 Work Order: 0307085
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: PAHLL_S

Sample ID: 0307085-01BMS	SampType: MS	TestCode: PAHLL_S	Units: µg/Kg	Prep Date: 7/16/2003	Run ID: 5972N_030723B
Client ID: TTNUS-Day35-T	Batch ID: 9085	TestNo: 8270SIM		Analysis Date: 7/23/2003	SeqNo: 200917

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Acenaphthene	128.7	6.67	166.7	5.333	74	33.7	107	0	0		
Benzo(g,h,i)perylene	112	6.67	166.7	6	63.6	15	128	0	0		
Chrysene	187.3	6.67	166.7	0	112	37.5	125	0	0		
Naphthalene	103.3	6.67	166.7	0	62	27.7	108	0	0		
Phenanthrene	114.7	6.67	166.7	4	66.4	20.2	139	0	0		
Pyrene	265.3	6.67	166.7	4	157	26.8	134	0	0		S

Sample ID: 0307085-01BMSD	SampType: MSD	TestCode: PAHLL_S	Units: µg/Kg	Prep Date: 7/16/2003	Run ID: 5972N_030723B
Client ID: TTNUS-Day35-T	Batch ID: 9085	TestNo: 8270SIM		Analysis Date: 7/23/2003	SeqNo: 200918

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Acenaphthene	111.3	6.67	166.7	5.333	63.6	33.7	107	128.7	14.4	20	
Benzo(g,h,i)perylene	113.3	6.67	166.7	6	64.4	15	128	112	1.18	20	
Chrysene	117.3	6.67	166.7	0	70.4	37.5	125	187.3	46.0	20	R
Naphthalene	114	6.67	166.7	0	68.4	27.7	108	103.3	9.82	20	
Phenanthrene	166	6.67	166.7	4	97.2	20.2	139	114.7	36.6	20	R
Pyrene	236	6.67	166.7	4	139	26.8	134	265.3	11.7	20	S

Sample ID: CCV-9085	SampType: CCV	TestCode: PAHLL_S	Units: µg/Kg	Prep Date:	Run ID: 5972N_030723B
Client ID: ZZZZZ	Batch ID: 9085	TestNo: 8270SIM		Analysis Date: 7/23/2003	SeqNo: 200911

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Acenaphthene	140	6.67	133.3	0	105	70	130	0	0		
Acenaphthylene	140	6.67	133.3	0	105	70	130	0	0		
Anthracene	116	6.67	133.3	0	87	70	130	0	0		
Benz(a)anthracene	140.7	6.67	133.3	0	106	70	130	0	0		
Benzo(a)pyrene	142	6.67	133.3	0	106	70	130	0	0		
Benzo(b)fluoranthene	150	6.67	133.3	0	112	70	130	0	0		
Benzo(g,h,i)perylene	140	6.67	133.3	0	105	70	130	0	0		
Benzo(k)fluoranthene	112	6.67	133.3	0	84	70	130	0	0		
Chrysene	128	6.67	133.3	0	96	70	130	0	0		

Qualifiers: ND - Not Detected at the Reporting Limit
 J - Analyte detected below quantitation limits

S - Spike Recovery outside accepted recovery limits
 R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

CLIENT: Enzyme Technologies
Work Order: 0307085
Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: PAHLL_S

Sample ID	CCV-9085	SampType:	CCV	TestCode:	PAHLL_S	Units:	µg/Kg	Prep Date:		Run ID:	5972N_030723B
Client ID:	ZZZZZ	Batch ID:	9085	TestNo:	8270SIM			Analysis Date:	7/23/2003	SeqNo:	200911
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Dibenz(a,h)anthracene	142	6.67	133.3	0	106	70	130	0	0		
Fluoranthene	124	6.67	133.3	0	93	70	130	0	0		
Fluorene	131.3	6.67	133.3	0	98.5	70	130	0	0		
Indeno(1,2,3-cd)pyrene	142.7	6.67	133.3	0	107	70	130	0	0		
Naphthalene	136.7	6.67	133.3	0	103	70	130	0	0		
Phenanthrene	144.7	6.67	133.3	0	108	70	130	0	0		
Pyrene	154.7	6.67	133.3	0	116	70	130	0	0		

Qualifiers: ND - Not Detected at the Reporting Limit
 J - Analyte detected below quantitation limits

S - Spike Recovery outside accepted recovery limits
 R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

CLIENT: Enzyme Technologies
 Work Order: 0307085
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: TPH_CWG

Sample ID MBLK	SampType: MBLK	TestCode: TPH_CWG	Units: mg/Kg	Prep Date:	Run ID: GC-O_030717B						
Client ID: ZZZZZ	Batch ID: R25752	TestNo: CWG_S		Analysis Date: 7/17/2003	SeqNo: 201352						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Diesel	ND	15									
Surr: o-terphenyl	30.1	0	33.33	0	90.3	50	150	0	0		

Sample ID LCS	SampType: LCS	TestCode: TPH_CWG	Units: mg/Kg	Prep Date:	Run ID: GC-O_030717B						
Client ID: ZZZZZ	Batch ID: R25752	TestNo: CWG_S		Analysis Date: 7/17/2003	SeqNo: 201353						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Diesel	157.9	15	166.6	0	94.7	75	125	0	0		
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Sample ID 0307059-01BDUP	SampType: DUP	TestCode: TPH_CWG	Units: mg/Kg	Prep Date:	Run ID: GC-O_030717B						
Client ID: ZZZZZ	Batch ID: R25752	TestNo: CWG_S		Analysis Date: 7/17/2003	SeqNo: 201358						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Diesel	8935	150	0	0	0	0	0	12670	34.5	20	R
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Sample ID CCV	SampType: CCV	TestCode: TPH_CWG	Units: mg/Kg	Prep Date:	Run ID: GC-O_030717B						
Client ID: ZZZZZ	Batch ID: R25752	TestNo: CWG_S		Analysis Date: 7/17/2003	SeqNo: 201354						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Diesel	339	15	335.3	0	101	85	115	0	0		
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Qualifiers: ND - Not Detected at the Reporting Limit S - Spike Recovery outside accepted recovery limits B - Analyte detected in the associated Method Blank
 J - Analyte detected below quantitation limits R - RPD outside accepted recovery limits

KEY TO FLAGS

- A. This sample contains a Gasoline Range Organic not identified as a specific hydrocarbon product. The result was quantified against gasoline calibration standards.
- A1. This sample contains a Diesel Range Organic not identified as a specific hydrocarbon product. The result was quantified against diesel calibration standards.
- A2. This sample contains a Lube Oil Range Organic not identified as a specific hydrocarbon product. The result was quantified against lube oil calibration standards.
- A3. Results determined to be non detect based on hydrocarbon pattern recognition. The product was carry-over from another hydrocarbon type.
- B. The blank exhibited a positive result greater than the reporting limit for this compound.
- C. The result confirmed by secondary column or GC/MS analysis.
- CN. See case narrative.
- CR. Result for this analyte maybe biased due to interferences. Confirmation by GC/MS or other technique is recommended.
- D. Surrogate was diluted outside reporting range.
- E. Result exceeds the calibration range for the compound. The result should be considered an estimate.
- F. The positive result for this hydrocarbon is due to single component contamination. The product does not match any hydrocarbon in the fuels library.
- G. Result may be biased high due to biogenic interferences. Silica gel clean-up recommended.
- H. Sample was analyzed outside recommended holding times.
- HT. At clients request, sample was analyzed outside method recommended holding time.
- J. The result for this analyte is between the MDL and the PQL, and should be considered an estimated concentration.
- K. Diesel result is biased high due to amount of oil contained in the sample.
- L. Diesel result is biased high due to amount of gasoline contained in the sample.
- M. Oil result is biased high due to amount of diesel contained in the sample.
- MC. Sample concentration is greater than 4x the spiked value; the spiked value is considered insignificant.
- MI. Outside control limits due to Matrix Interference.
- MSA. Value determined by Method of Standard Addition.
- N. Sample appears to contain biogenic material biasing quantification.
- O. Laboratory Control Standard (LCS) exceeded laboratory control limits, meets CCV criteria. Data meets EPA requirements.
- P. Detected levels of Methylene Chloride may be due to laboratory contamination, due to previous analysis or background levels.
- Q. Detection limits elevated due to sample matrix.
- R. RPD control limits were exceeded.
- RF. Duplicate failed, due to result being at or near method reporting limit.
- RP. Matrix spike values exceed established QC limits, post digestion spike is in control.
- S. Recovery outside control limits.
- *. The result for this parameter was greater than the maximum contaminant level or the TCLP regulatory limit.

