FIELD SUMMARY REPORT FOR THE CHEMICAL OXIDATION TREATABILITY STUDY ACTIVITIES AT INSTALLATION RESTORATION SITE 25

ALAMEDA POINT
ALAMEDA, CALIFORNIA

Environmental Remedial Action
Contract Number N62474-98-D-2076
Contract Task Order 0076

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January 31, 2003

Submitted to:

Department of the Navy
Southwest Division
Naval Facilities Engineering Command
Environmental Division
1220 Pacific Highway
San Diego, California 92132-5190

Submitted by:

IT Corporation
1045 Jadwin Avenue, Suite C
Richland, Washington 99352

DEPARTMENT OF THE NAVY
SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
1220 PACIFIC HIGHWAY
SAN DIEGO, CA 92132 - 5190

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January 31, 2003

Ms. Anna-Marie Cook
US Environmental Protection Agency
Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Dear Ms. Cook:

This letter transmits the *Field Activity Summary Report for the Chemical Oxidation Treatability Study Activities at Installation Restoration Site 25 Alameda Point, Alameda, California.* The document provides a summary of the evaluation of the potential to use chemical oxidation to remediate PAH-contaminated soils at Site 25 and is transmitted for your information. Navy is not anticipating agency review and comment on the document since the technology was not proven to be effective and will not be considered for Site 25 remediation.

Please feel free to contact me if you have questions.

Sincerely,

RICHARD C. WEISSENBORN, P.E.
Remedial Project Manager

Encl: (1) *Field Activity Summary Report for the Chemical Oxidation Treatability Study Activities at Installation Restoration Site 25 Alameda Point, Alameda, California*

Copy to:
Ms. Marcia Liao
Department of Toxic Substances Control
700 Heinz Avenue, Suite 200
Berkeley, CA 94710-2721

Ms. Judy Huang
San Francisco Bay Regional Water Quality Control Board
1515 Clay Street, Suite 1400
Oakland, CA 94612

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Acronyms and Abbreviations

ASTM	ASTM International
bgs	below ground surface
EPA	U.S. Environmental Protection Agency
IDW	investigation-derived waste
$KMnO_4$	potassium permanganate
mg/kg	milligram(s) per kilogram
$NaHSO_3$	sodium bisulfite
PAH	polynuclear aromatic hydrocarbon
PRG	preliminary remediation goal
SOD	soil oxidant demand
VOC	volatile organic compound

1.0 Introduction

This report documents the in-situ chemical oxidation field treatability study activities conducted by IT Corporation for the U.S. Navy at Installation Restoration Site 25 at Alameda Point, Alameda, California (Figure 1-1, "Site Location Map, Chemical Oxidation Treatability Study"). The treatability study targeted the shallow soils, which consisted of fill material used to create Alameda Island (where there were historically marshes or shallow bay). These fill materials have been identified as being contaminated with polynuclear aromatic hydrocarbons (PAH).

The field treatability study activities were conducted at Parcel 182, which comprises the area currently defined as Estuary Park (Figure 1-2, "Chemical Oxidation Treatability Study Site Map"). Between 1947 and 1966, the area was used for residential purposes and contained barracks-type housing. These buildings were reportedly demolished sometime between 1966 and 1970 (ERM-West, 1995). A currently used office building (Building 534) was constructed sometime between 1990 and 1992, in the southernmost portion of Parcel 182. No chemical spills or releases were documented within Parcel 182 (ERM-West, 1995).

1.1 Purpose and Objectives

The field treatability study was designed primarily to assess the following key technical issues:

- The attainable level of PAH treatment under conditions that mimic a potential full-scale application scenario
- The appropriate approach for subsurface delivery of potassium permanganate ($KMnO_4$) to the shallow soil
- The application dose of $KMnO_4$ that is required for treatment.

1.1.1 Evaluate Treatment Effectiveness

The principal goal of the treatability study was to evaluate the effectiveness of in-situ treatment of PAH-contaminated soil. Treatment effectiveness was measured by sampling and analysis of PAH concentrations in soil over time. Polynuclear aromatic hydrocarbon treatment effectiveness was evaluated in terms of PAH mass destruction, percent reduction, and residual PAH concentrations. The treatability study also assessed the rate of treatment and the overall duration required for treatment.

IMAGE	X-REF	OFFICE	DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
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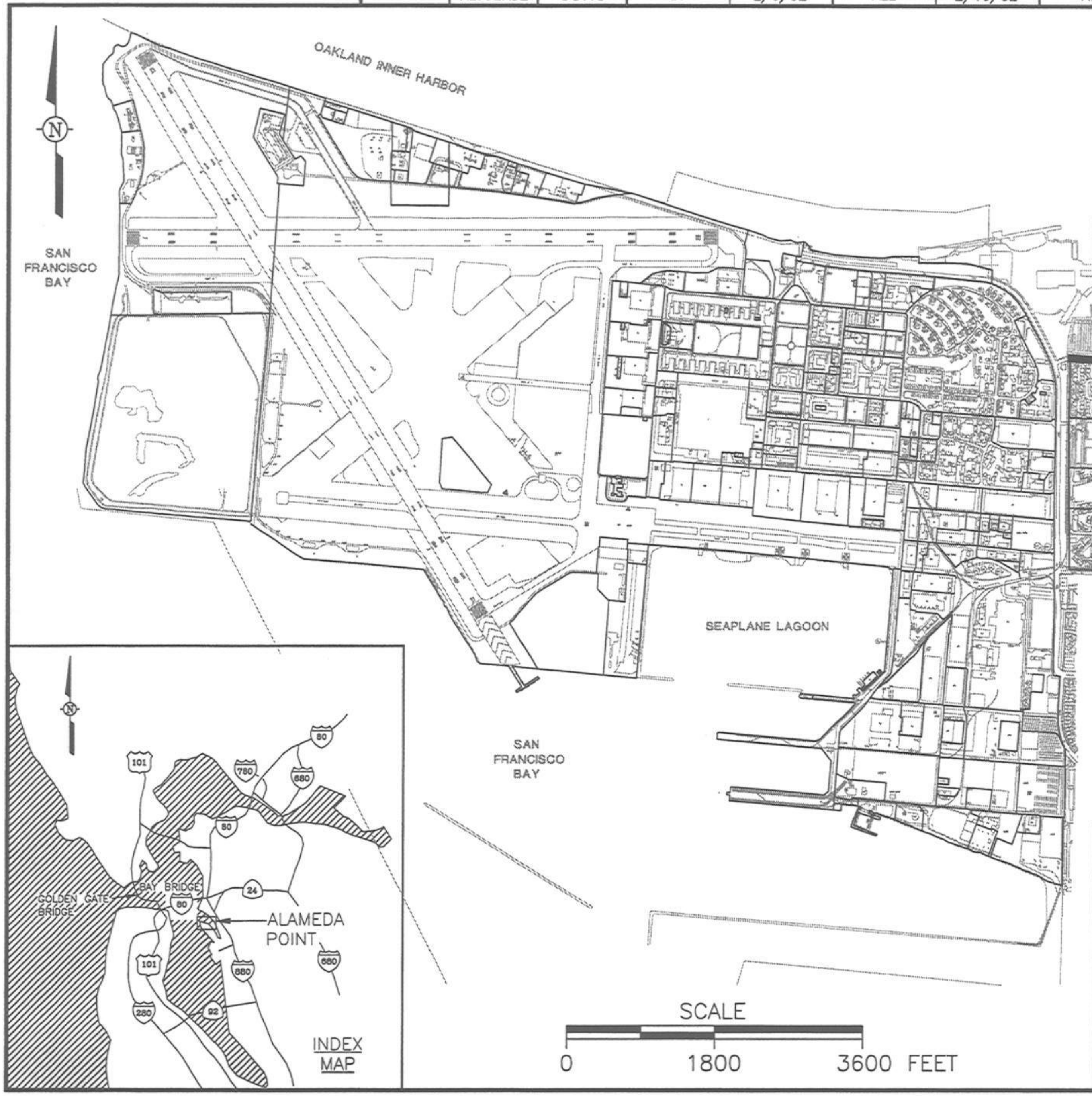

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SAN DIEGO, CALIFORNIA

FIGURE 1–1

SITE LOCATION MAP
CHEMICAL OXIDATION TREATABILITY STUDY

ALAMEDA POINT, CTO 078
ALAMEDA, CALIFORNIA

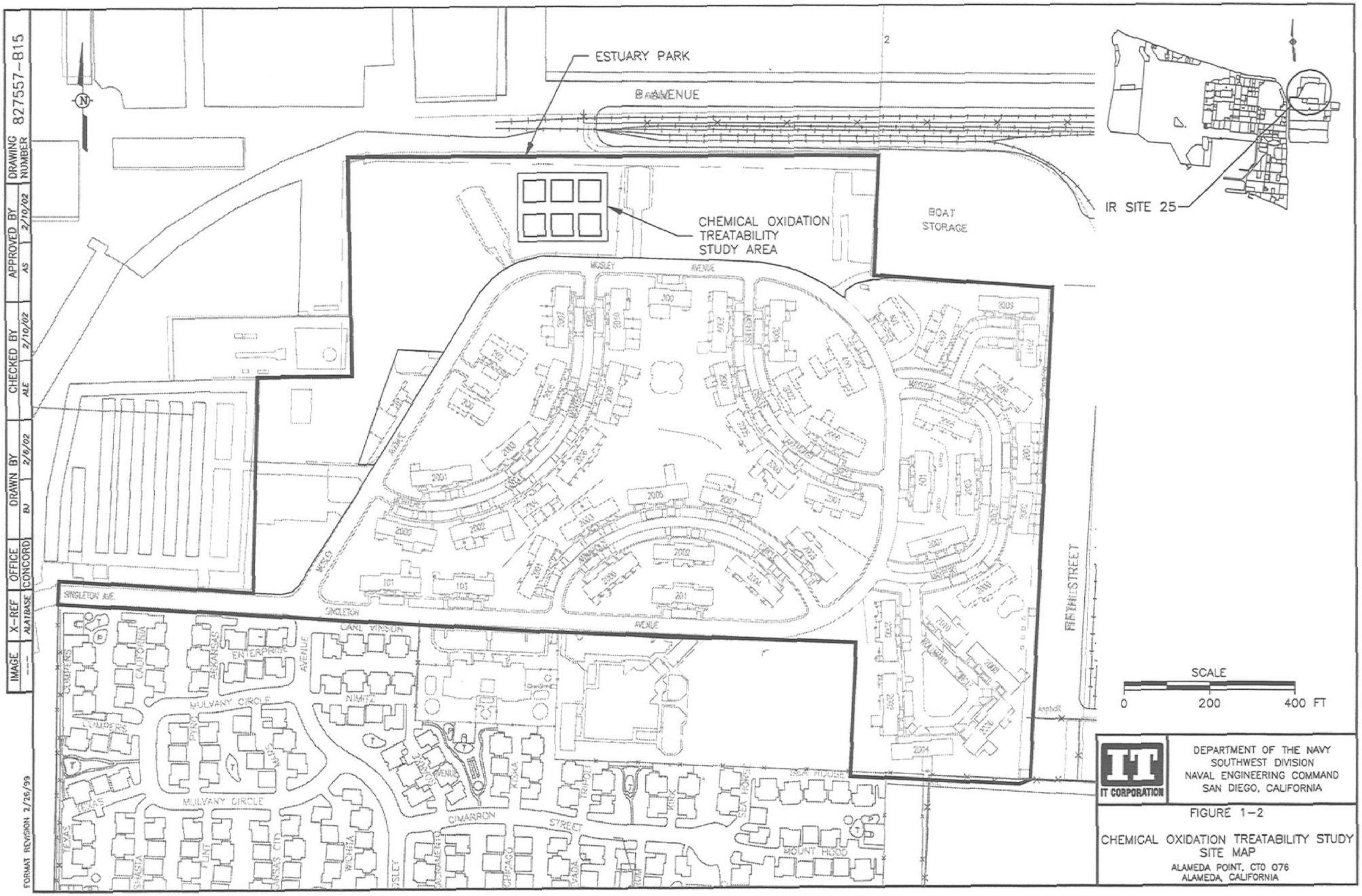


FIGURE 1-2

CHEMICAL OXIDATION TREATABILITY STUDY SITE MAP

ALAMEDA POINT, CTO 076
ALAMEDA, CALIFORNIA

1.1.2 Evaluate Permanganate Delivery Methods

Another important goal of the treatability study was to evaluate several options for how to contact oxidants with the contaminants. This is important because successful treatment requires uniform and predictable distribution of the $KMnO_4$ in the soil requiring treatment. The treatability study evaluated three methods of $KMnO_4$ delivery that might be logistically and technically feasible at the site. The delivery methods evaluated included the following:

- Shallow subsurface injection using driven injection points
- Application and mixing of solid permanganate crystals into the shallow soil by tilling
- Surface irrigation of permanganate solution.

These methods are discussed further in Section 3.0.

1.1.3 Evaluate Permanganate Dose Requirements

The final goal of the treatability study was to evaluate the $KMnO_4$ dose that was required for PAH treatment at the site. The $KMnO_4$ dose was evaluated in terms of the mass (grams) of $KMnO_4$ required per mass (kilogram) of soil. This information is important to provide a basis for evaluating full-scale treatment costs as well as to provide a basis for design of full-scale treatment systems.

1.2 Statutory Authority and Other Requirements

In September 1993, Naval Air Station Alameda (now referred to as Alameda Point) was designated for closure in accordance with the Base Closure and Realignment Act of 1988 and the Defense Base Closure and Realignment Act of 1990, as amended by the National Defense Authorization Act for Fiscal Year 1992 and 1993, collectively referred to as the Base Realignment and Closure. The Alameda Point Base Realignment and Closure Cleanup Plan addresses the status and strategy developed for the fast-track cleanup portion of the present program. The key elements of fast-track cleanup include establishing a cleanup team at every base; making clean parcels available for civilian use as quickly as possible; and accelerating the National Environmental Policy Act process, which analyzes the potential environmental consequences of the proposed community reuse plan. Alameda Point was added to the National Priorities List in July 1999. The listing was the result of evaluation of environmental data using the Hazard Ranking System.

This treatability study was conducted in support of the on-going remedial investigation/feasibility study for Installation Restoration Site 25 at Alameda Point. The

U.S. Navy is the lead federal agency responsible for the direction and conduct of this work. The U.S. Environmental Protection Agency (EPA), the California Environmental Protection Agency – Department of Toxic Substances Control, and the Regional Water Quality Control Board provide regulatory oversight and support to the Comprehensive Environmental Response, Compensation, and Liability Act process.

2.0 Field Treatability Study Activities

The goals of the field treatability study were to evaluate the treatment effectiveness, delivery methods, and dose requirements associated with in-situ oxidation of polynuclear aromatic hydrocarbon (PAH) contaminants with potassium permanganate ($KMnO_4$) in the upper 4 feet of soil at the site.

The treatability study mimicked conditions that might be practical for full-scale application. Three sets of test cells were constructed, each test cell was 50 feet long by 50 feet wide. This size was selected because the backyards of the Coast Guard housing apartments are approximately these dimensions. Three $KMnO_4$ delivery methods were tested side-by-side for effectiveness in removing PAH contamination, logistical implementation, and control of the delivered solutions. Control cells were watered and handled in the same manner as the test cells.

The main field activities of the treatability study included:

- Plans and notification
- Mobilization and preparatory activities
- Equipment and site control
- Underground utility clearance
- Preferential pathway investigation
- Test cell construction and maintenance
- Installation of data acquisition equipment
- Chemical application and storage
- Surveying
- Demobilization and site restoration
- Field documentation
- Investigation-derived waste disposal.

Field testing activities commenced in August 2001 and completed in November 2001. However, site restoration was not completed until April 18, 2002, with the removal of the temporary site fencing. These activities are described in detail in the following sections.

2.1 Plans and Notification

Planning and agency notifications were key phases needed for preparing for the field activities. The activities performed as part of this treatability study were conducted in accordance with the approved Chemical Oxidation Treatability Study Work Plan (Work Plan) (IT, 2001) and the IT Corporation Standard Operating Procedures (IT, 2000). Additionally, the Alameda County

Public Works Agency, Water Resources Section was notified of the planned drilling activities. The City of Alameda Fire Department rescue services and hazardous materials storage divisions were also notified of the treatability study activities and any associated potential hazards.

2.2 Mobilization and Preparatory Activities

This phase of work involved the mobilization of personnel, equipment, chemicals, general supplies, and the support trailer to the work area. Also included in the mobilization efforts were subsurface hazard clearance and installation of fencing and other security measures. Heavy equipment used on site during the installation of the temporary fencing, test cells, and piezometers were inspected for leaks and proper maintenance prior to use as described in the Work Plan (IT, 2001).

2.3 Equipment and Site Control

A subcontractor installed fencing around the test area perimeter. The fence was equipped with a single strand of barbed wire (located across the top of the fence) and a locking access gate. Lining the fence with nylon mesh fabric reduced the potential for dust migration off-site. The green nylon mesh also minimized the visual impact to residents.

The mobile support trailer was utilized for office and field laboratory space. The support trailer was also used for storage of health and safety equipment, groundwater and soil sampling equipment, and the field test kits and supplies. A generator was used to supply the support trailer and $KMnO_4$ mixing system with electricity.

The $KMnO_4$ mixing system consisted of a pump and eductor skid, manifold, two 1,800-gallon polyethylene mix tanks, and related equipment. The mixing system was mobilized to the former Naval Air Station Alameda from a previous Navy $KMnO_4$ treatability testing location at Hunters Point, California. Equipment assembly associated with the mixing skid system included the reconnection of tanks, hoses, pumps, and piping on the skid. Maintenance and repairs were completed on the skid and manifold prior to mixing $KMnO_4$ solution for the treatability study.

Chemicals pertaining to the treatability study were delivered to the site by the chemical vendor and immediately placed within the secured work area. Potassium permanganate and sodium bisulfite ($NaHSO_3$) were the only two chemicals utilized in bulk during the study. Other chemicals were used in small quantities for sample preservation and field tests. All chemicals used during the treatability study were stored on-site as described in Section 2.7.

2.4 Underground Utility Clearance

Underground utility clearance was performed in three steps. First, the location of an intrusive activity was marked in white paint. Next, the Underground Service Alert system was notified so that major utility companies would mark in-service utilities. Finally, a private geophysical locator was contracted to scan the work areas for evidence of buried objects.

The location of all borings, temporary fence posts, and test cells were marked on the ground using waterproof paint by IT Corporation representatives. Underground Service Alert marked the locations of known utilities within the testing area prior to invasive activities being conducted at the site. Land surface utility clearances were conducted by a subcontractor to locate subsurface drilling hazards in the vicinity of each proposed boring location and test cell. All suspected underground utilities, conduits, and structures were clearly marked with appropriately colored marking paint. The IT Corporation subcontractor cleared a minimum 10-foot radius around each boring or test cell location.

The park irrigation system laterals and main were identified and marked. The subsurface electrical lines associated with the park's irrigation system were also detected and marked. These electrical lines were used to control the automatic sprinkler system in the treatability study area. The irrigation system water and control lines appeared to be buried in the same trench. Some arbitrary sections of metal were also identified in the test area during the site survey. However, these sections were not part of a complete network of piping and appeared to have been abandoned in-place.

2.5 Preferential Pathway Investigation

Prior to initiating the treatability study, extensive research was conducted to identify potential preferential pathways for the migration of $KMnO_4$ out of the treatability study area. Records and drawings from the East Bay Municipal Utility District and Naval Station Alameda historic files were reviewed to identify any potential pathways leading to site storm sewers, sanitary sewers, or directly into the bay. A "white paper" detailing the literature search is presented as Appendix A.

Historic information indicated that the site previously contained barrack-type-housing units that were demolished sometime between 1966 and 1970. No utility drawings were located for the barracks. No conduits were identified that might act as preferential pathways for $KMnO_4$ migration out of the test area. Historic borings logs for the Estuary Park-area were also reviewed for potential preferential pathways. These logs indicated that shallow soils were fine sand with varying degrees of clay and silt. The soil tended to become coarser with increasing depth towards the water table. In addition, the area between the treatability study and San Francisco Bay was inspected for evidence of potential preferential pathways. Finally, exposed soil and soil cores were observed for indications of undetected buried pipes or other potential preferential migratory pathways during test cell construction and equipment installation.

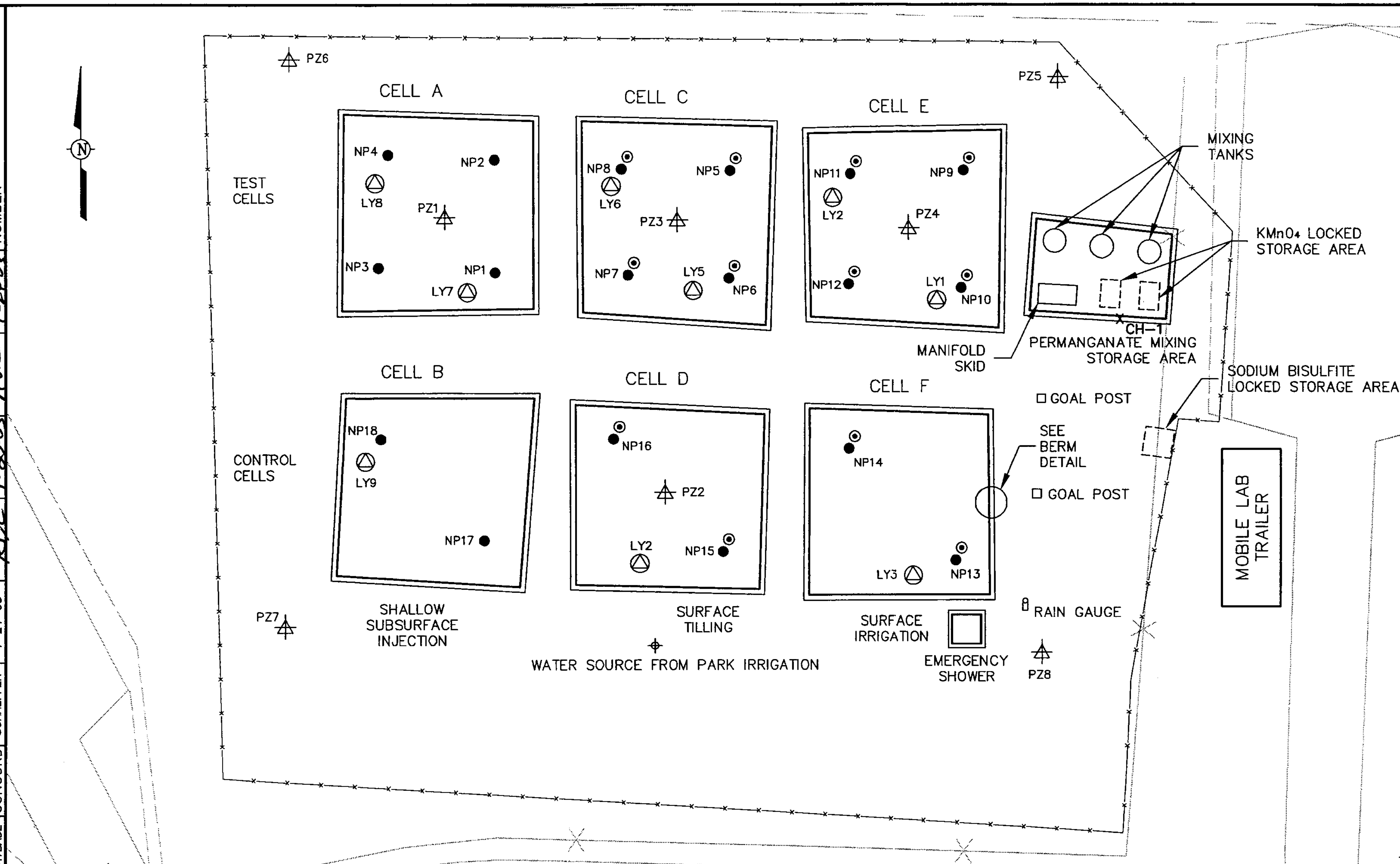
2.6 Test Cell Construction and Maintenance

The treatability study test area consisted of six test cells, three of which were treatment cells and three that were control cells. Each of the test cells was approximately 50-feet by 50-feet (Figure 2-1, "Chemical Oxidation Treatability Study Cell Layout Detail"). Each test cell was cleared of surface vegetation and enclosed within a 2-foot high berm.

The first stage of cell construction consisted of clearing and grubbing the area that was to be utilized for the tests. The test area had numerous sprinkler heads, control boxes, and irrigation piping throughout the vicinity. The majority of the irrigation piping in the test area was approximately 4 feet below ground surface (bgs). The objective of the treatability study was to evaluate the use of $KMnO_4$ to treat PAH-contaminated soil to a maximum depth of approximately 4-feet bgs within a controlled area at Installation Restoration Site 25. The oxidant delivery methods were expected to be implemented no deeper than 3-feet bgs. Therefore, the irrigation piping was not likely to pose an obstruction to any of the chemical delivery methods proposed for the treatability study and was left in place. The irrigation system did not extend beyond the limits of the treatability study area; therefore, it did not pose threat as a preferential pathway. Sprinkler heads and control boxes were removed prior to test cell construction.

Sod was removed from the test cells and temporarily stockpiled on visqueen sheeting in the secured work area. The sod was ultimately rototilled and then reused for berm construction. The soil berms were constructed by first placing heavy plastic sheeting on the ground around the perimeter of the test cells. The tilled sod was then placed on the plastic sheeting and the plastic sheeting rolled into 1 foot to 2-foot high soil-filled berms (Figure 2-1).

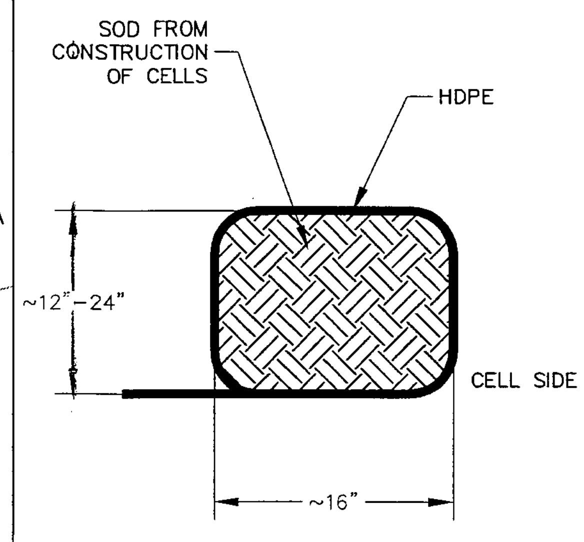
The main water line for irrigation was tapped to provide water for worker safety and treatability study activities such as for the safety shower, chemical mixing, and equipment decontamination. Irrigation water to the surrounding area was unaffected. Grassy areas within the secured area were regularly watered to minimize impacts of the study and minimize the potential for dust creation.



CELL LAYOUT DETAIL

SCALE

0 30 60 FEET



BERM DETAIL

SCALE

0 1 2 FEET

LEGEND

X	SAMPLE COLLECTED DURING OU–5 REMEDIAL INVESTIGATION
	LYSIMETER LOCATION
	NEUTRON PROBE LOCATION AND BASELINE SOIL SAMPLE LOCATION FOR PAHs AND Mn
	1–MONTH SOIL SAMPLE LOCATION
	PIEZOMETER LOCATION
	RAIN GAUGE
	GOAL POST
	WATER SOURCE
	BERM
	TRAILER
	MANIFOLD SKID
	STORAGE CONTAINER
KMn04	POTASSIUM PERMANGANATE
	FENCE
PAH	POLYCYCLIC AROMATIC HYDROCARBONS
Mn	MANGANESE

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SAN DIEGO, CALIFORNIA

FIGURE 2–1

CHEMICAL OXIDATION TREATABILITY STUDY
CELL LAYOUT DETAIL
ALAMEDA POINT, CTO 076
ALAMEDA, CALIFORNIA

DRAWING NUMBER	APPROVED BY	CHECKED BY	DRAWN BY	OFFICE	X-REF	IMAGE
827557–B16	AWS 1-24-03	RDL 1-23-03	SCHAEFFER 1-24-03	CONCORD	ALA1BASE	---

High winds, sun exposure, and rain throughout the duration of the treatability study made it necessary to continually maintain the berms. Maintenance included visual inspection of the berms, the addition of sandbags to prevent the plastic from blowing in the wind, patching small seeps at the seams of the berm, and retaping worn seams.

The treatment cells were covered with large nylon tarps during nonworking hours. The covers were designed to allow control of evaporation, minimize visual impacts, and to prevent animal exposure to $KMnO_4$. The control cells were also covered with nylon tarps to mimic the environment established in the treatment cells.

A berm (consisting of plastic sheeting and straw bales) was also created around the mixing skid to provide secondary containment for tanks containing $KMnO_4$ solution, as well as water resulting from the cleaning and maintenance of the skid. The berm around the mixing skid was filled with 25-pound bags of Solidisorb wrapped in high-density polyethylene plastic sheeting. This watertight containment area controlled any potential spills or leaks from the mixing system during storage, operation, or maintenance.

2.7 Chemical Application and Storage

The chemicals that were used in bulk and stored on site were $KMnO_4$ and $NaHSO_3$. The $KMnO_4$ was used as the chemical oxidizer and stored as a solid. Sodium bisulfite was used for neutralizing the $KMnO_4$ and was stored as 25 percent and 8 percent solutions. Additional chemicals, such as hydrogen peroxide, were used only in minute quantities for laboratory and field analyses.

The $KMnO_4$ was delivered to the site and stored in 5-gallon plastic buckets. The $KMnO_4$ was stored in locked containment pallets to restrict access to the oxidant. During the surface application technique, excess $KMnO_4$ solution was stored in the 1,800-gallon mixing tanks of the mixing system containment area. The valves on these tanks were covered and locked during nonworking hours.

The $NaHSO_3$ was stored in a locked containment pallet approximately 25 feet from the $KMnO_4$ mixing skid. This pallet held two drums of a 25 percent $NaHSO_3$ solution. The first drum of $NaHSO_3$ was used to neutralize $KMnO_4$ during decontamination of equipment, personal protective equipment, and chemical containers. The second drum was staged at the site to be used for emergency response in the event of an unintended release of $KMnO_4$. The 25 percent $NaHSO_3$ solution was diluted down to create two drums of 8 percent $NaHSO_3$ solution for neutralization of $KMnO_4$. The drums containing the 8 percent $NaHSO_3$ solution were also stored in the locked containment pallet. All other laboratory or field analysis chemicals were locked in the office/laboratory trailer during nonworking hours.

2.8 Installation of Data Acquisition Equipment

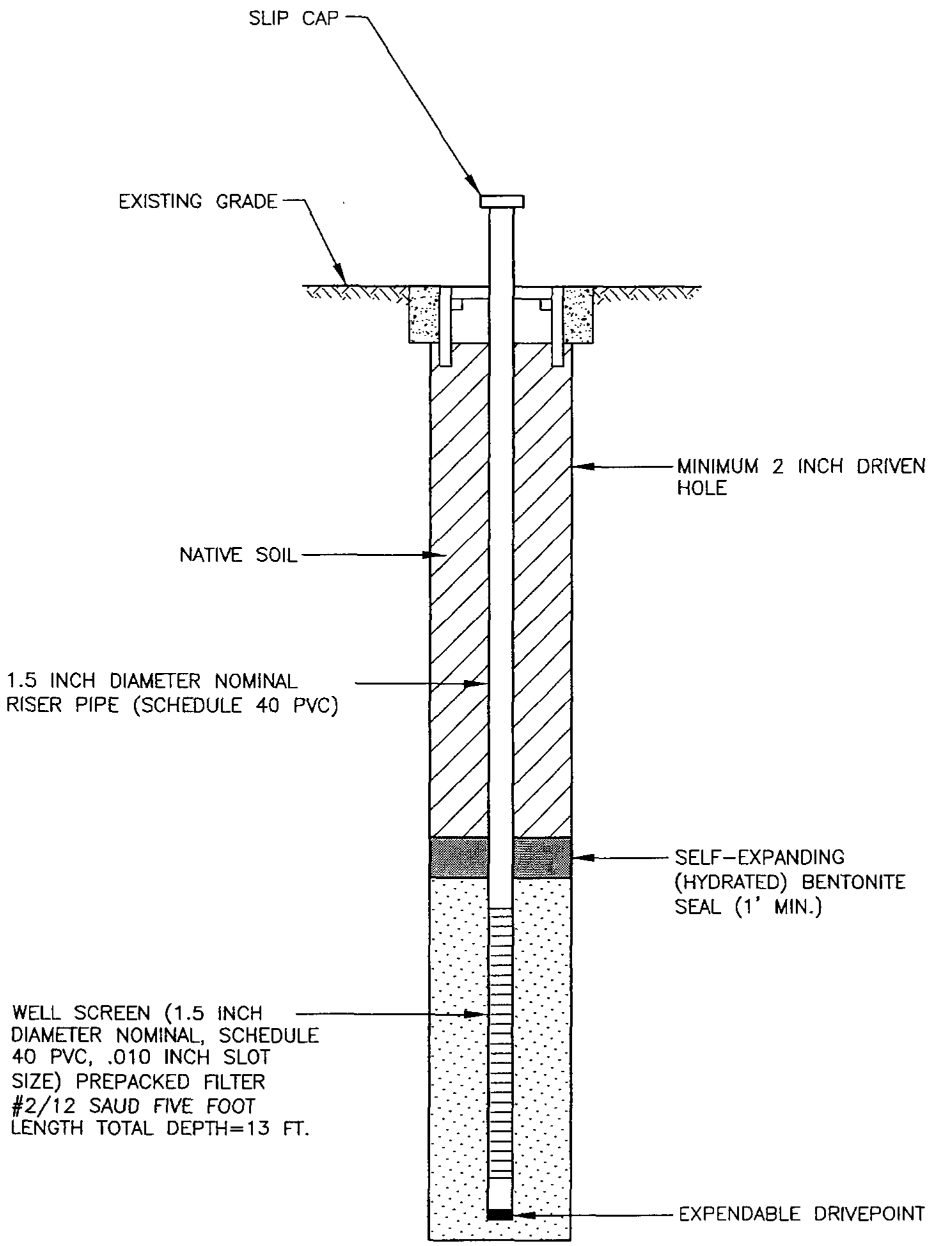
Temporary data acquisition equipment was installed in the treatability testing study area. This equipment allowed the collection of groundwater, soil pore water, and soil data throughout the treatability study. The temporary equipment included:

- Piezometers for groundwater monitoring
- Lysimeters for pore water sampling
- Access casings for the soil moisture measurements.