Specialty

0307085

ENZYME TECHNOLOGIES, INC.
 5228 NE 158th Ave.
 Portland, OR 97230
 Phone: 503-254-4331
 Fax: 503-254-1722

Chain of Custody Record Laboratory Analysis

Special Instructions

Turnaround

N - Normal:
 R - Rush:
 O - Other:

Project Information

Project Name: TTNUS
 Project #:
 P.O.#:
 Sampler's Name:
 Signature:

ETEC Contact:
 Phone Number:
 Comments:

Randy Mueller
503-546-3617

Remarks:

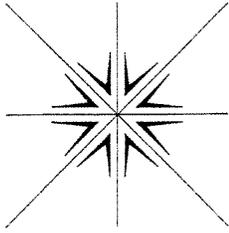
Analyses

Sample Identification	Date	Time	Matrix (S or W)	# of Containers	Analyses							Remarks
					HC-Degrading Plate Count	Heterotrophic Plate Count	EPA Method 8260	EPA Method 8270 Modified Sim	RCRA8	FL-Pro/nwTPH-DX	TPH-CWG	
1 TTNUS-Day 35-T	7/15/03	10 AM	S	1			X	X	X	X	X	
2 TTNUS-Day 35-C	7/15/03	10:30 AM	S	1			X	X	X	X	X	
3												
4												
5												
6												
7												
8												

Relinquished	
Signature <u>Randy Mueller</u>	Date <u>7/15/03</u>
Print Name <u>Randy Mueller</u>	Time <u>10 AM</u>
Company <u>ETEC</u>	
Received	
Signature <u>Cindy Hilliard</u>	Date <u>7/15/03</u>
Print Name <u>Cindy Hilliard</u>	Time <u>2:40</u>
Company <u>Specialty</u>	

Relinquished	
Signature	Date
Print Name	Time
Company	
Received	
Signature	Date
Print Name	Time
Company	

Relinquished	
Signature	Date
Print Name	Time
Company	
Received	
Signature	Date
Print Name	Time
Company	



Specialty Analytical

19761 S.W. 95th Place
Tualatin, OR 97062
(503) 612-9007
Fax (503) 612-8572
1 (877) 612-9007

August 18, 2003

Randy Mueller
Enzyme Technologies
5228 NE 158th Avenue
Portland, OR 97230

TEL: (503) 254-4331
FAX (503) 254-1722

RE: TTNUS Treatability

Dear Randy Mueller:

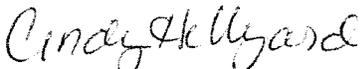
Order No.: 0307173

Specialty Analytical received 1 sample on 7/31/2003 for the analyses presented in the following report.

There were no problems with the analysis and all data for associated QC met EPA or laboratory specifications except where noted in the Case Narrative, or as qualified with flags. Results apply only to the samples analyzed. Without approval of the laboratory, the reproduction of this report is only permitted in its entirety.

If you have any questions regarding these tests, please feel free to call.

Sincerely,


for Dan Marrin
Project Manager


Technical Review

Specialty Analytical

Date: 18-Aug-03

CLIENT: Enzyme Technologies
Lab Order: 0307173
Project: TTNUS Treatability
Lab ID: 0307173-01

Client Sample ID: TTNUS-Final 1
Collection Date: 7/30/2003 9:00:00 AM

Matrix: SOIL

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PETROLEUM HYDROCARBONS-FLPRO						Analyst: btf
Diesel	2060			mg/Kg	2	8/14/2003
Surr: o-terphenyl	0	50-150		%REC	2	8/14/2003

Specialty Analytical

Date: 18-Aug-03

CLIENT: Enzyme Technologies
 Work Order: 0307173
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: FLPRO_S

Sample ID	MBLK	SampType:	MBLK	TestCode:	FLPRO_S	Units:	mg/Kg	Prep Date:	8/4/2003	Run ID:	GC-O_030814A			
Client ID:	ZZZZZ	Batch ID:	9222	TestNo:	FLPRO_S			Analysis Date:	8/14/2003	SeqNo:	206060			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Diesel	ND	0												
Surr: o-terphenyl	37.46	0	33.33	0	112	50	150	0	0					

Sample ID	LCS	SampType:	LCS	TestCode:	FLPRO_S	Units:	mg/Kg	Prep Date:	8/4/2003	Run ID:	GC-O_030814A			
Client ID:	ZZZZZ	Batch ID:	9222	TestNo:	FLPRO_S			Analysis Date:	8/14/2003	SeqNo:	206061			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Diesel	387.6	0	333.3	0	116	76.3	122	0	0					
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Sample ID	0308001-01ADUP	SampType:	DUP	TestCode:	FLPRO_S	Units:	mg/Kg	Prep Date:	8/4/2003	Run ID:	GC-O_030814A			
Client ID:	ZZZZZ	Batch ID:	9222	TestNo:	FLPRO_S			Analysis Date:	8/14/2003	SeqNo:	206065			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Diesel	9731	0	0	0	0	0	0	7071	31.7	20	R			
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Sample ID	CCV	SampType:	CCV	TestCode:	FLPRO_S	Units:	mg/Kg	Prep Date:	8/4/2003	Run ID:	GC-O_030814A			
Client ID:	ZZZZZ	Batch ID:	9222	TestNo:	FLPRO_S			Analysis Date:	8/14/2003	SeqNo:	206062			
Analyte		Result		PQL	SPK value	SPK Ref Val		%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Diesel	633.7	0	666.6	0	95.1	85	115	0	0					
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Qualifiers: ND - Not Detected at the Reporting Limit S - Spike Recovery outside accepted recovery limits B - Analyte detected in the associated Method Blank
 J - Analyte detected below quantitation limits R - RPD outside accepted recovery limits

KEY TO FLAGS

- A. This sample contains a Gasoline Range Organic not identified as a specific hydrocarbon product. The result was quantified against gasoline calibration standards.
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- A2. This sample contains a Lube Oil Range Organic not identified as a specific hydrocarbon product. The result was quantified against lube oil calibration standards.
- A3. Results determined to be non detect based on hydrocarbon pattern recognition. The product was carry-over from another hydrocarbon type.
- B. The blank exhibited a positive result greater than the reporting limit for this compound.
- C. The result confirmed by secondary column or GC/MS analysis.
- CN. See case narrative.
- CR. Result for this analyte maybe biased due to interferences. Confirmation by GC/MS or other technique is recommended.
- D. Surrogate was diluted outside reporting range.
- E. Result exceeds the calibration range for the compound. The result should be considered an estimate.
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- *. The result for this parameter was greater than the maximum contaminant level or the TCLP regulatory limit.

0307173

ENZYME TECHNOLOGIES, INC. 5228 NE 158 th Ave. Portland, OR 97230 Phone: 503-254-4331 Fax: 503-254-1722	<h1 style="margin: 0;">Chain of Custody Record</h1> <h2 style="margin: 0;">Laboratory Analysis</h2>	Special Instructions
--	---	----------------------

Turnaround	Project Information		
N - Normal:	Project Name:	TTNUS	ETEC Contact:
R - Rush :	Project #:		Phone Number:
O - Other:	P.O.#:		Comments:
	Sampler's Name:		
	Signature:		

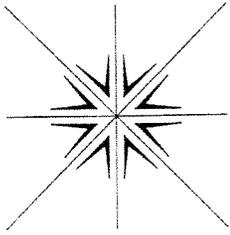
Randy Mueller
503-546-3617

Sample Identification				Matrix (S or W)		# of Containers		Analyses							Remarks
								HC-Degrading Plate Count	Heterotrophic Plate Count	Iron-Degrading Plate Count	Complete Nutrient Suite	Limited Nutrient Suite	pH	FLPRO/NUOTPH-DX	
Date	Time														
1	TTNUS-Final 1	7/30/03	9 AM	S	1								X		
2															
3															
4															
5															
6															
7															
8															

Relinquished	
Signature <i>Randy Mueller</i>	Date <i>7/30/03</i>
Print Name <i>Randy Mueller</i>	Time <i>9 AM</i>
Company <i>ETEC</i>	
Received	
Signature <i>Cindy Hillgard</i>	Date <i>7/31/03</i>
Print Name <i>Cindy Hillgard</i>	Time <i>9:25</i>
Company <i>Specialty Analytical</i>	

Relinquished	
Signature	Date
Print Name	Time
Company	
Received	
Signature	Date
Print Name	Time
Company	

Relinquished	
Signature	Date
Print Name	Time
Company	
Received	
Signature	Date
Print Name	Time
Company	



Specialty Analytical

19761 S.W. 95th Place
Tualatin, OR 97062
(503) 612-9007
Fax (503) 612-8572
1 (877) 612-9007

August 18, 2003

Randy Mueller
Enzyme Technologies
5228 NE 158th Avenue
Portland, OR 97230

TEL: (503) 254-4331

FAX (503) 254-1722

RE: TTNUS Treatability

Dear Randy Mueller:

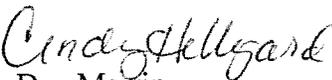
Order No.: 0308001

Specialty Analytical received 1 sample on 8/1/2003 for the analyses presented in the following report.

There were no problems with the analysis and all data for associated QC met EPA or laboratory specifications except where noted in the Case Narrative, or as qualified with flags. Results apply only to the samples analyzed. Without approval of the laboratory, the reproduction of this report is only permitted in its entirety.

If you have any questions regarding these tests, please feel free to call.