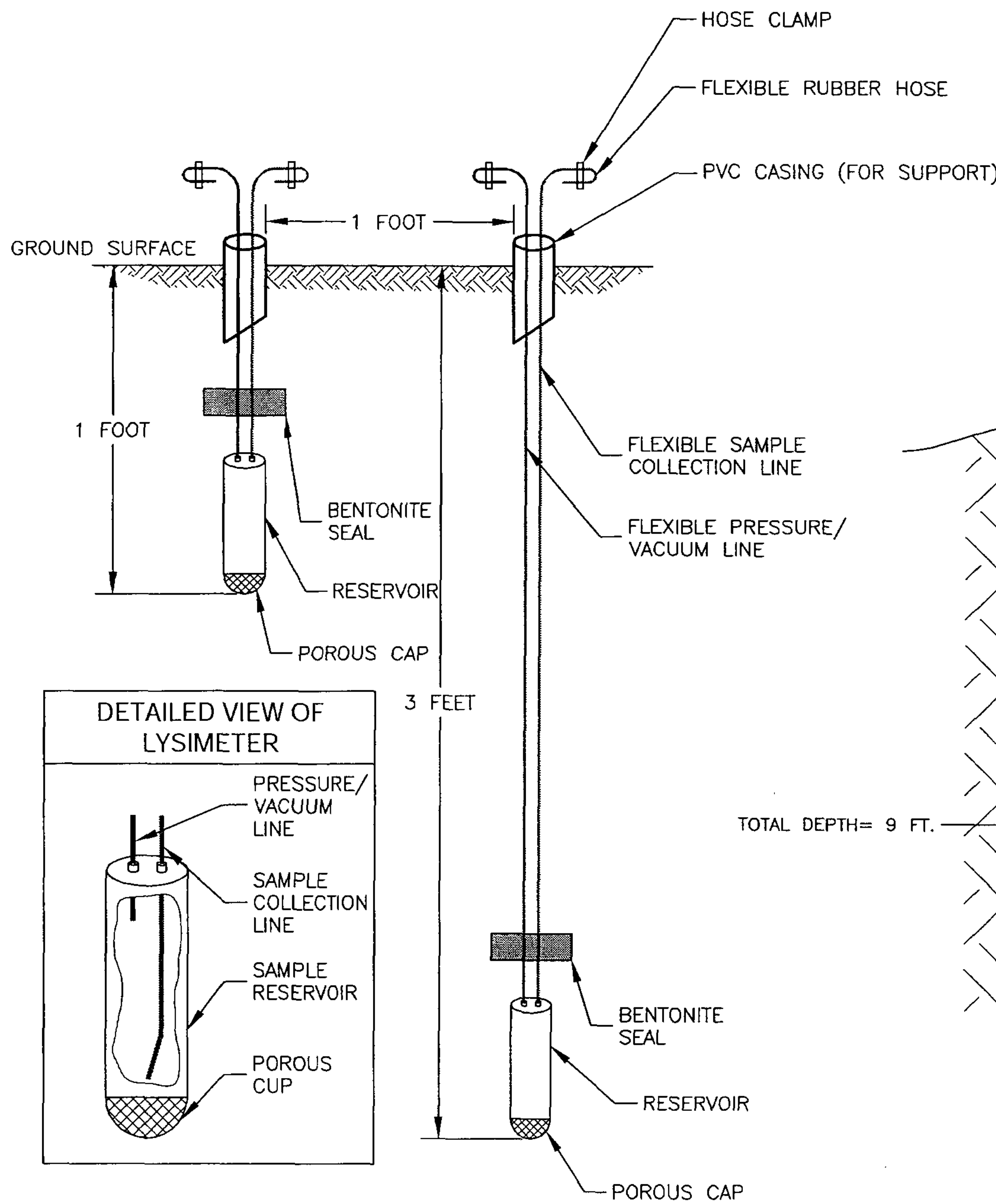
Schematic diagrams of each type of equipment listed above are presented in Figure 2-2, "Lysimeter, Piezometer, and Neutron Probe Casing Schematic."

A total of eight piezometers were installed. One in each of the treatment cells (Treatment Cells A, C, and E), one in the middle control cell (Control Cell D), and one at each corner of the treatability testing study area (approximately 20 feet from the corner of the test area). Each of the piezometers was installed to a depth of 13-feet bgs. The piezometers were constructed of 1.5-inch diameter polyvinyl chloride piping with a 5-foot slotted screen. The piezometers were installed using direct-push drilling techniques as described in IT Corporation Standard Operating Procedure 8.1 (2000). Soil generated during the installation process was collected in metal 55-gallon open-top drums, sampled for waste profiling, and then disposed according to the protocol described in the Section 2.12. Piezometers were developed using a high-rate peristaltic pump. Each piezometer was developed by pumping at a rate of 5 liters per minute until the development water flowed clear and water quality parameters (i.e., temperature, pH, and conductivity) stabilized.

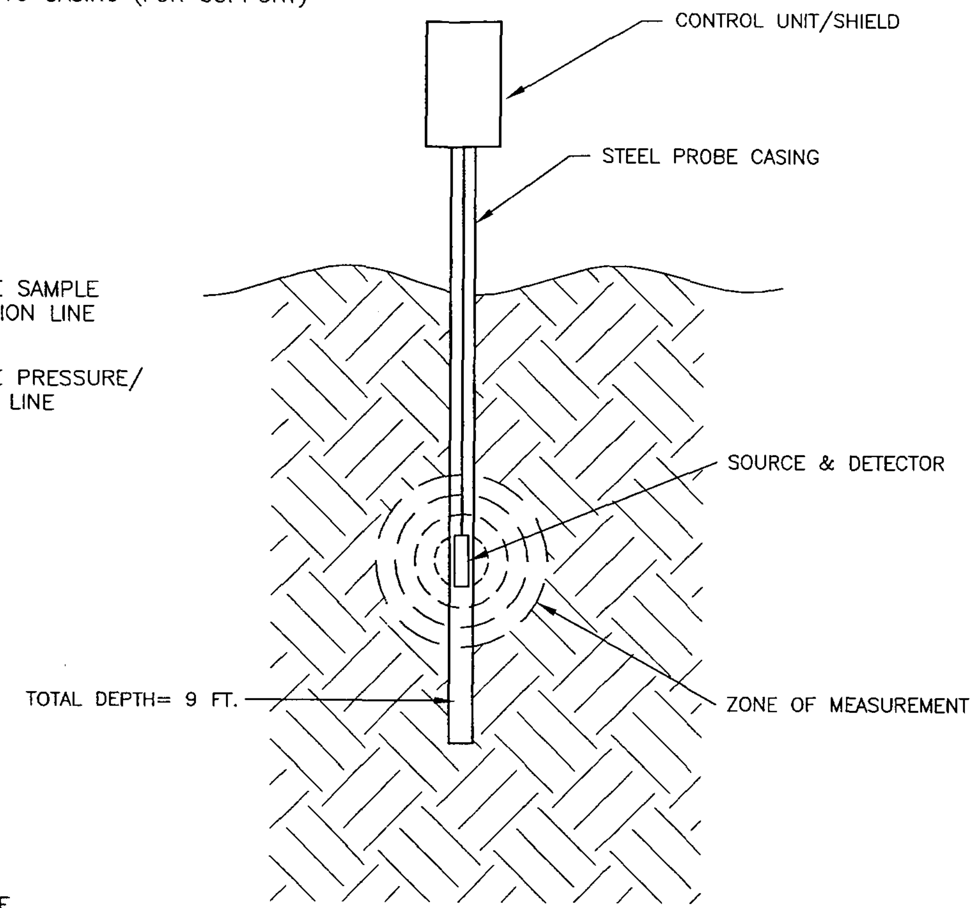
Lysimeter locations are shown on Figure 2-1. Two lysimeters were installed in each of the treatment cells (Treatment Cells A, C, and E). One lysimeter was installed in each of the control cells (Control Cells B, D, and F). According to the Work Plan (IT, 2001), the test design called for dual level lysimeters at each location, but equipment available required the installation of separate lysimeters at two different depths. In each pair of lysimeters, one was installed at 1-foot bgs and the second at 3-feet bgs using a hand auger. The two lysimeters were placed in separate borings 6-inches apart. Excess soils from the borings were collected in metal 55-gallon closed-top drums, sampled for waste profiling, and then disposed according to the protocol described in the Section 2.12.



PIEZOMETER



PRESSURE/VACUUM LYSIMETER



WATER CONTENT BY NEUTRON DEPTH PROBE METHOD

NOT TO SCALE

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FIGURE 2-2
LYSIMETER, PIEZOMETER AND
NEUTRON PROBE CASING SCHEMATIC
ALAMEDA POINT, CTO 076
ALAMEDA, CALIFORNIA

IMAGE	X-REF	OFFICE	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
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FORMAT REVISION 2/26/99

Eighteen neutron density probe access casings were installed in the test area. Four access casings were installed in each treatment test cell (Test Cells A, C, and E). Two access casings were installed in each control cell (Control Cells B, D, and F). The access casings were constructed from 10-foot lengths of 2-inch schedule 40 black iron pipe with a welded drive point. The casings were driven to approximately 9-feet bgs. The access casings were capped to prevent foreign material from entering the casing between sampling events.

2.9 Surveying

Land surveying was performed to establish the horizontal and vertical locations of the test cells, data acquisition equipment, and access casings. The location, ground surface elevation, and the top of each casing for each landmark were surveyed by a subcontractor to a local benchmark according to IT Corporation Standard Operating Procedure 23.1 (2000). Ground surface elevations for each survey point were determined to the nearest 0.1 foot and based on the National Geodetic Vertical Datum of 1929 as adjusted by the National Geodetic Survey in June 1991. The horizontal coordinates for each survey point were determined to the nearest foot and referenced to the California State Plane Coordinate System, Zone III (North American Datum 83.92), as published by the National Geodetic Survey. The survey was completed under the supervision, or direction, of a State of California-registered land surveyor.

2.10 Demobilization and Site Restoration

Demobilization and site restoration activities included:

- Removal and grouting of piezometers
- Cleanout and removal of the permanganate mixing systems
- Disposal of the containerized decontamination water
- Grading of the test cells
- Removal of the temporary fencing.

Demobilization of the electrical generator and support equipment occurred in October 2001. Site restoration began the week of February 11, 2002. The piezometers and neutron access casings were removed and the boreholes were grouted with a bentonite-cement mixture. The test cells were then graded.

The $KMnO_4$ mixing system was demobilized in March 2002. Neutralization fluids were containerized in a mobile 17,800-gallon steel storage tank. A sample of the fluid was collected and analyzed for:

- Volatile organic compounds (VOC) by U.S. Environmental Protection Agency (EPA) Method 8260
- Metals by EPA Method 6010
- pH by EPA Method 150.1
- Total suspended solids by EPA Method 160.2.

The results were provided to the East Bay Municipal Utility District for review and approval for discharge to the Publicly Owned Treatment Works. A Special Discharge Permit was issued to the Navy on March 19, 2002 (Permit Number 50249812 S), for discharge of the neutralized permanganate system rinseate. Approximately 1,500 gallons of neutralized water were discharged to the Publicly Owned Treatment Works.

The final site restoration activity, removal of the temporary fencing, was completed on April 18, 2002.

2.11 Field Documentation

Field documentation was prepared daily and maintained on site. Field documentation consisted of the following:

- Field Activity Daily Logs
- Daily Contractor Production Reports
- Daily Quality Control Reports
- Tailgate Safety Meeting logs
- Chain of Custody forms
- Sample Collection Logs.

Detailed boring logs were prepared for each piezometer and neutron density probe access casing location that was installed. The boring logs were reviewed by a senior hydrogeologist and are attached as Appendix B. Borings were logged in accordance with the ASTM International (ASTM) Method D2488 *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)* (2000a) and the Unified Soil Classification System.

2.12 Investigation-Derived Waste Disposal

The project investigation-derived waste (IDW) streams consisted of soil cuttings, personal protective equipment, purged groundwater, field laboratory wastewater, and decontamination fluids generated during drilling, sampling, and field laboratory activities.

Soil cuttings from installation of the piezometers, lysimeters, and access casings were contained in U.S. Department of Transportation-approved 55-gallon drums. One 4-point composite soil sample (representing no more than 500 cubic yards of IDW soil) was collected from the drums to represent the waste stream. The composite sample was analyzed for the following:

- Total petroleum hydrocarbons measured as diesel and motor oil by EPA Method 8015B Modified
- Semivolatile organic compounds by EPA Method 8270C
- VOCs by EPA Method 8260B
- California Code of Regulations Title 22 Metals by EPA Methods 6010B/7000A.

One discrete soil cuttings sample used to profile the VOCs, was collected using an EnCore™ sampler.

Equipment decontamination fluids, purged groundwater, and field laboratory wastewater was combined and stored in U.S. Department of Transportation-approved 55-gallon drums. One composite sample was collected and analyzed for:

- Total petroleum hydrocarbon measured as diesel and motor oil by EPA Method 8015B Modified
- Semivolatile organic compounds by EPA Method 8270
- VOCs by EPA Method 8260B.

Personal protective equipment was bagged and disposed of as municipal refuse. No disposal samples were required.

All IDW was containerized in U.S. Department of Transportation-approved 55-gallon metal drums at the Building 112 Storage Yard pending analytical results. The analytical results were evaluated by the IT Corporation transportation and disposal coordinator to determine proper disposition. All IDW presented on Table 2-1, "Investigation-Derived Waste Inventory and Disposition" was transported offsite on May 31, 2002 for disposition.

Table 2-1
Investigation-Derived Waste Inventory and Disposition

Number of 55-Gallon Drums	Waste Type	Waste Description	Disposal Location
10	Debris and Soil	Nonhazardous	Altamont Landfill Livermore, California
8	Decontamination and Purge Water	Nonhazardous	Altamont Landfill Livermore, California
3	Empty Sodium Bisulfite Drum	Not Applicable	Chemical Waste Management Kettleman Hills, California
4	Sodium Bisulfite Solution	Not Applicable	Chemical Waste Management Kettleman Hills, California

Note: All 55-gallon drums were not filled to capacity prior to disposition.

3.0 Permanganate Dosage and Delivery Methods

Evaluation of subsurface delivery methods was a primary goal of this treatability study. Two of the three delivery methods tested were not effective. Surface tilling was effective to the depth of tilling but additional transport of potassium permanganate ($KMnO_4$) was not observed. Very little to no transport of $KMnO_4$ was observed during the treatability study. This was due to the combination of very fine-grained soil and high soil oxidant demand (SOD) of these fine-grained soils. Soil oxidant demand is the amount of oxidant consumed by reaction with site soils and pore water (this is a measure of the combined influence of all reduced species such as organic carbon, reduced metals, and contaminants) over time. The units of SOD are grams of $KMnO_4$ per kilogram of soil. Further, there was evidence that $KMnO_4$ application reduced the formation's ability to accept water. This was likely a combination of localized clogging by manganese oxide solids and changes in mineral structure as a result of potassium addition.

Three methods of oxidant delivery were evaluated during the treatability study:

- Surface irrigation
- Surface tilling
- Shallow subsurface injection.

Surface irrigation was performed by repeatedly flooding the treatment cell with $KMnO_4$ solution. Surface tilling involved the spreading of dry $KMnO_4$ onto the surface of the treatment cell, tilling the oxidant into the ground, and subsequent irrigation of the cell. Shallow subsurface injection was attempted on a 5-foot grid across the treatment cell.

The effectiveness of the delivery method was judged based on three criteria:

- Ability of the method to distribute the $KMnO_4$ dosage over the treatment area
- Polynuclear aromatic hydrocarbon (PAH) destruction
- Logistical factors, such as length of time to deliver $KMnO_4$ and maintenance.

Each control cell received the same daily volume of potable water as the respective treatment cell ($KMnO_4$ was not added to the control cells).

Each of the test cells was "conditioned" with 500 gallons of water prior to $KMnO_4$ addition. Conditioning of the cells was performed to equalize the soil moisture content of all test cells and evaluate the infiltration rate. The soil within the test cells had dried to varying degrees during the time between disconnection of the sprinkler system and test cell preparation.

In general, delivery methods were tested in the control cells prior to $KMnO_4$ addition to treatment cells. This allowed equipment and procedures to be tested prior to handling the oxidant. In addition, observation of the control cell behavior prior to $KMnO_4$ addition allowed $KMnO_4$ to be applied in the most controlled manner.

3.1 Potassium Permanganate Dosage

In order to compare the different delivery methods, it was planned to apply the same dosage of $KMnO_4$ to all treatment cells. The permanganate dose was determined by testing the SOD of the soils, calculating the amount of residual manganese that could be added to the soil per pound of $KMnO_4$, and comparing the residual manganese to the preliminary remediation goal (PRG) for manganese. The SOD results are discussed in Section 4.2.3. Ultimately, the $KMnO_4$ dosage applied to each treatment cell was limited by the U.S. Environmental Protection Agency (EPA) Region 9 residential PRG for manganese (1,800 milligrams per kilogram [mg/kg]) and manganese compounds. The applied $KMnO_4$ mass was calculated as the difference between the manganese residential soil PRG and the maximum background manganese soil concentration.

Background, or baseline, manganese concentrations in the test cells were determined during the baseline sampling event, as explained in Section 4.1.1. The maximum manganese concentration from the baseline sampling was 584 mg/kg. The difference between the PRG and the maximum concentration was converted to a $KMnO_4$ mass using stoichimetric equations for manganese dioxide production. Based on this number, the maximum allowable $KMnO_4$ mass to be added to each test cell was determined to be 1,300 kilograms (approximately 2,860 pounds) of $KMnO_4$.

A scoping unsaturated flow model was constructed to evaluate the expected infiltration rates. This scoping model was used to simulate water infiltration using one soil characteristics curve and soil boring log that was available during the work plan preparation. The preliminary modeling was used to evaluate the volume of water applied to a test cell versus lateral migration outside the test cell. Numerical modeling of the infiltration process and permanganate reactive transport was conducted using the United States Geological Society code VS2DTI, which is a two-dimensional variably saturated flow and transport model. The model domain was 100 feet wide and 15 feet deep. Two soil characteristic curves (suction pressure versus soil moisture curve by ASTM International [ASTM] D5298 [1994]), soil porosity measurements, and the soil boring logs were used to estimate Van Genuchten hydraulic parameters for each layer of the cross section. The cross section was divided into two depth intervals based on the soil boring logs, 0 to 3 feet below grade and 3 to 15 feet below grade. The Van Genuchten hydraulic parameters from the sample collected at 2 feet were used for the 0 to 3 foot interval while a sample from 4 feet was used to estimate parameters for the 3 to 15 feet interval. The results of the model indicated that the infiltration rate would be low and that lateral spreading would occur if a large volume of water were applied to a test cell. Arsenic a result, it was determined that a lower volume of water would be used for the treatability testing at the risk of a higher exerted SOD. The SOD is dependent on the applied concentration of $KMnO_4$, therefore a larger volume, low concentration application would result in a lower observed SOD than if a concentrated solution was used. The project schedule and risk of loss of control of the oxidant were considered more important than minimizing the observed SOD. Therefore the applied concentration was at the practical solubility limit, 30.5 grams per liter, to minimize the volume of fluid that would be handled. An equal volume of water was applied to the tilled cell.

Surface application was tested first, then surface tilling, followed by shallow subsurface injection. This order was selected to allow the simpler delivery methods to precede the more complex delivery methods.

3.2 Surface Application

Surface application of the $KMnO_4$ solutions was performed rapidly but required prolonged periods for fluids to dissipate on the ground surface. The surface application delivery method was implemented in Treatment Cell E and the corresponding Control Cell F. The surface application of $KMnO_4$ consisted of mixing a $KMnO_4$ solution and flooding the treatment cell with the oxidant solution.

The surface application treatment and control cells were flooded with 2,450 gallons of fluid on four consecutive days. The surface application treatment Cell E was treated with 30.5 grams per liter of $KMnO_4$ solution, while control Cell F was flooded with potable water. Ponding in the treatment cell appeared to increase over the four days of flooding until on the fifth day, the water level did not subside sufficiently to allow for further $KMnO_4$ dosing. Several surface disruption techniques were utilized to encourage drainage of the $KMnO_4$ solution into the subsurface. The treatment cell was aerated using foot-mounted aerators, rakes, and water pressure from the discharge hose. Subsequent daily doses, of approximately 1,300 gallons of $KMnO_4$ solution were added. Treatment Cell E was flooded with a total of 8,664 gallons of 30.5 grams per liter $KMnO_4$.

Substantial ponding of the $KMnO_4$ solution was observed during each of the $KMnO_4$ solution delivery events to the surface application treatment cell (Treatment Cell E). Several days were required between $KMnO_4$ dosing events at this treatment cell for sufficient reduction in the moisture content of the soil to allow the introduction of additional fluid to the treatment cell. Similar to the surface tilling cells, ponding was also observed in the surface application control cell, Control Cell F, after the addition of plain water. The ponding in the control cell diminished more quickly than in the treatment cell.

3.3 Surface Tilling

Surface tilling rapidly and effectively delivered $KMnO_4$ over the depth of tillage. The surface tilling technique was implemented in Treatment Cell C and corresponding Control Cell D. Surface application was completed in two rounds of chemical addition, tilling, and watering.

Both Cells C and D were tilled using 12-inch tillers attached to a Bobcat. Tilling was conducted once in a north-south direction followed by a pass in the east-west direction. A minor amount of water was added to both test cells for dust suppression.

Solid $KMnO_4$ crystals were applied to the ground surface of Treatment Cell C by hand. The total dose of $KMnO_4$ was added to the treatment cell in two phases. The first application of $KMnO_4$ solids consisted of approximately 2,150 pounds of $KMnO_4$ followed by tilling. After tilling, the cell was flooded with approximately 4,400 gallons of water to dissolve the $KMnO_4$ solids and encourage oxidant infiltration into the subsurface. The control cell (Control Cell D) received the same tilling and water application, but $KMnO_4$ was not introduced.

The second phase of $KMnO_4$ addition occurred two weeks later. An additional 715 pounds of $KMnO_4$ were added to Treatment Cell C. The delay between the first and second $KMnO_4$ applications was necessary to allow safe maneuvering of the Bobcat during the second $KMnO_4$ application. Standing $KMnO_4$ solution in the treatment cell was allowed to fully absorb into the subsurface prior to the second $KMnO_4$ addition. The second $KMnO_4$ application was applied by hand and then tilled and watered (4,500 gallons).

During both applications, the $KMnO_4$ crystals were added to Treatment Cell C in the morning to avoid uncontrolled spreading of the solids by wind. Dust suppression was also used during the application of $KMnO_4$ to keep the crystals from migrating from the intended cell. Control Cell D was tilled in the same manner, without the addition of $KMnO_4$.

During delivery of $KMnO_4$ to the surface tilling cell vaporization of water was observed. The evolution of water vapor indicated that $KMnO_4$ reaction was occurring rapidly in localized areas of the soil surface. A 4-inch dial thermometer was inserted into an area emanating water vapor and no increase in temperature was observed as compared to the ambient air. Arsenic a precaution, additional water was added to the treatment cell for a total of 4,380 gallons. The vaporization of water stopped within one hour. The water ponded on the surface application cell for several days. After the water had subsided, a thin, dark, viscous coating was present on the surface of Treatment Cell C. This material may have been a manganese dioxide solid, a by-product of $KMnO_4$ degradation. Ponding of water also occurred on the surface of the corresponding control cell, Control Cell D, to a lesser degree. The ponding in Control Cell D did not persist as long as in Treatment Cell C.

3.4 Shallow Subsurface Injection

Shallow subsurface injection was not effective for delivering fluids to shallow soils at Site 25. The shallow depth and fine-grained texture of soils encountered in the first 3 feet below grade at this location precluded injection of fluids. Injections were successful when the injection rods were driven into deeper (3.5 to 4.5 feet below ground surface [bgs]) fine sands.

The shallow subsurface injection delivery method was tested at Control Cell B. A 5-foot grid of 64 injection points was established in Control Cell B. Injection depths were 1 foot, 2 feet, and 3 feet bgs at each injection point. The injections points were made from Geoprobe® rods with 48 offset ¼-inch holes over a 1-foot injection zone. The design volume of the injected solution was 50 gallons per injection depth and location. A total of 28 injections were attempted. The injection pressure ranged between 2 and 4 pounds per square inch at flowrates ranging from 0.2 to 1.9 gallons per minute.

Injected water rapidly short-circuited to the ground surface (usually within 3 to 5 minutes of injection). Short-circuiting occurred either as venting through fractures in the soil surface at distance or by leaking along the drive rod. Several relatively successful injections were performed with 20 to 50 gallons per injector using a 3 pounds per square inch injection pressure at the 3-foot depth interval. These locations represented less than 10 percent of the total injections attempted and likely had encountered sands that began at approximately 3.5 feet bgs. Because of the numerous injection attempt failures, techniques were implemented to prevent the loss of injection fluid to the surface. These included:

- Watering the cell to reduce cracking and displacement of soil along the injection rod during driving
- Tamping the rod/soil interface surface to compact the area prior to injection
- Top-down injections
- Bottom-up injections.

However, these techniques did not prevent short-circuiting or venting.

Due to the limited success of the control cell injections, this delivery method was not utilized for the application of $KMnO_4$ in Treatment Cell A. It is believed that the combination of shallow depth (i.e., low confining pressure) and low permeability of the soils (i.e., hard, fine-grained strata) made shallow subsurface injection infeasible at this site.

4.0 Field Sampling Phases and Methods

This section describes the field sampling activities conducted during the chemical oxidation treatability study.

4.1 Sampling Phases

Field sampling was conducted in three phases during the treatability study.

- Baseline sampling
- Operational sampling
- Performance sampling.

The baseline sampling was used to establish the site soil, pore water, and groundwater characteristics prior to permanganate treatment (Appendix C). The operational sampling was performed during the potassium permanganate ($KMnO_4$) application processes (Appendices D, E, and F). Performance samples were collected after one month of permanganate delivery (Appendix G). A second phase of performance sampling was planned for 3-months after delivery was completed. However, IT Corporation recommended to the Navy that the treatability study be curtailed based on the result of the operational and first month of performance monitoring. The performance data were used to determine the extent of polynuclear aromatic hydrocarbon (PAH) treatment achieved during the treatability study.

Table 4-1, "Chemical Oxidation Treatability Study Sampling Strategy," presents the types of samples that were to be collected during each phase of sampling.

4.1.1 Baseline Sampling

The baseline sampling was conducted to establish characteristics of the groundwater, soil matrix, and soil pore water prior to the chemical oxidation activities. Additionally, samples were collected for testing of geotechnical characteristics such as:

- Porosity
- Permeability
- Soil density
- Soil moisture curves.

The soil moisture curves plotted water content versus pressure head and were used for the scope modeling discussed in Section 3.1. The results from the geotechnical samples are presented in Table 4-2, "Summary of Geotechnical Results."

Table 4-1
Chemical Oxidation Treatability Study Sampling Strategy

Matrix	Test	Baseline (start of study)	Operational (during application)	Performance (1 month)
Soil	Moisture Content (neutron probe)	X	X	X
	Geotechnical testing • Permeability • Porosity • Soil density • Soil moisture curve	X		
	Manganese	X		X
	Polynuclear Aromatic Hydrocarbons	X		X
	Potassium Permanganate			X
	Soil Oxidant Demand	X		X
Pore Water	pH	X	X	X
	Oxidation Reduction Potential	X	X	X
	Potassium Permanganate		X	X
	Conductivity	X	X	X
Groundwater	Water Level	X	X	X
	Potassium Permanganate		X	X
	Chromium and Arsenic	X		X

Table 4-2
Summary of Geotechnical Testing Results

Sample Number	Moisture Content (ASTM D2216) percent	Dry Density (ASTM D2937) pcf	Specific Gravity (ASTM D854)	Hydraulic Conductivity (ASTM D5084) cm/sec
76-001	36.1	84.0	2.48	2.87E-08
76-002	76.2	54.8	2.36	1.00E-07
76-003	28.8	84.4	2.48	3.84E-07
76-004	13.6	105.3	2.62	1.31E-03

pcf denotes pounds per cubic feet

ASTM denotes ASTM International

cm/sec denotes centimeters per second

ASTM International (ASTM), 1998, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass, *D2216-98, West Conshohocken, Pennsylvania.*

ASTM International (ASTM), 2000b, Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, *D5084-00e1, West Conshohocken, Pennsylvania.*

ASTM International (ASTM), 2000d, Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method, *D2937-00e1, West Conshohocken, Pennsylvania.*

ASTM International (ASTM), 2002, Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer, *D854-02, West Conshohocken, Pennsylvania.*

Additionally, soil samples were collected for manganese, PAHs, and soil oxidant demand (SOD) analyses as outline in Table 4-1. Baseline pore water samples were analyzed for pH, oxidation-reduction potential, and conductivity (Appendix E). Baseline groundwater samples were collected and analyzed for hexavalent chromium and arsenic (Appendix C). Piezometers were used to measure groundwater elevations (Appendix D). The moisture content of the soil was also analyzed as part of the baseline sampling (Appendix F). Results are discussed in Section 5.0. Sampling procedures for all of the analyses are described in Section 4.2.

4.1.2 Operational Monitoring

Operational monitoring was conducted in two phases. Measurements were made daily during $KMnO_4$ or water delivery in the test cells. Measurements were collected biweekly following $KMnO_4$ delivery phase. The operational monitoring was conducted primarily to monitor the physical movement of fluids inside the treatment cells, to detect potential offsite migration of $KMnO_4$, and to determine if $KMnO_4$ moved downward out of the test zone (0 to 4 feet below ground surface [bgs]).

Due to substantial surface venting, the shallow subsurface injection of $KMnO_4$ was not attempted in Treatment Cell A. Therefore, operational monitoring was not conducted in either Treatment Cell A or Control Cell B.

The second phase of operational monitoring described in the Final Work Plan (IT, 2001) was not conducted due to early termination of the field study. Visual observations, measurements, and samples collected during the operational monitoring are summarized in Appendices D, E, and F. Data collection procedures are described in Section 4.2.

4.1.3 Performance Monitoring

Performance monitoring was conducted to assess the $KMnO_4$ persistence and extent of PAH degradation achieved over the course of the treatability study. The performance monitoring was to occur 1 month and 3 months after delivery of $KMnO_4$ to the treatment cells. However, the treatability study was terminated after only one month of treatment. One round of performance monitoring was completed (Appendix G). The performance sampling entailed the collection of soil, pore water, and groundwater samples from the test cells. Samples were not collected from the shallow subsurface injection test cells because the delivery method was deemed infeasible for the site.

4.2 Soil Sampling Methods

Arsenic described in the previous section, soil samples were collected at various stages of the treatability study and analyzed for geophysical properties, metals, PAHs, SOD, and $KMnO_4$ as summarized in Table 4-1. This section describes the sampling protocols followed during the treatability study.

4.2.1 Geotechnical Testing Samples

Geotechnical soil samples were obtained from two locations within the test area prior to construction of the test cells. The samples were collected in Shelby tubes using direct-push drilling methods. The samples were divided into four composites for analyses, as described in the Final Work Plan (IT, 2001). The samples were tested for the following:

- Permeability according to ASTM International (ASTM) Method D5084 (2000b)
- Porosity
- Soil density
- Moisture content according to ASTM Method D2216 (1998)
- Soil moisture curves according to ASTM Method D2325 (2000c).

The geophysical soil samples were collected as part of the baseline sampling event. The data from these samples are summarized in Table 4-2.

4.2.2 Polynuclear Aromatic Hydrocarbons and Manganese Samples

Polynuclear aromatic hydrocarbons are the main contaminants of concern at Installation Restoration Site 25 and were the focus of the treatability study. Manganese concentrations in soil were also monitored to evaluate the contribution of residual manganese to soil as a result of $KMnO_4$ treatment.

Soil samples for PAHs and manganese analyses were collected during both the baseline and one-month sampling events. Baseline composites were generated from soil cores collected during installation of the 18 neutron density probe casings. Soil cores were collected in 4-foot lengths of acetate liner. Each core was logged (Appendix B) and photographed (Appendix H). The PAH and manganese samples were collected from composite samples created over the 0 to 2 feet bgs and 2 to 4 feet bgs depth intervals at each boring location as detailed in Section 4.3 of the Final Work Plan (IT, 2001). Four duplicate samples were collected, processed, and analyzed with unique field identification numbers. Samples for PAHs were analyzed by U.S. Environmental Protection Agency (EPA) Method 8270 Selective Ion Monitoring while samples for manganese were analyzed by EPA Method 6010B.

Samples collected during the one-month performance sampling event were obtained using a hand auger instead of direct-push rig. Samples were collected at only 12 locations within Test Cells C through F because the one-month performance sampling did not include Test Cells A and B. The one-month performance samples were obtained from locations approximately 1 foot to the northeast of the baseline sampling locations.

During the one-month sampling event, two borings in each treatment cell and one boring in each control cell were sampled from composites over 0 to 1 foot, 1 to 2 feet, and 2 to 4 feet. Samples collected from the 0 to 1 foot interval were analyzed for PAHs, manganese, SOD, and $KMnO_4$. Samples from the 1 to 2 foot and 2 to 4 foot composites were analyzed for PAHs and manganese only. Also, two borings in the treatment cells and one boring in the control cells were sampled at 0 to 1 foot, 0 to 2 foot, and 2 to 4 foot depth intervals. Samples collected from all of these composites were submitted to the laboratory for PAHs and manganese analyses. Samples from these intervals were also tested for SOD and $KMnO_4$ in the field.

4.2.3 Soil Oxidant Demand Tests

Soil oxidant demand measured the amount of chemical oxidant that was consumed by reaction with the soil matrix over a specific period of time. The extent of SOD exerted by the system is dependent on both the amount of reducing material present in the soil matrix and the initial $KMnO_4$ concentration, or amount of $KMnO_4$ applied. Soil oxidant demand tests performed on contaminated soil also accounted for the oxidant demand exerted by the contaminants of concern.

Two rounds of field SOD tests were conducted during the treatability test at Installation Restoration Site 25. The first was conducted during the baseline sampling event and the second during the one-month sampling event. The soil samples tested were composites collected during sampling for PAHs.

Soil oxidant demand tests were conducted by exposing approximately 57 grams of the sample material to several different concentrations of $KMnO_4$ solutions for a specified period of time. The amount of $KMnO_4$ that degrades during the test period determines the SOD of the soil matrix. The SOD test results were used to determine the $KMnO_4$ dose for the treatment cells.

4.2.4 Soil Moisture Readings

The moisture content of the soil matrix was monitored to evaluate the movement of water or $KMnO_4$ solution in and below the target zone (0 to 4 feet bgs). Summaries of the soil moisture readings are included in Appendix F.

Soil moisture content was measured using a CPN Model 503DR Hydroprobe (neutron density probe). The hydroprobe was calibrated by CPN prior to shipment and a standard count was taken before each sampling day to ensure the neutron density probe was still calibrated. Four access casings were installed in each treatment cell and two access casings were installed in each control cell during the test area set up. The casings were installed as described in Section 4.5 of the Final Work Plan (IT, 2001). The soil moisture readings were taken at 1-foot intervals to a depth of 7 feet bgs.

The soil moisture content readings were collected more than once per day on most days. The surface application test cells and the surface tilling test cells, were tested twice per day for three days prior to the $KMnO_4$ or plain water application. Monitoring conducted after the applications was dependent on observations made during the application process and the ability of a technician to enter the test cells and open the access casings. Immediately after the $KMnO_4$ or water applications, entry to the access casings was limited due to standing water in the test cells.

4.3 Pore Water Readings

Pore water samples were collected to monitor the effects of the introduction of $KMnO_4$ into the subsurface. Pore water samples were collected from lysimeters placed at 1 foot and 3 feet bgs as described in Section 5.2. The pore water samples were analyzed for water quality parameters such as pH, oxidation-reduction potential, and conductivity. The concentration of $KMnO_4$ in pore water was to be determined if $KMnO_4$ was visually detected during sampling (purple color when greater than 1 milligram per liter). Samples were collected once per working day during the delivery phase of the treatability study and on a biweekly basis thereafter, as described in the Final Work Plan (IT, 2001). The field data from these readings are included in Appendix E.

Pore water samples were collected by inducing a vacuum in the lysimeter. The vacuum pulled pore water from the surrounding soil into the body of the lysimeter. The pore water was then pushed through a discharge line extending above the soil surface and sampled.

On some occasions, there was no pore water within the instrument and it was not possible to collect pore water data. An insufficient volume of pore water in the lysimeter may have been due to low pore volume saturation at the sampling depth or a leak in the instrument.