Sincerely,


for Dan Marrin
Project Manager


Technical Review

Specialty Analytical

Date: 18-Aug-03

CLIENT: Enzyme Technologies

Client Sample ID: TTNUS-Final 2

Lab Order: 0308001

Collection Date: 7/31/2003 4:00:00 PM

Project: TTNUS Treatability

Lab ID: 0308001-01

Matrix: SOIL

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PETROLEUM HYDROCARBONS-FLPRO						Analyst: btf
Diesel	7070			mg/Kg	10	8/14/2003
Surr: o-terphenyl	0	50-150		%REC	10	8/14/2003

Specialty Analytical

Date: 18-Aug-03

CLIENT: Enzyme Technologies
 Work Order: 0308001
 Project: TTNUS Treatability

ANALYTICAL QC SUMMARY REPORT

TestCode: FLPRO_S

Sample ID	SampType	TestCode	Units	Prep Date	Run ID						
MBLK	MBLK	FLPRO_S	mg/Kg	8/4/2003	GC-O_030814A						
Client ID: ZZZZZ	Batch ID: 9222	TestNo: FLPRO_S		Analysis Date: 8/14/2003	SeqNo: 206060						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel	ND	0									
Surr: o-terphenyl	37.46	0	33.33	0	112	50	150	0	0		
Sample ID	SampType	TestCode	Units	Prep Date	Run ID						
LCS	LCS	FLPRO_S	mg/Kg	8/4/2003	GC-O_030814A						
Client ID: ZZZZZ	Batch ID: 9222	TestNo: FLPRO_S		Analysis Date: 8/14/2003	SeqNo: 206061						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel	387.6	0	333.3	0	116	76.3	122	0	0		
Sample ID	SampType	TestCode	Units	Prep Date	Run ID						
0308001-01ADUP	DUP	FLPRO_S	mg/Kg	8/4/2003	GC-O_030814A						
Client ID: TTNUS-Final 2	Batch ID: 9222	TestNo: FLPRO_S		Analysis Date: 8/14/2003	SeqNo: 206065						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel	9731	0	0	0	0	0	0	7071	31.7	20	R
Sample ID	SampType	TestCode	Units	Prep Date	Run ID						
CCV	CCV	FLPRO_S	mg/Kg	8/4/2003	GC-O_030814A						
Client ID: ZZZZZ	Batch ID: 9222	TestNo: FLPRO_S		Analysis Date: 8/14/2003	SeqNo: 206062						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel	633.7	0	666.6	0	95.1	85	115	0	0		

Qualifiers:

ND - Not Detected at the Reporting Limit
 J - Analyte detected below quantitation limits

S - Spike Recovery outside accepted recovery limits
 R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

KEY TO FLAGS

- A. This sample contains a Gasoline Range Organic not identified as a specific hydrocarbon product. The result was quantified against gasoline calibration standards.
- A1. This sample contains a Diesel Range Organic not identified as a specific hydrocarbon product. The result was quantified against diesel calibration standards.
- A2. This sample contains a Lube Oil Range Organic not identified as a specific hydrocarbon product. The result was quantified against lube oil calibration standards.
- A3. Results determined to be non detect based on hydrocarbon pattern recognition. The product was carry-over from another hydrocarbon type.
- B. The blank exhibited a positive result greater than the reporting limit for this compound.
- C. The result confirmed by secondary column or GC/MS analysis.
- CN. See case narrative.
- CR. Result for this analyte maybe biased due to interferences. Confirmation by GC/MS or other technique is recommended.
- D. Surrogate was diluted outside reporting range.
- E. Result exceeds the calibration range for the compound. The result should be considered an estimate.
- F. The positive result for this hydrocarbon is due to single component contamination. The product does not match any hydrocarbon in the fuels library.
- G. Result may be biased high due to biogenic interferences. Silica gel clean-up recommended.
- H. Sample was analyzed outside recommended holding times.
- HT. At clients request, sample was analyzed outside method recommended holding time.
- J. The result for this analyte is between the MDL and the PQL, and should be considered an estimated concentration.
- K. Diesel result is biased high due to amount of oil contained in the sample.
- L. Diesel result is biased high due to amount of gasoline contained in the sample.
- M. Oil result is biased high due to amount of diesel contained in the sample.
- MC. Sample concentration is greater than 4x the spiked value; the spiked value is considered insignificant.
- MI. Outside control limits due to Matrix Interference.
- MSA. Value determined by Method of Standard Addition.
- N. Sample appears to contain biogenic material biasing quantification.
- O. Laboratory Control Standard (LCS) exceeded laboratory control limits, meets CCV criteria. Data meets EPA requirements.
- P. Detected levels of Methylene Chloride may be due to laboratory contamination, due to previous analysis or background levels.
- Q. Detection limits elevated due to sample matrix.
- R. RPD control limits were exceeded.
- RF. Duplicate failed, due to result being at or near method reporting limit.
- RP. Matrix spike values exceed established QC limits, post digestion spike is in control.
- S. Recovery outside control limits.
- *. The result for this parameter was greater than the maximum contaminant level or the TCLP regulatory limit.

0308001

Specialty

ENZYME TECHNOLOGIES, INC.
 5228 NE 158th Ave.
 Portland, OR 97230
 Phone: 503-254-4331
 Fax: 503-254-1722

Chain of Custody Record Laboratory Analysis

Special Instructions

Turnaround		Project Information			
N - Normal:	✓	Project Name:	TTNUS	ETEC Contact:	Randy Mueller
R - Rush:		Project #:		Phone Number:	503-546-3617
O - Other:		P.O.#:		Comments:	
		Sampler's Name:			
		Signature:			

Remarks:				Matrix (S or W)	# of Containers	Analyses								Remarks
Sample Identification	Date	Time				HC-Degrading Plate Count	Heterotrophic Plate Count	Iron-Degrading Plate Count	Complete Nutrient Suite	Limited Nutrient Suite	pH	FL PRO/NWT PH - OX		
1	TTNUS - Final 2	7/31/03	4:00 PM	S	1							X		
2														
3														
4														
5														
6														
7														
8														

Relinquished	
Signature <i>Randy Mueller</i>	Date <i>7/31/03</i>
Print Name <i>Randy Mueller</i>	Time <i>4:00 PM</i>
Company <i>ETEC</i>	
Received	
Signature <i>Dean Strom</i>	Date <i>8-1-2003</i>
Print Name <i>Dean Strom</i>	Time <i>8:30 am</i>
Company <i>Specialty Analytical</i>	

Relinquished	
Signature	Date
Print Name	Time
Company	
Received	
Signature	Date
Print Name	Time
Company	

Relinquished	
Signature	Date
Print Name	Time
Company	
Received	
Signature	Date
Print Name	Time
Company	



Report Date: June 30, 2003
Job Number: A30610T
PO Number: None Provided
Project No: None Provided
Project Name: TTNUS Treatability

Randy Mueller
Enzyme Technologies Inc
5228 NE 158th Ave
Portland, OR 97230

Analytical Narrative

The sample was received on 06/10/03 by Coffey Laboratories, Inc. (CLI) Sample Reception personnel under strict chain of custody protocol. The following information was provided at the time of sample reception:

Laboratory Sample ID	Field Identification	Matrix	Collection Date	Collection Time
A30610T-1	TTNUS-Day 00-TC	Sand	06/10/03	0900

The recommended holding time for each batch of analyses was in accordance with the data quality objectives as specified in the CLI Quality Assurance Plan unless otherwise noted.

Acceptable precision and accuracy were achieved for all analyses associated with this work order as demonstrated by the recoveries of the quality control samples analyzed concurrently with each batch.

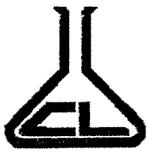
The data submitted in this report is for the sole and exclusive use of the above-named client. All samples associated with the work order will be retained a maximum of 15 days from the report date or until the maximum holding time expires. All results pertain only to samples submitted.

Thank you for allowing Coffey Laboratories to be of service to you. If you have questions or need further assistance, please do not hesitate to call our Customer Services Department.

Sincerely,

Technical Services

TS /atc



Analytical Data

Enzyme Technologies Inc

Job Number: A30610T

Page Number: 2 of 2

Lab Sample ID: A30610T-1

Field ID: TTNUS-Day 00-TC

Date/Time: 06/10/03 0900

Matrix: Sand

EPA Category: Inorganic Chemicals

<u>Parameter</u>	<u>Method</u>	<u>Detection Limit</u>	<u>Analytical Result</u>	<u>Units</u>
Ammonia Nitrogen	sm4500nh3bc	16.	ND	mg/L
Nitrate	EPA 300.0	0.1	ND	mg/L
Nitrite	EPA 300.0	0.1	ND	mg/L
ortho Phosphate	EPA 300.0	0.5	ND	mg/L
Sulfate	EPA 300.0	1.	7.	mg/L
Potassium	SM 3111B	15.85	40.	mg/Kg
Iron	EPA 200.7	31.7	670.	mg/Kg
Manganese	EPA 200.7	31.7	50.	mg/Kg

ND means none detected at or above the detection limit listed.



Report Date: August 20, 2003
Job Number: A30617BQ
PO Number: None Provided
Project No: None Provided
Project Name: TTNUS

Randy Mueller
Enzyme Technologies Inc
5228 NE 158th Ave
Portland, OR 97230

Analytical Narrative

The sample was received on 06/17/03 by Coffey Laboratories, Inc. (CLI) Sample Reception personnel under strict chain of custody protocol. The following information was provided at the time of sample reception:

Laboratory Sample ID	Field Identification	Matrix	Collection Date	Collection Time
A30617BQ-1	TTNUS-Day 7-T	Solid	06/17/03	1228

The recommended holding time for each batch of analyses was in accordance with the data quality objectives as specified in the CLI Quality Assurance Plan unless otherwise noted.