Permanganate was not detected in the lysimeters. On occasion, $KMnO_4$ was observed in a sample jar, which likely resulted from contamination of the lysimeter tubing. However, the resulting $KMnO_4$ concentration was measured and recorded.

4.4 Groundwater Monitoring

Groundwater monitoring was conducted in order to determine if $KMnO_4$ moved out of the target zone and to the water table. The piezometers were utilized to measure water levels in accordance with IT Corporation Standard Operating Procedure 5.1 (2000). Figures 4-1, "Baseline Groundwater Elevations September 18, 2001" and 4-2, "1-Month Groundwater Elevations October 2, 2001" present the baseline and one-month testing groundwater elevations. Water levels were tabulated on a weekly basis and during the water level gauging, the groundwater was also visually monitored for the presence of $KMnO_4$.

Groundwater samples were collected during the baseline and one-month sampling events. These samples were analyzed for aqueous phase chromium and arsenic concentrations by EPA Method 6010. Groundwater samples were collected according to IT Corporation Standard Operating Procedure 9.1 (2000). Analytical results for the metals analysis and water levels are discussed in Section 5.0.

4.5 Quality Control

Field quality control samples were collected and analyzed during the project to assess the consistency and performance of the sampling program. Field quality control samples for this project included field duplicates for groundwater and soil samples, trip blanks for water samples, and temperature blanks.

Field duplicates consisted of two samples (a primary sample and its duplicate) of the same matrix collected at the same time and location to the extent possible, using the same sampling techniques. The purpose of field duplicate samples was to assess the overall sample matrix variability of the site. Field duplicates for groundwater and soil were collected at a frequency of one per ten samples and were analyzed for the same parameters as the primary sample. Field duplicates were not collected for waste samples.

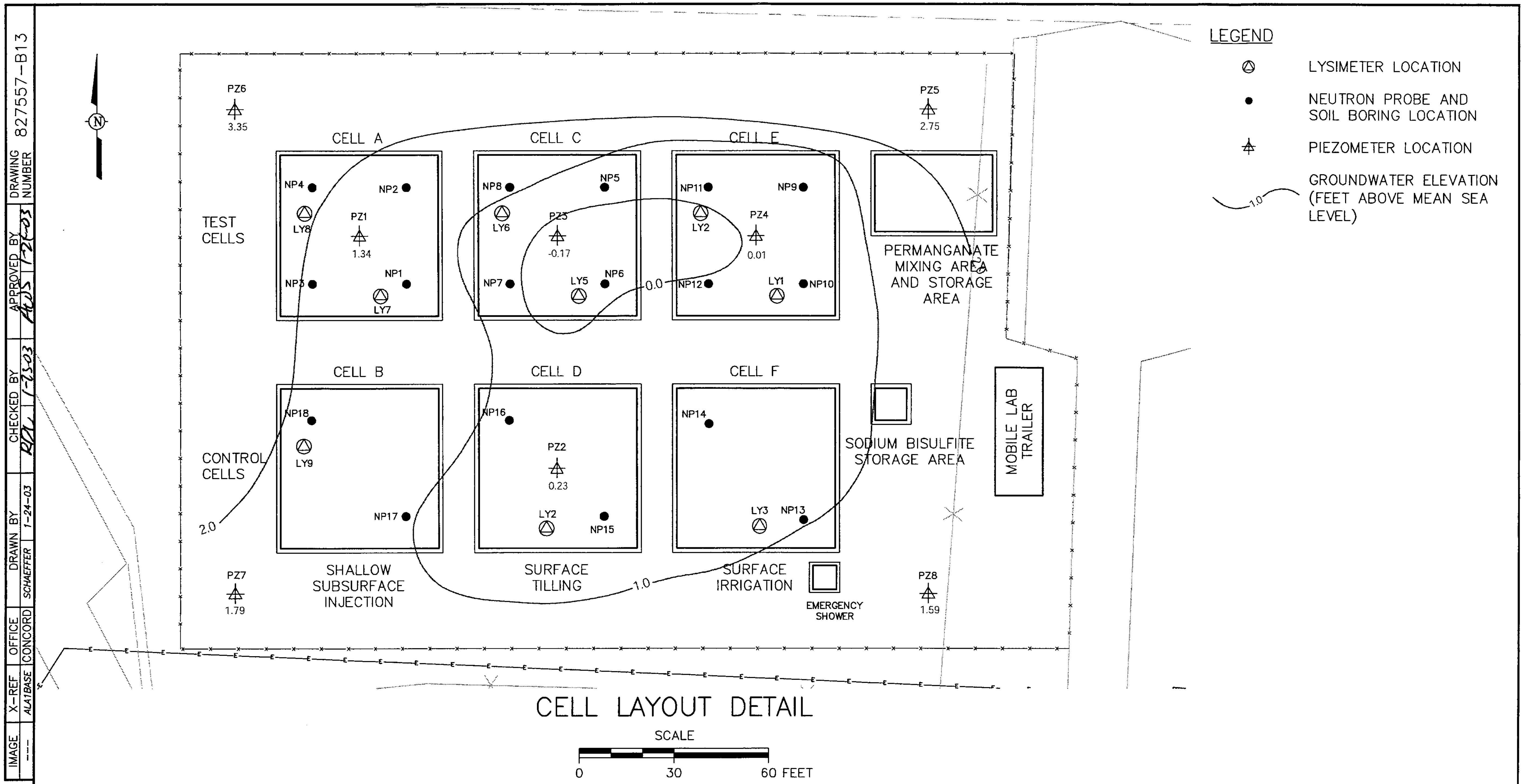

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FIGURE 4–1
CHEMICAL OXIDATION TREATABILITY STUDY
BASELINE GROUNDWATER ELEVATIONS
SEPTEMBER 18, 2001
ALAMEDA POINT, CTO 076
ALAMEDA, CALIFORNIA

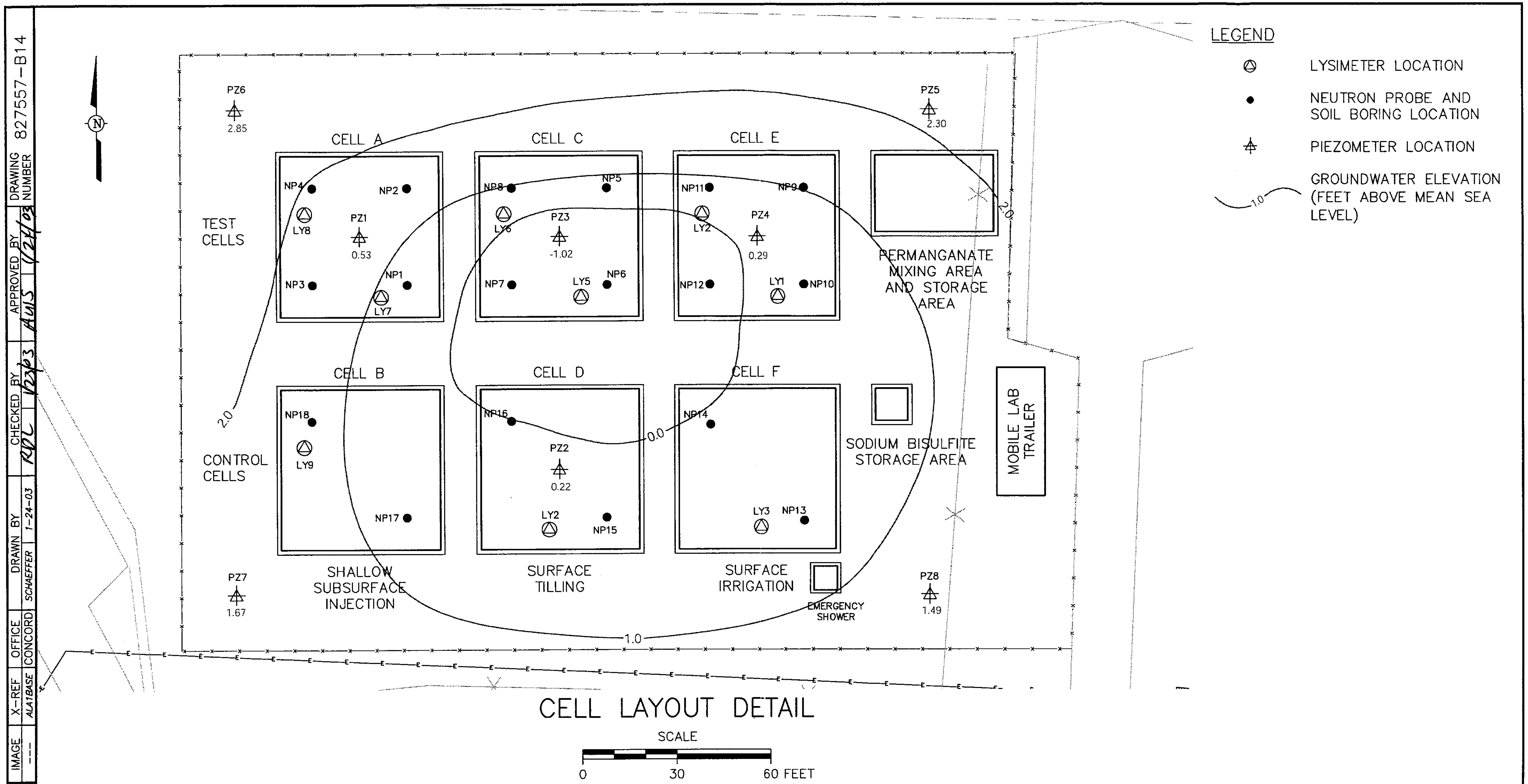

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FIGURE 4-2
CHEMICAL OXIDATION TREATABILITY STUDY
1-MONTH GROUNDWATER ELEVATIONS
OCTOBER 2, 2001
ALAMEDA POINT, CTO 076
ALAMEDA, CALIFORNIA

5.0 Treatability Study Results

The results of the delivery methods testing indicated that shallow subsurface injection was not feasible at Installation Restoration Site 25. Surface tilling and flooding effectively applied the potassium permanganate ($KMnO_4$) to the treatment cells. This section will discuss the monitoring results and overall effectiveness of chemical oxidation of shallow soil at the site. Overall, chemical oxidation of the polynuclear aromatic hydrocarbons (PAH) in the shallow soils was not effective. The limited effectiveness was mainly the result of the combination of two factors.

First, the low hydraulic conductivity of the shallow soils (see Table 4-2) prevented $KMnO_4$ and water infiltration. Soil moisture values deeper than 2 feet below grade were less than half of those expected indicating that evaporation dominated infiltration. In addition, the $KMnO_4$ appeared to reduce the permeability of the surface soil, likely via a combination of manganese dioxide deposition leading to clogging and clay mineral alteration via reaction with potassium.

The second factor that limited chemical oxidation was the relatively low dose of $KMnO_4$ that was applied as compared to the soil oxidant demand (SOD). The applied dosage was approximately 25 percent of the measured SOD. Section 3.1 discussed how the allowable residual manganese controlled the maximum dosage of $KMnO_4$ to ensure that the soil preliminary remediation goal (PRG) for manganese was not exceeded at the end of the treatability study. The average SOD value for the shallow soils at Site 25 was 15 grams per kilogram, which is quite high.

These conclusions were supported by the combination of soil moisture and pore water measurements. The soil moisture measurements indicated that very little applied water moved downward through the target zone supporting the conclusion that low hydraulic conductivity limited oxidant transport. Pore water measurements showed that some applied water moved downward but that this water did not contain permanganate. This suggests that the applied $KMnO_4$ was consumed locally, which supports the conclusion that the relatively high SOD of the shallow soils further limited movement of permanganate as compared to the applied water. Soil PAH results varied widely across the test sites and between sampling events leading to no conclusive evidence of treatment of PAH by $KMnO_4$ in this geologic setting with the three tested delivery approaches.

5.1 Soil Moisture

Soil moisture readings were collected during all phases of monitoring in all test cells and control cells (Appendix F). Test Cell A and Control Cell B, were treated as a baseline for comparison to natural variations at the site. There is little variation (less than 2 percent) in moisture content among a series of readings from a single neutron probe within these two cells. The variations in soil moisture content among the neutron probes from a single cell are likely due to the tendency for fine grained soils to retain water to varying degrees based on minor differences in soil texture.

The treatment process was expected to affect the moisture content most noticeably in the first 4 feet of the soil matrix. In the tilling Test Cell C, there was little change in soil moisture content at any depth, which indicates that little to none of the 4,580 gallons of water applied to the cell infiltrated. These results imply that water loss from the tilling test cell was due to evaporation. One neutron probe (NP-7) indicated a slight increase in soil moisture (3 percent to 5 percent) in the upper 3 feet of soil. However, this response was not observed in the other three neutron probes. In comparison, the results from Control Cell D indicate an increase in soil moisture of between 6 percent to 9 percent in the upper foot of the soil column. A sustained increase in the soil moisture was observed throughout the upper four feet of soil, becoming gradually less discernable with depth.

Similar results were observed in the surface flood test cells, Test Cell E and Control Cell F. Generally, no distinctive increase in soil moisture was observed at any depth within the treatment cell.

Overall, the changes in soil moisture content were much less than the expected, based on the scoping modeling and pore volume calculations. For example, based on rough estimates of the site soil porosity, 4,500 gallons of water is equivalent to about 15 percent of the pore space available in the upper 4 feet of soil. Therefore, it was expected that the soil moisture content would increase by about 15 percent, particularly in the upper 1 or 2 feet of soil.

5.2 Pore Water

Pore water monitoring in all the test cells indicated that there was little vertical migration of $KMnO_4$ into the subsurface (Appendix E). Potassium permanganate was detected only once in Lysimeter 2 (Cell E) at a concentration of 160 milligrams per liter. Pore water oxidation-reduction potential values shifted from moderately reducing to moderately oxidizing after fluid application. The oxidation-reduction potential values did not increase to levels where permanganate would be expected in the samples. The conductivity results showed a steady increase in value after fluid application to the cells. This data indicated that $KMnO_4$ did not migrate to 1 foot of depth even in the test cell that was tilled to 12-inches in depth.

5.3 Groundwater

Groundwater samples for $KMnO_4$ analysis were to be collected only if $KMnO_4$ was visually detected in the piezometers. No $KMnO_4$ was ever detected in any of the piezometers.

Groundwater was also monitored to assess the affects of $KMnO_4$ treatment on redox sensitive metals mobility. Potassium permanganate may temporarily increase the aqueous concentrations of redox sensitive metals. Groundwater samples were collected and analyzed for aqueous phase arsenic and chromium. Hexavalent chromium was not detected in the groundwater during either the baseline or one-month sampling events. Aqueous arsenic was detected in all piezometers during both sampling periods. Although the arsenic concentrations appear to increase in some piezometers at the one-month sample point, there is no correlation between the locations with elevated arsenic concentrations and $KMnO_4$ treatment. For example, the arsenic concentrations measured in both treatment cells (Treatment Cell C and Treatment Cell E) are lower at the one-month sample point than baseline conditions while the piezometers that were not located in areas near $KMnO_4$ treatment appear to have increased arsenic concentrations. Based on this information, the introduction of $KMnO_4$ did not affect arsenic or chromium concentrations in groundwater.

5.4 Soil Polynuclear Aromatic Hydrocarbon Results

Soil samples were collected and analyzed for PAH concentrations to assess the extent of contaminant treatment attained at Installation Restoration Site 25. No clear contaminant reduction due to treatment with $KMnO_4$ could be discerned. In the surface tilling cells (Treatment Cell C and Control Cell D) the PAH concentrations are lower in the surface soils than in deeper samples. Nonetheless, no significant trends in the PAH concentrations were observed in the soil sample results. Therefore, it is concluded that treatment was not achieved.

The $KMnO_4$ surface application cell (Treatment Cell E) and corresponding control cell (Control Cell F) produced similar results where the PAH concentrations appear lower in the first foot of sampling. But, erratic results from all sample intervals demonstrate that the appearance of a decrease in PAH concentrations cannot be attributed solely to $KMnO_4$ degradation.

The heterogeneous distribution of the PAHs in the soil makes it difficult to assess the actual $KMnO_4$ treatment. However, based on the lack of evidence of significant $KMnO_4$ transport over the target zone it is unlikely that extensive PAH treatment was achieved.

5.5 Soil Manganese Results

In both control cells, the average manganese concentrations in soil remained essentially constant at 232 milligrams per kilogram (mg/kg) to 240 mg/kg and were similar to the baseline background concentrations measured across the site prior to starting permanganate treatment, which averaged 264 mg/kg. Based on the baseline data, the manganese distribution in the soil matrix was shown to be relatively uniform as compared to the PAH distribution.

The results of the treatability study indicated that low hydraulic conductivity and high SOD limited the transport of $KMnO_4$ to the upper 2 feet of the 4-foot thick target zone. The dosage calculations assumed that the $KMnO_4$ would be delivered equally over 4 feet of depth. Therefore, the incremental increase in soil manganese in the first 2 feet of soil, based on the 4-foot assumption, is likely double than planned. Appendix G summarizes the one-month soil samples. The maximum manganese detected in the 0 to 2 foot below ground surface (bgs) composite was 3,650 mg/kg in comparison to the U.S. Environmental Protection Agency (EPA) Preliminary Remedial Goal for manganese of 1,800 mg/kg. The amount of permanganate that was applied to the test cells produced 715 kilograms of manganese per test cell. If this amount of manganese is equally distributed over a 2-foot thickness with an initial manganese content equal to the maximum observed during the baseline sampling, 584 mg/kg, the 0 to 2 foot manganese concentration calculated is 3,445 mg/kg. However, if the manganese concentrations were averaged over the entire treatment cell and 4 foot treatment depth interval, the average manganese concentrations are only 1,182 mg/kg to 1,340 mg/kg.

5.6 Soil Oxidant Demand

The applied dose of $KMnO_4$ was approximately 25 percent of the average SOD observed during baseline sampling. The lower dose was selected so that on average the post treatment total manganese concentration was at or below the EPA Region 9 residential PRG. The average measured one-month performance SOD ranged from 14 grams $KMnO_4$ per kilogram soil to 30 grams per kilogram soil.

5.7 Geologic Limitations to In-Situ Delivery of Amendments

At Site 25, the primary obstacle to uniform delivery of $KMnO_4$ at depth was the low permeability of shallow fine-grained soils. Based on the results of the SOD tests and field observations made during the implementation phase, it is likely that manganese oxide solids, a byproduct of $KMnO_4$ degradation, were generated rapidly and locally. Potassium addition may have also altered the clay mineral structure of the fine-grained fraction of the soil affecting the hydraulic properties of the shallow zone. Therefore, the generally fine-grained soil matrix reacted with $KMnO_4$ thereby, limiting transport and consuming the PRG-limited dosage prior to significant PAH oxidation.

6.0 Conclusions and Recommendations

This treatability study indicated that treatment of shallow soils with potassium permanganate ($KMnO_4$) at Installation Restoration Site 25 was not effective. No significant oxidation of the polynuclear aromatic hydrocarbon (PAH) contamination was observed. In addition, no significant transport of $KMnO_4$ was observed. This outcome was likely the result of a combination of factors.

First, the geology of the target zone was dominated by fine-grained soils. The historic boring logs that were reviewed during work plan preparation indicated that the target zone, 0 to 4 feet below ground surface (bgs), were fine sands with varying degrees of fineness. In reality, the target zone was predominately highly plastic fine-grained soil with minor amounts of fine sand. Arsenic a result, the hydraulic conductivity was low and the soil oxidant demand (SOD) was high.

The low hydraulic conductivity of the fine-grained soils lead to evaporation dominating over infiltration. Less than half of the volume of applied fluids appeared to infiltrate. In addition, it appeared that the reaction of the clays with $KMnO_4$ further reduced the formation permeability. Coatings of dark, viscous materials were observed on the tilled soils and infiltration rates were consistently lower in the treatment cells than the control cells. This may be somewhat related to natural soil variation but seemed to be dominated by the rapid consumption of $KMnO_4$ by the site soils.

The extent of treatment was also limited because the allowable dosage of $KMnO_4$ was less than the measured SOD. The site soils had an average SOD of 20 grams of $KMnO_4$ per kilogram of soil. Further the shallow soils were relatively accessible to the public; therefore, it was deemed necessary to limit the $KMnO_4$ dosage to levels that would not result in soil manganese concentrations exceeding the U.S. Environmental Protection Agency (EPA) residential preliminary remediation goal (PRG) for manganese. On average, $KMnO_4$ deposits about 0.73 grams of manganese dioxide for every gram of $KMnO_4$ applied to a unit volume of soil. The $KMnO_4$ dosage was calculated using the maximum baseline manganese concentration, the manganese production rate from $KMnO_4$, the SOD test results, and the assumption of uniform delivery over 4 feet of soil (see Section 3.1). The PRG was used as the upper limit of the acceptable residual manganese concentration assuming uniform delivery over 4 feet of depth. The actual depth of delivery was more likely 2 feet or less. Arsenic a result, the total mass of manganese that was deposited in a thinner vertical interval than was anticipated during the work plan preparation. The limitation on the depth of delivery also increased the applied $KMnO_4$ dosage in the first 2 feet of soil by a factor of two. Nonetheless, this dosage was still only 50 percent of the measured SOD for the shallow soils. Arsenic a result, the applied $KMnO_4$ was likely consumed locally in nonproductive reactions with the fine-grained soil prior to oxidizing PAH.

Surface tilling and injection of fluids was effective under some conditions during the treatability study. Surface tilling rapidly and effectively delivered the $KMnO_4$ to the depth of tillage. Therefore, effectiveness in the tilling cell was more likely limited by the relatively high soil SOD as compared to physical delivery. Injection of fluids was successful when the injection rods were driven into moderately permeable materials found below the shallow, fine-grained soils. The design volume of water was successfully injected, with no surface venting, when sands were encountered.

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APPENDIX A
LITERATURE REVIEW ("WHITE PAPER") CHEMICAL OXIDATION TREATABILITY STUDY INSTALLATION RESTORATION SITE 25
ALAMEDA POINT
ALAMEDA, CALIFORNIA

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Acronyms and Abbreviations

ISCO	in-situ chemical oxidation
$KMnO_4$	potassium permanganate
PAH	polynuclear aromatic hydrocarbon

1.0 Introduction

A field treatability study and literature review was conducted to assess the treatment of polynuclear aromatic hydrocarbon (PAH) contamination in shallow soils at Installation Restoration Site 25 at Alameda Point, Alameda, California by in-situ chemical oxidation (ISCO). The PAH soil contamination was derived from contaminated sediments dredged from San Francisco Bay and used for landfill during the early 1900s. The need to assess PAH treatment is driven by the fact that the PAH are located at shallow depths within a residential area. Furthermore, options evaluated to date for reducing the potential health hazard associated with the PAH-contaminated soils involved either capping or excavation. Implementing these options in a residential area may pose significant logistical and technical challenges and limitations. Therefore, the Navy wanted to evaluate alternative in-place methods for destroying PAH contamination in soils, thereby reducing the potential health hazards.

The Work Plan identified ISCO as a promising alternative remedial technology; consequently, a literature review of ISCO technologies and ISCO field treatability studies was conducted. The literature review was performed to provide additional information concerning in-situ chemical oxidation of PAHs (Section 2.0) and to provide a basis for the design and interpretation of the Site 25 field treatability tests of ISCO using potassium permanganate.

The literature review was performed with respect to the chemical oxidation of PAH compounds because there is a strong literature basis for the chemical oxidation of recalcitrant organics such as PAHs. Four references to the treatment of PAH with potassium permanganate were identified, and will be discussed in later sections. The oxidation of PAHs by ozone- and peroxide-based processes was also reviewed to further document ISCO of PAHs and to identify possible oxidation by-products.

2.0 Literature Review

The objective of the literature review was to evaluate the previous work that has been reported with respect to oxidation of PAHs. The literature was reviewed to assess the information that is available to evaluate the chemistry associated with potassium permanganate ($KMnO_4$) oxidation of PAH contaminants in shallow subsurface soils at Installation Restoration Site 25. The chemical oxidation literature was reviewed with respect to several electorphillic oxidants:

- Potassium permanganate
- Ozone
- Peroxide-based reagents (i.e., Fenton's reagent).

This literature review was intended to provide additional information to supplement the field treatability test of delivery methods and the effectiveness of $KMnO_4$-based ISCO of PAHs.

The following sections present a general discussion of the ISCO literature followed by a discussion of literature references relating to $KMnO_4$ oxidation of PAHs. Another objective of the literature review was to evaluate the effectiveness of oxidation of PAHs by alternative oxidants. The review of alternative oxidants may assist in the understanding of the oxidation pathways and intermediate products that may be formed by permanganate oxidation. There is a relatively large body of literature concerning ISCO of PAH by alternative oxidants (14 references are discussed).

In-situ chemical oxidation involves the injection of oxidizing (electron and energy-rich chemicals that are inherently reactive) agents into the subsurface where the chemical oxidants react with contaminants and geologic media. The literature review is primarily focused on the chemistry of oxidation of PAH but delivery of the oxidizers to the contaminants should not be over looked. An assessment of delivery processes must be conducted at each ISCO candidate site and was the focus of the field treatability study.

The ISCO of certain classes of compounds, such as chlorinated solvents, are better documented in the literature than oxidation of PAHs (Hood et al., 2000). In addition, chemical oxidation of many additional classes of compounds (chlorinated pesticides, dioxins, furans, and heterocyclic compounds) is well documented in water-wastewater treatment literature. The difference between ISCO and water-wastewater treatment is the addition of soil. Soil minerals and organics react with chemical oxidants in both positive and negative ways; for instance, soil humic matter has been identified as both an inhibitor and promoter of hydroxyl radical formation. This literature review was focused on ISCO literature, but relevant references relating to applications for water-wastewater treatment have also been included when appropriate.

2.1 Potassium Permanganate Oxidation of Polynuclear Aromatic Hydrocarbons

The majority of the published material on ISCO using $KMnO_4$ is focused on the treatment of volatile organic compounds, such as trichloroethene and tetrachloroethene, (Hood et al., 2000). There is less literature concerning chemical oxidation of PAHs via $KMnO_4$. However, the oxidation of PAHs with $KMnO_4$ has been documented in four published and one IT Corporation treatability test (2000).

Potassium permanganate is currently used in approximately 250 drinking water treatment facilities in North America and 30 in Europe. The most common application of potassium permanganate is for removal of dissolved iron and manganese from drinking water. Permanganate is used to recharge green sand filters and as an algaecide in sand filters and storage tanks (Vella, 1998). Potassium permanganate is also used for the treatment of wastewater containing phenols and aromatics (Yin and Allen, 1999). Permanganate has also been applied with limited success to improve drinking water taste and odor resulting from unspecified organic compounds (Cherry, 1962). However, researchers have concluded that ozone-based and peroxide-based oxidation processes are more effective for the removal of taste and odor-causing compounds than $KMnO_4$ (Glaze et al., 1990).

Gates et al. (1995) is the first literature reference identified concerning oxidation of PAHs by $KMnO_4$. Gates et al. performed small-scale laboratory experiments to compare the effectiveness of $KMnO_4$ and hydrogen peroxide oxidation for various compounds in soil-groundwater slurries. The slurry samples were artificially contaminated with known quantities (330 milligrams per kilogram) of naphthalene, phenanthrene, and pyrene. A $KMnO_4$ dose of 20 grams per kilogram soil was added to the slurry samples and the samples were analyzed 48-hours later for contaminant levels. Complete destruction of the added PAHs was achieved in both sandy and clayey soils within 48 hours.

Gates-Anderson and her co-authors (2001) examined the effects of the total organic carbon content of soil and the use of surfactants to improve removal efficiencies, particularly for peroxide-based oxidations. Several experiments were performed with $KMnO_4$ dosages ranging from 1.5 to 20 grams per kilogram soil. The treatment efficiency for naphthalene, phenanthrene, and pyrene generally increased with increasing $KMnO_4$ dosages. Moderate treatment was observed, 10 to 30 percent destruction, at low $KMnO_4$ dosages while 95 to 100 percent of the PAHs were destroyed when permanganate dosages were greater than 15 grams per kilogram.

Additional experiments were performed to compare treatment effectiveness at fixed permanganate dosages in different types of soil. A $KMnO_4$ dosage of 16 grams per kilogram was applied to clays and sands with the same PAH concentrations. Greater than 90 percent of the PAH was destroyed for all compounds tested with slightly lower removal efficiencies reported for clayey soils. It should be noted that this study indicated that $KMnO_4$ was more effective than either Fenton's reagent or hydrogen peroxide alone, but this conclusion must be considered cautiously as site-specific soil conditions such as pH and total organic carbon may affect the results (Huling, 2000).

Brown et al. (2001) compared $KMnO_4$ oxidation to persulfate oxidation. Persulfate is an oxidizer currently under research for application for ISCO. Persulfate ISCO holds the promise of high oxidation potential with low reactivity with soil organic carbon. Unfortunately, the persulfate ion must be thermally, or catalyitically, activated to achieve the desired oxidation chemistry. As a result, persulfate-based ISCO has not been applied widely. Of interest is the authors' report of "complete, achieves detection limit" treatment of PAH by permanganate. The PAH compounds that were tested are described as naphthalene, a 3-ring PAH, a 4-ring PAH, and a 5,6-ring PAH, which include benzo(a)pyrene and the carcinogenic (cancer-causing) PAH that are included in the calculation of the benzo(a)pyrene-equivalent concentration. The carcinogenic PAH include:

- Benz(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Chrysene
- Dibenz(a,h)anthracene
- Indeno(1,2,3-cd)pyrene.

No information concerning $KMnO_4$ dosage or soil conditions was provided in this reference.

A feasibility test of PAH treatment of soil with permanganate was conducted at the IT Corporation Technology Applications Laboratory in Knoxville, Tennessee. Three series of experiments were performed to evaluate the degradation of PAHs by the addition of $KMnO_4$. The change in concentration of the 15 PAHs was monitored after the introduction of $KMnO_4$ to soil slurries after specific durations (e.g., 48 hours, 72 hours, etc.). The majority of the PAH destruction took place in the first 72 hours of the test. During the first 72 hours, the concentration of approximately half of the PAH compounds were reduced by at least 75 percent. After 144 hours of treatment, twelve of the fifteen PAH compounds had decreased in concentration more than 75 percent from the initial concentration. Only fluoranthene, chrysene, and benzo(b)fluoranthene were not reduced more than 75 percent (ranged between 54 and 75 percent of the original concentrations).

A field investigation of permanganate treatment of a creosote source zone was conducted at the Canadian Air Force Base Borden in Borden, Ontario by researchers from the University of Waterloo (Lamarche et al., 2002). Bench testing showed favorable results; therefore, six injections of permanganate were performed upgradient of an emplaced creosote source zone. A total of 150 kilograms of $KMnO_4$ was added to the source zone that contained between 27 and 34 liters of creosote. Difficulty in delivering the final injections of permanganate was encountered. The effectiveness of the field pilot test was not reported.

2.2 Ozone-based Oxidation of Polynuclear Aromatic Hydrocarbons

Ozone is a chemical oxidant with slightly higher oxidation potential than potassium permanganate. As a result, compounds that are not reactive with permanganate may be reactive with ozone. More importantly, the body of literature concerning oxidation with ozone is much larger than for permanganate. As a result, information concerning the generation of oxidation intermediates, and by-products, is available for ozone oxidation. The majority of field applications of ozone-based ISCO for PAH remediation have been performed at former manufactured gas plant sites and wood treatment sites impacted by creosote. In addition, the water-wastewater treatment literature contains many references to oxidation of PAHs with ozone.

Three references from the water-wastewater treatment literature document oxidation of PAHs in aqueous solutions. Butkovic et al. (1983) demonstrated the oxidation of pyrene, phenanthrene, and benzo(a)pyrene. Polynuclear aromatic hydrocarbon was oxidized rapidly and ozone was consumed with a half-life on the order of seconds. Beltran et al. (1995) also demonstrated the oxidation of fluorene, phenanthrene, and acenaphthene in aqueous solutions. Investigators (Corless et al., 1990) performed experiments to examine the pyrene oxidation pathway with low levels of dissolved ozone. The experiments showed that when pyrene oxidation was incomplete and that short-chain aliphatics were formed.

A 1980 study by Legube et al. more clearly elucidated the step-wise oxidation of PAHs. Oxidation of aromatics, such as phenol and hydroquinone, was studied and partial oxidation products were observed. The partial oxidation products that were identified were both resistant to further oxidation and readily biodegradable. Legube et al. identified a hydroxylation of the primary ring structure resulting in the formation of quinones that were more oxidizable than the parent compounds. The quinones were further oxidized to acids and then aldehydes, which oxidize slower than the parent PAH. Acids formed include oxalic, glyoxylic, and formic acids, which are also biological oxidation intermediates. Aldehydes formed included muconaldehyde and actelyaldehyde, which are also susceptible to further biological oxidation. The researchers further investigated the total oxygen demand and total organic carbon of ozonated waters. The total oxygen demand of the water declined faster than the total organic carbon. The researchers concluded that this indicated that ozonation converts the parent compounds into smaller, more biodegradable oxygenated compounds.

The next study that was reviewed evaluated PAH oxidation by ozone in unsaturated soil columns (Masten, 1997). Masten's research demonstrates that pyrene, naphthalene, chrysene, and phenanthrene are oxidized under conditions found in the subsurface, i.e., high soil to water ratio. The treatment efficiency was lower for the more hydrophobic compounds tested. A minimum of 80 percent removal of each PAH was observed. Ozone dosages ranged from 0.2 to 0.4 grams per kilogram of soil. Ozone consumption, and hence required dosage, increased with increasing moisture content in the soil column.

Three field applications of ozone for ISCO of PAHs were located in the literature. Marvin et al. (1998) reported greater than 97 percent destruction of PAHs in soil slurry systems and greater than 80 percent removal of PAHs from groundwater and pore water during a field trial. Multilevel ozone injection into unsaturated zone soils was performed at a former wood-treating site. The field demonstration ultimately documented greater than 93 percent destruction of the mass of the PAHs in the subsurface (Clayton, 2000). Approximately 7 pounds of ozone was consumed for every pound of PAH destroyed (this is less than the stoichimetric amount of ozone required to oxidize benzo(a)pyrene to carbon dioxide). A second and third field application of ozone-based ISCO were reported for former manufactured gas plant sites in Iowa and California (Dablow et al., 2001). The California site was remediated to risk-based closure levels in 18 months, while similar rates of treatment were observed at the Iowa site.

2.3 Documentation of Peroxide-based Oxidation of Polynuclear Aromatic Hydrocarbons

A review of the peroxide-based oxidation literature was also performed to determine if information relevant to oxidation via permanganate was available. Peroxide-based oxidation may take several forms:

- Direct oxidation by hydrogen peroxide
- Oxidation by solid peroxygen compounds, such as calcium peroxide

- Catalytic production of the hydroxyl radical (hydrogen peroxide and ferrous iron) via "Fenton's reagent."

The literature review of peroxide-based oxidations was more limited in scope than the ozone-based oxidations because the hydroxyl radical is a much higher powered oxidant than permanganate, thus the relevance to this body of literature to potassium permanganate is more limited than ozone-based literature.

Fenton's chemistry is the generation of the hydroxyl radical via catalytic reaction between hydrogen peroxide and ferrous iron. Fenton's chemistry has been used in the chemical processing industry for wastewater treatment for more than 50 years. A variety of compounds including phenol, benzene, and other aromatics and amines are treated with Fenton's chemistry (Bigda, 1995). In light of its versatility in treating process waters, Fenton's chemistry has recently gained popularity in the hazardous waste remediation field.

Gates-Anderson et al. (2001) showed that Fenton's reagent was capable of achieving 99 percent destruction in soil of three common PAH constituents: naphthalene, phenanthrene, and pyrene. During this study, it was estimated that 90 percent or more of the contaminant mass existed in the non-aqueous phase liquid-phase prior to treatment. However, it is worth noting that the soil-water slurries that were treated with $KMnO_4$ had the higher PAH destruction efficiency than slurries treated with Fenton's reagent.

Nesheiway and Swanson (2000) also summarized several cases were peroxide was used to treat PAHs. For example, Farhataziz and Ross (1977) listed several reaction rates for carcinogenic PAHs and radicals in their compendium of reaction rates.

The literature also has numerous references to both positive and negative effects of soil and groundwater characteristics on the oxidation of PAHs. For instance, Kawahara et al. (1995) concluded that Fenton's chemistry caused the release of PAHs from clay soil. The researchers suggested that the treatment might enhance soil remediation. Other studies suggest that dissolved organic matter and fulvic acids (humic matter) inhibit hydroxyl radical formation and limit the effectiveness of treatment. Huling et al. (2000) and Kanel et al. (2002) also indicate that inorganic ions, such as chloride and bicarbonate, may inhibit treatment by the hydroxyl radical. Finally, Fenton's reagent has been reported as a pre-treatment to convert non-biodegradable PAH ring structures to compounds that are more amenable to biodegradation (Nesheiway and Swanson, 2000).

3.0 Field Treatability Study Rationale

The rationale for the field treatability study is the need to develop further technical information to assess the in-situ options for remediating the PAH-contaminated soil at Site 25. The baseline remedial options for Site 25 were excavation and/or placement of a surface cap. The Navy determined that these two options were likely to involve significant limitations and logistical difficulties during implementation. Therefore, the Navy was interested in assessing other remediation options that are based on treating the contaminated soils without excavation. In-situ treatment of the PAHs may potentially offer substantial benefit over excavation and/or capping. However, technical data gaps exist that prevent full-scale application of in-situ treatment. In-situ treatment of PAHs with $KMnO_4$ was selected for evaluation in the Field Treatability Study Work Plan (IT, 2000). This option was selected over others based on a screening-level assessment of the site remediation requirements. This section describes the baseline remediation options that were considered in the Work Plan and provides an overview of alternative remediation technologies. In-situ treatment involves application of a treatment process below the ground (i.e., in the subsurface). Since the Navy is seeking alternatives to excavation and/or capping, this review is limited to in-situ treatment technologies. This review was also limited to soil treatment (as opposed to groundwater treatment), since the target treatment zone is the shallow (upper 4-feet) soil at the site. This section briefly summarizes the remediation technologies that may be used in place of excavation. A discussion of the screening-level assessment is also provided in the Work Plan (IT, 2000).

In-situ soil treatment technologies are achieved by one of two general mechanisms: extraction or destruction. Extraction-based soil treatment technologies involve removing either soil vapor or liquids, such as groundwater. The PAH must first be transferred from the soil to the removal media, and then collected for treatment aboveground. Since PAHs have very low water solubility and volatility (they do not vaporize), they are not amenable to extraction by simple soil vapor extraction or water flooding. Extractive technologies that are potentially applicable for PAH use are surfactants or co-solvent flushes to increase the solubility of the PAHs in groundwater. This technology is not commonly applied because of the high cost and difficulty in collecting the flushing fluid and the mobilized PAHs for aboveground treatment. At Site 25, this would be especially true, since the target treatment zone is above the water table (i.e., unsaturated zone). Another extraction-based technology that has been used for PAH remediation is thermal treatment. Subsurface thermal treatment involves the injection of steam or the heating of the target zone by radio or microwave energy. Increasing the heat of the target zone increases the solubility and volatility of the PAHs, which increases the efficiency of recovery by the removal fluid. In most cases, subsurface thermal treatment technologies require that large volumes of groundwater, soil gas, or non-phase liquids are passed through the treatment zone and then recovered and treated aboveground. The recovered PAHs are then concentrated for off-site disposal.

In-situ destruction technologies are more likely to succeed at Site 25, because they do not require extraction of the PAHs. Instead amendments are delivered to the contaminated interval that breakdown the PAHs in-place. However, PAH degradation requires an aggressive approach, because the molecular structure of the PAHs is relatively stable and as a result more difficult to degrade than many other organic compounds, such as simple petroleum hydrocarbons.

In-situ chemical oxidation is an in-situ destructive treatment technology that involves the injection of an oxidant to chemically break down the amenable contaminants. The oxidant has stored chemical potential energy that is released on reaction with the PAHs and other reduced soil constituents removing electrons from the contaminant molecules, breaking molecular bonds, and causing the contaminants to be destroyed. Oxidation has been used for treatment of organic compounds for over 100 years, but the use of chemical oxidants for in-situ treatment is relatively new. In-situ oxidation was developed in the 1990s in order to provide a more cost effective treatment approach than extraction-based technologies, for a range of organic compounds such as PAHs that are resistant to other treatment approaches. In-situ chemical oxidation has the advantages of being rapid and of being able to achieve high levels of contaminant destruction given adequate contact time with the contaminant and adequate oxidant to drive the reactions to completion.

There are three primary chemical oxidizers used for in-situ chemical oxidation: permanganate, ozone gas, and Fenton's reagent.

The permanganate ion is a chemical oxidant that is commonly applied as a liquid solution of either $KMnO_4$ or sodium permanganate. The permanganate ion is a less energetic and less aggressive oxidizer than ozone or Fenton's reagent. This often results in more favorable transport properties for permanganate than ozone or Fenton's reagent. As a result, in situations where permanganate is adequately powerful to oxidize the target contaminants, it may offer performance advantages such as the ability to move the permanganate over larger distances from the injection well prior to consumption. Slower reaction allows additional contact-time between contaminants and the oxidant that will allow desorption and diffusion processes to proceed prior to complete oxidant consumption. Potassium permanganate oxidation typically proceeds for weeks as compared to days for hydrogen peroxide and ozone gas.

Ozone gas is generated from on-site from oxygen using electrical corona discharge. The ozone gas is then injected into the subsurface through injection wells. Ozone gas oxidizes PAH as a result of two chemical pathways: direct oxidation of the contaminant or reaction with soil transition metals to form the hydroxyl radical radical. Injection of the ozone gas is performed over a period of months (or years) until the required oxidant dose is achieved and the PAHs are treated to acceptable levels.

Fenton's reagent is the reaction of hydrogen peroxide and ferrous iron. The hydrogen peroxide reacts with the ferrous iron to produce hydroxyl radicals, a short-lived but powerful oxidant. Fenton's reagent is generally applied in a batch process, where hydrogen peroxide, ferrous iron, and an acid, or other chemicals that keep ferrous iron in solution, are injected into the subsurface as liquid solutions, and the oxidation proceeds for several days until the peroxide is consumed. The following discussion considers the benefits and technical challenges of the three primary chemical oxidants. The benefits and technical challenges are summarized in Table 3-1 based on treatment system logistics, duration, effectiveness, treatment applicability, and safety.

Chemical oxidation is effective for the destruction of PAHs. Chemical oxidation via Fenton's Chemistry and ozone has been demonstrated at former manufactured gas plant sites for the treatment of PAH. The effectiveness of Fenton's chemistry may be limited in the unsaturated zone due to the difficulties in mixing the contaminants, hydrogen peroxide and ferrous iron in the target zone as these fluids move downward under gravity and capillary forces. In comparison, ozone gas has been demonstrated for PAH destruction in both the unsaturated and saturated zones. Ozone is produced as a gas and therefore is more applicable for use in the unsaturated zone where most of the soil pore volume is filled with gas. Chemical oxidation with the permanganate ion has been evaluated on the bench-top for PAH destruction. The bench-top evaluation results indicate that PAH destruction to below the method detection limit was achieved within 96 hours of $KMnO_4$ addition (IT, 2000). Further field-testing of delivery of both solid and liquid forms of $KMnO_4$ is required prior to full-scale application. Polynuclear aromatic hydrocarbon treatment is further limited by the formation of a skin, as a result of weathering and contact with water, that may reduce the mass transfer of PAHs to groundwater (Ramaswami, 1997). Chemical oxidation will attack this skin and increase the availability of the PAHs for chemical oxidation. Logistical issues often affect remedial technology selection due to constraints such as constructability, economics, and schedule. Logistical issues concerning ozone gas may preclude its use in residential areas. Production of ozone gas in quantities required for oxidation of PAHs requires industrial electrical power. Delivery of $KMnO_4$ is simpler than ozone gas because $KMnO_4$ solutions may be prepared with simpler equipment than ozone gas. Ozone gas requires injection wells and a soil vapor extraction system to prevent fugitive emissions. The ozone gas equipment is much more logistically challenging in a shallow soil treatment application than $KMnO_4$ addition. Delivery of the permanganate is labor intensive over a short duration followed by little to no additional intrusive activities. Permanganate oxidation is often completed within three to six months.

Ultimately, in-situ destruction of PAH by $KMnO_4$ had the best mix of effectiveness, logistical difficulties, and safety issues for application at Site 25. Intrusion into the subsurface will be minimized and destruction of the PAHs may be achieved in-place.

Table 3-1
Summary Matrix of Potential In-Situ Polynuclear Aromatic Hydrocarbon Treatment Technologies

	Ozone Oxidation	Fenton's Reagent	Permanganate Oxidation
Treatment System Logistics	Continuous Operation	Batch Operation	Batch Operation
Likely Duration	~ 1 year[1]	~ 1- 3 months[1]	~ 1- 3 months[1]
Anticipated Effectiveness	High	High	High
Applicability to Shallow Unsaturated Zone Soils	High	Low	Moderate
Safety Considerations	High	High	Moderate

[1]Data Gap exists on these values. Estimates represented here for preliminary comparison.

4.0 Summary and Conclusions

The body of literature indicates that oxidation of PAHs occurs rapidly. The three primary oxidants used for ISCO have all been demonstrated to destroy PAH compounds. The literature suggests that this process is step-wise through several intermediate compounds that generally have higher reaction rates than the parent PAH until aldehydes are formed. Aldehydes have low reaction rates with most chemical oxidants but are readily biodegradable, in comparison to the parent PAH compounds. Therefore, subsequent natural microbial action likely leads to complete oxidation of the PAHs to carbon dioxide and water.

The successful oxidation of PAHs by permanganate ISCO is documented; however, its effectiveness is dependent of the dosage of permanganate. The primary limitation to ISCO of PAHs using permanganate, or any other in-place remediation technique is delivery method and delivery efficiency. As a result, field-testing of delivery methods and site-specific oxidation of PAHs is warranted.

5.0 References

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APPENDIX B
BORING LOGS

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: PZ1 Cell A	COORDINATES:		DATE: 8/13/01
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: "
ENGINEER/GEOLOGIST:	Depth	Date/Time	DATE COMPLETED: "
DRILLING METHODS:			PAGE 1 OF 3

DEPTH (ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	NONE			Dark Brown (3/3) topsoil with grass and roots.	OH			
				Clay w/gravel (~~20~~ 50% gravel)	CL			iron staining
3				Dark Brown (4/2) Clay	CL			1.5 in dia. pvc riser pipe
4				olive Brown (4/4) Sand	SW			
5								
6								water between 6 + 7 ft.

NOTES:

Drilling Contractor: Kehoe

Drilling Equipment: Power Probe

Driller: Tyler

Foam seal above bentonite

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: PZ1 - Cell A	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 3

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Very Dark gray (3/1) Sand	SC		Bentonite seal	self expanding bentonite seal
7				Very Dark gray (3/1) Bay Mud	OL			
8							Slotted screen	
9								1.5 in. slotted PVC (0.010 in. slot size)
0								prepacked filter #2/12
1				Very Dark Gray (3/1) Sand w/ clay	SC			
12								

NOTES:

Drilling Contractor

Drilling Equipment

Driller:

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: PZ1 - Cell A	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 3 OF 3

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Very Dark gray (3/1) Sand w/ clay	SC			1.5in. (I.D.) slotted PVC casing (0.010 inch slot size) prepacked filter #2/12
3				Very Dark gray (3/1) Bay Mud	OL			
4								
5								
6				total depth 16 Ft.				

NOTES:

Drilling Contractor ______

Drilling Equipment ______

Driller: ______

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827557	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: PZ2-Cell D	COORDINATES:	DATE: 3/14/01	
ELEVATION:	GWL: Depth 6.5 ft Date/Time	DATE STARTED: "	
ENGINEER/GEOLOGIST: N. Buchholz	Depth Date/Time	DATE COMPLETED: "	
DRILLING METHODS: Direct Push		PAGE 1 OF 3	

DEPTH (ft)	SAMPLE TYPE AND	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	None			DARK BROWN (3/3) topsoil w/ roots	OH			
				DARK Brown (4/2) Clayey Sand w/gravel	SC			
1				DARK Brown (4/2) Sandy Clay ↓	CL			1.5 in. dia. PVC riser pipe
2								
3				DARK Brown (4/2) Clay	CL			
				Olive Brown (4/4) Sand ↓	SW			
4								
5								
							(WS)	Foam seal above bentonite

NOTES:

Drilling Contractor: Kehoe

Drilling Equipment: Power Probe

Driller: Tyler

243B-3-88

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: PZ 2 Cell D	COORDINATES:	DATE.
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 3

DEPTH (Ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Olive Brown (4/4) Sand ↓	SW			Self expanding bentonite seal; water 6.5 ft.
7								
				Very Dark gray (3/1) Sand w/clay ↓	SC			
8								1.5 in. slotted PVC (0.010 in slot size) prepacked filter #2/12
9								
				Very Dark gray (3/1) Bay Mud ↓	OL			
0								
1								
				Very Dark gray (3/1) Sand w/clay	SC			
2								

NOTES:

Drilling Contractor

Drilling Equipment

Driller:

243B-3-88

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: P22 Cell D	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 3 OF 3

DEPTH (ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Very Dark Gray (3/1) Sand w/clay	SC			
13				↓				
				Very Dark Gray (3/1) Bay Mud	OL			
4				↓				
5				↓				
6				Total Depth 16 ft.				

NOTES:

Drilling Contractor

Drilling Equipment

Driller:

2435-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study	
BORING NUMBER: PZ3 Cell C	COORDINATES:	DATE: 8/15/01
ELEVATION:	GWL: Depth 7 ft Date/Time	DATE STARTED: "
ENGINEER/GEOLOGIST: N. Buchholz	Depth Date/Time	DATE COMPLETED: "
DRILLING METHODS: Direct Push		PAGE 1 OF 3

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	none			Dark Brown (3/3) top soil w/ roots ↓	OH			1.5 in. dia. PVC Riser pipe
1				Dark reddish brown clay w/ gravel ↓	CL			
2								
				Olive Brown (4/4) Sand ↓	SW			
3								
				Dark Brown (4/2) Clay	CL			
				Olive Brown (4/4) Sand	SW			
4								
5								
6								Foam Seal above bentonite

NOTES:

Drilling Contractor Kehoe

rilling Equipment Power Probe

Driller: Tyler

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: PZ3 Cell C	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 3

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Very Dark gray (3/1) Sand w/Clay water ~6.5 to 7ft	SC			Self expanding bentonite seal
7								
8				more sand less clay.				
9				Very Dark gray (3/1) Bay Mud	OL			1.5 in slotted PVC (0.010 in slot size) prepacked filter #2/12
10								
11				Very Dark gray (3/1) Sand w/ some clay	SC			
12								

NOTES:

Drilling Contractor ____________________

Drilling Equipment ____________________

Driller: ____________________

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: PZ3 Cell C	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 3 OF 3

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Very Dark Gray (3/1) Bay Mud	OL			
13				Very Dark Gray (3/1) Sand w/ Clay	SC			
4				Very Dark Gray (3/1) Bay Mud	OL			
15				Very Dark Gray (3/1) Sand w/ clay	SC			
				Very Dark Gray Bay Mud.	OL			
16				Total Depth 16 ft.				

NOTES:

Drilling Contractor ______

Drilling Equipment ______

Driller: ______

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: PZ4 Cell E	COORDINATES:	DATE: 8/15/01	
ELEVATION:	GWL: Depth 7.5 ft Date/Time	DATE STARTED: "	
ENGINEER/GEOLOGIST: N. Buchholz	Depth Date/Time	DATE COMPLETED: "	
DRILLING METHODS: Direct Push		PAGE 1	OF 3

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	none			DARK BROWN (3/3) TOP SOIL with roots	OH			1.5 in. dia. PVC Riser Pipe
1				DARK Brown (4/2) Clay w/ gravel (10% gravel)	CL-G			
2								
3				Olive Brown (4/4) Sand	SW			
				DARK BROWN (4/2) Clay	CL			
4				DARK Brown (4/2) Sandy Clay seashells at 4 ft.	SC			
5								
6							Pre	Foam Seal Above Bentonite

NOTES:

Drilling Contractor Kehoe

Drilling Equipment Power Probe

Driller: Tyler

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: PZ4 cell E	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 3

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				DARK Brown Sandy Clay ↓	SC			self Expanding Bentonite
7				Very Dark gray (3/1) Sand w/Clay	SC			
8								
9				Very Dark gray (3/1) Bay Mud	OL			1.5 in. slotted PVC (0.010 in slot size)
10								prepacked filter #2/12
11				Very DARK gray (3/1) Sand w/clay	SC			
12								

NOTES:

Drilling Contractor

Drilling Equipment

Driller:

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: PZ4 Cell E	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 3 OF 3

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Very Dark Gray (3/1) Sand w/clay	SC			
3								
4				Very Dark Gray (3/1) Bay mud	OL			
5								
				Very Dark Gray (3/1) Sand w/clay	SC			
6				Total depth 16 ft.				

NOTES:

Drilling Contractor

Drilling Equipment

Driller:

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: PZ5	COORDINATES:	DATE: 8/15/09	
ELEVATION:	GWL: Depth 7.5 ft Date/Time	DATE STARTED: "	
ENGINEER/GEOLOGIST: N. Buchholz	Depth Date/Time	DATE COMPLETED: "	
DRILLING METHODS: Direct Push		PAGE 1 OF 3	

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	None			Dark Brown (3/3) Topsoil w/roots	OH			1.5 in. dia. PVC Riser Pipe
1				Dark Brown (4/2) Clay with with gravel	CL-G			
2				Dark Brown (4/2) Clay	CL			
3				Olive Brown (4/4) Sand	SW			
4				App. 3 in. Dark Brown (4/2) Clay	CL			
				Olive Brown (4/4) Sand	SW			
5								Foam Seal above Bentonite
6				App. 3 in Dark Brown (4/2) Clay	CL			

NOTES:

Drilling Contractor Kehoe

Drilling Equipment Power Probe

Driller: Tyler.

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: P25	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 3

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Olive Brown (4/4) Sand	SW			Self expanding Bentonite
				1 in Band of unknown black material				
				Olive Brown (4/4) Sand	SW			
7								
				~~Dark Brown~~ Very Dark gray (3/1) Sand with Clay	SC			
8				Very Dark gray (3/1) Bay Mud	OL			1.5 in. slotted PVC (0.010 in slot size) prepacked filter #2/12
9								
10				Very Dark gray (3/1) Sand with Clay	SC			
11				Very Dark gray Bay Mud	OL			
12								

NOTES:

Drilling Contractor

Drilling Equipment

Driller:

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: PZ5	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 3 OF 3

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Very Dark gray Sand with Clay	SC			
3								
4				Very Dark gray Bay Mud	OL			
5								
				Total Depth 16 ft.				

NOTES:

Drilling Contractor

Drilling Equipment

Other:

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: PZ6	COORDINATES:	DATE: 8/05/01	
ELEVATION:	GWL: Depth 7.5ft Date/Time	DATE STARTED: "	
ENGINEER/GEOLOGIST: N. Buchholz	Depth Date/Time	DATE COMPLETED: "	
DRILLING METHODS: Direct Push		PAGE 1	OF 3

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
0	None			DARK Brown (3/3) topsoil with roots	OH			1.5 inch PVC Riser Pipe
1				DARK Brown (4/2) Clay w/ Gravel	CL-G			
2				↑ iron staining ↓				
3				Dark Brown (4/2) Clay w/ Sand	SC			
4								
5				Dark Brown Clayey Sand w/ some gravel	SC			
				Very Dark Gray (3/1) Bay Mud	OL			Foam Seal Above Bentonite
6								

NOTES:

Drilling Contractor Kehoe

Drilling Equipment Power Probe

Driller: Tyler

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: PZ 6	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 3

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Very Dark Gray (3/1) Bay Mud	OL			self expanding bentonite
				Small bands of sand @ app. 7.25 + 7.75 feet. (1/2 to 3/4 inch wide)				
1								
3								1.5 inch slotted PVC (0.010 in. slot size)
7								
5								prepacked filter #2/12
1				Dark Gray (4/1) Bay Mud	OL			
2								

NOTES:

Drilling Contractor __________

...lling Equipment __________

...riller: __________

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: PZ 6	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 3 OF 3

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Very Dark Gray (3/1) Bay Mud ↓	OL			
3								
1								
5				Dark Gray (4/1) Bay Mud ↓	OL			
				Total Depth 16 ft.				

NOTES:

Drilling Contractor ______

Drilling Equipment ______

er: ______

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: PZ 7	COORDINATES:		DATE: 8/15/01
ELEVATION:	GWL: Depth 8 ft.	Date/Time	DATE STARTED: "
ENGINEER/GEOLOGIST: N. Buchholz	Depth	Date/Time	DATE COMPLETED: "
DRILLING METHODS: Direct Push			PAGE 1 OF 3

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	none			DArK Brown (3/3) Top Soil w/ roots	OH			1.5 inch PVC Riser Pipe
				Dark Brown (3/4) Clay	CL			
2				Light Gray (7/1) Possibly Concrete				
				Dark Brown (3/4) Clayey Sand	SC			
3				DarK Brown (3/4) Stf Clay	CL			
4				Olive Brown (4/4) Sand	SW			
5								
6				DArK Brown (3/4) Clay ~ 3 inches	CL			Foam Seal above Bentonite

NOTES:

Drilling Contractor Kehoe

Drilling Equipment Power Probe

[Dril]ler: Tyler

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: PZ 7	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 3

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Olive Brown (4/4) Sand	SW			self expending Bentonite
1				Very Dark Gray (3/1) Sand w/Clay	SC			
				Very Dark gray (3/1) Bay Mud	OL			
3				Very Dark gray (3/1) Sand w/clay	SC			1.5 inch slotted PVC (0.010 in. slot size) prepacked filter #2/12
1								
0				Very Dark gray (3/1) Bay Mud	OL			
				Very Dark gray (3/1) Sand w/Clay	SC			
11				Very Dark gray (3/1) Bay Mud	OL			
				Very Dark gray (3/1) Sand w/ Clay	SC			
12								

NOTES:

Drilling Contractor ______

Drilling Equipment ______

Driller: ______

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

JECT NUMBER:	PROJECT NAME:	
BORING NUMBER: PZ-7	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 3 OF 3

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Very Dark gray (3/1) Sand With clay	SC			
3								
4								
5								
				Total Depth 16 ft				

NOTES:

Drilling Contractor

Drilling Equipment

er:

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: PZ 8	COORDINATES:	DATE: 8/15/01	
ELEVATION:	GWL: Depth 8 ft Date/Time	DATE STARTED: "	
ENGINEER/GEOLOGIST: N. Buchholz	Depth Date/Time	DATE COMPLETED: "	
DRILLING METHODS: Direct Push		PAGE 1 OF 3	

DEPTH (ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	none			DARK Brown (3/3) top soil with roots	OH			1.5 inch dia PVC Riser Pipe
				DARK Brown (4/2) Clayey Sand	SC			
				DARK Brown (4/2) Clayey Sand w/ gravel	SC			
3				DARK Brown (4/2) Clay	CL			
				Olive Brown (4/4) Sand ↓	SW			
							10'	Foam Seal Above Bentonite

NOTES:

Drilling Contractor Kehoe

Drilling Equipment Power Probe

Tyler

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: PZ8	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 3

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Olive Brown (4/4) Sand	SW			self expanding bentonite
				Very Dark gray (3/1) Bay mud	OL			
7				Very Dark gray (3/1) Sand w/ Clay	SC			
8								1.5 inch slotted PVC (0.010 inch slot size) prepacked filter #2/12
9								
10								
11								
12								

NOTES:

Drilling Contractor

Drilling Equipment

Driller:

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INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:		
BORING NUMBER: P28	COORDINATES:		DATE:
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth	Date/Time	DATE COMPLETED:
DRILLING METHODS:			PAGE 3 OF 3

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Very Dark Gray (3/1) Sand w/ Clay ↓	SC			
3								
4								
5								
				Very DARK Gray (3/1) Bay Mud	OL			
				Very DARK Gray (3/1) Sand w/ Clay				
6				Total Depth 16 ft.				

NOTES:

Drilling Contractor ____________

'ing Equipment ____________

Driller: ____________

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: NP1-Cell A	COORDINATES:		DATE: 8/13/01
ELEVATION:	GWL: Depth 6.5 Ft.	Date/Time	DATE STARTED: "
ENGINEER/GEOLOGIST: N. Buchholz	Depth	Date/Time	DATE COMPLETED: "
DRILLING METHODS: Direct Push			PAGE 1 OF 2

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
0–1	Composite Sample TS25L-S-001 TS25F-S-002 (0–2)			Dark Brown (3/3) Top Soil with grass and roots	OH		Installed steel casing for Neutron Probe	
1				Approx. 4 in layer that appears to be broken concrete				
1–4				grades into a Dark Brown (4/2) Clay with iron staining throughout	CL			
2	Composite Sample TS25L-S-003 TS25F-S-004 (2–4)							
4–5				Olive Brown (4/4) Sand	SW			
5–6				Very Dark Gray 10YR (3/1) Sand w/Clay	SC			water at about 6.5ft.

NOTES:

Drilling Contractor: Kehoe

Drilling Equipment: Power Probe

Driller: Tyler

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INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: NPI Cell A	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 2

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Very dark gray (3/1) Bay mud	OL			Strong odor
7								
8								
9								
10								
11								
12				Total Depth 12 Ft.				

NOTES:

Drilling Contractor ______

illing Equipment ______

Driller: ______

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INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: NP2-Cell A	COORDINATES:		DATE: 8/13/01
ELEVATION:	GWL: Depth ~7 ft	Date/Time	DATE STARTED: "
ENGINEER/GEOLOGIST: N. Buchholz	Depth	Date/Time	DATE COMPLETED: "
DRILLING METHODS: Direct Push			PAGE 1 OF 2

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
0–2	Comp. Composite Sample T525-L-5005, T525-F-5006			Dark Brown (3/3) top soil with grass and roots	OH		Installed Steel Casing for Neutron Probe	
1				Sandy Clay with iron staining	CL-SC			
				Possible Clay pipe or brick approx. 3 in. in length.				
2–4	Composite Sample T525-L-5-007, T525-F-5-008			Continue Sandy Clay				
3				Olive Brown (4/4) Sand	SW			
5				approx. 3 in. layer of Dark Brown Clay	CL			
				Very Dark Gray (3/1) Sand w/ Clay	SC			
6								

NOTES:

Drilling Contractor: Kehoe

Drilling Equipment: Power Probe

Driller: Tyler

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: NP2 - Cell A	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 2

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Very Dark Gray (3/1) Sand w/ Clay	SC			water @ 7ft.
7				Very Dark Gray (3/1) Bay Mud	OL			
8								
9								Strong odor
0				Very Dark Gray (3/1) Sand w/ Clay	SC			
				Very Dark Gray (3/1) Bay Mud	OL			
11								
12				Total Depth 12 ft				

NOTES:

Drilling Contractor

illing Equipment

Driller:

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INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: NP3- Cell A	COORDINATES:		DATE: 8/13/01
ELEVATION:	GWL: Depth 6 to 6.5 ft	Date/Time	DATE STARTED: "
ENGINEER/GEOLOGIST: N. Buchholz	Depth	Date/Time	DATE COMPLETED: "
DRILLING METHODS: Direct Push			PAGE 1 OF 2

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
0	Composite Sample T525L-5-010/009-Dup. T525F-5-011 (0–2)			Dark Brown (3/3) Topsoil with grass and roots	OH		Installed Steel Casing for neutron probe (0–6)	
1				Dark Brown (4/2) Clay with ~~little~~ some gravel (10%)	CL			Iron Staining
2	Composite Sample T525L-5-012 T525F-5-013 (2–4)							
3				Olive Brown (4/4) Sand	~~SC~~ SW			
4								
5								
6								Water at 6 to 6.5 ft.

NOTES:

Drilling Contractor: Kehoe

Drilling Equipment: Power Probe

Driller: Tyler

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: NP3 Cell A	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 2

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Very Dark gray (3/1) Bay Mud	OL			
7				↓				Some odor
8								
9								
10								
11								
				Dark gray (4/1) Sand w/clay	SC			
12				Total Depth 12 Ft				

NOTES:

Drilling Contractor ______

Drilling Equipment ______

Driller: ______

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INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study	
BORING NUMBER: NP4-Cell A	COORDINATES:	DATE: 8/13/01
ELEVATION:	GWL: Depth 6 to 7 ft Date/Time	DATE STARTED: "
ENGINEER/GEOLOGIST: N. Buchholz	Depth Date/Time	DATE COMPLETED: "
DRILLING METHODS: Direct Push		PAGE 1 OF 2

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
0	Composite Sample TS25L-S-014 TS25F-S-015			Dark Brown (3/3) Topsoil with grass and roots	OH		Installed steel casing for neutron probe.	
				Dark Brown (4/2) Clay with gravel, 10 to 20% gravel	~~CL~~ ~~GH~~ GC			
2	Composite Sample TS25L-S-016 TS25F-S-017							
3				Dark Brown (4/2) Clay with sand	CL			
4								
5				Olive Brown Sand (4/4)	~~SC~~ SW	nb		Water between 6 to 7 ft.
6								

NOTES:

Drilling Contractor Kehoe

Drilling Equipment Power Probe

Driller: Tyler

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: NP4 Cell A	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 2

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Very Dark gray (3/1) Sand w/ Clay	SC			
7				Very Dark Gray (3/1) Bay mud	OL			some odor
8								
9								
10								
11								
12				Total Depth 12 ft.				

NOTES:

Drilling Contractor

illing Equipment

Driller:

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INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: NPS Cell C	COORDINATES:	DATE: 8/13/01	
ELEVATION:	GWL: Depth 7.0ft Date/Time	DATE STARTED: "	
ENGINEER/GEOLOGIST: N. Buchholz	Depth Date/Time	DATE COMPLETED: "	
DRILLING METHODS: Direct Push		PAGE 1	OF 2

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	Composite Sample T525L-S-018 T525F-S-019			Dark Brown (3/3) topsoil with roots ↓	OH		Installed steel casing for Neutron Probe	
1				Dark Brown (4/2) Clay ↓	CL			
2	Composite Sample T525L-S-020 T525F-S-021			Approx. 1 in. Light Gray Silt	MH			
				Dark Brown (4/2) Clay ↓	CL			
3				Olive Brown (4/4) Sand ↓	SW			
4								
5				Very Dark Gray (3/1) Bay mud	OL			
				Very Dark Gray (3/1) Sand w/clay ↓	SC			
6								

NOTES:

Drilling Contractor Kehoe

Drilling Equipment Power Probe

Driller: Tyler

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INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: NP5 Cell C	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 2

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Very Dark gray (3/1) Sand w/clay	SC			Water at 7 ft
				Very Dark Gray (3/1) Bay mud	OL			
7				Very Dark Gray (3/1) Sand w/clay	SC			
8				Very Dark Gray (3/1) Bay mud.	OL			
9								
10								
11								
12				Total Depth 12 ft				

NOTES:

Drilling Contractor ________

lling Equipment ________

Driller: ________

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: NP6 Cell C	COORDINATES:	DATE: 8/13/01	
ELEVATION:	GWL: Depth 7 ft Date/Time	DATE STARTED: "	
ENGINEER/GEOLOGIST: N. Buchholz	Depth Date/Time	DATE COMPLETED: "	
DRILLING METHODS: Direct Push		PAGE	OF

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Dark Brown (3/3) Top soil with roots	OH		Installed steel casing for Neutron Probe	
1				Dark Brown (4/2) Clay with gravel (20 to 30% gravel)	~~CL~~ ~~G~~ GC	NB		
2								
3				Dark Brown (4/2) Clay with no gravel	CL			
4				Olive Brown (4/4) Sand	SW			
5				approx. 2 in. band of Dark Brown (4/2) Clay	CL			
6				grading into Very Dark gray (3/1) (cont.)	OL			

NOTES:

Drilling Contractor Kehoe

Drilling Equipment Power Probe

Driller: Tyler

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INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: NP6 Cell C	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE OF

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				(cont.) Bay mud	OL			
				approx. 4in. band of Very Dark gray (3/1) Sand w/ Clay	SC			water at 7 ft.
7				Very Dark Gray (3/1) Bay Mud	OL			
8								
9								
10								
11								
12				Total Depth 12 ft				

NOTES:

Drilling Contractor ______

Drilling Equipment ______

Driller: ______

______

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INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: NP7 Cell C	COORDINATES:		DATE: 8/13/01
ELEVATION:	GWL: Depth ~7 ft	Date/Time	DATE STARTED: "
ENGINEER/GEOLOGIST: N. Buchholz	Depth	Date/Time	DATE COMPLETED: "
DRILLING METHODS: Direct Push			PAGE OF 2

DEPTH (ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	Composite Sample TS25L-S-026 TS25F-S-027			Top Soil with roots Dark Brown (3/3)	OH		Installed steel casing for neutron probe	
				Dark Brown (4/2) Clay with gravel (20-30%)	~~CL~~ GC			
2				↓	GC			
3	Composite Sample TS25L-S-028 TS25F-S-029			grades to dark brown (4/2) Clay with no gravel ↓	CL			
4				Olive Brown (4/4) Sand	SW ~~SG~~			
				Dark Brown (4/2) Clay with Sand	~~CL~~ SC			
5								
6								

NOTES:

Drilling Contractor Kehoe

Drilling Equipment Power Probe

Driller: Tyler

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INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: NP7 Cell C	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 2

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Dark Brown (4/2) Clay with Sand	CL-SC			
7				Very Dark gray (3/1) Sand w/ clay ↓	SC			
8				Very Dark gray (3/1) Bay Mud ↓	OL			
9				Very Dark gray (3/1) Sand w/clay	SC			
				Very Dark Gray (3/1) Bay Mud	OL			
10				↓				
11								
12				Total Depth 12 ft				

NOTES:

Drilling Contractor ______

Drilling Equipment ______

Driller: ______

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: NP8 Cell C	COORDINATES:		DATE: 8/13/01
ELEVATION:	GWL: Depth 6.5 ft	Date/Time	DATE STARTED: "
ENGINEER/GEOLOGIST: N. Buchholz	Depth	Date/Time	DATE COMPLETED: "
DRILLING METHODS: Direct Push			PAGE 1 OF 2

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
0–1	Composite Sample T325L-S-030 + 031 dup. T325F-S-032			DArk Brown (3/3) top soil with roots	OH		Installed Steel Casing for neutron probe	
1				DArk Brown (4/2) Clay	CL			
2				Approx. 2 in. light gray silt	MH			
2	Composite Sample T325L-S-033 T325F-S-034			Dark Brown (4/2) Clay	CL			
4				Olive Brown (4/4) Sand	SW			Some iron staining
6				Approx. 2 in. Dark Brown (4/2) Clay	CL			

NOTES:

Drilling Contractor ________

Drilling Equipment ________

Driller: ________

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INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: NP8 Cell C	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 2

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Very Dark Gray (3/1) Sand w/ Clay ↓	~~CL~~ SC			Water at ~ 7ft.
1				Very Dark Gray (3/1) Bay Mud ↓	OL			
3				Very Dark Gray (3/1) Sand w/clay ↓	SC			
9 / 10 / 11				Very Dark Gray (3/1) Bay Mud ↓	OL			
12				Dark gray (4/1) Bay mud ↓ Total Depth 12ft.	OL			

NOTES:

Drilling Contractor ______________________

rilling Equipment ______________________

Driller: ______________________

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: NP9 Cell E	COORDINATES:	DATE: 8/14/01	
ELEVATION:	GWL: Depth ~6.5 ft Date/Time	DATE STARTED: "	
ENGINEER/GEOLOGIST: N. Buchholz	Depth Date/Time	DATE COMPLETED: "	
DRILLING METHODS: Direct Push		PAGE 1	OF 2

DEPTH (Ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	Composite Sample T525L-S-035 T525F-S-036			Dark Brown (3/3) Topsoil with roots	OH		Installed steel casing for neutron probe	
				Dark Brown (4/2) Clay with gravel (approx. 50% gravel) ↓	~~CL~~ GC nb			
				seashells @ approx. 2 ft.				
3	Composite Sample T525L-S-037 T525F-S-038			grades to Dark Brown (4/2) Clay with no gravel ↓	CL			
				Olive Brown (4/4) Sand	~~SC~~ SW nb			
5				Dark Brown (4/2) Clay with Sand approx. 50%	~~CL~~ SC nb			water app. 6.5 ft
6								

NOTES:

Drilling Contractor: Kehoe

Drilling Equipment: Power Probe

Driller: Tyler

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: NP9 Cell E	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 2

DEPTH (Ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				DARK Brown (4/2) Clay with Sand	CL-SC			
				Very Dark Gray (3/1) Sand w/ Clay ↓	SC			
				Very Dark Gray (3/1) Bay Mud ↓	OL			
1								
)								
1								
2				Total Depth 12 ft				

NOTES:

Drilling Contractor

..ing Equipment

Driller:

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: NP10- Cell E	COORDINATES:	DATE: 8/14/01	
ELEVATION:	GWL: Depth 7ft Date/Time	DATE STARTED: "	
ENGINEER/GEOLOGIST: N. Buchholz	Depth Date/Time	DATE COMPLETED: "	
DRILLING METHODS: Direct Push		PAGE 1	OF 2

DEPTH (Ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	Composite Sample TS25L-S-039 TS25F-S-040			Dark Brown (3/3) Top soil with roots ↓	OH		Installed Steel casing for neutron probe	
				Dark Brown (3/3) Clay with gravel ↓	~~CL~~ GC			
	Composite Sample TS25L-S-041, 042dup. TS25F-S-043			DARK Brown (3/3) Clay	CL			
3				Olive Brown (4/4) Sand	SW			
				DARK Brown (3/3) Clay	CL			
4				Olive Brown (4/4) Sand ↓	SW			
5								
6								

NOTES:

Drilling Contractor Kehoe

Drilling Equipment Power Probe

Driller: Tyler

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: NP10 Cell E	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 2

DEPTH (Ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Olive Brown (4/4) Sand	SC SW	nb		Water 6.5 ft
				App. 1 inch Black Petroleum smell - looks like asphault				
1				Very Dark Gray (3/1) Sand w/ clay	SC			
?								
?								
0								
1								
2				total depth 12 ft.				