Acceptable precision and accuracy were achieved for all analyses associated with this work order as demonstrated by the recoveries of the quality control samples analyzed concurrently with each batch.

The data submitted in this report is for the sole and exclusive use of the above-named client. All samples associated with the work order will be retained a maximum of 15 days from the report date or until the maximum holding time expires. All results pertain only to samples submitted.

Thank you for allowing Coffey Laboratories to be of service to you. If you have questions or need further assistance, please do not hesitate to call our Customer Services Department.

Sincerely,

Technical Services

TS /atc



Analytical Data

Enzyme Technologies Inc

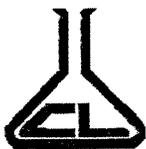
Job Number: A30617BQ
Page Number: 2 of 2

Lab Sample ID: A30617BQ-1
Field ID: TTNUS-Day 7-T
Date/Time: 06/17/03 1228
Matrix: Solid

EPA Category: Inorganic Chemicals

<u>Parameter</u>	<u>Method</u>	<u>Detection Limit</u>	<u>Analytical Result</u>	<u>Units</u>
Ammonia Nitrogen	SM4500NH3BC	20.	ND	mg/Kg
Nitrate	EPA 300.0	1.0	ND	mg/Kg
Nitrite	EPA 300.0	1.0	ND	mg/Kg
Sulfate	EPA 300.0	48.	1100.	mg/Kg
Potassium	SM 3111B	17.	70.	mg/Kg
Iron	EPA 200.7	33.	610.	mg/Kg
Manganese	EPA 200.7	33.	ND	mg/Kg

ND means none detected at or above the detection limit listed.



Report Date: July 15, 2003
Job Number: A30624BG
PO Number: None Provided
Project No: None Provided
Project Name: TTNUS

Randy Mueller
Enzyme Technologies Inc
5228 NE 158th Ave
Portland, OR 97230

Analytical Narrative

The sample was received on 06/24/03 by Coffey Laboratories, Inc. (CLI) Sample Reception personnel under strict chain of custody protocol. The following information was provided at the time of sample reception:

Laboratory Sample ID	Field Identification	Matrix	Collection Date	Collection Time
A30624BG-1	TTNUS-Day 14-T	Soil	06/24/03	0945

The recommended holding time for each batch of analyses was in accordance with the data quality objectives as specified in the CLI Quality Assurance Plan unless otherwise noted.

Acceptable precision and accuracy were achieved for all analyses associated with this work order as demonstrated by the recoveries of the quality control samples analyzed concurrently with each batch.

The data submitted in this report is for the sole and exclusive use of the above-named client. All samples associated with the work order will be retained a maximum of 15 days from the report date or until the maximum holding time expires. All results pertain only to samples submitted.

Thank you for allowing Coffey Laboratories to be of service to you. If you have questions or need further assistance, please do not hesitate to call our Customer Services Department.

Sincerely,

Technical Services

TS /atc



Analytical Data

Enzyme Technologies Inc

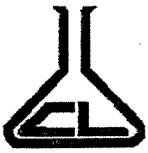
Job Number: A30624BG
Page Number: 2 of 2

Lab Sample ID: A30624BG-1
Field ID: TTNUS-Day 14-T
Date/Time: 06/24/03 0945
Matrix: Soil

EPA Category: Inorganic Chemicals

<u>Parameter</u>	<u>Method</u>	<u>Detection Limit</u>	<u>Analytical Result</u>	<u>Units</u>
Ammonia Nitrogen	sm4500nh3bc	25.	ND	mg/Kg
Nitrate	EPA 300.0	7.	ND	mg/Kg
Nitrite	EPA 300.0	7.	ND	mg/Kg
ortho Phosphate	EPA 300.0	15.	ND	mg/Kg
Sulfate	EPA 300.0	37.	1200.	mg/Kg
Potassium	SM 3111B	16.	80.	mg/Kg
Iron	EPA 200.7	20.	620.	mg/Kg
Manganese	EPA 200.7	20.	20.	mg/Kg

ND means none detected at or above the detection limit listed.



Report Date: July 22, 2003
Job Number: A30701CI
PO Number: None Provided
Project No: None Provided
Project Name: TTNUS

Randy Mueller
Enzyme Technologies Inc
5228 NE 158th Ave
Portland, OR 97230

Analytical Narrative

The sample was received on 07/01/03 by Coffey Laboratories, Inc. (CLI) Sample Reception personnel under strict chain of custody protocol. The following information was provided at the time of sample reception:

Laboratory Sample ID	Field Identification	Matrix	Collection Date	Collection Time
A30701CI-1	TTNUS-Day 21-T	Solid	07/01/03	0930

The recommended holding time for each batch of analyses was in accordance with the data quality objectives as specified in the CLI Quality Assurance Plan unless otherwise noted.

Acceptable precision and accuracy were achieved for all analyses associated with this work order as demonstrated by the recoveries of the quality control samples analyzed concurrently with each batch.

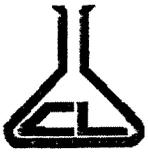
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Thank you for allowing Coffey Laboratories to be of service to you. If you have questions or need further assistance, please do not hesitate to call our Customer Services Department.

Sincerely,

Technical Services

TS /atc



Analytical Data

Enzyme Technologies Inc

Job Number: A30701CI

Page Number: 2 of 2

Lab Sample ID: A30701CI-1

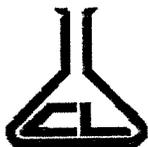
Field ID: TTNUS-Day 21-T

Date/Time: 07/01/03 0930

Matrix: Solid

EPA Category: Inorganic Chemicals

<u>Parameter</u>	<u>Method</u>	<u>Detection Limit</u>	<u>Analytical Result</u>	<u>Units</u>
Ammonia Nitrogen	sm4500nh3bc	20.	120.	mg/Kg
Nitrate	EPA 300.0	9.	43.	mg/Kg
Nitrite	EPA 300.0	9.	20.	mg/Kg
ortho Phosphate	EPA 300.0	18.	20.	mg/Kg
Sulfate	EPA 300.0	44.	1100.	mg/Kg
Potassium	SM 3111B	16.	150.	mg/Kg
Iron	EPA 200.7	20.	780.	mg/Kg
Manganese	EPA 200.7	20.	30.	mg/Kg



Report Date: July 28, 2003
Job Number: A30709BK
PO Number: None Provided
Project No: None Provided
Project Name: TTNUS

Randy Mueller
Enzyme Technologies Inc
5228 NE 158th Ave
Portland, OR 97230

Analytical Narrative

The sample was received on 07/09/03 by Coffey Laboratories, Inc. (CLI) Sample Reception personnel under strict chain of custody protocol. The following information was provided at the time of sample reception:

Laboratory Sample ID	Field Identification	Matrix	Collection Date	Collection Time
A30709BK-1	TTNUS - Day 28 - T	Soil	07/08/03	0900

The recommended holding time for each batch of analyses was in accordance with the data quality objectives as specified in the CLI Quality Assurance Plan unless otherwise noted.

Acceptable precision and accuracy were achieved for all analyses associated with this work order as demonstrated by the recoveries of the quality control samples analyzed concurrently with each batch.

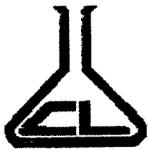
The data submitted in this report is for the sole and exclusive use of the above-named client. All samples associated with the work order will be retained a maximum of 15 days from the report date or until the maximum holding time expires. All results pertain only to samples submitted.

Thank you for allowing Coffey Laboratories to be of service to you. If you have questions or need further assistance, please do not hesitate to call our Customer Services Department.

Sincerely,

Technical Services

TS /atc



Analytical Data

Enzyme Technologies Inc

Job Number: A30709BK

Page Number: 2 of 2

Lab Sample ID: A30709BK-1

Field ID: TTNUS - Day 28 - T

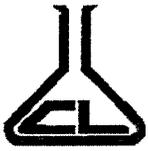
Date/Time: 07/08/03 0900

Matrix: Soil

EPA Category: Inorganic Chemicals

Parameter	Method	Detection Limit	Analytical Result	Units
Ammonia Nitrogen	sm4500nh3bc	28.	30.	mg/Kg
Nitrate	EPA 300.0	8.	ND	mg/Kg
Nitrite	EPA 300.0	8.	ND	mg/Kg
ortho Phosphate	EPA 300.0	17.	20.	mg/Kg
Sulfate	EPA 300.0	42.	1000.	mg/Kg
Potassium	SM 3111B	10.	180.	mg/Kg
Iron	EPA 200.7	20.	690.	mg/Kg
Manganese	EPA 200.7	20.	30.	mg/Kg

ND means none detected at or above the detection limit listed.



Report Date: July 28, 2003
Job Number: A30715AF
PO Number: None Provided
Project No: None Provided
Project Name: TTNUS

Randy Mueller
Enzyme Technologies Inc
5228 NE 158th Ave
Portland, OR 97230

Analytical Narrative

The sample was received on 07/15/03 by Coffey Laboratories, Inc. (CLI) Sample Reception personnel under strict chain of custody protocol. The following information was provided at the time of sample reception:

Laboratory Sample ID	Field Identification	Matrix	Collection Date	Collection Time
A30715AF-1	TTNUS-Day 35-T	Soil	07/15/03	1000
A30715AF-2	TTNUS-Day 35-C	Soil	07/15/03	1030

The recommended holding time for each batch of analyses was in accordance with the data quality objectives as specified in the CLI Quality Assurance Plan unless otherwise noted.

Acceptable precision and accuracy were achieved for all analyses associated with this work order as demonstrated by the recoveries of the quality control samples analyzed concurrently with each batch.

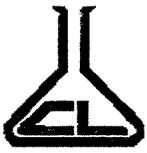
The data submitted in this report is for the sole and exclusive use of the above-named client. All samples associated with the work order will be retained a maximum of 15 days from the report date or until the maximum holding time expires. All results pertain only to samples submitted.

Thank you for allowing Coffey Laboratories to be of service to you. If you have questions or need further assistance, please do not hesitate to call our Customer Services Department.

Sincerely,

Technical Services

TS /atc



Analytical Data

Enzyme Technologies Inc

Job Number: A30715AF

Page Number: 2 of 3

Lab Sample ID: A30715AF-1

Field ID: TTNUS-Day 35-T

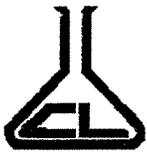
Date/Time: 07/15/03 1000

Matrix: Soil

EPA Category: Inorganic Chemicals

Parameter	Method	Detection Limit	Analytical Result	Units
Ammonia Nitrogen	sm4500nh3bc	25.	30.	mg/Kg
Nitrate	EPA 300.0	8.	ND	mg/Kg
Nitrite	EPA 300.0	8.	ND	mg/Kg
ortho Phosphate	EPA 300.0	16.	ND	mg/Kg
Sulfate	EPA 300.0	40.	830.	mg/Kg
Potassium	SM 3111B	10.	180.	mg/Kg
Iron	EPA 200.7	20.	670.	mg/Kg
Manganese	EPA 200.7	20.	30.	mg/Kg

ND means none detected at or above the detection limit listed.



Analytical Data

Enzyme Technologies Inc

Job Number: A30715AF

Page Number: 3 of 3

Lab Sample ID: A30715AF-2

Field ID: TTNUS-Day 35-C

Date/Time: 07/15/03 1030

Matrix: Soil

EPA Category: Inorganic Chemicals

<u>Parameter</u>	<u>Method</u>	<u>Detection Limit</u>	<u>Analytical Result</u>	<u>Units</u>
Ammonia Nitrogen	sm4500nh3bc	25.	ND	mg/Kg
Nitrate	EPA 300.0	9.	ND	mg/Kg
Nitrite	EPA 300.0	9.	ND	mg/Kg
ortho Phosphate	EPA 300.0	18.	ND	mg/Kg
Sulfate	EPA 300.0	44.	780.	mg/Kg
Potassium	SM 3111B	10.	43.	mg/Kg
Iron	EPA 200.7	20.	680.	mg/Kg
Manganese	EPA 200.7	20.	20.	mg/Kg

ND means none detected at or above the detection limit listed.

BioLogic Resources, LLC

6950 SW Juniper Terrace

Beaverton, OR 97008

Phone 503.720.3876

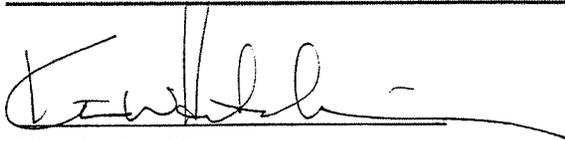
Fax 503.646.5322

For: Enzyme Technologies, Inc.
5228 NE 158th Ave.
Portland, OR 97230
Attn: Randy Mueller

Received: 06.10.03
Tested: 06.10.03
Completed: 06.20.03

Lab #	Sample	Hydrocarbon Degrading Bacteria CFU/g
ET647	TTNUS-Day 00-TC 06-10-03 0900	8.9×10^5

Project: TTNUS Treatability



Kim W. Hutchinson
Microbiologist/Principal

BioLogic Resources, LLC

6950 SW Juniper Terrace

Beaverton, OR 97008

Phone 503.720.3876

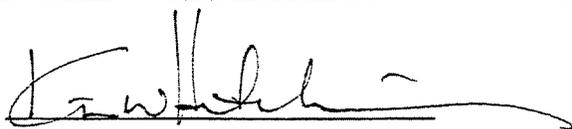
Fax 503.646.5322

For: Enzyme Technologies, Inc.
5228 NE 158th Ave.
Portland, OR 97230
Attn: Randy Mueller

Received: 06.17.03
Tested: 06.17.03
Completed: 06.27.03

Lab #	Sample	Hydrocarbon Degrading Bacteria CFU/g
ET660	TTNUS-Day 07-T 06-17-03 12:28p	1.1×10^8

Project: TTNUS Treatability



Kim W. Hutchinson
Microbiologist/Principal

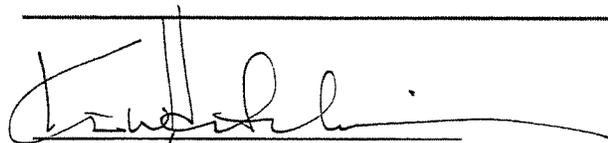
BioLogic Resources, LLC
10260 SW Nimbus Ave., Suite M7A
Portland, OR 97223
Phone 503.670.1312
Fax 503.670.7262

For: Enzyme Technologies, Inc.
5228 NE 158th Ave.
Portland, OR 97230
Attn: Randy Mueller

Received: 06.24.03
Tested: 06.24.03
Completed: 07.04.03

Lab #	Sample	Hydrocarbon Degrading Bacteria CFU/g
ET693	TTNUS-Day 14-T 06-24-03 9:45a	9.4 x 10 ⁷

Project: TTNUS Treatability



Kim W. Hutchinson
Microbiologist/Principal

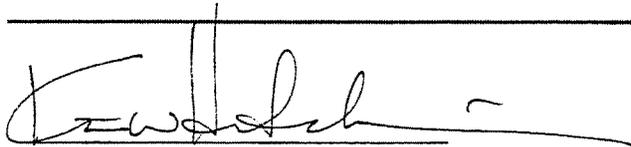
BioLogic Resources, LLC
10260 SW Nimbus Ave., Suite M7A
Portland, OR 97223
Phone 503.670.1312
Fax 503.670.7262

For: Enzyme Technologies, Inc.
5228 NE 158th Ave.
Portland, OR 97230
Attn: Randy Mueller

Received: 07.01.03
Tested: 07.01.03
Completed: 07.11.03

Lab #	Sample	Hydrocarbon Degrading Bacteria CFU/g
ET715	TTNUS-Day 21-T 07-01-03 9:30a	2.1×10^8

Project: TTNUS Treatability



Kim W. Hutchinson
Microbiologist/Principal

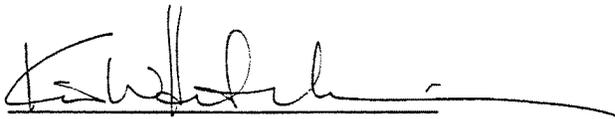
BioLogic Resources, LLC
10260 SW Nimbus Ave., Suite M7A
Portland, OR 97223
Phone 503.670.1312
Fax 503.670.7262

For: Enzyme Technologies, Inc.
5228 NE 158th Ave.
Portland, OR 97230
Attn: Randy Mueller

Received: 07.09.03
Tested: 07.09.03
Completed: 07.19.03

Lab #	Sample	Hydrocarbon Degrading Bacteria CFU/g
ET719	TTNUS-Day 28-T 07-08-03 9:00a	1.0 x 10 ⁸

Project: TTNUS Treatability



Kim W. Hutchinson
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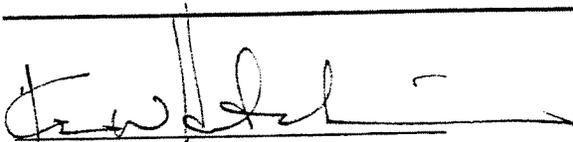
BioLogic Resources, LLC
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For: Enzyme Technologies, Inc.
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Portland, OR 97230
Attn: Randy Mueller

Received: 07.15.03
Tested: 07.15.03
Completed: 07.25.03

Lab #	Sample	Hydrocarbon Degrading Bacteria CFU/g
ET728	TTNUS-Day 35-T 07-15-03 1000	2.6×10^8
ET729	TTNUS-Day 35-C 07-15-03 1030	3.0×10^7

Project: TTNUS Treatability



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Microbiologist/Principal

APPENDIX E

**TECHNICAL DOCUMENT FOR
DEFAULT SCTLs**

Draft

Technical Report:

**Development of
Cleanup Target Levels (CTLs)
for Chapter 62-777, F.A.C.**

Prepared for the
Division of Waste Management
Florida Department of Environmental Protection

by

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February 26, 2004

6. Development of SCTLs for Total Recoverable Petroleum Hydrocarbons (TRPHs)

The TRPH SCTLs were developed to be used in a two-tiered approach with a default TRPH SCTL as the starting value. Default TRPH SCTLs for direct exposure and leachability included in Table 2 are to be compared with site-specific results obtained using the Florida Petroleum Residual Organic (FL-PRO) analytical method. Currently, the FL-PRO method is limited to measuring the concentration of mixed petroleum hydrocarbons in the range of C₈-C₄₀. While FL-PRO does not measure hydrocarbons in the C₅-C₇ range, the most toxic and prevalent chemicals within this range are quantified by other analyses and have individual SCTLs. Therefore, the default TRPH SCTL is based on the most conservative and health protective carbon range that can be detected by FL-PRO, the >C₈-C₁₀ carbon range (Table C-5, Appendix C).