NOTES:

Drilling Contractor

rilling Equipment

Driller:

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: NP11 Cell E	COORDINATES:		DATE: 8/14/01
ELEVATION:	GWL: Depth ~7 ft.	Date/Time	DATE STARTED: "
ENGINEER/GEOLOGIST: N. Buchholz	Depth	Date/Time	DATE COMPLETED: "
DRILLING METHODS: Direct Push			PAGE 1 OF 2

DEPTH (Ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	Composite Sample T525L-S-044 T525F-S-045			DARK Brown (3/3) top soil with roots	OH		Installed steel casing for neutron probe	
				DARK Brown (3/3) Clay with gravel app. 10% gravel	CL	nb		
				DARK Brown (4/2) Clay	CL			
3	Composite Sample T525L-S-046 T525F-S-047			Olive Brown (4/4) Sand	SW	nb		
5				DARK Brown (4/2) Clay	CL			
				Olive Brown (4/4) Sand	SW			
6								

NOTES:

Drilling Contractor Kehoe

[Drill]ing Equipment Power Probe

Driller: Tyler

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: NPII Cell E	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 2

DEPTH (Ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	T525L-5048 HOLD not to LAB			Very Dark gray (3/1) Sand w/ clay	SC			Water ~ 7ft
7				Approx. 0.75 in. layer w/ sheen (nepthlene)				
				Very Dark gray (3/1) Sand w/ clay	SC			
8								
9								
10								
11								
12				total depth 12 ft				

NOTES:

Drilling Contractor ______

Drilling Equipment ______

Driller: ______

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: NP12 Cell E	COORDINATES:	DATE: 8/14/01	
ELEVATION:	GWL: Depth 7ft Date/Time	DATE STARTED: "	
ENGINEER/GEOLOGIST: N. Buchholz	Depth Date/Time	DATE COMPLETED: "	
DRILLING METHODS: Direct Push		PAGE 1	OF 2

DEPTH (Ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
0–1	Composite Sample T525L-S-049 T525F-S-050			DARK Brown (3/3) top soil with roots.	OH		Installed steel casing for neutron probe	
1–2				DARK Brown (4/2) Clay with gravel	GC			
2–3	Composite Sample T525L-S-051 T525F-S-052			Dark Brown ~~(4/2)~~ (4/2) clay	CL			
3–4				Olive Brown (4/4) Sand	SW			
4–6								

NOTES:

Drilling Contractor Kehoe

Drilling Equipment Power Probe

Driller: Tyler

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: NP12 Cell E	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 2

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Olive Brown (4/4) Sand ↓	SW			
1								
				Very Dark Gray (3/1) Sand w/clay ↓	SC			
8								
9								
10				Very Dark Gray (3/1) Bay Mud ↓	OL			
11								
				Very Dark Gray (3/1) Sand w/clay ↓ total depth 12ft	SC			
12								

NOTES:

Drilling Contractor ____________________

'ing Equipment ____________________

Driller: ____________________

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study	
BORING NUMBER: NP13 Cell F	COORDINATES:	DATE: 8/14/01
ELEVATION:	GWL: Depth 7 ft Date/Time	DATE STARTED: "
ENGINEER/GEOLOGIST: N. Buchholz	Depth Date/Time	DATE COMPLETED: "
DRILLING METHODS: Direct Push		PAGE 1 OF 2

DEPTH (Ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	Composite sample TS25L-S-053 TS25F-S-054			DArK Brown (3/3) top soil with roots	OH		Installed steel casing for Neutron probe	
1				Sandy Clay with gravel DArK Brown (4/2)	GC			
2	Composite sample TS25L-S-055 TS25F-S-056			Olive Brown (4/4) Sand	SC SW	nb		
3				DArK Brown (4/2) Clay	CL			
4				Olive Brown (4/4) Sand	SW			
5				DArK Brown (4/2) Clay	CL			
6								

NOTES:

Drilling Contractor Kehoe

Drilling Equipment Power Probe

Driller: Tyler

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: NP13 Cell F	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 2

DEPTH (Ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Very Dark Gray (3/1) Sand w/clay	SC			water @ ~ 7ft sheen @ 7ft (~~no~~ nb napthlane?)
7								
8								
9								
10								
11								
12				total depth 12 ft.				

NOTES:

Drilling Contractor ____________

Drilling Equipment ____________

Driller: ____________

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: NP14 Cell F	COORDINATES:	DATE: 8/14/01	
ELEVATION:	GWL: Depth ~7ft Date/Time	DATE STARTED: "	
ENGINEER/GEOLOGIST: N. Buchholz	Depth Date/Time	DATE COMPLETED: "	
DRILLING METHODS: Direct Push		PAGE 1 OF 2	

DEPTH (Ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
0–1	Composite Sample T525L-5-057 T525F-5-058 (0–2)			DARK Brown (3/3) TOP SOIL w/roots	OH		Installed Steel casing for neutron probe	
1–2				Dark Brown (4/2) Sandy Clay w/gravel	GC			
2–3.5	Composite Sample T525L-5-059 T525F-5-060 (2–4)							
3.5–4				DARK Brown (4/2) Clay	CL			
4–6				Olive Brown (4/4) Sand ↓	SW			

NOTES:

Drilling Contractor Kehoe

Drilling Equipment Power Probe

Driller: Tyler

2438-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: NP14 Cell F	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 2

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Very Dark Gray (3/1) Sand w/ Clay	SC			Water ~ 7ft
				↓				sheen @ 7 ft.
12				Total Depth 12 ft.				

NOTES:

Drilling Contractor ________

Drilling Equipment ________

Driller: ________

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: NP15 Cell D	COORDINATES:		DATE: 8/14/01
ELEVATION:	GWL: Depth ~6 ft	Date/Time	DATE STARTED: "
ENGINEER/GEOLOGIST: N. Buchholz	Depth	Date/Time	DATE COMPLETED: "
DRILLING METHODS: Direct Push			PAGE 1 OF 2

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
0–1	Composite Sample TS25L-S-061, 062 dup, TS25F-S-063 (0–2)			Dark Brown (3/3) Top soil w/roots ↓	OH		Installed steel casing for neutron probe	
1–2				Dark Brown (4/2) Sandy Clay w/gravel ↓	GC			
3	Composite Sample TS25L-S-064, TS25F-S-065 (2–4)			Olive Brown (4/4) Sand	SW			
				DARK Brown (4/2) Clay	CL			
4–6				Olive Brown (4/4) Sand ↓	SW			Water ~6 ft

NOTES:

Drilling Contractor: Kehoe

[Dril]ling Equipment: Power Probe

Driller: Tyler

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: NP15 Cell D	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 2

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Olive Brown (4/4) Sand	SW			
				Very DArK gray Sand w/clay (3/1)	SC			
7				Very DArK gray Bay Mud (3/1)	OL			
8				Very Dark gray (3/1) Sand w/clay ↓	SC			
9								
10								
11				Very Dark gray (3/1) Bay Mud ↓	OL			
12				Total Depth 12 ft				

NOTES:

Drilling Contractor ______

Drilling Equipment ______

Driller: ______

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: NP16 Cell D	COORDINATES:	DATE: 8/14/01	
ELEVATION:	GWL: Depth 6.5 ft. Date/Time	DATE STARTED: "	
ENGINEER/GEOLOGIST: N. Buchholz	Depth Date/Time	DATE COMPLETED: "	
DRILLING METHODS: Direct Push		PAGE 1	OF 2

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
0–1	Composite Sample TS25L-S-066 TS25F-S-067			Dark Brown (3/3) top soil with roots	OH		Installed ~~steel~~ steel Casing for neutron probe	
1–2				Clayey Sand [Dark Brown (4/2)]	SC			
2–3	Composite Sample TS25L-S-068 TS25F-S-069			Dark Brown (4/2) Clay	CL			
3–6				Olive Brown (4/4) Sand	SW			

NOTES:

Drilling Contractor: Kehoe

Drilling Equipment: Power Probe

Driller: Tyler

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: NP16 Cell D	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 2

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Olive Brown (4/4) Sand	SW			water 6.5 feet.
1				Very Dark gray (3/1) Sand w/clay	SC			
8								
9								
0				Very Dark Gray (3/1) Bay Mud	OL			
				Very Dark Gray (3/1) Sand w/clay	SC			
1								
2				Total Depth 12 ft.				

NOTES:

Drilling Contractor

illing Equipment

Driller:

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study		
BORING NUMBER: NP17 Cell B	COORDINATES:	DATE: 8/14/01	
ELEVATION:	GWL: Depth 6.5ft Date/Time	DATE STARTED: "	
ENGINEER/GEOLOGIST: N. Buchholz	Depth Date/Time	DATE COMPLETED: "	
DRILLING METHODS: Direct Push		PAGE 1 OF 2	

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
0–1	Composite Sample TS25L-S-070 TS25F-S-071			Dark Brown (3/3) top soil w/ roots ↓	OH		Installed steel casing for neutron probe	
1–2				Dark Brown (4/2) Clayey Sand ↓	SC			
2–2.7	Composite sample TS25L-S-072 TS25F-S-073			Dark Brown (4/2) Clay	CL			
2.7–6				Olive Brown (4/4) Sand ↓	SW			

NOTES:

Drilling Contractor: Kehoe

Drilling Equipment: Power Probe

Driller: Tyler

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: NP17 Cell B	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 2

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Olive Brown (4/4) Sand ↓	SW			water 6.5 ft.
7				Very Dark gray (3/1) Sand w/clay ↓	SC			
8								
9								
10				Very Dark gray (3/1) Bay Mud	OL			
11				Very Dark gray (3/1) Sand w/clay ↓	SC			
12				Total Depth 12 ft.				

NOTES:

Drilling Contractor ______

illing Equipment ______

Driller: ______

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827577	PROJECT NAME: Chemical Oxidation Treatability Study	
BORING NUMBER: NP18 Cell B	COORDINATES:	DATE: 8/14/01
ELEVATION:	GWL: Depth ~6.5 ft Date/Time	DATE STARTED: "
ENGINEER/GEOLOGIST: N. Buchholz	Depth Date/Time	DATE COMPLETED: "
DRILLING METHODS: Direct Push		PAGE 1 OF 2

DEPTH (ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	Composite Sample T525L-S-074 T525F-S-075			Dark Brown (3/3) topsoil with roots	OH		Installed steel casing for neutron probe	
				DArk Brown clay ↓	CL ↓			
1				0.5 in. black possibly asphalt				
	Composite Sample T525L-S-076 T525F-S-077			DArk Brown clay ↓	CL			
3				Olive Brown (4/4) Sand ↓	SW			
4								
5								
6				Very little recovery approx. 6 in of clay at 6 ft.				

NOTES:

Drilling Contractor Kehoe

Drilling Equipment Power Probe

Driller: Tyler

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: NP18 Cell B	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 2

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Olive Brown (4/4) Sand ↓	SW			
1								
				Very Dark Gray (3/1) Sand with Clay ↓	SC			
3								
7								
0				Very Dark Gray (3/1) Bay mud ↓	OL			
1				Very Dark gray (3/1) Sand with Clay ↓	SC			
2				total depth 12 ft.				

NOTES:

Drilling Contractor ________________

:ling Equipment ________________

Driller: ________________

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 827557	PROJECT NAME: Chemical Oxidation Treatability Study	
BORING NUMBER: PZ2-Cell D	COORDINATES:	DATE: 8/14/01
ELEVATION:	GWL: Depth 6.5ft Date/Time	DATE STARTED: "
ENGINEER/GEOLOGIST: N. Buchholz	Depth Date/Time	DATE COMPLETED: "
DRILLING METHODS: Direct Push		PAGE 1 OF 3

DEPTH (ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	None			DARK Brown (3/3) topsoil w/ roots	OH			
				DARK Brown (4/2) Clayey Sand w/gravel	SC			
1				DarkBrown (4/2) Sandy Clay ↓	CL			1.5 in. dia. PVC riser pipe
2								
3				DArk Brown (4/2) Clay	CL			
				Olive Brown (4/4) Sand ↓	SW			
4								
5								
								Foam seal above bentonite
6								

NOTES:

Drilling Contractor Kehoe

Drilling Equipment Power Probe

Driller: Tyler

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: PZ2 Cell D	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 2 OF 3

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Olive Brown (4/4) Sand ↓	SW			Self expanding bentonite seal; water 6.5 ft.
7								
				Very Dark gray (3/1) Sand w/clay ↓	SC			1.5 in. slotted PVC (0.010 in slot size) prepacked filter #2/12
8								
9								
				Very Dark gray (3/1) Bay Mud ↓	OL			
10								
11								
				Very Dark gray (3/1) Sand w/clay	SC			
12								

NOTES:

Drilling Contractor ______

Drilling Equipment ______

Driller: ______

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER: PZ2- Cell D	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE 3 OF 3

DEPTH (ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Very Dark Gray (3/1) Sand w/clay ↓	SC			
3								
				Very Dark Gray (3/1) Bay Mud ↓	OL			
4								
5								
6				Total Depth 16 ft.				

NOTES:

Drilling Contractor ______

Drilling Equipment ______

Driller: ______

243B-3-86

APPENDIX C
BASELINE MONITORING SAMPLE RESULTS

List of Tables

Table C-1
Baseline Manganese Concentrations in Soil

Sample Number	Neutron Probe Location	Depth (feet bgs)	Manganese (mg/kg)
TS25L-S-001	NP1 - Cell A	0 to 2	411
TS25L-S-003	NP1 - Cell A	2 to 4	166
TS25L-S-005	NP2 - Cell A	0 to 2	584
TS25L-S-007	NP2 - Cell A	2 to 4	239
TS25L-S-009	NP3 - Cell A	0 to 2	505
TS25L-S-010	NP3 - Cell A	0 to 2 (duplicate)	459
TS25L-S-012	NP3 - Cell A	2 to 4	178
TS25L-S-014	NP4 - Cell A	0 to 2	224
TS25L-S-016	NP4 - Cell A	2 to 4	231
TS25L-S-018	NP5 - Cell C	0 to 2	320
TS25L-S-020	NP5 - Cell C	2 to 4	209
TS25L-S-022	NP6 - Cell C	0 to 2	401
TS25L-S-024	NP6 - Cell C	2 to 4	187
TS25L-S-026	NP7 - Cell C	0 to 2	366
TS25L-S-028	NP7 - Cell C	2 to 4	208
TS25L-S-030	NP8 - Cell C	0 to 2	280
TS25L-S-031	NP8 - Cell C	0 to 2 (duplicate)	349
TS25L-S-033	NP8 - Cell C	2 to 4	258
TS25L-S-035	NP9 - Cell E	0 to 2	250
TS25L-S-037	NP9 - Cell E	2 to 4	201
TS25L-S-039	NP9 - Cell E	0 to 2	388
TS25L-S-041	NP10 - Cell E	2 to 4	159
TS25L-S-042	NP10 - Cell E	2 to 4 (duplicate)	278
TS25L-S-044	NP11 - Cell E	0 to 2	277
TS25L-S-046	NP11 - Cell E	2 to 4	198
TS25L-S-049	NP12 - Cell E	0 to 2	285
TS25L-S-051	NP12 - Cell E	2 to 4	142
TS25L-S-053	NP13 - Cell F	0 to 2	237
TS25L-S-055	NP13 - Cell F	2 to 4	147
TS25L-S-057	NP14 - Cell F	0 to 2	396

Table C-1 (continued)
Baseline Manganese Concentrations in Soil

Sample Number	Neutron Probe Location	Depth (feet bgs)	Manganese (mg/kg)
TS25L-S-059	NP14 - Cell F	2 to 4	166
TS25L-S-061	NP15 - Cell D	0 to 2	271
TS25L-S-062	NP15 - Cell D	0 to 2 (duplicate)	258
TS25L-S-064	NP15 - Cell D	2 to 4	143
TS25L-S-066	NP16 - Cell D	0 to 2	244
TS25L-S-068	NP16 - Cell D	2 to 4	111
TS25L-S-070	NP17 - Cell B	0 to 2	184
TS25L-S-072	NP17 - Cell B	2 to 4	160
TS25L-S-074	NP18 - Cell B	0 to 2	256
TS25L-S-076	NP18 - Cell B	2 to 4	221

mg/kg denotes milligrams per kilogram
bgs denotes below ground surface

Table C-2
Baseline Polycyclic Aromatic Hydrocarbon Soil Results with Benzo(a)Pyrene-Equivalent Concentrations – Test Cells

Sample Number		TS25L-S-001		TS25L-S-003		TS25L-S-005		TS25L-S-007		TS25L-S-009		TS25L-S-010		TS25L-S-012	
Neutron Probe Location		NP1-CELL A		NP1-CELL A		NP2-CELL A		NP2-CELL A		NP3-CELL A		NP3-CELL A		NP3-CELL A	
Sample Depth (feet bgs)		0 - 2		2 - 4		0 - 2		2 - 4		0 - 2		0 - 2		2 - 4	
Sample Collection Date		08/13/2001		08/13/2001		08/13/2001		08/13/2001		08/13/2001		08/13/2001		08/13/2001	
Parameter	Units	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.
PAH (EPA 8270-SIM)															
Naphthalene	µg/kg	170		60		130		54		1600		1200		170	
2-Methylnaphthalene	µg/kg	42	U	39	U	41	U	42	U	160	U	110		37	U
Acenaphthylene	µg/kg	170		67		41	U	42		940		980		190	
Acenaphthene	µg/kg	94		39	U	64		42	U	1000		810		100	
Fluorene	µg/kg	57		39	U	41	U	42	U	580		580		64	
Phenanthrene	µg/kg	1300		470		310		260		9400		8000		1100	
Anthracene	µg/kg	200		100		68		60		1600		840		200	
Fluoranthene	µg/kg	2500		820		500		760		11000		12000		1500	
Pyrene	µg/kg	3600		990		590		980		12000		13000		1900	
Benzo(a)anthracene	µg/kg	1100		320		180		300		4200		3700		600	
Chrysene	µg/kg	1300		370		200		350		4700		4500		640	
Benzo(b)fluoranthene	µg/kg	2800		600		320		750		7600		6500		1400	
Benzo(k)fluoranthene	µg/kg	42	U	39	U	41	U	42	U	160	U	39	U	37	U
Benzo(a)pyrene	µg/kg	1900		490		260		550		6100		5400		1000	
Indeno(1,2,3-cd)pyrene	µg/kg	1700		330		150		400		3600		3300		720	
Dibenz(a,h)anthracene	µg/kg	42	U	39	U	41	U	47		160	U	840		100	
Benzo(g,h,i)perylene	µg/kg	2200		420		190		450		4300		3800		850	
Benzo(a)pyrene - Equivalents	µg/kg	2510		660		370		750		7810		7600		1380	

Table C-2 (continued)
Baseline Polycyclic Aromatic Hydrocarbon Soil Results with Benzo(a)Pyrene-Equivalent Concentrations – Test Cells

Sample Number		TS25L-S-013		TS25L-S-016		TS25L-S-018		TS25L-S-020		TS25L-S-022		TS25L-S-024		TS25L-S-026	
Neutron Probe Location		NP4-CELL A		NP4-CELL A		NP5-CELL C		NP5-CELL C		NP6-CELL C		NP6-CELL C		NP7-CELL C	
Sample Depth (feet bgs)		0 - 2		2 - 4		0 - 2		2 - 4		0 - 2		2 - 4		0 - 4	
Sample Collection Date		08/13/2001		08/13/2001		08/13/2001		08/13/2001		08/13/2001		08/13/2001		08/13/2001	
Parameter	Units	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.
PAH (EPA 8270-SIM)															
Naphthalene	µg/kg	6200		470		2000		230		360		1300		1900	
2-Methylnaphthalene	µg/kg	690		81		330		46		160	U	200		200	
Acenaphthylene	µg/kg	3300		770		1500		200		620		3400		1100	
Acenaphthene	µg/kg	4000		220		1300		300		190		1900		610	
Fluorene	µg/kg	2400		240		790		180		200		1600		560	
Phenanthrene	µg/kg	28000		5600		11000		2300		3400		16000		7700	
Anthracene	µg/kg	3900		920		1700		520		710		2000		1200	
Fluoranthene	µg/kg	46000		11000		21000		3500		7100		21000		10000	
Pyrene	µg/kg	36000		13000		23000		4700		8000		21000		13000	
Benzo(a)anthracene	µg/kg	13000		4100		7600		1500		2700		8500		4200	
Chrysene	µg/kg	15000		4900		9500		1700		2900		7300		4000	
Benzo(b)fluoranthene	µg/kg	21000		7400		16000		2700		5900		12000		7600	
Benzo(k)fluoranthene	µg/kg	150	U	45	U	170	U	39	U	160	U	150	U	150	U
Benzo(a)pyrene	µg/kg	20000		5700		12000		2100		4300		11000		5900	
Indeno(1,2,3-cd)pyrene	µg/kg	9300		3300		11000		1400		2700		4900		3200	
Dibenz(a,h)anthracene	µg/kg	2800		770		2200		39	U	160	U	1200		540	
Benzo(g,h,i)perylene	µg/kg	9900		3900		8100		1900		3200		5700		4200	
Benzo(a)pyrene - Equivalents	µg/kg	27150		7960		17680		2710		5600		14750		7950	

Table C-2 (continued)
Baseline Polycyclic Aromatic Hydrocarbon Soil Results with Benzo(a)Pyrene-Equivalent Concentrations – Test Cells

Sample Number		TS25L-S-028		TS25L-S-030		TS25L-S-031		TS25L-S-033		TS25L-S-035		TS25L-S-037		TS25L-S-039	
Neutron Probe Location		NP7-CELL C		NP8-CELL C		NP8-CELL C		NP8-CELL C		NP9-CELL E		NP9-CELL E		NP10-CELL E	
Sample Depth (feet bgs)		2 - 4		0 - 2		0 - 2		2 - 4		0 - 2		2 - 4		0 - 2	
Sample Collection Date		08/13/2001		08/13/2001		08/13/2001		08/13/2001		08/14/2001		08/14/2001		08/14/2001	
Parameter	Units	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.
PAH (EPA 8270-SIM)															
Naphthalene	µg/kg	110		1000		800		100		980		790		270	
2-Methylnaphthalene	µg/kg	37	U	170	U	170	U	37	U	200		170		68	
Acenaphthylene	µg/kg	97		1200		960		88		1800		1600		510	
Acenaphthene	µg/kg	53		470		380		46		640		570		160	
Fluorene	µg/kg	44		400		290		37	U	880		940		230	
Phenanthrene	µg/kg	610		7500		5200		480		18000		15000		4600	
Anthracene	µg/kg	110		1300		990		200		1300		1600		580	
Fluoranthene	µg/kg	1100		14000		10000		2000		30000		23000		7400	
Pyrene	µg/kg	1600		17000		13000		2100		40000		31000		8200	
Benzo(a)anthracene	µg/kg	480		6300		4600		730		12000		8700		3000	
Chrysene	µg/kg	530		5900		5700		870		12000		9700		2800	
Benzo(b)fluoranthene	µg/kg	1000		12000		11000		1400		17000		13000		4500	
Benzo(k)fluoranthene	µg/kg	37	U	170	U	170	U	37	U	78	U	47	U	39	U
Benzo(a)pyrene	µg/kg	760		9000		7900		1200		15000		12000		4000	
Indeno(1,2,3-cd)pyrene	µg/kg	550		7300		5700		760		13000		11000		4400	
Dibenz(a,h)anthracene	µg/kg	37	U	1400		170	U	120		2800		2300		810	
Benzo(g,h,i)perylene	µg/kg	740		9400		7100		980		17000		14000		5800	
						FIELD DUP									
						0F- 030									
Benzo(a)pyrene - Equivalents	µg/kg	1010		12970		10210		1620		22020		17590		6010	

Table C-2 (continued)
Baseline Polycyclic Aromatic Hydrocarbon Soil Results with Benzo(a)Pyrene-Equivalent Concentrations – Test Cells

Sample Number		TS25L-S-041		TS25L-S-042		TS25L-S-044		TS25L-S-046		TS25L-S-049		TS25L-S-051	
Neutron Probe Location		NP10-CELL E		NP10-CELL E		NP11-CELL E		NP11-CELL E		NP12-CELL E		NP12-CELL E	
Sample Depth (feet bgs)		2 - 4		2 - 4		0 - 2		2 - 4		0 - 2		2 - 4	
Sample Collection Date		08/14/2001		08/14/2001		08/14/2001		08/14/2001		08/14/2001		08/14/2001	
Parameter	Units	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.
PAH (EPA 8270-SIM)													
Naphthalene	µg/kg	600		600		1300		190		500		770	
2-Methylnaphthalene	µg/kg	120		120		250		87		130		76	
Acenaphthylene	µg/kg	1500		1200		2000		100		610		570	
Acenaphthene	µg/kg	780		540		920		150		370		1200	
Fluorene	µg/kg	450		530		980		79		440		390	
Phenanthrene	µg/kg	12000		8700		19000		920		6300		5600	
Anthracene	µg/kg	2100		2600		3300		170		800		1000	
Fluoranthene	µg/kg	24000		16000		31000		1700		6900		6800	
Pyrene	µg/kg	32000		18000		42000		2400		7400		7600	
Benzo(a)anthracene	µg/kg	9100		5700		12000		720		2700		2900	
Chrysene	µg/kg	9500		6300		13000		910		2100		2100	
Benzo(b)fluoranthene	µg/kg	12000		7300		18000		1200		3000		3400	
Benzo(k)fluoranthene	µg/kg	37	U	36	U	83	U	41	U	39	U	37	U
Benzo(a)pyrene	µg/kg	11000		7100		16000		1200		2700		3400	
Indeno(1,2,3-cd)pyrene	µg/kg	8500		5900		14000		1100		2600		2900	
Dibenz(a,h)anthracene	µg/kg	2100		1400		3300		230		580		680	
Benzo(g,h,i)perylene	µg/kg	11000		7400		18000		1500		3400		3800	
				FIELD DUP									
				OF - 041									
Benzo(a)pyrene – Equivalents	µg/kg	16070		10400		23720		1740		4120		5010	

bgs denotes below ground surface *U denotes not detected* *µg/kg denotes microgram per kilogram*

Table C-3
Baseline Polycyclic Aromatic Hydrocarbon Soil Results with Benzo(a)Pyrene-Equivalent Concentrations – Control Cells

Sample Number		TS25L-S-070		TS25L-S-072		TS25L-S-074		TS25L-S-076		TS25L-S-061		TS25L-S-062		TS25L-S-064	
Neutron Probe Location		NP17-CELL B		NP17-CELL B		NP18-CELL B		NP18-CELL B		NP15-CELL D		NP15-CELL D		NP15-CELL D	
Sample Depth (feet bgs)		0 - 2		2 - 4		0 - 2		2 - 4		0 - 2		0 - 2		2 - 4	
Sample Collection Date		08/14/2001		08/14/2001		08/14/2001		08/14/2001		08/14/2001		08/14/2001		08/14/2001	
Parameter	Units	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.
PAHs (EPA 8270-SIM)															
Naphthalene	µg/kg	440		35	U	2000		260		310		280		300	
2-Methylnaphthalene	µg/kg	96		35	U	360		61		52		52		32	J
Acenaphthylene	µg/kg	870		35	U	3500		310		590		590		630	
Acenaphthene	µg/kg	280		35	U	1100		340		200		230		190	
Fluorene	µg/kg	330		35	U	1200		200		170		180		130	
Phenanthrene	µg/kg	6400		79		20000		3000		3800		4100		5700	
Anthracene	µg/kg	1100		18	J	4000		560		650		700		1200	
Fluoranthene	µg/kg	12000		220		38000		5000		7800		8200		8800	
Pyrene	µg/kg	15000		310		38000		5100		11000		11000		11000	
Benzo(a)anthracene	µg/kg	4700		100		13000		1900		3200		3200		3600	
Chrysene	µg/kg	4800		95		15000		2200		3100		3300		3700	
Benzo(b)fluoranthene	µg/kg	7000		160		25000		3600		4500		4800		4600	
Benzo(k)fluoranthene	µg/kg	71	U	35	U	160	U	38	U	35	U	35	U	35	U
Benzo(a)pyrene	µg/kg	6200		160		20000		2800		4300		4500		4400	
Indeno(1,2,3-cd)pyrene	µg/kg	5200		160		11000		1700		3900		4200		3600	
Dibenz(a,h)anthracene	µg/kg	1400		33	J	3100		340		930		960		910	
Benzo(g,h,i)perylene	µg/kg	6600		220		13000		2100		5300		5500		4700	
												FIELD DUP			
												OF -061			
Benzo(a)pyrene - Equivalents	µg/kg	9300		240		28020		3870		6400		6690		6500	

Table C-3 (continued)
Baseline Polycyclic Aromatic Hydrocarbon Soil Results with Benzo(a)Pyrene-Equivalent Concentrations – Control Cells

Sample Number		TS25L-S-066		TS25L-S-068		TS25L-S-053		TS25L-S-055		TS25L-S-057		TS25L-S-059	
Neutron Probe Location		NP16-CELL D		NP16-CELL D		NP13-CELL F		NP13-CELL F		NP14-CELL F		NP14-CELL F	
Sample Depth (feet bgs)		0 - 2		2 - 4		0 - 2		2 - 4		0 - 2		2 - 4	
Sample Collection Date		08/14/2001		08/14/2001		08/14/2001		08/14/2001		08/14/2001		08/14/2001	
Parameter	Units	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.
PNAs (EPA 8270-SIM)													
Naphthalene	µg/kg	340		72		410		320		130		910	
2-Methylnaphthalene	µg/kg	70		36	U	85		30	J	21	J	110	
Acenaphthylene	µg/kg	520		24	J	730		1100		110		1500	
Acenaphthene	µg/kg	170		69		290		550		53		250	
Fluorene	µg/kg	190		24	J	320		580		38		530	
Phenanthrene	µg/kg	3500		250		5000		13000		900		15000	
Anthracene	µg/kg	550		51		700		1200		160		3100	
Fluoranthene	µg/kg	6700		560		7000		12000		1700		20000	
Pyrene	µg/kg	9100		770		7600		13000		2600		22000	
Benzo(a)anthracene	µg/kg	2700		240		2400		4900		740		8900	
Chrysene	µg/kg	3000		220		2200		3400		940		5400	
Benzo(b)fluoranthene	µg/kg	4400		400		3000		4800		1300		9100	
Benzo(k)fluoranthene	µg/kg	35	U	36	U	35	U	41	U	37	U	39	U
Benzo(a)pyrene	µg/kg	3800		340		2900		4600		1100		9400	
Indeno(1,2,3-cd)pyrene	µg/kg	3800		380		2400		3500		1300		7200	
Dibenz(a,h)anthracene	µg/kg	860		70		530		890		270		1800	
Benzo(g,h,i)perylene	µg/kg	4900		490		3400		4200		1800		8900	
Benzo(a)pyrene - Equivalents	µg/kg	5760		520		4220		6820		1710		13730	

bgs denotes below ground surface *U denotes not detected* *µg/kg denotes microgram per kilogram*

Table C-4
Baseline Soil Oxidant Demand

Neutron Probe Casing Number	Cell	Sample Interval (feet bgs)	Initial Solution ($KMnO_4$) (mg/L)	Oxidant Demand (g $KMnO_4$/kg Soil)	Average Demand (g $KMnO_4$/kg Soil)
1	A	0 - 2	5000	8.57	7.81
1	A	0 - 2	7500	11.75	
1	A	0 - 2	10000	16.05	
1	A	2 - 4	1000	1.49	
1	A	2 - 4	2500	3.15	
1	A	2 - 4	5000	5.85	
2	A	0 - 2	7500	12.85	13.41
2	A	0 - 2	10000	16.49	
2	A	0 - 2	20000	28.52	
2	A	2 - 4	2500	4.08	
2	A	2 - 4	5000	7.59	
2	A	2 - 4	7500	10.96	
3	A	0 - 2	5000	8.32	7.36
3	A	0 - 2	7500	12.77	
3	A	0 - 2	10000	4.98	
3	A	2 - 4	2500	3.31	
3	A	2 - 4	5000	6.18	
3	A	2 - 4	7500	8.62	
4	A	0 - 2	5000	8.57	11.96
4	A	0 - 2	7500	12.32	
4	A	0 - 2	10000	14.38	
4	A	2 - 4	5000	8.22	
4	A	2 - 4	7500	12.53	
4	A	2 - 4	10000	15.74	