In the event that any of these default SCTLs is exceeded, the assessment should enter a second tier where TRPH site concentrations for individual fraction ranges are compared with their respective SCTLs. There are currently two analytical methods that provide concentrations for ranges that do not necessarily encompass the same fractions. FDEP has approved using the FL-PRO method, and the method developed by the Massachusetts Department of Environmental Protection (MADEP, 1997). The FL-PRO method has some drawbacks that can make evaluation of TRPH contamination incomplete. For example, it cannot distinguish between aliphatics and the generally more toxic aromatics. In addition, quantitation of individual compounds using the FL-PRO method is difficult and not confirmative, as only “fresh” petroleum hydrocarbons provide distinct peaks in analysis by gas chromatography (GC). Weathered petroleum hydrocarbons such as those found at contaminated sites produce “hills” rather than peaks when analyzed by GC. Therefore, the FL-PRO method can only obtain an estimate over the entire C-range of the fraction of petroleum hydrocarbons that are present in the sample. Although not free of complications, the MADEP method can detect the more toxicologically relevant aliphatic C₅-C₈ fraction range, and more importantly, it allows differentiation of aromatics from aliphatics.

TRPH SCTLs for fractions evaluated through the FL-PRO and the MADEP methods are derived from chemical/physical parameters and toxicity values assigned to each carbon range as described in Appendix C. It should be noted that an absolute ranking of risks posed by exposure to these fraction ranges is not possible because for example, while the >C₈-C₁₀ aromatic fraction has the most restrictive inhalation RfD, the >C₁₆ aromatic fractions currently have the most restrictive oral RfD (TPHCWG, 1997c; Table C-4, Appendix C).

XIV. Appendix C: Technical Basis for the TRPH SCTLs

A. Development of SCTLs for Hydrocarbon Fractions Developed by the Total Petroleum Hydrocarbon Criteria Working Group

The following calculations for total recoverable petroleum hydrocarbon (TRPH) values were adopted essentially as described by the Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG, 1997a,b,c). The application of a general standard for TRPHs is difficult because of the variation in mobility and toxicity of the chemicals included. To overcome this problem, the TPHCWG (1997a) suggested a sub-classification methodology in which aromatics and aliphatics are considered separately because these groups vary considerably in their environmental behavior. Each of these groups was then further subdivided on the basis of equivalent carbon number index (EC). The EC is a function of the molecular weight (MW) and boiling point (BP) of a chemical normalized to the BP of the n-alkanes, or its retention time in a BP gas chromatographic column. This approach is used since it is consistent with methods routinely used in the petroleum industry for separating complex mixtures and is a more appropriate differentiation technique than the actual carbon number of the chemical.

Table C-1
Hydrocarbon Fractions Defined by the Total Petroleum Hydrocarbon
Criteria Working Group

Range of Equivalent Carbon Number (EC)	Avg EC	Classification
C ₅ -C ₇	6.5	Aromatic
>C ₇ -C ₈	7.5	Aromatic
>C ₈ -C ₁₀	9.0	Aromatic
>C ₁₀ -C ₁₂	11	Aromatic
>C ₁₂ -C ₁₆	14	Aromatic
>C ₁₆ -C ₂₁	18.5	Aromatic
>C ₂₁ -C ₃₅	28.5	Aromatic
C ₅ -C ₆	5.5	Aliphatic
>C ₆ -C ₈	7.0	Aliphatic
>C ₈ -C ₁₀	9.0	Aliphatic
>C ₁₀ -C ₁₂	11	Aliphatic
>C ₁₂ -C ₁₆	14	Aliphatic
>C ₁₆ -C ₂₁	18.5	Aliphatic

1. Calculation of TRPH Fraction-Specific Physical Properties

Several alternatives for estimating representative physical/chemical properties for each fraction were reviewed by the TPHCWG. They included simple averaging of all available property data, composition-based averaging in which a weighted average of the available property data was computed based on the relative mass of each component in gasoline, and correlation to relative boiling point index in which the properties were developed based on EC values. While all of the approaches had similar results, it was determined that the correlations approach was most useful, because if the definitions of the fractions change, new properties can be easily computed for each fraction.

Utilizing the values correlations approach, the TRPHs are grouped into EC fractions, a method which allows for the calculation of the fate and transport characteristics of solubility (S), organic carbon partition coefficient (K_{oc}) and vapor pressure (VP). While Henry's Law constant (HLC) could also be estimated from a similar type of equation, the TPHCWG determined that using the estimated molecular weights, solubilities and vapor pressures to calculate HLC allowed for internal consistency with the other estimated values. The formulas provided by the TPHCWG (1997a) are as follows:

Aromatics:

$$\begin{aligned}\text{Log } S &= (-0.21 \times \text{EC}) + 3.7 \\ \text{Log } K_{oc} &= (0.10 \times \text{EC}) + 2.3\end{aligned}$$

Aliphatics:

$$\begin{aligned}\text{Log } S &= (-0.55 \times \text{EC}) + 4.58 \\ \text{Log } K_{oc} &= (0.45 \times \text{EC}) + 0.43\end{aligned}$$

Aliphatics and Aromatics

$$\begin{aligned}\text{Log } VP &= (-0.50 \times \text{EC}) + 2.30 \text{ [for } \text{EC} \leq 12] \\ \text{Log } VP &= (-0.36 \times \text{EC}) + 0.72 \text{ [for } \text{EC} > 12]\end{aligned}$$

$$H' \text{ (unitless)} = \frac{\text{Vapor Pressure (atm)} \times \text{Molecular Weight (g/mol)}}{\text{Solubility (mg/L)} \times 8.2 \times 10^{-5} \text{ (atm} \cdot \text{m}^3/\text{mol} \cdot \text{K)} \times 293\text{K}}$$

$$\text{Henry's Law constant (atm} \cdot \text{m}^3/\text{mol)} = H' \text{ (unitless)}/41$$

When diffusivity in air or water was plotted as a function of equivalent carbon number, the TPHCWG found that the values did not vary significantly from compound to compound. Thus, a conservative, reasonable assumption was to set $D_{\text{air}} = 10^{-1} \text{ cm}^2/\text{sec}$ and $D_{\text{water}} = 10^{-5} \text{ cm}^2/\text{sec}$ for all fractions.

Using the models above, the following chemical values for the TRPH fractions have been assigned:

Table C-2

Assigned Chemical Properties of TRPH Fractions Based on an Equivalent Carbon Number (EC)

TRPH Fraction	Avg. EC	Proposed Value				
		HLC (atm-m ³ /mol) ^a	MW (g/mol)	K _{oc} (mL/g) ^b	S (mg/L) ^b	VP (atm) ^b
C ₅ -C ₇ Aromatic	6.5	5.61 E-3	NC	NC	NC	NC
>C ₇ -C ₈ Aromatic	7.5	6.64 E-3	NC	NC	NC	NC
>C ₈ -C ₁₀ Aromatic	9.0	1.17 E-2	1.2 E+2	1.58 E+3	6.5 E+1	6.3 E-3
>C ₁₀ -C ₁₂ Aromatic	11	3.41 E-3	1.3 E+2	2.51 E+3	2.5 E+1	6.3 E-4
>C ₁₂ -C ₁₆ Aromatic	14	1.29 E-3	1.5 E+2	5.01 E+3	5.8 E+0	4.8 E-5
>C ₁₆ -C ₂₁ Aromatic	18.5	3.17 E-4	1.9 E+2	1.58 E+4	6.5 E-1	1.1 E-6
>C ₂₁ -C ₃₅ Aromatic	28.5	1.63 E-5	2.4 E+2	1.26 E+5	6.6 E-3	4.4 E-10
C ₅ -C ₆ Aliphatic	5.5	8.05 E-1	8.1 E+1	7.94 E+2	3.6 E+1	3.5 E-1
>C ₆ -C ₈ Aliphatic	7.0	1.22 E+0	1.0 E+2	3.98 E+3	5.4 E+0	6.3 E-2
>C ₈ -C ₁₀ Aliphatic	9.0	1.93 E+0	1.3 E+2	3.16 E+4	4.3 E-1	6.3 E-3
>C ₁₀ -C ₁₂ Aliphatic	11	2.93 E+0	1.6 E+2	2.51 E+5	3.4 E-2	6.3 E-4
>C ₁₂ -C ₁₆ Aliphatic	14	1.29 E+1	2.0 E+2	5.01 E+6	7.6 E-4	4.8 E-5
>C ₁₆ -C ₂₁ Aliphatic	18.5	1.20 E+2	2.7 E+2	6.30 E+8	2.5 E-6	1.1 E-6

NC: Values for the C₅-C₇ and >C₇-C₈ aromatics, were made to correspond to benzene and toluene, respectively per TPHCWG guidance. Chemical-specific values for these fractions were assumed to be equal to those of benzene and toluene.

^a Henry's Law constant (HLC) calculated using methods described above. Final values rounded to two significant figures.

^b Organic carbon normalized soil-water partition coefficient (K_{oc}), Solubility (S), and Vapor Pressure (VP) values calculated according to formulas in Tables 7, 9, and 12 of TPHCWG 1997a.