Table C-4 (continued)
Baseline Soil Oxidant Demand

Neutron Probe Casing Number	Cell	Sample Interval (feet bgs)	Initial Solution ($KMnO_4$) (mg/L)	Oxidant Demand (g $KMnO_4$/kg Soil)	Average Demand (g $KMnO_4$/kg Soil)
5	C	0 - 2	7500	12.67	12.33
5	C	0 - 2	10000	16.40	
5	C	0 - 2	20000	28.31	
5	C	2 - 4	2500	3.30	
5	C	2 - 4	5000	5.63	
5	C	2 - 4	7500	7.65	
6	C	0 - 2	2500	4.17	7.44
6	C	0 - 2	5000	7.94	
6	C	0 - 2	7500	11.21	
6	C	2 - 4	2500	3.83	
6	C	2 - 4	5000	7.05	
6	C	2 - 4	7500	10.47	
7	C	0 - 2	5000	8.54	8.89
7	C	0 - 2	7500	11.55	
7	C	0 - 2	10000	16.19	
7	C	2 - 4	2500	3.26	
7	C	2 - 4	5000	5.31	
7	C	2 - 4	7500	8.52	
8	C	0 - 2	5000	7.05	7.93
8	C	0 - 2	7500	10.07	
8	C	0 - 2	10000	13.37	
8	C	2 - 4	2500	3.26	
8	C	2 - 4	5000	5.31	
8	C	2 - 4	7500	8.52	
9	E	0 - 2	7500	12.63	13.60
9	E	0 - 2	10000	16.56	
9	E	0 - 2	20000	27.95	
9	E	2 - 4	2500	3.60	
9	E	2 - 4	7500	9.25	
9	E	2 - 4	10000	11.59	

Table C-4 (continued)
Baseline Soil Oxidant Demand

Neutron Probe Casing Number	Cell	Sample Interval (feet bgs)	Initial Solution ($KMnO_4$) (mg/L)	Oxidant Demand (g $KMnO_4$/kg Soil)	Average Demand (g $KMnO_4$/kg Soil)
10	E	0 - 2	20000	34.41	11.71
10	E	2 - 4	1000	1.47	
10	E	2 - 4	2500	3.39	
10	E	2 - 4	7500	7.59	
11	E	0 - 2	10000	17.19	17.23
11	E	0 - 2	20000	29.73	
11	E	2 - 4	5000	8.21	
11	E	2 - 4	10000	13.80	
12	E	0 - 2	10000	17.29	14.12
12	E	0 - 2	20000	31.16	
12	E	2 - 4	1000	1.56	
12	E	2 - 4	5000	6.46	
13	F	0 - 2	7500	12.87	8.78
13	F	0 - 2	10000	16.49	
13	F	2 - 4	1000	1.57	
13	F	2 - 4	2500	4.20	
14	F	0 - 2	10000	14.90	11.48
14	F	0 - 2	20000	33.49	
14	F	2 - 4	2500	-9.48	
14	F	2 - 4	5000	7.01	
15	D	0 - 2	2500	3.99	6.33
15	D	0 - 2	5000	7.77	
15	D	0 - 2	7500	10.53	
15	D	2 - 4	2500	2.88	
15	D	2 - 4	5000	5.11	
15	D	2 - 4	7500	7.69	

Table C-4 (continued)
Baseline Soil Oxidant Demand

Neutron Probe Casing Number	Cell	Sample Interval (feet bgs)	Initial Solution ($KMnO_4$) (mg/L)	Oxidant Demand (g $KMnO_4$/kg Soil)	Average Demand (g $KMnO_4$/kg Soil)
16	D	0 - 2	1000	1.59	5.28
16	D	0 - 2	2500	4.07	
16	D	0 - 2	5000	7.67	
16	D	2 - 4	2500	3.51	
16	D	2 - 4	5000	6.02	
16	D	2 - 4	7500	8.83	
17	B	0 - 2	2500	4.12	4.45
17	B	0 - 2	5000	8.21	
17	B	0 - 2	7500	11.17	
17	B	2 - 4	1000	-0.13	
17	B	2 - 4	2500	1.22	
17	B	2 - 4	5000	2.14	
18	B	0 - 2	2500	4.22	7.12
18	B	0 - 2	5000	5.93	
18	B	0 - 2	7500	12.49	
18	B	2 - 4	2500	3.08	
18	B	2 - 4	5000	4.95	
18	B	2 - 4	7500	12.04	

$KMnO_4$ denotes potassium permanganate
mg/L denotes milligrams per liter
g denotes gram
kg denotes kilogram
bgs denotes below ground surface

Table C-5
Baseline Arsenic and Hexavalent Chromium Concentrations in Groundwater

Sample Number	Location	Arsenic (µg/L)	Hexavalent Chromium (mg/L)
TS25L-GW-080	PZ 1 Cell A	3.9	ND < 0.01
TS25L-GW-082	PZ 2 Cell D	4.6	ND < 0.01
TS25L-GW-079	PZ 3 Cell C	7.6	ND < 0.01
TS25L-GW-078	PZ 4 Cell E	8.2	ND < 0.01
TS25L-GW-085	PZ 5 northeast corner	17.8	ND < 0.01
TS25L-GW-086	PZ 6 northwest corner	13.3	ND < 0.01
TS25L-GW-081	PZ 7 southwest corner	13.6	ND < 0.01
TS25L-GW-083	PZ 8 southeast corner	16.1	ND < 0.01
TS25L-GW-084	PZ 8 (duplicate)	17.2	ND < 0.01

ND denotes non-detect

µg/L denotes micrograms per liter

mg/L denotes milligrams per liter

PZ denotes piezometer

APPENDIX D
WATER LEVEL MEASUREMENTS – OPERATIONAL MONITORING

Table D-1
Bi-Weekly Water Levels

Well ID	Date	Time	Depth to Water (BTOC)
PZ 4	09/11/2001	9:45	9.42
PZ 5	09/11/2001	9:15	9.00
PZ 6	09/11/2001	9:30	12.80
PZ 6	09/11/2001	9:35	9.25
PZ 8	09/11/2001	9:00	9.50
PZ 1	09/12/2001	8:52	7.71
PZ 2	09/12/2001	9:00	8.34
PZ 3	09/12/2001	8:55	8.70
PZ 4	09/12/2001	8:30	8.01
PZ 5	09/12/2001	8:35	9.00
PZ 6	09/12/2001	8:49	11.02
PZ 7	09/12/2001	8:46	9.33
PZ 8	09/12/2001	8:43	9.54
PZ 4	09/13/2001	8:55	8.01
PZ 5	09/13/2001	8:57	9.04
PZ 6	09/13/2001	8:57	10.05
PZ 7	09/13/2001	9:03	9.37
PZ 8	09/13/2001	8:46	9.61
PZ 4	09/14/2001	8:40	8.03
PZ 5	09/14/2001	8:45	9.00
PZ 6	09/14/2001	8:50	9.24
PZ 7	09/14/2001	8:55	9.41
PZ 8	09/14/2001	8:30	9.57
PZ 4	09/17/2001	10:21	8.02
PZ 5	09/17/2001	10:18	9.01
PZ 6	09/17/2001	10:24	8.53
PZ 7	09/17/2001	10:28	9.50
PZ 8	09/17/2001	10:16	9.64
PZ 1	09/18/2001	7:50	7.09
PZ 2	09/18/2001	8:05	8.50
PZ 3	09/18/2001	7:45	8.00

Table D-1 (continued)
Bi-Weekly Water Levels

Well ID	Date	Time	Depth to Water (BTOC)
PZ 4	09/18/2001	7:40	8.52
PZ 5	09/18/2001	7:35	9.05
PZ 6	09/18/2001	7:55	8.25
PZ 7	09/18/2001	8:00	9.51
PZ 8	09/18/2001	7:30	9.61
PZ 3	09/19/2001	7:50	8.91
PZ 1	09/20/2001	8:03	7.79
PZ 2	09/20/2001	8:05	8.41
PZ 3	09/20/2001	8:10	7.25
PZ 4	09/20/2001	8:13	8.05
PZ 5	09/20/2001	8:19	9.05
PZ 6	09/20/2001	8:23	8.15
PZ 7	09/20/2001	8:27	9.54
PZ 8	09/20/2001	8:30	9.65
PZ 1	09/24/2001	7:00	7.04
PZ 2	09/24/2001	7:00	8.42
PZ 3	09/24/2001	7:00	8.00
PZ 4	09/24/2001	9:01	8.05
PZ 5	09/24/2001	7:22	9.01
PZ 6	09/24/2001	7:24	8.38
PZ 7	09/24/2001	7:28	9.48
PZ 8	09/24/2001	7:20	9.68
PZ 1	09/25/2001	11:00	7.71
PZ 2	09/25/2001	11:15	8.40
PZ 3	09/25/2001	10:30	8.00
PZ 4	09/25/2001	10:00	8.10
PZ 5	09/25/2001	7:35	9.02
PZ 6	09/25/2001	7:30	8.61
PZ 7	09/25/2001	7:25	9.05
PZ 8	09/25/2001	7:20	9.65
PZ 1	09/26/2001	8:40	7.90

Table D-1 (continued)
Bi-Weekly Water Levels

Well ID	Date	Time	Depth to Water (BTOC)
PZ 2	09/26/2001	8:25	8.05
PZ 3	09/26/2001	8:45	7.09
PZ 5	09/26/2001	8:50	9.11
PZ 6	09/26/2001	8:35	8.49
PZ 7	09/26/2001	8:30	9.07
PZ 8	09/26/2001	8:20	9.71
PZ 1	10/02/2001	8:15	7.90
PZ 2	10/02/2001	8:00	8.51
PZ 3	10/02/2001	11:30	8.85
PZ 4	10/02/2001	11:30	8.24
PZ 5	10/02/2001	7:45	9.50
PZ 6	10/02/2001	7:40	8.75
PZ 7	10/02/2001	7:35	9.63
PZ 8	10/02/2001	7:30	9.71
PZ 2	10/24/2001	15:30	8.43
PZ 3	10/24/2001	15:32	8.18
PZ 4	10/24/2001	15:36	8.35
PZ 5	10/24/2001	15:40	9.34
PZ 6	10/24/2001	15:42	8.56
PZ 7	10/24/2001	15:46	9.89
PZ 8	10/24/2001	15:50	9.94

BTOC denotes below top of casing

APPENDIX E
PORE WATER DATA SUMMARY

Table E-1
Pore Water Data Summary

Lysimeter	Well Depth (feet bgs)	Date	Time	pH	Conductivity (in micro Siemens)	ORP	Comments
LY 1	1	07-Sep-01	10:15	INS	INS	INS	Did not hold vacuum
LY 1	3	07-Sep-01	10:15	6.8	100	-45	low samples may have affected Conductivity reading
LY 2	1	07-Sep-01	10:25	6.5	100	-99	low samples may have affected Conductivity reading
LY 2	3	07-Sep-01	10:25	6.4	69	-104	
LY 3	1	07-Sep-01	10:35	INS	INS	INS	held vacuum and dry
LY 3	3	07-Sep-01	10:35	6.4	80	-55	
LY 4	1	07-Sep-01	10:40	INS	INS	INS	held vacuum and dry
LY 4	3	07-Sep-01	10:40	6.7	47.3	-67	
LY 5	1	07-Sep-01	10:55	6.8	55.5	-87	
LY 5	3	07-Sep-01	10:55	6.6	79	-72	
LY 6	1	07-Sep-01	11:10	INS	INS	INS	held vacuum and dry
LY 6	3	07-Sep-01	11:10	6.6	69.6	-66	
LY 7	1	07-Sep-01	11:25	6.4	100	-65	low samples may have affected Conductivity reading
LY 7	3	07-Sep-01	11:25	6.4	143	-91	low samples may have affected Conductivity reading
LY 8	1	07-Sep-01	11:35	6.6	60.6	-91	
LY 8	3	07-Sep-01	11:35	6.6	100	-102	low samples may have affected Conductivity reading
LY 9	1	07-Sep-01	11:45	6.3	400	39	low samples may have affected Conductivity reading
LY 9	3	07-Sep-01	11:45	6.5	68.7	38	
LY 3	1	11-Sep-01	8:45	INS	INS	INS	Despite having flooded with 2,453 gallons a day before
LY 3	3	11-Sep-01	8:45	6.4	71	-53	Tap water on this day sampled at 9 am: pH : 8.2, Cond: 6.7, ORP : 265

Table E-1 (continued)
Pore Water Data Summary

Lysimeter	Well Depth (feet bgs)	Date	Time	pH	Conductivity (in micro Siemens)	ORP	Comments
LY 3	1	12-Sep-01	8:00	5.8	56.3	195	Significant jump in ORP
LY 3	3	12-Sep-01	8:00	INS	INS	INS	Despite having flooded with 2453 gal. twice in previous days
LY 3	1	13-Sep-01	8:00	6.6	62.9	178	
LY 3	3	13-Sep-01	8:00	INS	INS	INS	held vacuum and dry
LY 3	1	14-Sep-01	7:30	5.8	66.5	168	
LY 3	3	14-Sep-01	7:30	INS	INS	INS	held vacuum and dry
LY 1	1	17-Sep-01	8:45	INS	INS	INS	No vacuum, no sample
LY 1	3	17-Sep-01	8:45	5.7	27.6	195	
LY 2	1	17-Sep-01	8:25	6.3	81	-71	
LY 2	3	17-Sep-01	8:25	6.3	70.7	-107	
LY 3	1	17-Sep-01	8:00	6.2	67.1	105	
LY 3	3	17-Sep-01	8:00	INS	INS	INS	Vacuum held, yet no sample
LY 1	1	18-Sep-01	8:35	INS	INS	INS	lost vacuum yet dry
LY 1	3	18-Sep-01	8:35	6.4	72.6	-107	large sample
LY 2	1	18-Sep-01	8:20	INS	INS	INS	lost vacuum yet dry
LY 2	3	18-Sep-01	8:20	INS	INS	INS	held vacuum and dry
LY 3	1	18-Sep-01	8:05	5.8	200	185	
LY 3	3	18-Sep-01	8:05	6.8	73.5	145	large sample
LY 4	1	18-Sep-01	8:58	INS	INS	INS	broken vacuum
LY 4	3	18-Sep-01	8:58	INS	INS	INS	lost vacuum yet dry

Table E-1 (continued)
Pore Water Data Summary

Lysimeter	Well Depth (feet bgs)	Date	Time	pH	Conductivity (in micro Siemens)	ORP	Comments
LY 5	1	18-Sep-01	8:40	6.5	64.3	-45	large sample
LY 5	3	18-Sep-01	8:40	6.5	78.4	-44	large sample
LY 6	1	18-Sep-01	8:47	INS	INS	INS	lost vacuum yet dry
LY 6	3	18-Sep-01	8:47	6.5	64.4	-18	large sample
LY 1	1	19-Sep-01	8:00	INS	INS	INS	No vacuum, no sample
LY 1	3	19-Sep-01	8:01	INS	INS	INS	held vacuum and dry
LY 2	1	19-Sep-01	8:14	INS	INS	INS	lost vacuum yet dry
LY 2	3	19-Sep-01	8:10	6.5	67.8	-92	
LY 3	1	19-Sep-01	7:50	INS	INS	INS	held vacuum an dry
LY 3	3	19-Sep-01	7:52	6.4	75.7	-20	
LY 4	1	19-Sep-01	9:00	INS	INS	INS	No vacuum, no sample
LY 4	3	19-Sep-01	9:05	6.6	49	-11	
LY 5	1	19-Sep-01	9:58	6.8	63.1	5	
LY 5	3	19-Sep-01	9:50	6.7	75.1	2	
LY 6	1	19-Sep-01	10:12	6.4	115	29	large sample
LY 6	3	19-Sep-01	10:10	6.9	64.8	-9	
LY 7	1	19-Sep-01	8:20	6.3	54.6	-12	large sample
LY 7	3	19-Sep-01	8:30	6.4	133	-101	large sample
LY 8	1	19-Sep-01	8:45	6.3	61.9	-44	large sample
LY 8	3	19-Sep-01	8:38	6.3	169	-111	large sample, cloudy

Table E-1 (continued)
Pore Water Data Summary

Lysimeter	Well Depth (feet bgs)	Date	Time	pH	Conductivity (in micro Siemens)	ORP	Comments
LY 9	1	19-Sep-01	8:55	6.1	68.9	-5	large sample
LY 9	3	19-Sep-01	8:45	6.3	67	-30	broken after sampling (tube was cut by polyvinyl chloride)
LY 1	1	20-Sep-01	9:20	INS	INS	INS	held vacuum and dry
LY 1	3	20-Sep-01	9:20	NA	NA	NA	Lost capillary contact
LY 2	1	20-Sep-01	9:10	INS	INS	INS	held vacuum and dry
LY 2	3	20-Sep-01	9:10	6.5	65.5	-63	
LY 3	1	20-Sep-01	8:08	6.3	200	151	
LY 3	3	20-Sep-01	8:08	INS	INS	INS	held vacuum and dry
LY 4	1	20-Sep-01	8:29	7.1	10	348	
LY 4	3	20-Sep-01	8:29	6.8	53.7	277	
LY 5	1	20-Sep-01	9:40	6.6	66.4	-34	
LY 5	3	20-Sep-01	9:40	6.6	80.9	-30	
LY 6	1	20-Sep-01	9:50	6.6	109	4	
LY 6	3	20-Sep-01	9:50	6.5	78.3	20	
LY 7	1	20-Sep-01	9:00	INS	INS	INS	held vacuum and dry
LY 7	3	20-Sep-01	9:00	6.5	95	-84	
LY 8	1	20-Sep-01	8:50	6.7	200	226	
LY 8	3	20-Sep-01	8:50	INS	INS	INS	held vacuum and dry
LY 9	1	20-Sep-01	8:40	INS	INS	INS	held vacuum and dry
LY 9	3	20-Sep-01	8:40	NA	NA	NA	broken lysimeter

Table E-1 (continued)
Pore Water Data Summary

Lysimeter	Well Depth (feet bgs)	Date	Time	pH	Conductivity (in micro Siemens)	ORP	Comments
LY 1	1	24-Sep-01	9:05	7.1	32.2	68	
LY 1	3	24-Sep-01	9:10	6.2	30	68	
LY 2	1	24-Sep-01	9:15	6.2	84.3	-20	
LY 2	3	24-Sep-01	9:25	6.2	64	-60	
LY 3	1	24-Sep-01	7:20	6.2	72.2	158	
LY 3	3	24-Sep-01	7:25	6.5	79.9	142	
LY 4	1	24-Sep-01	7:35	INS	INS	INS	
LY 4	3	24-Sep-01	7:40	7	63.3	94	
LY 5	1	24-Sep-01	8:15	6.4	70.8	-40	
LY 5	3	24-Sep-01	8:18	6.4	96.5	-41	
LY 6	1	24-Sep-01	8:20	6.2	97.1	-19	
LY 6	3	24-Sep-01	8:25	6.3	95.4	-5	
LY 7	1	24-Sep-01	7:55	INS	INS	INS	
LY 7	3	24-Sep-01	8:00	6.2	76.9	-15	
LY 8	1	24-Sep-01	8:10	6.7	58.2	-50	
LY 8	3	24-Sep-01	8:05	6.4	148	-79	
LY 9	1	24-Sep-01	7:45	6.8	61.1	111	
LY 9	3	24-Sep-01	7:50	INS	INS	INS	
LY 1	1	26-Sep-01	10:00	6.3	180	72	large, dark sample
LY 1	3	26-Sep-01	10:10	7	38.7	51	no permanganate

Table E-1 (continued)
Pore Water Data Summary

Lysimeter	Well Depth (feet bgs)	Date	Time	pH	Conductivity (in micro Siemens)	ORP	Comments
LY 2	1	26-Sep-01	10:20	6.7	81.1	-26	no permanganate
LY 2	3	26-Sep-01	10:30	INS	INS	INS	No vacuum, no sample
LY 3	1	26-Sep-01	8:26	6.1	1.3	138	
LY 3	3	26-Sep-01	8:28	6.7	73.7	128	
LY 4	1	26-Sep-01	8:35	INS	INS	INS	held vacuum
LY 4	3	26-Sep-01	8:37	7	63.7	109	
LY 5	1	26-Sep-01	9:20	INS	INS	INS	lost vacuum yet dry
LY 5	3	26-Sep-01	9:16	6.6	98.9	-35	
LY 6	1	26-Sep-01	9:12	INS	INS	INS	lost vacuum yet dry
LY 6	3	26-Sep-01	9:10	6.3	105	-8	
LY 7	1	26-Sep-01	9:05	6.4	42.8	-20	
LY 7	3	26-Sep-01	9:00	6.3	62.3	-24	dark sample
LY 8	1	26-Sep-01	8:58	6.6	54.4	-32	
LY 8	3	26-Sep-01	8:55	6.5	90	-54	dark sample
LY 9	1	26-Sep-01	8:51	6.3	57.4	118	
LY 9	3	26-Sep-01	8:50	INS	INS	INS	
LY 1	1	27-Sep-01	8:05	6.2	380	150	
LY 1	3	27-Sep-01	8:10	5.7	40	167	
LY 2	1	27-Sep-01	8:15	7.1	400	380	Permanganate conc. 160 milligrams per liter
LY 2	3	27-Sep-01	8:20	6.8	50	360	

Table E-1 (continued)
Pore Water Data Summary

Lysimeter	Well Depth (feet bgs)	Date	Time	pH	Conductivity (in micro Siemens)	ORP	Comments
LY 1	1	02-Oct-01	10:10	5.7	404	60	
LY 1	3	02-Oct-01	10:05	6.3	57.3	97	
LY 2	1	02-Oct-01	10:15	8.1	77.9	-95	
LY 2	3	02-Oct-01	10:20	7.1	59.5	-51	
LY 3	1	02-Oct-01	8:40	6.3	76.2	188	
LY 3	3	02-Oct-01	10:30	6.7	100	-6	
LY 4	1	02-Oct-01	10:40	7	47.4	-10	
LY 4	3	02-Oct-01	10:45	6.9	64.4	1	
LY 5	1	02-Oct-01	8:55	6.4	94.5	200	
LY 5	3	02-Oct-01	8:50	6.7	1.44	198	
LY 6	1	02-Oct-01	9:05	6.5	76.5	141	
LY 6	3	02-Oct-01	9:00	6.4	118	175	
LY 7	1	02-Oct-01	11:15	6.7	300	30	
LY 7	3	02-Oct-01	11:20	6.3	56	43	
LY 8	1	02-Oct-01	11:30	6.5	400	28	
LY 8	3	02-Oct-01	11:15	6.3	121	19	
LY 9	1	02-Oct-01	11:00	6.8	57.6	30	
LY 9	3	02-Oct-01	NA	NA	NA	NA	Fixed today, no sample,
LY 1	1	05-Oct-01	8:30	6.6	410	422	Date uncertain, notice ORP
LY 1	3	05-Oct-01	8:35	8	60.5	182	Date uncertain, notice pH

Table E-1 (continued)
Pore Water Data Summary

Lysimeter	Well Depth (feet bgs)	Date	Time	pH	Conductivity (in micro Siemens)	ORP	Comments
LY 2	1	05-Oct-01	8:50	6.6	500	175	Date uncertain
LY 2	3	05-Oct-01	9:00	6.6	56.4	-10	Date uncertain
LY 1	1	09-Oct-01	9:23	6.2	505	57	
LY 1	3	09-Oct-01	9:20	6.2	74.9	143	
LY 2	1	09-Oct-01	9:30	6.3	56.9	-5	
LY 2	3	09-Oct-01	9:27	6.8	600	-1	
LY 3	1	09-Oct-01	7:30	5.7	77.8	191	
LY 3	3	09-Oct-01	7:25	INS	INS	INS	held vacuum and dry
LY 4	1	09-Oct-01	7:40	6.7	71.7	176	
LY 4	3	09-Oct-01	7:45	6.6	54.2	173	
LY 5	1	09-Oct-01	7:50	INS	INS	INS	lost vacuum yet dry
LY 5	3	09-Oct-01	7:50	6.4	128	197	
LY 6	1	09-Oct-01	8:00	6.3	92.2	41	
LY 6	3	09-Oct-01	7:55	6.3	122	134	
LY 1	1	24-Oct-01	14:30	INS	INS	INS	Pressure (!) instead of vacuum
LY 1	3	24-Oct-01	14:30	INS	INS	INS	Spilled sample
LY 2	1	24-Oct-01	14:40	INS	INS	INS	Pressure (!) instead of vacuum
LY 2	3	24-Oct-01	14:40	INS	INS	INS	No vacuum, no sample
LY 3	1	24-Oct-01	13:00	INS	INS	INS	No vacuum, no sample
LY 3	3	24-Oct-01	13:00	6.4	73.6	215	Large sample

Table E-1 (continued)
Pore Water Data Summary

Lysimeter	Well Depth (feet bgs)	Date	Time	pH	Conductivity (in micro Siemens)	ORP	Comments
LY 4	1	24-Oct-01	13:05	6.8	54.1	140	Large sample
LY 4	3	24-Oct-01	13:05	6.8	68.5	170	Large sample
LY 5	1	24-Oct-01	14:10	INS	INS	INS	No vacuum, no sample
LY 5	3	24-Oct-01	14:10	INS	INS	INS	No vacuum, no sample
LY 6	1	24-Oct-01	14:00	6.7	130	-24	
LY 6	3	24-Oct-01	14:00	6.3	151	-8	
LY 7	1	24-Oct-01	13:40	6.6	50.2	69	Large sample
LY 7	3	24-Oct-01	13:40	6.3	48.2	84	
LY 8	1	24-Oct-01	13:55	6.6	54.5	-30	
LY 8	3	24-Oct-01	13:55	6.3	135	-20	
LY 9	1	24-Oct-01	13:10	6.3	61	132	Large sample
LY 9	3	24-Oct-01	13:10	6.3	36.6	127	

ORP denotes Oxidation Reduction Potential
INS denotes insufficient water to obtain reading
NA denotes not applicable
bgs denotes below ground surface

APPENDIX F
MOISTURE CONTENT DATA SUMMARY – OPERATIONAL MONITORING

Table F-1
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 01	1	09/06/2001	NA	20.96
NP 01	1	09/17/2001	AM	21.15
NP 01	1	09/18/2001	AM	21.07
NP 01	1	09/18/2001	PM	21.01
NP 01	1	09/19/2001	AM	20.79
NP 01	1	09/21/2001	NA	21.11
NP 01	1	09/24/2001	AM	20.89
NP 01	1	09/25/2001	AM	21.04
NP 01	1	09/26/2001	AM	21.96
NP 01	1	09/27/2001	AM	21.63
NP 01	1	10/02/2001	AM	21.42
NP 01	1	10/03/2001	NA	21.32
NP 01	2	09/06/2001	NA	16.35
NP 01	2	09/17/2001	AM	17.07
NP 01	2	09/18/2001	AM	17.07
NP 01	2	09/18/2001	PM	16.69
NP 01	2	09/19/2001	AM	16.93
NP 01	2	09/21/2001	NA	16.70
NP 01	2	09/24/2001	AM	16.57
NP 01	2	09/25/2001	AM	16.82
NP 01	2	09/26/2001	AM	16.83
NP 01	2	09/27/2001	AM	16.60
NP 01	2	10/02/2001	AM	16.62
NP 01	2	10/03/2001	NA	16.23
NP 01	3	09/06/2001	NA	15.85
NP 01	3	09/17/2001	AM	15.09
NP 01	3	09/18/2001	AM	15.26
NP 01	3	09/18/2001	PM	15.16
NP 01	3	09/19/2001	AM	15.04
NP 01	3	09/21/2001	NA	15.31
NP 01	3	09/24/2001	AM	14.93

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 01	3	09/25/2001	AM	14.71
NP 01	3	09/26/2001	AM	15.15
NP 01	3	09/27/2001	AM	14.80
NP 01	3	10/02/2001	AM	14.85
NP 01	3	10/03/2001	NA	14.68
NP 01	4	09/06/2001	NA	21.35
NP 01	4	09/17/2001	AM	21.87
NP 01	4	09/18/2001	AM	21.68
NP 01	4	09/18/2001	PM	21.62
NP 01	4	09/19/2001	AM	21.30
NP 01	4	09/21/2001	NA	21.68
NP 01	4	09/24/2001	AM	21.52
NP 01	4	09/25/2001	AM	21.10
NP 01	4	09/26/2001	AM	21.35
NP 01	4	09/27/2001	AM	21.35
NP 01	4	10/02/2001	AM	21.72
NP 01	4	10/03/2001	NA	21.03
NP 01	5	09/06/2001	NA	27.28
NP 01	5	09/17/2001	AM	27.31
NP 01	5	09/18/2001	AM	26.89
NP 01	5	09/18/2001	PM	27.01
NP 01	5	09/19/2001	AM	26.98
NP 01	5	09/21/2001	NA	27.31
NP 01	5	09/24/2001	AM	26.90
NP 01	5	09/25/2001	AM	26.69
NP 01	5	09/26/2001	AM	27.05
NP 01	5	09/27/2001	AM	27.10
NP 01	5	10/02/2001	AM	27.32
NP 01	5	10/03/2001	NA	26.88
NP 01	6	09/06/2001	NA	28.21

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 01	6	09/17/2001	AM	28.81
NP 01	6	09/18/2001	AM	28.35
NP 01	6	09/18/2001	PM	28.37
NP 01	6	09/19/2001	AM	28.31
NP 01	6	09/21/2001	NA	28.21
NP 01	6	09/24/2001	AM	28.60
NP 01	6	09/25/2001	AM	28.41
NP 01	6	09/26/2001	AM	28.44
NP 01	6	09/27/2001	AM	28.34
NP 01	6	10/02/2001	AM	28.12
NP 01	6	10/03/2001	NA	28.75
NP 01	7	09/06/2001	NA	26.91
NP 01	7	09/17/2001	AM	27.32
NP 01	7	09/18/2001	AM	27.22
NP 01	7	09/18/2001	PM	27.18
NP 01	7	09/19/2001	AM	27.01
NP 01	7	09/21/2001	NA	27.04
NP 01	7	09/24/2001	AM	27.21
NP 01	7	09/25/2001	AM	27.00
NP 01	7	09/26/2001	AM	27.14
NP 01	7	09/27/2001	AM	27.11
NP 01	7	10/02/2001	AM	26.73
NP 01	7	10/03/2001	NA	26.87
NP 02	1	09/06/2001	NA	19.79
NP 02	1	09/17/2001	AM	20.84
NP 02	1	09/18/2001	AM	20.12
NP 02	1	09/18/2001	PM	20.64
NP 02	1	09/19/2001	AM	20.39
NP 02	1	09/21/2001	NA	20.52
NP 02	1	09/24/2001	AM	20.01
NP 02	1	09/25/2001	AM	20.44

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 02	1	09/26/2001	AM	20.76
NP 02	1	09/27/2001	AM	20.89
NP 02	1	10/02/2001	AM	20.48
NP 02	1	10/03/2001	NA	21.28
NP 02	2	09/06/2001	NA	23.35
NP 02	2	09/17/2001	AM	23.44
NP 02	2	09/18/2001	AM	23.58
NP 02	2	09/18/2001	PM	24.09
NP 02	2	09/19/2001	AM	23.61
NP 02	2	09/21/2001	NA	23.53
NP 02	2	09/24/2001	AM	24.02
NP 02	2	09/25/2001	AM	23.31
NP 02	2	09/26/2001	AM	23.92
NP 02	2	09/27/2001	AM	23.41
NP 02	2	10/02/2001	AM	23.92
NP 02	2	10/03/2001	NA	23.81
NP 02	3	09/06/2001	NA	20.77
NP 02	3	09/17/2001	AM	20.77
NP 02	3	09/18/2001	AM	20.61
NP 02	3	09/18/2001	PM	20.72
NP 02	3	09/19/2001	AM	20.82
NP 02	3	09/21/2001	NA	20.53
NP 02	3	09/24/2001	AM	20.41
NP 02	3	09/25/2001	AM	20.11
NP 02	3	09/26/2001	AM	20.66
NP 02	3	09/27/2001	AM	20.27
NP 02	3	10/02/2001	AM	19.72
NP 02	3	10/03/2001	NA	20.49
NP 02	4	09/06/2001	NA	20.53
NP 02	4	09/17/2001	AM	20.63
NP 02	4	09/18/2001	AM	20.58

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 02	4	09/18/2001	PM	20.18
NP 02	4	09/19/2001	AM	20.81
NP 02	4	09/21/2001	NA	20.84
NP 02	4	09/24/2001	AM	20.42
NP 02	4	09/25/2001	AM	20.05
NP 02	4	09/26/2001	AM	20.42
NP 02	4	09/27/2001	AM	20.58
NP 02	4	10/02/2001	AM	20.13
NP 02	4	10/03/2001	NA	20.26
NP 02	5	09/06/2001	NA	23.17
NP 02	5	09/17/2001	AM	23.06
NP 02	5	09/18/2001	AM	23.01
NP 02	5	09/18/2001	PM	23.39
NP 02	5	09/19/2001	AM	23.13
NP 02	5	09/21/2001	NA	23.20
NP 02	5	09/24/2001	AM	23.01
NP 02	5	09/25/2001	AM	23.24
NP 02	5	09/26/2001	AM	23.39
NP 02	5	09/27/2001	AM	22.97
NP 02	5	10/02/2001	AM	23.10
NP 02	5	10/03/2001	NA	23.15
NP 02	6	09/06/2001	NA	25.69
NP 02	6	09/17/2001	AM	26.05
NP 02	6	09/18/2001	AM	26.26
NP 02	6	09/18/2001	PM	25.58
NP 02	6	09/19/2001	AM	25.92
NP 02	6	09/21/2001	NA	25.98
NP 02	6	09/24/2001	AM	26.14
NP 02	6	09/25/2001	AM	25.84
NP 02	6	09/26/2001	AM	25.19
NP 02	6	09/27/2001	AM	26.01

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 02	6	10/02/2001	AM	25.83
NP 02	6	10/03/2001	NA	25.43
NP 02	7	09/06/2001	NA	27.56
NP 02	7	09/17/2001	AM	27.55
NP 02	7	09/18/2001	AM	27.94
NP 02	7	09/18/2001	PM	27.73
NP 02	7	09/19/2001	AM	27.40
NP 02	7	09/21/2001	NA	27.69
NP 02	7	09/24/2001	AM	27.62
NP 02	7	09/25/2001	AM	27.59
NP 02	7	09/26/2001	AM	27.28
NP 02	7	09/27/2001	AM	27.32
NP 02	7	10/02/2001	AM	27.27
NP 02	7	10/03/2001	NA	27.17
NP 03	1	09/06/2001	NA	19.96
NP 03	1	09/17/2001	AM	20.13
NP 03	1	09/18/2001	AM	20.26
NP 03	1	09/18/2001	PM	19.97
NP 03	1	09/19/2001	AM	20.22
NP 03	1	09/21/2001	NA	20.18
NP 03	1	09/24/2001	AM	20.21
NP 03	1	09/25/2001	AM	20.04
NP 03	1	09/26/2001	AM	20.06
NP 03	1	09/27/2001	AM	20.56
NP 03	1	10/02/2001	AM	20.18
NP 03	1	10/03/2001	NA	19.89
NP 03	2	09/06/2001	NA	24.44
NP 03	2	09/17/2001	AM	24.77
NP 03	2	09/18/2001	AM	24.63
NP 03	2	09/18/2001	PM	24.30
NP 03	2	09/19/2001	AM	24.22

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 03	2	09/21/2001	NA	24.51
NP 03	2	09/24/2001	AM	24.26
NP 03	2	09/25/2001	AM	24.82
NP 03	2	09/26/2001	AM	24.11
NP 03	2	09/27/2001	AM	24.59
NP 03	2	10/02/2001	AM	24.21
NP 03	2	10/03/2001	NA	24.53
NP 03	3	09/06/2001	NA	13.43
NP 03	3	09/17/2001	AM	12.67
NP 03	3	09/18/2001	AM	13.15
NP 03	3	09/18/2001	PM	12.55
NP 03	3	09/19/2001	AM	12.62
NP 03	3	09/21/2001	NA	12.68
NP 03	3	09/24/2001	AM	12.40
NP 03	3	09/25/2001	AM	12.70
NP 03	3	09/26/2001	AM	12.58
NP 03	3	09/27/2001	AM	12.31
NP 03	3	10/02/2001	AM	12.10
NP 03	3	10/03/2001	NA	12.03
NP 03	4	09/06/2001	NA	20.60
NP 03	4	09/17/2001	AM	20.12
NP 03	4	09/18/2001	AM	20.10
NP 03	4	09/18/2001	PM	19.99
NP 03	4	09/19/2001	AM	20.06
NP 03	4	09/21/2001	NA	19.93
NP 03	4	09/24/2001	AM	19.75
NP 03	4	09/25/2001	AM	19.81
NP 03	4	09/26/2001	AM	20.07
NP 03	4	09/27/2001	AM	19.90
NP 03	4	10/02/2001	AM	20.04
NP 03	4	10/03/2001	NA	19.36

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 03	5	09/06/2001	NA	25.58
NP 03	5	09/17/2001	AM	25.47
NP 03	5	09/18/2001	AM	25.15
NP 03	5	09/18/2001	PM	25.22
NP 03	5	09/19/2001	AM	24.99
NP 03	5	09/21/2001	NA	25.38
NP 03	5	09/24/2001	AM	25.54
NP 03	5	09/25/2001	AM	25.17
NP 03	5	09/26/2001	AM	25.15
NP 03	5	09/27/2001	AM	25.50
NP 03	5	10/02/2001	AM	25.36
NP 03	5	10/03/2001	NA	25.06
NP 03	6	09/06/2001	NA	27.73
NP 03	6	09/17/2001	AM	27.34
NP 03	6	09/18/2001	AM	27.86
NP 03	6	09/18/2001	PM	27.98
NP 03	6	09/19/2001	AM	27.80
NP 03	6	09/21/2001	NA	27.90
NP 03	6	09/24/2001	AM	28.00
NP 03	6	09/25/2001	AM	27.96
NP 03	6	09/26/2001	AM	28.08
NP 03	6	09/27/2001	AM	28.22
NP 03	6	10/02/2001	AM	27.95
NP 03	6	10/03/2001	NA	27.98
NP 03	7	09/06/2001	NA	26.80
NP 03	7	09/17/2001	AM	27.10
NP 03	7	09/18/2001	AM	26.87
NP 03	7	09/18/2001	PM	27.17
NP 03	7	09/19/2001	AM	27.65
NP 03	7	09/21/2001	NA	27.13
NP 03	7	09/24/2001	AM	27.04

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 03	7	09/25/2001	AM	27.01
NP 03	7	09/26/2001	AM	27.29
NP 03	7	09/27/2001	AM	27.06
NP 03	7	10/02/2001	AM	27.43
NP 03	7	10/03/2001	NA	26.71
NP 04	1	09/06/2001	NA	16.70
NP 04	1	09/17/2001	AM	16.99
NP 04	1	09/18/2001	AM	17.08
NP 04	1	09/18/2001	PM	17.24
NP 04	1	09/19/2001	AM	16.78
NP 04	1	09/21/2001	NA	16.97
NP 04	1	09/24/2001	AM	16.91
NP 04	1	09/25/2001	AM	17.07
NP 04	1	09/26/2001	AM	16.58
NP 04	1	09/27/2001	AM	16.98
NP 04	1	10/02/2001	AM	16.55
NP 04	1	10/03/2001	NA	17.99
NP 04	2	09/06/2001	NA	23.40
NP 04	2	09/17/2001	AM	23.35
NP 04	2	09/18/2001	AM	23.94
NP 04	2	09/18/2001	PM	23.62
NP 04	2	09/19/2001	AM	23.45
NP 04	2	09/21/2001	NA	23.88
NP 04	2	09/24/2001	AM	23.48
NP 04	2	09/25/2001	AM	23.67
NP 04	2	09/26/2001	AM	23.76
NP 04	2	09/27/2001	AM	23.98
NP 04	2	10/02/2001	AM	23.43
NP 04	2	10/03/2001	NA	23.88
NP 04	3	09/06/2001	NA	25.10
NP 04	3	09/17/2001	AM	25.08

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 04	3	09/18/2001	AM	25.35
NP 04	3	09/18/2001	PM	25.56
NP 04	3	09/19/2001	AM	25.16
NP 04	3	09/21/2001	NA	25.65
NP 04	3	09/24/2001	AM	24.97
NP 04	3	09/25/2001	AM	25.48
NP 04	3	09/26/2001	AM	25.36
NP 04	3	09/27/2001	AM	25.48
NP 04	3	10/02/2001	AM	25.43
NP 04	3	10/03/2001	NA	25.07
NP 04	4	09/06/2001	NA	21.49
NP 04	4	09/17/2001	AM	21.39
NP 04	4	09/18/2001	AM	20.94
NP 04	4	09/18/2001	PM	21.11
NP 04	4	09/19/2001	AM	21.36
NP 04	4	09/21/2001	NA	21.35
NP 04	4	09/24/2001	AM	21.08
NP 04	4	09/25/2001	AM	21.25
NP 04	4	09/26/2001	AM	20.82
NP 04	4	09/27/2001	AM	20.92
NP 04	4	10/02/2001	AM	20.79
NP 04	4	10/03/2001	NA	20.67
NP 04	5	09/06/2001	NA	24.89
NP 04	5	09/17/2001	AM	25.19
NP 04	5	09/18/2001	AM	25.23
NP 04	5	09/18/2001	PM	25.34
NP 04	5	09/19/2001	AM	25.50
NP 04	5	09/21/2001	NA	25.39
NP 04	5	09/24/2001	AM	25.72
NP 04	5	09/25/2001	AM	25.21
NP 04	5	09/26/2001	AM	25.00

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 04	5	09/27/2001	AM	25.06
NP 04	5	10/02/2001	AM	24.71
NP 04	5	10/03/2001	NA	25.29
NP 04	6	09/06/2001	NA	28.21
NP 04	6	09/17/2001	AM	28.48
NP 04	6	09/18/2001	AM	28.13
NP 04	6	09/18/2001	PM	28.48
NP 04	6	09/19/2001	AM	28.23
NP 04	6	09/21/2001	NA	28.42
NP 04	6	09/24/2001	AM	28.54
NP 04	6	09/25/2001	AM	27.76
NP 04	6	09/26/2001	AM	28.38
NP 04	6	09/27/2001	AM	28.27
NP 04	6	10/02/2001	AM	28.73
NP 04	6	10/03/2001	NA	27.65
NP 04	7	09/06/2001	NA	25.75
NP 04	7	09/17/2001	AM	25.51
NP 04	7	09/18/2001	AM	26.14
NP 04	7	09/18/2001	PM	25.68
NP 04	7	09/19/2001	AM	25.22
NP 04	7	09/21/2001	NA	25.90
NP 04	7	09/24/2001	AM	25.56
NP 04	7	09/25/2001	AM	25.51
NP 04	7	09/26/2001	AM	25.77
NP 04	7	09/27/2001	AM	25.33
NP 04	7	10/02/2001	AM	25.74
NP 04	7	10/03/2001	NA	25.62
NP 05	1	08/30/2001	NA	23.21
NP 05	1	09/06/2001	NA	23.76
NP 05	1	09/11/2001	AM	23.25
NP 05	1	09/11/2001	PM	23.28

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 05	1	09/12/2001	AM	23.54
NP 05	1	09/12/2001	PM	23.39
NP 05	1	09/13/2001	AM	23.90
NP 05	1	09/13/2001	PM	23.27
NP 05	1	09/14/2001	AM	23.67
NP 05	1	09/17/2001	AM	23.63
NP 05	1	09/18/2001	AM	23.40
NP 05	1	09/19/2001	AM	23.80
NP 05	1	09/19/2001	PM	24.32
NP 05	1	09/21/2001	NA	24.02
NP 05	1	09/24/2001	AM	23.93
NP 05	1	09/25/2001	AM	24.06
NP 05	1	09/26/2001	AM	23.65
NP 05	1	09/27/2001	AM	24.05
NP 05	1	09/29/2001	AM	23.80
NP 05	1	10/01/2001	AM	24.11
NP 05	1	10/02/2001	AM	24.10
NP 05	1	10/03/2001	NA	23.94
NP 05	1	10/09/2001	NA	24.51
NP 05	1	10/11/2001	NA	21.56
NP 05	1	10/23/2001	NA	24.15
NP 05	2	08/30/2001	NA	18.05
NP 05	2	09/06/2001	NA	16.63
NP 05	2	09/11/2001	AM	16.16
NP 05	2	09/11/2001	PM	16.51
NP 05	2	09/12/2001	AM	16.50
NP 05	2	09/12/2001	PM	16.79
NP 05	2	09/13/2001	AM	16.31
NP 05	2	09/13/2001	PM	16.26
NP 05	2	09/14/2001	AM	16.47
NP 05	2	09/17/2001	AM	16.78

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 05	2	09/18/2001	AM	16.61
NP 05	2	09/19/2001	AM	16.61
NP 05	2	09/19/2001	PM	16.57
NP 05	2	09/21/2001	NA	16.81
NP 05	2	09/24/2001	AM	16.64
NP 05	2	09/25/2001	AM	16.75
NP 05	2	09/26/2001	AM	16.38
NP 05	2	09/27/2001	AM	16.59
NP 05	2	09/29/2001	AM	16.65
NP 05	2	10/01/2001	AM	16.62
NP 05	2	10/02/2001	AM	16.61
NP 05	2	10/03/2001	NA	16.57
NP 05	2	10/09/2001	NA	16.50
NP 05	2	10/11/2001	NA	18.17
NP 05	2	10/23/2001	NA	16.42
NP 05	3	08/30/2001	NA	19.94
NP 05	3	09/06/2001	NA	19.87
NP 05	3	09/11/2001	AM	19.98
NP 05	3	09/11/2001	PM	20.21
NP 05	3	09/12/2001	AM	19.94
NP 05	3	09/12/2001	PM	20.00
NP 05	3	09/13/2001	AM	19.96
NP 05	3	09/13/2001	PM	19.72
NP 05	3	09/14/2001	AM	20.18
NP 05	3	09/17/2001	AM	19.92
NP 05	3	09/18/2001	AM	19.84
NP 05	3	09/19/2001	AM	19.78
NP 05	3	09/19/2001	PM	19.65
NP 05	3	09/21/2001	NA	20.28
NP 05	3	09/24/2001	AM	20.38
NP 05	3	09/25/2001	AM	19.90

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 05	3	09/26/2001	AM	19.94
NP 05	3	09/27/2001	AM	19.85
NP 05	3	09/29/2001	AM	20.07
NP 05	3	10/01/2001	AM	19.62
NP 05	3	10/02/2001	AM	19.55
NP 05	3	10/03/2001	NA	19.95
NP 05	3	10/09/2001	NA	20.16
NP 05	3	10/11/2001	NA	16.46
NP 05	3	10/23/2001	NA	20.19
NP 05	4	08/30/2001	NA	23.31
NP 05	4	09/06/2001	NA	23.00
NP 05	4	09/11/2001	AM	22.71
NP 05	4	09/11/2001	PM	22.64
NP 05	4	09/12/2001	AM	22.91
NP 05	4	09/12/2001	PM	22.48
NP 05	4	09/13/2001	AM	22.76
NP 05	4	09/13/2001	PM	22.67
NP 05	4	09/14/2001	AM	22.90
NP 05	4	09/17/2001	AM	22.74
NP 05	4	09/18/2001	AM	23.24
NP 05	4	09/19/2001	AM	22.99
NP 05	4	09/19/2001	PM	22.32
NP 05	4	09/21/2001	NA	22.55
NP 05	4	09/24/2001	AM	22.96
NP 05	4	09/25/2001	AM	22.55
NP 05	4	09/26/2001	AM	22.73
NP 05	4	09/27/2001	AM	23.32
NP 05	4	09/29/2001	AM	22.79
NP 05	4	10/01/2001	AM	22.19
NP 05	4	10/02/2001	AM	22.86
NP 05	4	10/03/2001	NA	22.14

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 05	4	10/09/2001	NA	22.49
NP 05	4	10/11/2001	NA	25.77
NP 05	4	10/23/2001	NA	22.93
NP 05	5	08/30/2001	NA	22.91
NP 05	5	09/06/2001	NA	23.77
NP 05	5	09/11/2001	AM	23.83
NP 05	5	09/11/2001	PM	24.00
NP 05	5	09/12/2001	AM	23.74
NP 05	5	09/12/2001	PM	23.60
NP 05	5	09/13/2001	AM	23.15
NP 05	5	09/13/2001	PM	23.72
NP 05	5	09/14/2001	AM	23.59
NP 05	5	09/17/2001	AM	23.31
NP 05	5	09/18/2001	AM	23.39
NP 05	5	09/19/2001	AM	23.13
NP 05	5	09/19/2001	PM	23.36
NP 05	5	09/21/2001	NA	23.50
NP 05	5	09/24/2001	AM	23.64
NP 05	5	09/25/2001	AM	23.47
NP 05	5	09/26/2001	AM	23.70
NP 05	5	09/27/2001	AM	23.56
NP 05	5	09/29/2001	AM	23.47
NP 05	5	10/01/2001	AM	23.65
NP 05	5	10/02/2001	AM	23.54
NP 05	5	10/03/2001	NA	23.36
NP 05	5	10/09/2001	NA	23.45
NP 05	5	10/11/2001	NA	21.63
NP 05	5	10/23/2001	NA	23.37
NP 05	6	08/30/2001	NA	22.65
NP 05	6	09/06/2001	NA	22.45
NP 05	6	09/11/2001	AM	22.74

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 05	6	09/11/2001	PM	22.37
NP 05	6	09/12/2001	AM	22.81
NP 05	6	09/12/2001	PM	22.45
NP 05	6	09/13/2001	AM	22.69
NP 05	6	09/13/2001	PM	22.08
NP 05	6	09/14/2001	AM	22.51
NP 05	6	09/17/2001	AM	22.84
NP 05	6	09/18/2001	AM	22.91
NP 05	6	09/19/2001	AM	22.53
NP 05	6	09/19/2001	PM	22.50
NP 05	6	09/21/2001	NA	22.74
NP 05	6	09/24/2001	AM	22.61
NP 05	6	09/25/2001	AM	22.35
NP 05	6	09/26/2001	AM	22.59
NP 05	6	09/27/2001	AM	22.18
NP 05	6	09/29/2001	AM	22.69
NP 05	6	10/01/2001	AM	22.48
NP 05	6	10/02/2001	AM	22.84
NP 05	6	10/03/2001	NA	22.52
NP 05	6	10/09/2001	NA	22.21
NP 05	6	10/11/2001	NA	26.48
NP 05	6	10/23/2001	NA	22.64
NP 05	7	08/30/2001	NA	26.47
NP 05	7	09/06/2001	NA	26.83
NP 05	7	09/11/2001	AM	26.71
NP 05	7	09/11/2001	PM	26.36
NP 05	7	09/12/2001	AM	26.53
NP 05	7	09/12/2001	PM	26.58
NP 05	7	09/13/2001	AM	26.63
NP 05	7	09/13/2001	PM	26.25
NP 05	7	09/14/2001	AM	26.34

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 05	7	09/17/2001	AM	26.48
NP 05	7	09/18/2001	AM	26.27
NP 05	7	09/19/2001	AM	26.69
NP 05	7	09/19/2001	PM	26.32
NP 05	7	09/21/2001	NA	26.31
NP 05	7	09/24/2001	AM	26.23
NP 05	7	09/25/2001	AM	26.64
NP 05	7	09/26/2001	AM	25.63
NP 05	7	09/27/2001	AM	26.41
NP 05	7	09/29/2001	AM	26.51
NP 05	7	10/01/2001	AM	26.14
NP 05	7	10/02/2001	AM	26.16
NP 05	7	10/03/2001	NA	26.47
NP 05	7	10/09/2001	NA	25.98
NP 05	7	10/11/2001	NA	27.44
NP 05	7	10/23/2001	NA	26.47
NP 06	1	08/30/2001	NA	20.67
NP 06	1	09/06/2001	NA	20.63
NP 06	1	09/11/2001	AM	21.14
NP 06	1	09/11/2001	PM	20.37
NP 06	1	09/12/2001	AM	20.29
NP 06	1	09/12/2001	PM	21.01
NP 06	1	09/13/2001	AM	20.56
NP 06	1	09/13/2001	PM	20.35
NP 06	1	09/14/2001	AM	20.46
NP 06	1	09/17/2001	AM	20.56
NP 06	1	09/18/2001	AM	20.61
NP 06	1	09/19/2001	AM	21.73
NP 06	1	09/19/2001	PM	21.10
NP 06	1	09/21/2001	NA	21.57
NP 06	1	09/24/2001	AM	21.46

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 06	1	09/25/2001	AM	21.74
NP 06	1	09/26/2001	AM	21.59
NP 06	1	09/27/2001	AM	21.42
NP 06	1	09/29/2001	AM	21.20
NP 06	1	10/01/2001	AM	21.05
NP 06	1	10/02/2001	AM	21.66
NP 06	1	10/03/2001	NA	21.76
NP 06	1	10/09/2001	NA	21.23
NP 06	1	10/11/2001	NA	20.44
NP 06	1	10/23/2001	NA	21.75
NP 06	2	08/30/2001	NA	18.16
NP 06	2	09/06/2001	NA	18.27
NP 06	2	09/11/2001	AM	17.21
NP 06	2	09/11/2001	PM	18.34
NP 06	2	09/12/2001	AM	17.99
NP 06	2	09/12/2001	PM	18.21
NP 06	2	09/13/2001	AM	18.14
NP 06	2	09/13/2001	PM	18.13
NP 06	2	09/14/2001	AM	18.85
NP 06	2	09/17/2001	AM	18.55
NP 06	2	09/18/2001	AM	18.22
NP 06	2	09/19/2001	AM	18.91
NP 06	2	09/19/2001	PM	18.64
NP 06	2	09/21/2001	NA	18.25
NP 06	2	09/24/2001	AM	17.83
NP 06	2	09/25/2001	AM	17.88
NP 06	2	09/26/2001	AM	17.80
NP 06	2	09/27/2001	AM	18.52
NP 06	2	09/29/2001	AM	17.81
NP 06	2	10/01/2001	AM	17.83
NP 06	2	10/02/2001	AM	19.07

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 06	2	10/03/2001	NA	18.78
NP 06	2	10/09/2001	NA	18.78
NP 06	2	10/11/2001	NA	23.36
NP 06	2	10/23/2001	NA	18.18
NP 06	3	08/30/2001	NA	16.73
NP 06	3	09/06/2001	NA	16.19
NP 06	3	09/11/2001	AM	16.18
NP 06	3	09/11/2001	PM	16.48
NP 06	3	09/12/2001	AM	16.26
NP 06	3	09/12/2001	PM	16.14
NP 06	3	09/13/2001	AM	16.12
NP 06	3	09/13/2001	PM	15.19
NP 06	3	09/14/2001	AM	16.27
NP 06	3	09/17/2001	AM	16.60
NP 06	3	09/18/2001	AM	16.11
NP 06	3	09/19/2001	AM	16.14
NP 06	3	09/19/2001	PM	15.72
NP 06	3	09/21/2001	NA	15.82
NP 06	3	09/24/2001	AM	15.88
NP 06	3	09/25/2001	AM	15.44
NP 06	3	09/26/2001	AM	15.86
NP 06	3	09/27/2001	AM	15.95
NP 06	3	09/29/2001	AM	15.97
NP 06	3	10/01/2001	AM	16.13
NP 06	3	10/02/2001	AM	15.59
NP 06	3	10/03/2001	NA	15.37
NP 06	3	10/09/2001	NA	15.77
NP 06	3	10/11/2001	NA	16.93
NP 06	3	10/23/2001	NA	16.18
NP 06	4	08/30/2001	NA	25.78
NP 06	4	09/06/2001	NA	24.75

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 06	4	09/11/2001	AM	25.64
NP 06	4	09/11/2001	PM	25.33
NP 06	4	09/12/2001	AM	25.35
NP 06	4	09/12/2001	PM	26.09
NP 06	4	09/13/2001	AM	25.90
NP 06	4	09/13/2001	PM	25.61
NP 06	4	09/14/2001	AM	25.81
NP 06	4	09/17/2001	AM	25.82
NP 06	4	09/18/2001	AM	25.65
NP 06	4	09/19/2001	AM	25.33
NP 06	4	09/19/2001	PM	25.24
NP 06	4	09/21/2001	NA	25.40
NP 06	4	09/24/2001	AM	25.51
NP 06	4	09/25/2001	AM	25.44
NP 06	4	09/26/2001	AM	25.53
NP 06	4	09/27/2001	AM	25.33
NP 06	4	09/29/2001	AM	25.85
NP 06	4	10/01/2001	AM	25.50
NP 06	4	10/02/2001	AM	25.10
NP 06	4	10/03/2001	NA	25.22
NP 06	4	10/09/2001	NA	25.16
NP 06	4	10/11/2001	NA	26.70
NP 06	4	10/23/2001	NA	25.27
NP 06	5	08/30/2001	NA	21.34
NP 06	5	09/06/2001	NA	21.09
NP 06	5	09/11/2001	AM	21.47
NP 06	5	09/11/2001	PM	21.11
NP 06	5	09/12/2001	AM	21.46
NP 06	5	09/12/2001	PM	21.39
NP 06	5	09/13/2001	AM	21.41
NP 06	5	09/13/2001	PM	21.65

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 06	5	09/14/2001	AM	21.28
NP 06	5	09/17/2001	AM	21.21
NP 06	5	09/18/2001	AM	21.79
NP 06	5	09/19/2001	AM	21.49
NP 06	5	09/19/2001	PM	21.68
NP 06	5	09/21/2001	NA	21.44
NP 06	5	09/24/2001	AM	21.41
NP 06	5	09/25/2001	AM	21.76
NP 06	5	09/26/2001	AM	21.08
NP 06	5	09/27/2001	AM	21.60
NP 06	5	09/29/2001	AM	20.94
NP 06	5	10/01/2001	AM	21.49
NP 06	5	10/02/2001	AM	21.22
NP 06	5	10/03/2001	NA	21.40
NP 06	5	10/09/2001	NA	21.24
NP 06	5	10/11/2001	NA	23.94
NP 06	5	10/23/2001	NA	21.15
NP 06	6	08/30/2001	NA	25.98
NP 06	6	09/06/2001	NA	26.19
NP 06	6	09/11/2001	AM	26.28
NP 06	6	09/11/2001	PM	25.84
NP 06	6	09/12/2001	AM	25.80
NP 06	6	09/12/2001	PM	25.99
NP 06	6	09/13/2001	AM	25.69
NP 06	6	09/13/2001	PM	25.98
NP 06	6	09/14/2001	AM	26.20
NP 06	6	09/17/2001	AM	25.94
NP 06	6	09/18/2001	AM	26.42
NP 06	6	09/19/2001	AM	26.22
NP 06	6	09/19/2001	PM	25.78
NP 06	6	09/21/2001	NA	26.70

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 06	6	09/24/2001	AM	25.94
NP 06	6	09/25/2001	AM	25.86
NP 06	6	09/26/2001	AM	26.24
NP 06	6	09/27/2001	AM	25.71
NP 06	6	09/29/2001	AM	26.25
NP 06	6	10/01/2001	AM	25.81
NP 06	6	10/02/2001	AM	25.81
NP 06	6	10/03/2001	NA	25.87
NP 06	6	10/09/2001	NA	25.98
NP 06	6	10/11/2001	NA	26.70
NP 06	6	10/23/2001	NA	26.15
NP 06	7	08/30/2001	NA	27.81
NP 06	7	09/06/2001	NA	27.04
NP 06	7	09/11/2001	AM	27.36
NP 06	7	09/11/2001	PM	27.46
NP 06	7	09/12/2001	AM	27.69
NP 06	7	09/12/2001	PM	27.19
NP 06	7	09/13/2001	AM	27.35
NP 06	7	09/13/2001	PM	27.48
NP 06	7	09/14/2001	AM	27.64
NP 06	7	09/17/2001	AM	27.34
NP 06	7	09/18/2001	AM	27.38
NP 06	7	09/19/2001	AM	27.51
NP 06	7	09/19/2001	PM	27.36
NP 06	7	09/21/2001	NA	27.31
NP 06	7	09/24/2001	AM	27.54
NP 06	7	09/25/2001	AM	27.37
NP 06	7	09/26/2001	AM	27.45
NP 06	7	09/27/2001	AM	27.70
NP 06	7	09/29/2001	AM	27.36
NP 06	7	10/01/2001	AM	27.70

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 06	7	10/02/2001	AM	27.01
NP 06	7	10/03/2001	NA	27.49
NP 06	7	10/09/2001	NA	27.73
NP 06	7	10/11/2001	NA	27.11
NP 06	7	10/23/2001	NA	27.45
NP 07	1	08/30/2001	NA	16.14
NP 07	1	09/06/2001	NA	16.46
NP 07	1	09/17/2001	AM	16.36
NP 07	1	09/18/2001	AM	16.62
NP 07	1	09/19/2001	AM	16.95
NP 07	1	09/19/2001	PM	17.03
NP 07	1	09/21/2001	NA	16.76
NP 07	1	09/24/2001	AM	16.93
NP 07	1	09/25/2001	AM	16.56
NP 07	1	09/26/2001	AM	16.85
NP 07	1	09/27/2001	AM	16.53
NP 07	1	09/29/2001	AM	16.87
NP 07	1	10/01/2001	AM	16.55
NP 07	1	10/02/2001	AM	19.41
NP 07	1	10/03/2001	NA	19.34
NP 07	1	10/09/2001	NA	19.98
NP 07	1	10/11/2001	NA	23.42
NP 07	1	10/23/2001	NA	20.07
NP 07	2	08/30/2001	NA	20.82
NP 07	2	09/06/2001	NA	21.32
NP 07	2	09/17/2001	AM	21.60
NP 07	2	09/18/2001	AM	20.72
NP 07	2	09/19/2001	AM	21.39
NP 07	2	09/19/2001	PM	21.54
NP 07	2	09/21/2001	NA	21.11
NP 07	2	09/24/2001	AM	21.77

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 07	2	09/25/2001	AM	21.27
NP 07	2	09/26/2001	AM	21.89
NP 07	2	09/27/2001	AM	21.22
NP 07	2	09/29/2001	AM	21.59
NP 07	2	10/01/2001	AM	21.63
NP 07	2	10/02/2001	AM	22.85
NP 07	2	10/03/2001	NA	22.98
NP 07	2	10/09/2001	NA	23.50
NP 07	2	10/11/2001	NA	24.28
NP 07	2	10/23/2001	NA	23.44
NP 07	3	08/30/2001	NA	12.24
NP 07	3	09/06/2001	NA	12.22
NP 07	3	09/17/2001	AM	11.93
NP 07	3	09/18/2001	AM	11.96
NP 07	3	09/19/2001	AM	11.76
NP 07	3	09/19/2001	PM	12.13
NP 07	3	09/21/2001	NA	12.38
NP 07	3	09/24/2001	AM	12.59
NP 07	3	09/25/2001	AM	12.64
NP 07	3	09/26/2001	AM	12.72
NP 07	3	09/27/2001	AM	12.60
NP 07	3	09/29/2001	AM	12.43
NP 07	3	10/01/2001	AM	12.32
NP 07	3	10/02/2001	AM	12.89
NP 07	3	10/03/2001	NA	13.71
NP 07	3	10/09/2001	NA	15.77
NP 07	3	10/11/2001	NA	16.01
NP 07	3	10/23/2001	NA	17.62
NP 07	4	08/30/2001	NA	25.94
NP 07	4	09/06/2001	NA	25.92
NP 07	4	09/17/2001	AM	25.88

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 07	4	09/18/2001	AM	25.83
NP 07	4	09/19/2001	AM	25.90
NP 07	4	09/19/2001	PM	26.09
NP 07	4	09/21/2001	NA	26.20
NP 07	4	09/24/2001	AM	25.94
NP 07	4	09/25/2001	AM	26.33
NP 07	4	09/26/2001	AM	26.10
NP 07	4	09/27/2001	AM	26.24
NP 07	4	09/29/2001	AM	26.40
NP 07	4	10/01/2001	AM	25.73
NP 07	4	10/02/2001	AM	25.93
NP 07	4	10/03/2001	NA	25.95
NP 07	4	10/09/2001	NA	25.83
NP 07	4	10/11/2001	NA	25.69
NP 07	4	10/23/2001	NA	26.53
NP 07	5	08/30/2001	NA	23.92
NP 07	5	09/06/2001	NA	23.82
NP 07	5	09/17/2001	AM	24.23
NP 07	5	09/18/2001	AM	23.69
NP 07	5	09/19/2001	PM	23.67
NP 07	5	09/19/2001	AM	23.73
NP 07	5	09/21/2001	NA	23.98
NP 07	5	09/24/2001	AM	24.09
NP 07	5	09/25/2001	AM	24.46
NP 07	5	09/26/2001	AM	23.87
NP 07	5	09/27/2001	AM	24.16
NP 07	5	09/29/2001	AM	23.85
NP 07	5	10/01/2001	AM	23.45
NP 07	5	10/02/2001	AM	24.44
NP 07	5	10/03/2001	NA	23.78
NP 07	5	10/09/2001	NA	24.27

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 07	5	10/11/2001	NA	23.00
NP 07	5	10/23/2001	NA	23.85
NP 07	6	08/30/2001	NA	26.95
NP 07	6	09/06/2001	NA	26.98
NP 07	6	09/17/2001	AM	26.85
NP 07	6	09/18/2001	AM	26.98
NP 07	6	09/19/2001	AM	26.91
NP 07	6	09/19/2001	PM	27.06
NP 07	6	09/21/2001	NA	27.25
NP 07	6	09/24/2001	AM	26.80
NP 07	6	09/25/2001	AM	26.77
NP 07	6	09/26/2001	AM	27.08
NP 07	6	09/27/2001	AM	26.80
NP 07	6	09/29/2001	AM	27.16
NP 07	6	10/01/2001	AM	27.07
NP 07	6	10/02/2001	AM	26.20
NP 07	6	10/03/2001	NA	26.92
NP 07	6	10/09/2001	NA	27.20
NP 07	6	10/11/2001	NA	26.22
NP 07	6	10/23/2001	NA	26.79
NP 07	7	08/30/2001	NA	27.27
NP 07	7	09/06/2001	NA	26.80
NP 07	7	09/17/2001	AM	27.26
NP 07	7	09/18/2001	AM	27.18
NP 07	7	09/19/2001	PM	27.14
NP 07	7	09/19/2001	AM	27.30
NP 07	7	09/21/2001	NA	27.11
NP 07	7	09/24/2001	AM	26.70
NP 07	7	09/25/2001	AM	27.37
NP 07	7	09/26/2001	AM	26.90
NP 07	7	09/27/2001	AM	26.77

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 07	7	09/29/2001	AM	27.37
NP 07	7	10/01/2001	AM	27.51
NP 07	7	10/02/2001	AM	26.92
NP 07	7	10/03/2001	NA	27.11
NP 07	7	10/09/2001	NA	27.21
NP 07	7	10/11/2001	NA	26.92
NP 07	7	10/23/2001	NA	26.98
NP 08	1	08/30/2001	NA	22.68
NP 08	1	09/06/2001	NA	22.85
NP 08	1	09/17/2001	AM	23.01
NP 08	1	09/18/2001	AM	22.69
NP 08	1	09/19/2001	PM	22.95
NP 08	1	09/19/2001	AM	23.02
NP 08	1	09/21/2001	NA	22.97
NP 08	1	09/24/2001	AM	23.22
NP 08	1	09/25/2001	AM	22.75
NP 08	1	09/26/2001	AM	23.34
NP 08	1	09/27/2001	AM	22.78
NP 08	1	09/29/2001	AM	23.16
NP 08	1	10/01/2001	AM	23.02
NP 08	1	10/02/2001	AM	23.32
NP 08	1	10/03/2001	NA	22.74
NP 08	1	10/09/2001	NA	23.25
NP 08	1	10/11/2001	NA	24.52
NP 08	1	10/23/2001	NA	23.99
NP 08	2	08/30/2001	NA	23.79
NP 08	2	09/06/2001	NA	24.05
NP 08	2	09/17/2001	AM	24.15
NP 08	2	09/18/2001	AM	24.00
NP 08	2	09/19/2001	PM	23.63
NP 08	2	09/19/2001	AM	23.91

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 08	2	09/21/2001	NA	24.33
NP 08	2	09/24/2001	AM	24.02
NP 08	2	09/25/2001	AM	24.22
NP 08	2	09/26/2001	AM	24.07
NP 08	2	09/27/2001	AM	24.39
NP 08	2	09/29/2001	AM	23.93
NP 08	2	10/01/2001	AM	23.86
NP 08	2	10/02/2001	AM	24.54
NP 08	2	10/03/2001	NA	23.80
NP 08	2	10/09/2001	NA	24.12
NP 08	2	10/11/2001	NA	20.12
NP 08	2	10/23/2001	NA	24.06
NP 08	3	08/30/2001	NA	16.46
NP 08	3	09/06/2001	NA	16.47
NP 08	3	09/17/2001	AM	16.37
NP 08	3	09/18/2001	AM	16.52
NP 08	3	09/19/2001	AM	16.06
NP 08	3	09/19/2001	PM	16.23
NP 08	3	09/21/2001	NA	16.20
NP 08	3	09/24/2001	AM	15.67
NP 08	3	09/25/2001	AM	16.00
NP 08	3	09/26/2001	AM	16.25
NP 08	3	09/27/2001	AM	15.45
NP 08	3	09/29/2001	AM	15.77
NP 08	3	10/01/2001	AM	15.77
NP 08	3	10/02/2001	AM	15.77
NP 08	3	10/03/2001	NA	15.90
NP 08	3	10/09/2001	NA	16.25
NP 08	3	10/11/2001	NA	16.36
NP 08	3	10/23/2001	NA	16.87
NP 08	4	08/30/2001	NA	25.32

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 08	4	09/06/2001	NA	25.60
NP 08	4	09/17/2001	AM	25.43
NP 08	4	09/18/2001	AM	25.22
NP 08	4	09/19/2001	PM	25.42
NP 08	4	09/19/2001	AM	25.60
NP 08	4	09/21/2001	NA	25.87
NP 08	4	09/24/2001	AM	25.78
NP 08	4	09/25/2001	AM	25.80
NP 08	4	09/26/2001	AM	25.93
NP 08	4	09/27/2001	AM	25.27
NP 08	4	09/29/2001	AM	25.12
NP 08	4	10/01/2001	AM	25.49
NP 08	4	10/02/2001	AM	25.64
NP 08	4	10/03/2001	NA	25.44
NP 08	4	10/09/2001	NA	25.81
NP 08	4	10/11/2001	NA	22.89
NP 08	4	10/23/2001	NA	25.49
NP 08	5	08/30/2001	NA	23.20
NP 08	5	09/06/2001	NA	22.81
NP 08	5	09/17/2001	AM	22.69
NP 08	5	09/18/2001	AM	22.48
NP 08	5	09/19/2001	AM	22.65
NP 08	5	09/19/2001	PM	22.66
NP 08	5	09/21/2001	NA	22.96
NP 08	5	09/24/2001	AM	22.80
NP 08	5	09/25/2001	AM	22.65
NP 08	5	09/26/2001	AM	22.93
NP 08	5	09/27/2001	AM	22.00
NP 08	5	09/29/2001	AM	22.38
NP 08	5	10/01/2001	AM	22.65
NP 08	5	10/02/2001	AM	22.35