Table C-3

Calculated Chemical Properties of TRPH Fractions

TRPH Fraction	Calculated Fraction-Specific Values*		
	D _a (cm ² /sec)	Volatilization Factor** (m ³ /kg)	
		Residential	Industrial
C ₅ -C ₇ Aromatic	2.439E-03	1.408E+03	2.875E+03
>C ₇ -C ₈ Aromatic	1.166E-03	2.037E+03	4.157E+03
>C ₈ -C ₁₀ Aromatic	2.635E-04	4.285E+03	8.748E+03
>C ₁₀ -C ₁₂ Aromatic	4.901E-05	9.935E+03	2.028E+04
>C ₁₂ -C ₁₆ Aromatic	9.338E-06	2.276E+04	4.646E+04
>C ₁₆ -C ₂₁ Aromatic	7.280E-07	8.152E+04	1.664E+05
>C ₂₁ -C ₃₅ Aromatic	4.797E-09	1.004E+06	2.050E+06
C ₅ -C ₆ Aliphatic	1.582E-02	5.530E+02	1.129E+03
>C ₆ -C ₈ Aliphatic	7.966E-03	7.794E+02	1.591E+03
>C ₈ -C ₁₀ Aliphatic	2.060E-03	1.533E+03	3.129E+03
>C ₁₀ -C ₁₂ Aliphatic	4.186E-04	3.400E+03	6.939E+03
>C ₁₂ -C ₁₆ Aliphatic	9.343E-05	7.196E+03	1.469E+04
>C ₁₆ -C ₂₁ Aliphatic	6.933E-06	2.642E+04	5.392E+04

*All calculations carried out to 18 decimal places. Values provided have been rounded for presentation in this table.

**For residential exposure to non-carcinogens, VFs are based on exposure duration of six years. Industrial exposure duration is 25 years.

2. Derivation of TRPH Fraction Toxicological Values

The toxicity values for the various TRPH fractions (Table C-4) were obtained from the TPHCWG (1997b) or were derived from route-to-route extrapolation.

Table C-4
Toxicity Values of TRPH Classes^a

TRPH Fraction	GI absorption (%) ^b	RfD _o (mg/kg-day)	RfD _d (mg/kg-day) ^c	RfD _i (mg/kg-day) ^d
C ₅ -C ₇ Aromatic	90%	0.2	0.180	0.1143
>C ₇ -C ₈ Aromatic	80%	0.2	0.160	0.1143
>C ₈ -C ₁₀ Aromatic	50%	0.04	0.020	0.05714
>C ₁₀ -C ₁₂ Aromatic	50%	0.04	0.020	0.05714
>C ₁₂ -C ₁₆ Aromatic	50%	0.04	0.020	0.05714
>C ₁₆ -C ₂₁ Aromatic	50%	0.03	0.015	0.015 ^e
>C ₂₁ -C ₃₅ Aromatic	50%	0.03	0.015	0.015 ^e
C ₅ -C ₆ Aliphatic	50%	5.0	2.5	5.257
>C ₆ -C ₈ Aliphatic	50%	5.0	2.5	5.257
>C ₈ -C ₁₀ Aliphatic	50%	0.1	0.05	0.2857
>C ₁₀ -C ₁₂ Aliphatic	50%	0.1	0.05	0.2857
>C ₁₂ -C ₁₆ Aliphatic	50%	0.1	0.05	0.2857
>C ₁₆ -C ₃₅ Aliphatic	50%	2.0	1.0	1.0 ^e

^a Toxicity Values from TPHCWG 1997b.

^b Developed using professional judgment based on ATSDR Toxicological Profile for TPH (ATSDR, 1999).

^c RfD_d values extrapolated from RfD_o, using fraction-specific GI absorption (see Appendix B).

^d RfD_i values extrapolated from RfC_i values when available (see Appendix B).

^e RfD_i values extrapolated from RfD_o, using fraction-specific GI absorption (see Appendix B).

3. Derivation of TRPH SCTLs

The TRPH SCTLs are based on a 2-tiered approach. The first tier consists of comparing site total TRPH concentrations to a default TRPH SCTL developed using the toxicity values and other inputs developed for the >C₈-C₁₀ aromatic range. If the default SCTL is exceeded, then the TRPHs may be sub-classified so that each fraction can be compared to its respective fraction-specific SCTL. Given the potential for the sub-classification methodology to yield relatively high SCTLs, it is possible that the human health SCTL for some constituents, particularly those with relatively low toxicity and low mobility potential could result in staining, odor and/or nuisance conditions.

The default TRPH SCTL is based on the >C₈-C₁₀ carbon range as a result of two factors. First, the analytical method identified by the FDEP for the purpose of measuring petroleum hydrocarbons in water and soil is limited to the detection of products within a carbon chain range of C₈-C₄₀. This method, the

Florida Petroleum Residual Organic (FL-PRO) — Alternative Method to Total Petroleum Hydrocarbons, 418.1 or 9073 — combines several of the commonly used methods so that the targeted range of petroleum hydrocarbons can be analyzed in a single step. However, because of its limitations, the smallest detectable C-range using the FL-PRO method is the >C₈-C₁₀ grouping. Secondly, the TRPH SCTL value was selected based on the identification of the most conservative values. The calculation of the SCTLs (listed below) using standard FDEP and USEPA protocols results in the most conservative values for the C₅-C₇ aromatics. However, due to the limitations of the TRPH method of analysis, and since the most toxic and prevalent chemicals within this range are addressed by other analyses and individual SCTLs, the values in this group are not used as TRPH SCTLs. The most conservative values for residential and industrial direct exposure that occur within a carbon range that can be analyzed by FL-PRO are found in the >C₈-C₁₀ aromatics grouping. Therefore, the default TRPH SCTL values are based on this group of total petroleum hydrocarbons.

With the assignment of the above chemical and toxicological values, the determination of risk-based SCTLs follows the same methodology as that used for individual compounds.

Table C-5
Calculated SCTLs for TRPH Fractions

TRPH Fraction	SCTL (mg/kg)		
	Residential	Industrial	Leachability ^a
C ₅ -C ₇ Aromatic	340	1800	34
>C ₇ -C ₈ Aromatic	490	3700	59
>C₈-C₁₀ Aromatic	460	2700	340
>C ₁₀ -C ₁₂ Aromatic	900	5900	520
>C ₁₂ -C ₁₆ Aromatic	1500	12000	1000
>C ₁₆ -C ₂₁ Aromatic	1300	11000	3200
>C ₂₁ -C ₃₅ Aromatic	2300	40000	25000
C ₅ -C ₆ Aliphatic	6200	33000	470
>C ₆ -C ₈ Aliphatic	8700	46000	1300
>C ₈ -C ₁₀ Aliphatic	850	4800	7000
>C ₁₀ -C ₁₂ Aliphatic	1700	10000	51000
>C ₁₂ -C ₁₆ Aliphatic	2900	21000	*
>C ₁₆ -C ₃₅ Aliphatic	42000	280000	*

^a Based on the acceptable concentration of 5000 µg/L for groundwater and surface waters.

* Not a health concern for this exposure scenario.

B. Development of SCTLs for Hydrocarbon Fractions Identified Using the MADEP Approach

As mentioned earlier, the two main advantages of the MADEP approach over the FL-PRO analytical method are that it can quantify petroleum hydrocarbons in the C₅-C₈ range, and it can distinguish between aliphatics and aromatics. Like FL-PRO, the MADEP approach provides an alternative to the determination of TRPHs, which is not particularly useful in health risk assessment.

1. Analytical Methodology

MADEP developed the Volatile Petroleum Hydrocarbons (VPH) and Extractable Petroleum Hydrocarbons (EPH) methods based on USEPA analytical approaches that have traditionally used the purge and trap method for the analysis of volatile organics, and solvent extraction for the semi-volatile/extractable organics. The use of two approaches to determine petroleum hydrocarbons is needed because neither approach alone is capable of measuring petroleum compounds in all of the hydrocarbon ranges of interest. The MADEP approach breaks up the C₉-C₁₈ aliphatic range (despite the fact that compounds in this range are considered to be relatively consistent in terms of toxicity) to enable detection of all gasoline-range hydrocarbons by the VPH method. As a result, the aliphatic and aromatic hydrocarbons are divided into six separate ranges, three detected by the VPH method, and three by the EPH method, as follows:

Table C-6
Hydrocarbon Fractions Identified Using the MADEP Methodology

Toxicologically Defined Hydrocarbon Fractions	Analytically Defined Hydrocarbon Fractions	Analytical Method
C ₉ -C ₂₂ Aromatics	C ₉ -C ₁₀ Aromatics	VPH
	C ₁₁ -C ₂₂ Aromatics	EPH
C ₅ -C ₈ Aliphatics	C ₅ -C ₈ Aliphatics	VPH
C ₉ -C ₁₈ Aliphatics	C ₉ -C ₁₂ Aliphatics	VPH
	C ₉ -C ₁₈ Aliphatics	EPH
C ₁₉ -C ₃₆ Aliphatics	C ₁₉ -C ₃₆ Aliphatics	EPH

The MADEP VPH method is a purge and trap procedure. The collective concentrations of hydrocarbon fractions can be quantified in solid and aqueous matrices. This method is comparable to the Gasoline Range Organics (GRO) method, because both detect hydrocarbons in the C₅-C₁₂ range. The VPH goes one step further and separates the GRO fraction into 3 subfractions (see Table C-6 above) and also provides specific measurements of six target compounds: benzene, toluene, ethylbenzene, xylenes

(BTEX), methyl tert-butyl ether (MTBE), and naphthalene. Detection is achieved by a photoionization detector (PID) and flame ionization detector (FID) working in series. The PID chromatogram is used to determine the collective fractional concentration of aromatic hydrocarbons in the C₉-C₁₀ range. Because the PID can detect sample analytes without destroying them, compounds can then pass through the FID where they are combusted in a hydrogen flame. In theory, the FID will detect the total concentrations of all petroleum hydrocarbons in the sample, and the PID will detect only aromatic compounds. Aliphatic compounds can then be quantified by subtracting the PID response from the FID response.

Two potential problems have been identified for the use of the VPH method:

1. Given that the PID detects both *Pi* and double carbon bonds, alkenes will be falsely quantitated as aromatics. This is not considered a major methodological limitation because alkenes are not typically found in high concentration in most petroleum products, and because they are more toxicologically similar to aromatics than to aliphatics.
2. Some aliphatic compounds, especially heavier molecular weight branched and cyclic alkenes will produce some response on the PID detector. This response can lead to significant over-quantitation of the aromatic fraction when dealing with products such as kerosene and Jet A fuel, which contain predominantly aliphatic compounds within this range.

The MADEP EPH method is a solvent extraction/fractionation gas chromatography (GC) / FID procedure. The EPH method can be viewed as directly comparable to the TPH USEPA Method 418.1. Like the TPH, the EPH method quantitates hydrocarbons > C₉ in solid and aqueous samples. In addition, the EPH method separates the TPH fraction into three subfractions (see Table C-6 above) and measures 17 targeted PAH compounds. Samples are extracted with methylene chloride, exchanged into hexane, and loaded onto silica gel. The silica gel is first rinsed with hexane to strip aliphatic compounds, and then with methylene chloride to strip aromatic compounds. Both extracts are then analyzed separately by direct injection into a temperature-programmed GC/FID.

Two methodological elements should be considered when evaluating EPH data:

1. Small errors during the fractionation between aromatic and aliphatic compounds can result in significant over- or underestimation of aromatic and aliphatic ranges. For this reason, the method specifies the use of a *Fractionation Check Solution* to verify proper separation of the aliphatic and aromatic fractions.
2. Laboratories using the EPH method must use a *forced projected baseline* when integrating chromatographic areas of fractional ranges. This means that, when quantifying peak areas by internal or external calibration, the collective peak area integration for the fractional ranges must be from baseline. This is necessary because, like any GC/FID procedure, the EPH method may produce an Unresolved Complex Mixture (UCM), particularly when analyzing weathered products. This UCM is produced when many individual hydrocarbons are eluting from the capillary column at the same time, preventing the detector signal from returning to baseline. If a forced projected baseline is not used, resultant fractional range data may significantly under-report true hydrocarbon concentrations.

2. Development of Cleanup Target levels

This section describes the procedures used to develop Cleanup Target Levels (CTLs) for the petroleum hydrocarbon fractions identified using the MADEP methodology. Although MADEP has developed CTLs for residential and industrial scenarios (S1 and S2 standards), the different climatic conditions between Massachusetts and Florida preclude their direct use. In addition, MADEP has decided to use ceiling criteria based on professional judgment and, as a result, most of their CTLs are not health-based.

All exposure assumptions used in these calculations are consistent with Chapter 62-777, F.A.C. GI absorption was estimated as 50% for all fractions using professional judgment based on the 1999 ATSDR toxicological profile for TPH (1999).

a) Toxicity values

Reference Doses (RfDs) used were those developed by the TPHCWG for fractions that encompass similar ranges of hydrocarbons to those identified by the MADEP methodology. This approach for developing RfDs is consistent with SCTLs based in TPHCWG fractions, and is based on a combination of approaches including the assessment of toxicity of mixtures and the use of surrogate chemicals representative of the fractions under study. It must be noted that MADEP has developed RfDs for use

with the fractions defined by their method using surrogate compounds for each fraction. Oral reference doses (RfD_o) used by MADEP are for the most part either similar or higher than the RfDs developed by the TPHCWG (1997b). Inhalation RfDs (RfD_i) were calculated from Reference Concentrations (RfC) when available, or extrapolated from RfD_os, assuming that GI absorption is 50%. Dermal RfDs (RfD_d) were extrapolated from RfD_o using also a GI absorption value of 50%.

Table C-7
Reference Doses Used for Developing CTLs for Hydrocarbons
Identified Using the MADEP Approach

MADEP Fraction	Comparable TPHCWG Fraction	RfD_o (mg/kg-day)	RfD_d (mg/kg-day)	RfD_i (mg/kg-day)
Aromatics				
C ₉ -C ₁₀	>C ₈ -C ₁₀	0.04	0.02	0.05714
C ₁₁ -C ₂₂	>C ₁₂ -C ₁₆	0.04	0.02	0.05714
Aliphatics				
C ₅ -C ₈	>C ₆ -C ₈	5.0	2.5	5.257
C ₉ -C ₁₂	>C ₁₀ -C ₁₂	0.1	0.05	0.2857
C ₉ -C ₁₈	>C ₁₂ -C ₁₆	0.1	0.05	0.2857
C ₁₉ -C ₃₆	>C ₁₆ -C ₃₅	2.0	1.0	1.0

b) Physical-Chemical Properties

To conduct fate and transport evaluations/modeling, we used the approaches and procedures set forth in the document *Volume 3: Selection of Representative TPH Fractions Based on Fate and Transport Considerations* (TPHCWG, 1997a). Chemical-physical properties for each fraction were calculated using the correlation approach using the average Equivalent Carbon Number (EC) as the independent variable. The fraction-specific chemical-physical properties presented in the table below were obtained from MADEP (1997), except for the aliphatic C₁₉-C₃₆ fraction, for which data for the C₁₆-C₂₁ fraction from the TPHCWG were used. MADEP has assumed that this fraction is immobile. However, this assumption may not be valid for compounds at the lighter end of this fraction, and therefore the more conservative approach of using data for the C₁₆-C₂₁ fraction provided by the TPHCWG has been adopted.

Table C-8
Physical-Chemical Properties Assigned to MADEP Fractions
Based on Equivalent Carbon Number (EC)

Range of Carbons	Avg. EC	MW (g/mol)	VP (atm)	S (mg/L)	Henry's Law Constant	Koc (mL/g)	D (cm²/s)
C ₉ -C ₁₀ Aromatics	9.5	120	2.9 E-3	51	0.33	1778	0.07
C ₁₁ -C ₂₂ Aromatics	14	150	3.2 E-5	5.8	0.03	5000	0.06
C ₅ -C ₈ Aliphatics	6.5	94	1.0 E-1	11	54	2265	0.08
C ₉ -C ₁₂ Aliphatics	10.5	149	8.7 E-4	0.07	65	1.5 E+5	0.07
C ₉ -C ₁₈ Aliphatics	12	170	1.4 E-4	0.01	69	6.8 E+5	0.07
C ₁₉ -C ₃₆ Aliphatics	18.5*	270	1.1E-6	2.5E-6	4900	6.3E+8	6.9E-6

*EC and derived physical / chemical properties correspond to those of the surrogate TPHCWG C16-C21 fraction (see text above).

3. SCTLs for Petroleum Hydrocarbon Fractions Identified Using the MADEP Approach

The following tables present the CTLs developed to evaluate laboratory results that use the MADEP approach for fractionation of TRPHs. In some instances, MADEP laboratory results may include Benzene, Toluene, Ethylbenzene, Xylene, MTBE, and individual PAH concentrations. However, this method has not been approved for quantification of these compounds in Florida. CTLs for the comparable fractions identified using the TPHCWG methodology are also provided. Leachability values were calculated using 5000 µg/L as the groundwater and surface water acceptable concentration.

Table C-9
Direct Exposure and Leachability Soil CTLs for TRPH Fractions
Identified Using the MADEP and the TPHCWG Methodologies

MADEP Fraction	Comparable TPHCWG Fraction	MADEP Fraction Residential Soil CTL (mg/kg)	TPHCWG Fraction Residential Soil CTL (mg/kg)	MADEP Fraction Industrial Soil CTL (mg/kg)	TPHCWG Fraction Industrial Soil CTL (mg/kg)	MADEP Fraction Leachability Soil CTL (mg/kg)	TPHCWG Fraction Leachability Soil CTL (mg/kg)
Aromatics							
C ₉ -C ₁₀	>C ₈ -C ₁₀	560	460	3400	2700	380	340
C ₁₁ -C ₂₂	>C ₁₂ -C ₁₆	1800	1500	15000	12000	1000	1000
Aliphatics							
C ₅ -C ₈	>C ₆ -C ₈	7100	8700	38000	46000	960	1300
C ₉ -C ₁₂	>C ₁₀ -C ₁₂	1700	1700	11000	10000	31000	51000
C ₉ -C ₁₈	>C ₁₂ -C ₁₆	2900	2900	21000	21000	140000	1000000
C ₁₉ -C ₃₆	>C ₁₆ -C ₂₁	42000	42000	280000	280000	1000000	1000000