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 08	5	10/03/2001	NA	22.49
NP 08	5	10/09/2001	NA	22.13
NP 08	5	10/11/2001	NA	23.24
NP 08	5	10/23/2001	NA	22.35
NP 08	6	08/30/2001	NA	25.56
NP 08	6	09/06/2001	NA	25.85
NP 08	6	09/17/2001	AM	26.13
NP 08	6	09/18/2001	AM	25.81
NP 08	6	09/19/2001	PM	25.63
NP 08	6	09/19/2001	AM	25.76
NP 08	6	09/21/2001	NA	25.93
NP 08	6	09/24/2001	AM	26.09
NP 08	6	09/25/2001	AM	26.00
NP 08	6	09/26/2001	AM	25.84
NP 08	6	09/27/2001	AM	26.01
NP 08	6	09/29/2001	AM	26.24
NP 08	6	10/01/2001	AM	25.76
NP 08	6	10/02/2001	AM	25.87
NP 08	6	10/03/2001	NA	25.52
NP 08	6	10/09/2001	NA	25.47
NP 08	6	10/11/2001	NA	22.03
NP 08	6	10/23/2001	NA	25.38
NP 08	7	08/30/2001	NA	26.95
NP 08	7	09/06/2001	NA	27.16
NP 08	7	09/17/2001	AM	27.17
NP 08	7	09/18/2001	AM	27.31
NP 08	7	09/19/2001	AM	26.80
NP 08	7	09/19/2001	PM	26.95
NP 08	7	09/21/2001	NA	26.71
NP 08	7	09/24/2001	AM	27.03
NP 08	7	09/25/2001	AM	26.81

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 08	7	09/26/2001	AM	27.23
NP 08	7	09/27/2001	AM	27.09
NP 08	7	09/29/2001	AM	27.21
NP 08	7	10/01/2001	AM	27.17
NP 08	7	10/02/2001	AM	26.68
NP 08	7	10/03/2001	NA	26.92
NP 08	7	10/09/2001	NA	26.69
NP 08	7	10/11/2001	NA	26.34
NP 08	7	10/23/2001	NA	26.79
NP 09	1	08/30/2001	NA	19.42
NP 09	1	09/06/2001	NA	19.47
NP 09	1	09/11/2001	AM	19.64
NP 09	1	09/11/2001	PM	19.65
NP 09	1	09/12/2001	PM	19.54
NP 09	1	09/12/2001	AM	19.67
NP 09	1	09/13/2001	PM	19.51
NP 09	1	09/13/2001	AM	19.73
NP 09	1	09/14/2001	AM	19.40
NP 09	1	09/17/2001	AM	20.30
NP 09	1	09/18/2001	AM	19.71
NP 09	1	09/19/2001	AM	19.49
NP 09	1	09/19/2001	AM	19.71
NP 09	1	09/21/2001	NA	19.74
NP 09	1	09/24/2001	AM	20.34
NP 09	1	09/25/2001	AM	20.26
NP 09	1	09/26/2001	AM	20.72
NP 09	1	09/27/2001	AM	20.57
NP 09	1	09/28/2001	AM	20.65
NP 09	1	10/01/2001	AM	20.85
NP 09	1	10/02/2001	AM	21.10
NP 09	1	10/03/2001	NA	20.97

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 09	1	10/09/2001	NA	20.90
NP 09	1	10/11/2001	NA	20.57
NP 09	1	10/23/2001	NA	20.80
NP 09	2	08/30/2001	NA	25.11
NP 09	2	09/06/2001	NA	24.55
NP 09	2	09/11/2001	AM	25.30
NP 09	2	09/11/2001	PM	25.53
NP 09	2	09/12/2001	PM	25.04
NP 09	2	09/12/2001	AM	25.21
NP 09	2	09/13/2001	PM	24.57
NP 09	2	09/13/2001	AM	25.12
NP 09	2	09/14/2001	AM	25.28
NP 09	2	09/17/2001	AM	25.08
NP 09	2	09/18/2001	AM	25.07
NP 09	2	09/19/2001	AM	24.42
NP 09	2	09/19/2001	AM	25.08
NP 09	2	09/21/2001	NA	24.73
NP 09	2	09/24/2001	AM	24.42
NP 09	2	09/25/2001	AM	24.78
NP 09	2	09/26/2001	AM	25.17
NP 09	2	09/27/2001	AM	25.35
NP 09	2	09/28/2001	AM	25.07
NP 09	2	10/01/2001	AM	25.02
NP 09	2	10/02/2001	AM	25.13
NP 09	2	10/03/2001	NA	24.58
NP 09	2	10/09/2001	NA	24.75
NP 09	2	10/11/2001	NA	24.88
NP 09	2	10/23/2001	NA	25.24
NP 09	3	08/30/2001	NA	14.84
NP 09	3	09/06/2001	NA	14.67
NP 09	3	09/11/2001	PM	13.66

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 09	3	09/11/2001	AM	14.42
NP 09	3	09/12/2001	AM	14.08
NP 09	3	09/12/2001	PM	14.13
NP 09	3	09/13/2001	PM	13.69
NP 09	3	09/13/2001	AM	13.99
NP 09	3	09/14/2001	AM	13.80
NP 09	3	09/17/2001	AM	13.67
NP 09	3	09/18/2001	AM	13.64
NP 09	3	09/19/2001	AM	13.48
NP 09	3	09/19/2001	AM	13.55
NP 09	3	09/21/2001	NA	13.76
NP 09	3	09/24/2001	AM	13.44
NP 09	3	09/25/2001	AM	13.36
NP 09	3	09/26/2001	AM	13.06
NP 09	3	09/27/2001	AM	12.75
NP 09	3	09/28/2001	AM	13.09
NP 09	3	10/01/2001	AM	13.17
NP 09	3	10/02/2001	AM	13.26
NP 09	3	10/03/2001	NA	13.27
NP 09	3	10/09/2001	NA	13.59
NP 09	3	10/11/2001	NA	13.91
NP 09	3	10/23/2001	NA	15.07
NP 09	4	08/30/2001	NA	16.92
NP 09	4	09/06/2001	NA	15.52
NP 09	4	09/11/2001	PM	15.47
NP 09	4	09/11/2001	AM	15.78
NP 09	4	09/12/2001	PM	15.36
NP 09	4	09/12/2001	AM	15.45
NP 09	4	09/13/2001	PM	15.67
NP 09	4	09/13/2001	AM	15.82

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 09	4	09/14/2001	AM	15.86
NP 09	4	09/17/2001	AM	15.67
NP 09	4	09/18/2001	AM	15.68
NP 09	4	09/19/2001	AM	15.50
NP 09	4	09/19/2001	AM	15.73
NP 09	4	09/21/2001	NA	15.59
NP 09	4	09/24/2001	AM	15.35
NP 09	4	09/25/2001	AM	15.31
NP 09	4	09/26/2001	AM	14.92
NP 09	4	09/27/2001	AM	15.32
NP 09	4	09/28/2001	AM	15.17
NP 09	4	10/01/2001	AM	15.42
NP 09	4	10/02/2001	AM	14.78
NP 09	4	10/03/2001	NA	16.58
NP 09	4	10/09/2001	NA	15.03
NP 09	4	10/11/2001	NA	15.30
NP 09	4	10/23/2001	NA	15.38
NP 09	5	08/30/2001	NA	20.82
NP 09	5	09/06/2001	NA	19.71
NP 09	5	09/11/2001	AM	20.24
NP 09	5	09/11/2001	PM	20.90
NP 09	5	09/12/2001	PM	20.23
NP 09	5	09/12/2001	AM	20.52
NP 09	5	09/13/2001	AM	20.17
NP 09	5	09/13/2001	PM	20.21
NP 09	5	09/14/2001	AM	20.10
NP 09	5	09/17/2001	AM	20.28
NP 09	5	09/18/2001	AM	20.14
NP 09	5	09/19/2001	AM	19.92
NP 09	5	09/19/2001	AM	20.42
NP 09	5	09/21/2001	NA	20.21

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 09	5	09/24/2001	AM	19.67
NP 09	5	09/25/2001	AM	20.26
NP 09	5	09/26/2001	AM	19.98
NP 09	5	09/27/2001	AM	20.32
NP 09	5	09/28/2001	AM	20.12
NP 09	5	10/01/2001	AM	19.87
NP 09	5	10/02/2001	AM	20.00
NP 09	5	10/03/2001	NA	19.74
NP 09	5	10/09/2001	NA	20.05
NP 09	5	10/11/2001	NA	19.94
NP 09	5	10/23/2001	NA	19.79
NP 09	6	08/30/2001	NA	21.61
NP 09	6	09/06/2001	NA	20.97
NP 09	6	09/11/2001	PM	21.17
NP 09	6	09/11/2001	AM	21.25
NP 09	6	09/12/2001	PM	20.72
NP 09	6	09/12/2001	AM	21.02
NP 09	6	09/13/2001	PM	21.03
NP 09	6	09/13/2001	AM	21.36
NP 09	6	09/14/2001	AM	21.56
NP 09	6	09/17/2001	AM	21.23
NP 09	6	09/18/2001	AM	21.02
NP 09	6	09/19/2001	AM	21.31
NP 09	6	09/19/2001	AM	21.51
NP 09	6	09/21/2001	NA	21.28
NP 09	6	09/24/2001	AM	21.02
NP 09	6	09/25/2001	AM	21.25
NP 09	6	09/26/2001	AM	21.36
NP 09	6	09/27/2001	AM	20.94
NP 09	6	09/28/2001	AM	20.97
NP 09	6	10/01/2001	AM	21.17

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 09	6	10/02/2001	AM	21.71
NP 09	6	10/03/2001	NA	21.11
NP 09	6	10/09/2001	NA	21.27
NP 09	6	10/11/2001	NA	21.43
NP 09	6	10/23/2001	NA	21.20
NP 09	7	08/30/2001	NA	27.03
NP 09	7	09/06/2001	NA	26.83
NP 09	7	09/11/2001	PM	27.26
NP 09	7	09/11/2001	AM	27.47
NP 09	7	09/12/2001	AM	27.11
NP 09	7	09/12/2001	PM	27.13
NP 09	7	09/13/2001	PM	26.87
NP 09	7	09/13/2001	AM	27.14
NP 09	7	09/14/2001	AM	27.42
NP 09	7	09/17/2001	AM	27.33
NP 09	7	09/18/2001	AM	27.16
NP 09	7	09/19/2001	AM	26.80
NP 09	7	09/19/2001	AM	27.13
NP 09	7	09/21/2001	NA	26.99
NP 09	7	09/24/2001	AM	27.75
NP 09	7	09/25/2001	AM	27.35
NP 09	7	09/26/2001	AM	27.01
NP 09	7	09/27/2001	AM	26.56
NP 09	7	09/28/2001	AM	27.12
NP 09	7	10/01/2001	AM	27.00
NP 09	7	10/02/2001	AM	26.63
NP 09	7	10/03/2001	NA	27.33
NP 09	7	10/09/2001	NA	27.21
NP 09	7	10/11/2001	NA	27.31
NP 09	7	10/23/2001	NA	27.11
NP 10	1	08/30/2001	NA	19.07

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 10	1	09/06/2001	NA	18.81
NP 10	1	09/11/2001	PM	19.00
NP 10	1	09/11/2001	AM	19.02
NP 10	1	09/12/2001	AM	18.94
NP 10	1	09/12/2001	PM	19.11
NP 10	1	09/13/2001	PM	18.59
NP 10	1	09/13/2001	AM	18.64
NP 10	1	09/14/2001	AM	18.88
NP 10	1	09/17/2001	AM	18.83
NP 10	1	09/18/2001	AM	19.13
NP 10	1	09/19/2001	AM	19.28
NP 10	1	09/19/2001	AM	19.39
NP 10	1	09/21/2001	NA	18.98
NP 10	1	09/24/2001	AM	22.13
NP 10	1	09/25/2001	AM	22.55
NP 10	1	09/26/2001	AM	22.34
NP 10	1	09/27/2001	AM	22.29
NP 10	1	09/28/2001	AM	22.46
NP 10	1	10/01/2001	AM	22.64
NP 10	1	10/02/2001	AM	23.16
NP 10	1	10/03/2001	NA	22.86
NP 10	1	10/09/2001	NA	22.93
NP 10	1	10/11/2001	NA	22.52
NP 10	1	10/23/2001	NA	22.72
NP 10	2	08/30/2001	NA	8.91
NP 10	2	09/06/2001	NA	9.08
NP 10	2	09/11/2001	AM	8.85
NP 10	2	09/11/2001	PM	8.88
NP 10	2	09/12/2001	AM	8.54
NP 10	2	09/12/2001	PM	8.69
NP 10	2	09/13/2001	PM	8.61

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 10	2	09/13/2001	AM	8.77
NP 10	2	09/14/2001	AM	8.73
NP 10	2	09/17/2001	AM	8.59
NP 10	2	09/18/2001	AM	8.78
NP 10	2	09/19/2001	AM	8.56
NP 10	2	09/19/2001	AM	8.60
NP 10	2	09/21/2001	NA	8.27
NP 10	2	09/24/2001	AM	14.21
NP 10	2	09/25/2001	AM	14.53
NP 10	2	09/26/2001	AM	14.09
NP 10	2	09/27/2001	AM	14.14
NP 10	2	09/28/2001	AM	14.53
NP 10	2	10/01/2001	AM	13.97
NP 10	2	10/02/2001	AM	14.11
NP 10	2	10/03/2001	NA	14.10
NP 10	2	10/09/2001	NA	14.54
NP 10	2	10/11/2001	NA	14.84
NP 10	2	10/23/2001	NA	13.56
NP 10	3	08/30/2001	NA	21.51
NP 10	3	09/06/2001	NA	21.20
NP 10	3	09/11/2001	AM	21.49
NP 10	3	09/11/2001	PM	21.62
NP 10	3	09/12/2001	PM	21.35
NP 10	3	09/12/2001	AM	21.86
NP 10	3	09/13/2001	AM	21.56
NP 10	3	09/13/2001	PM	21.57
NP 10	3	09/14/2001	AM	21.64
NP 10	3	09/17/2001	AM	21.39
NP 10	3	09/18/2001	AM	21.00
NP 10	3	09/19/2001	AM	20.95
NP 10	3	09/19/2001	AM	21.62

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 10	3	09/21/2001	NA	21.82
NP 10	3	09/24/2001	AM	21.76
NP 10	3	09/25/2001	AM	21.66
NP 10	3	09/26/2001	AM	21.96
NP 10	3	09/27/2001	AM	22.19
NP 10	3	09/28/2001	AM	22.38
NP 10	3	10/01/2001	AM	22.62
NP 10	3	10/02/2001	AM	22.06
NP 10	3	10/03/2001	NA	22.27
NP 10	3	10/09/2001	NA	22.61
NP 10	3	10/11/2001	NA	22.50
NP 10	3	10/23/2001	NA	21.87
NP 10	4	08/30/2001	NA	13.09
NP 10	4	09/06/2001	NA	12.72
NP 10	4	09/11/2001	AM	13.00
NP 10	4	09/11/2001	PM	13.11
NP 10	4	09/12/2001	PM	12.95
NP 10	4	09/12/2001	AM	13.06
NP 10	4	09/13/2001	PM	12.72
NP 10	4	09/13/2001	AM	13.31
NP 10	4	09/14/2001	AM	12.73
NP 10	4	09/17/2001	AM	12.84
NP 10	4	09/18/2001	AM	12.95
NP 10	4	09/19/2001	AM	12.68
NP 10	4	09/19/2001	AM	13.15
NP 10	4	09/21/2001	NA	13.00
NP 10	4	09/24/2001	AM	12.49
NP 10	4	09/25/2001	AM	13.02
NP 10	4	09/26/2001	AM	13.34
NP 10	4	09/27/2001	AM	13.42
NP 10	4	09/28/2001	AM	13.49

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 10	4	10/01/2001	AM	14.02
NP 10	4	10/02/2001	AM	13.76
NP 10	4	10/03/2001	NA	14.03
NP 10	4	10/09/2001	NA	14.62
NP 10	4	10/11/2001	NA	15.09
NP 10	4	10/23/2001	NA	14.36
NP 10	5	08/30/2001	NA	23.77
NP 10	5	09/06/2001	NA	23.16
NP 10	5	09/11/2001	PM	23.52
NP 10	5	09/11/2001	AM	23.55
NP 10	5	09/12/2001	AM	23.58
NP 10	5	09/12/2001	PM	24.02
NP 10	5	09/13/2001	PM	23.36
NP 10	5	09/13/2001	AM	23.79
NP 10	5	09/14/2001	AM	23.61
NP 10	5	09/17/2001	AM	23.34
NP 10	5	09/18/2001	AM	23.33
NP 10	5	09/19/2001	AM	23.33
NP 10	5	09/19/2001	AM	23.34
NP 10	5	09/21/2001	NA	23.34
NP 10	5	09/24/2001	AM	23.21
NP 10	5	09/25/2001	AM	22.80
NP 10	5	09/26/2001	AM	23.41
NP 10	5	09/27/2001	AM	23.12
NP 10	5	09/28/2001	AM	23.26
NP 10	5	10/01/2001	AM	23.57
NP 10	5	10/02/2001	AM	23.45
NP 10	5	10/03/2001	NA	23.73
NP 10	5	10/09/2001	NA	23.44
NP 10	5	10/11/2001	NA	23.80
NP 10	5	10/23/2001	NA	23.51

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 10	6	08/30/2001	NA	28.33
NP 10	6	09/06/2001	NA	28.46
NP 10	6	09/11/2001	AM	28.11
NP 10	6	09/11/2001	PM	28.83
NP 10	6	09/12/2001	AM	28.52
NP 10	6	09/12/2001	PM	28.57
NP 10	6	09/13/2001	PM	28.47
NP 10	6	09/13/2001	AM	28.76
NP 10	6	09/14/2001	AM	28.69
NP 10	6	09/17/2001	AM	28.94
NP 10	6	09/18/2001	AM	29.01
NP 10	6	09/19/2001	AM	28.34
NP 10	6	09/19/2001	AM	28.57
NP 10	6	09/21/2001	NA	28.78
NP 10	6	09/24/2001	AM	28.31
NP 10	6	09/25/2001	AM	28.61
NP 10	6	09/26/2001	AM	28.77
NP 10	6	09/27/2001	AM	28.71
NP 10	6	09/28/2001	AM	28.91
NP 10	6	10/01/2001	AM	29.16
NP 10	6	10/02/2001	AM	28.88
NP 10	6	10/03/2001	NA	28.51
NP 10	6	10/09/2001	NA	28.59
NP 10	6	10/11/2001	NA	28.52
NP 10	6	10/23/2001	NA	28.24
NP 10	7	08/30/2001	NA	26.88
NP 10	7	09/06/2001	NA	26.75
NP 10	7	09/11/2001	PM	26.90
NP 10	7	09/11/2001	AM	27.41
NP 10	7	09/12/2001	PM	27.06
NP 10	7	09/12/2001	AM	27.31

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 10	7	09/13/2001	AM	27.00
NP 10	7	09/13/2001	PM	27.20
NP 10	7	09/14/2001	AM	27.01
NP 10	7	09/17/2001	AM	27.21
NP 10	7	09/18/2001	AM	27.38
NP 10	7	09/19/2001	AM	26.94
NP 10	7	09/19/2001	AM	27.14
NP 10	7	09/21/2001	NA	26.74
NP 10	7	09/24/2001	AM	26.88
NP 10	7	09/25/2001	AM	26.99
NP 10	7	09/26/2001	AM	26.92
NP 10	7	09/27/2001	AM	26.43
NP 10	7	09/28/2001	AM	27.08
NP 10	7	10/01/2001	AM	27.03
NP 10	7	10/02/2001	AM	27.06
NP 10	7	10/03/2001	NA	26.87
NP 10	7	10/09/2001	NA	27.20
NP 10	7	10/11/2001	NA	26.86
NP 10	7	10/23/2001	NA	26.87
NP 11	1	08/30/2001	NA	20.89
NP 11	1	09/06/2001	NA	21.15
NP 11	1	09/11/2001	PM	21.52
NP 11	1	09/11/2001	AM	21.73
NP 11	1	09/12/2001	PM	21.42
NP 11	1	09/12/2001	AM	21.58
NP 11	1	09/13/2001	PM	21.38
NP 11	1	09/13/2001	AM	21.59
NP 11	1	09/14/2001	AM	21.90
NP 11	1	09/17/2001	AM	21.25
NP 11	1	09/18/2001	AM	21.80
NP 11	1	09/19/2001	AM	21.73

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 11	1	09/19/2001	AM	21.83
NP 11	1	09/21/2001	NA	21.66
NP 11	1	09/24/2001	AM	21.99
NP 11	1	09/25/2001	AM	21.62
NP 11	1	09/26/2001	AM	22.13
NP 11	1	09/27/2001	AM	21.79
NP 11	1	09/28/2001	AM	20.60
NP 11	1	10/01/2001	AM	21.67
NP 11	1	10/02/2001	AM	22.17
NP 11	1	10/03/2001	NA	22.67
NP 11	1	10/09/2001	NA	21.40
NP 11	1	10/11/2001	NA	22.20
NP 11	1	10/23/2001	NA	21.93
NP 11	2	08/30/2001	NA	24.88
NP 11	2	09/06/2001	NA	24.78
NP 11	2	09/11/2001	AM	24.39
NP 11	2	09/11/2001	PM	24.94
NP 11	2	09/12/2001	AM	24.76
NP 11	2	09/12/2001	PM	25.00
NP 11	2	09/13/2001	AM	24.35
NP 11	2	09/13/2001	PM	24.63
NP 11	2	09/14/2001	AM	24.85
NP 11	2	09/17/2001	AM	24.51
NP 11	2	09/18/2001	AM	24.72
NP 11	2	09/19/2001	AM	24.59
NP 11	2	09/19/2001	AM	24.86
NP 11	2	09/21/2001	NA	24.68
NP 11	2	09/24/2001	AM	24.67
NP 11	2	09/25/2001	AM	24.64
NP 11	2	09/26/2001	AM	24.81
NP 11	2	09/27/2001	AM	24.92

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 11	2	09/28/2001	AM	24.76
NP 11	2	10/01/2001	AM	24.94
NP 11	2	10/02/2001	AM	24.32
NP 11	2	10/03/2001	NA	24.42
NP 11	2	10/09/2001	NA	24.76
NP 11	2	10/11/2001	NA	24.64
NP 11	2	10/23/2001	NA	24.40
NP 11	3	08/30/2001	NA	16.25
NP 11	3	09/06/2001	NA	15.76
NP 11	3	09/11/2001	AM	15.70
NP 11	3	09/11/2001	PM	15.97
NP 11	3	09/12/2001	PM	15.57
NP 11	3	09/12/2001	AM	16.40
NP 11	3	09/13/2001	AM	15.68
NP 11	3	09/13/2001	PM	15.89
NP 11	3	09/14/2001	AM	15.84
NP 11	3	09/17/2001	AM	15.73
NP 11	3	09/18/2001	AM	15.57
NP 11	3	09/19/2001	AM	15.34
NP 11	3	09/19/2001	AM	15.43
NP 11	3	09/21/2001	NA	15.56
NP 11	3	09/24/2001	AM	15.32
NP 11	3	09/25/2001	AM	15.32
NP 11	3	09/26/2001	AM	15.15
NP 11	3	09/27/2001	AM	15.56
NP 11	3	09/28/2001	AM	15.19
NP 11	3	10/01/2001	AM	15.19
NP 11	3	10/02/2001	AM	15.01
NP 11	3	10/03/2001	NA	15.36
NP 11	3	10/09/2001	NA	14.78
NP 11	3	10/11/2001	NA	15.06

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 11	3	10/23/2001	NA	15.54
NP 11	4	08/30/2001	NA	27.37
NP 11	4	09/06/2001	NA	26.81
NP 11	4	09/11/2001	PM	27.28
NP 11	4	09/11/2001	AM	27.33
NP 11	4	09/12/2001	AM	26.95
NP 11	4	09/12/2001	PM	27.42
NP 11	4	09/13/2001	PM	27.10
NP 11	4	09/13/2001	AM	27.20
NP 11	4	09/14/2001	AM	27.85
NP 11	4	09/17/2001	AM	27.41
NP 11	4	09/18/2001	AM	27.43
NP 11	4	09/19/2001	AM	27.36
NP 11	4	09/19/2001	AM	27.63
NP 11	4	09/21/2001	NA	27.22
NP 11	4	09/24/2001	AM	27.52
NP 11	4	09/25/2001	AM	27.70
NP 11	4	09/26/2001	AM	27.15
NP 11	4	09/27/2001	AM	27.21
NP 11	4	09/28/2001	AM	27.09
NP 11	4	10/01/2001	AM	27.28
NP 11	4	10/02/2001	AM	27.32
NP 11	4	10/03/2001	NA	27.32
NP 11	4	10/09/2001	NA	27.49
NP 11	4	10/11/2001	NA	26.90
NP 11	4	10/23/2001	NA	27.48
NP 11	5	08/30/2001	NA	21.19
NP 11	5	09/06/2001	NA	21.18
NP 11	5	09/11/2001	AM	21.44
NP 11	5	09/11/2001	PM	21.56
NP 11	5	09/12/2001	PM	20.77

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 11	5	09/12/2001	AM	21.10
NP 11	5	09/13/2001	AM	20.94
NP 11	5	09/13/2001	PM	21.04
NP 11	5	09/14/2001	AM	21.07
NP 11	5	09/17/2001	AM	21.30
NP 11	5	09/18/2001	AM	21.18
NP 11	5	09/19/2001	AM	21.06
NP 11	5	09/19/2001	AM	21.27
NP 11	5	09/21/2001	NA	21.11
NP 11	5	09/24/2001	AM	21.35
NP 11	5	09/25/2001	AM	21.21
NP 11	5	09/26/2001	AM	21.19
NP 11	5	09/27/2001	AM	21.51
NP 11	5	09/28/2001	AM	21.10
NP 11	5	10/01/2001	AM	21.52
NP 11	5	10/02/2001	AM	20.88
NP 11	5	10/03/2001	NA	21.10
NP 11	5	10/09/2001	NA	21.03
NP 11	5	10/11/2001	NA	21.38
NP 11	5	10/23/2001	NA	20.98
NP 11	6	08/30/2001	NA	24.28
NP 11	6	09/06/2001	NA	24.11
NP 11	6	09/11/2001	PM	23.61
NP 11	6	09/11/2001	AM	23.95
NP 11	6	09/12/2001	PM	23.36
NP 11	6	09/12/2001	AM	24.15
NP 11	6	09/13/2001	AM	23.83
NP 11	6	09/13/2001	PM	24.01
NP 11	6	09/14/2001	AM	23.84
NP 11	6	09/17/2001	AM	23.81
NP 11	6	09/18/2001	AM	23.90

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 11	6	09/19/2001	AM	23.48
NP 11	6	09/19/2001	AM	23.65
NP 11	6	09/21/2001	NA	23.79
NP 11	6	09/24/2001	AM	23.94
NP 11	6	09/25/2001	AM	23.56
NP 11	6	09/26/2001	AM	24.16
NP 11	6	09/27/2001	AM	24.09
NP 11	6	09/28/2001	AM	23.92
NP 11	6	10/01/2001	AM	24.06
NP 11	6	10/02/2001	AM	24.26
NP 11	6	10/03/2001	NA	24.09
NP 11	6	10/09/2001	NA	23.60
NP 11	6	10/11/2001	NA	23.68
NP 11	6	10/23/2001	NA	23.82
NP 11	7	08/30/2001	NA	24.79
NP 11	7	09/06/2001	NA	24.81
NP 11	7	09/11/2001	PM	24.68
NP 11	7	09/11/2001	AM	25.25
NP 11	7	09/12/2001	PM	24.76
NP 11	7	09/12/2001	AM	24.83
NP 11	7	09/13/2001	PM	24.87
NP 11	7	09/13/2001	AM	25.13
NP 11	7	09/14/2001	AM	24.46
NP 11	7	09/17/2001	AM	24.55
NP 11	7	09/18/2001	AM	25.04
NP 11	7	09/19/2001	AM	24.63
NP 11	7	09/19/2001	AM	24.99
NP 11	7	09/21/2001	NA	24.85
NP 11	7	09/24/2001	AM	24.62
NP 11	7	09/25/2001	AM	24.65
NP 11	7	09/26/2001	AM	24.96

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 11	7	09/27/2001	AM	24.72
NP 11	7	09/28/2001	AM	24.67
NP 11	7	10/01/2001	AM	24.63
NP 11	7	10/02/2001	AM	24.87
NP 11	7	10/03/2001	NA	25.02
NP 11	7	10/09/2001	NA	24.99
NP 11	7	10/11/2001	NA	24.61
NP 11	7	10/23/2001	NA	24.61
NP 12	1	08/30/2001	NA	22.57
NP 12	1	09/06/2001	NA	22.43
NP 12	1	09/11/2001	AM	22.44
NP 12	1	09/11/2001	PM	22.66
NP 12	1	09/12/2001	PM	22.48
NP 12	1	09/12/2001	AM	22.58
NP 12	1	09/13/2001	PM	22.44
NP 12	1	09/13/2001	AM	22.58
NP 12	1	09/14/2001	AM	22.43
NP 12	1	09/17/2001	AM	21.83
NP 12	1	09/18/2001	AM	22.35
NP 12	1	09/19/2001	AM	21.83
NP 12	1	09/19/2001	AM	22.28
NP 12	1	09/21/2001	NA	22.37
NP 12	1	09/24/2001	AM	22.91
NP 12	1	09/25/2001	AM	22.46
NP 12	1	09/26/2001	AM	22.53
NP 12	1	09/27/2001	AM	22.78
NP 12	1	09/28/2001	AM	22.33
NP 12	1	10/01/2001	AM	22.36
NP 12	1	10/02/2001	AM	22.94
NP 12	1	10/03/2001	NA	22.57
NP 12	1	10/09/2001	NA	22.94

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 12	1	10/11/2001	NA	22.68
NP 12	1	10/23/2001	NA	22.60
NP 12	2	08/30/2001	NA	11.96
NP 12	2	09/06/2001	NA	11.76
NP 12	2	09/11/2001	AM	11.92
NP 12	2	09/11/2001	PM	11.92
NP 12	2	09/12/2001	PM	11.77
NP 12	2	09/12/2001	AM	12.01
NP 12	2	09/13/2001	PM	11.71
NP 12	2	09/13/2001	AM	12.10
NP 12	2	09/14/2001	AM	12.03
NP 12	2	09/17/2001	AM	11.87
NP 12	2	09/18/2001	AM	11.56
NP 12	2	09/19/2001	AM	11.32
NP 12	2	09/19/2001	AM	11.59
NP 12	2	09/21/2001	NA	11.39
NP 12	2	09/24/2001	AM	11.71
NP 12	2	09/25/2001	AM	11.79
NP 12	2	09/26/2001	AM	11.83
NP 12	2	09/27/2001	AM	11.40
NP 12	2	09/28/2001	AM	11.86
NP 12	2	10/01/2001	AM	11.27
NP 12	2	10/02/2001	AM	11.73
NP 12	2	10/03/2001	NA	11.63
NP 12	2	10/09/2001	NA	11.56
NP 12	2	10/11/2001	NA	11.57
NP 12	2	10/23/2001	NA	11.84
NP 12	3	08/30/2001	NA	22.53
NP 12	3	09/06/2001	NA	22.46
NP 12	3	09/11/2001	AM	21.93
NP 12	3	09/11/2001	PM	22.13

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 12	3	09/12/2001	PM	22.21
NP 12	3	09/12/2001	AM	22.58
NP 12	3	09/13/2001	AM	22.14
NP 12	3	09/13/2001	PM	22.52
NP 12	3	09/14/2001	AM	22.01
NP 12	3	09/17/2001	AM	22.46
NP 12	3	09/18/2001	AM	22.88
NP 12	3	09/19/2001	AM	22.64
NP 12	3	09/19/2001	AM	22.83
NP 12	3	09/21/2001	NA	22.56
NP 12	3	09/24/2001	AM	22.84
NP 12	3	09/25/2001	AM	23.07
NP 12	3	09/26/2001	AM	23.36
NP 12	3	09/27/2001	AM	23.45
NP 12	3	09/28/2001	AM	22.75
NP 12	3	10/01/2001	AM	23.28
NP 12	3	10/02/2001	AM	22.93
NP 12	3	10/03/2001	NA	23.14
NP 12	3	10/09/2001	NA	22.93
NP 12	3	10/11/2001	NA	22.89
NP 12	3	10/23/2001	NA	23.15
NP 12	4	08/30/2001	NA	22.02
NP 12	4	09/06/2001	NA	21.37
NP 12	4	09/11/2001	PM	21.26
NP 12	4	09/11/2001	AM	21.75
NP 12	4	09/12/2001	AM	21.32
NP 12	4	09/12/2001	PM	21.62
NP 12	4	09/13/2001	AM	21.60
NP 12	4	09/13/2001	PM	21.67
NP 12	4	09/14/2001	AM	21.21
NP 12	4	09/17/2001	AM	21.54

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 12	4	09/18/2001	AM	21.30
NP 12	4	09/19/2001	AM	20.81
NP 12	4	09/19/2001	AM	21.51
NP 12	4	09/21/2001	NA	21.53
NP 12	4	09/24/2001	AM	21.59
NP 12	4	09/25/2001	AM	21.43
NP 12	4	09/26/2001	AM	21.78
NP 12	4	09/27/2001	AM	21.59
NP 12	4	09/28/2001	AM	21.82
NP 12	4	10/01/2001	AM	21.56
NP 12	4	10/02/2001	AM	21.84
NP 12	4	10/03/2001	NA	21.35
NP 12	4	10/09/2001	NA	21.95
NP 12	4	10/11/2001	NA	21.66
NP 12	4	10/23/2001	NA	21.21
NP 12	5	08/30/2001	NA	24.46
NP 12	5	09/06/2001	NA	23.97
NP 12	5	09/11/2001	PM	24.16
NP 12	5	09/11/2001	AM	24.44
NP 12	5	09/12/2001	AM	24.39
NP 12	5	09/12/2001	PM	24.51
NP 12	5	09/13/2001	AM	24.16
NP 12	5	09/13/2001	PM	24.48
NP 12	5	09/14/2001	AM	24.20
NP 12	5	09/17/2001	AM	23.98
NP 12	5	09/18/2001	AM	24.40
NP 12	5	09/19/2001	AM	23.67
NP 12	5	09/19/2001	AM	23.78
NP 12	5	09/21/2001	NA	24.01
NP 12	5	09/24/2001	AM	24.31
NP 12	5	09/25/2001	AM	24.47

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 12	5	09/26/2001	AM	24.46
NP 12	5	09/27/2001	AM	23.81
NP 12	5	09/28/2001	AM	24.37
NP 12	5	10/01/2001	AM	24.02
NP 12	5	10/02/2001	AM	23.84
NP 12	5	10/03/2001	NA	24.06
NP 12	5	10/09/2001	NA	24.06
NP 12	5	10/11/2001	NA	24.20
NP 12	5	10/23/2001	NA	24.52
NP 12	6	08/30/2001	NA	27.21
NP 12	6	09/06/2001	NA	28.10
NP 12	6	09/11/2001	PM	27.78
NP 12	6	09/11/2001	AM	28.29
NP 12	6	09/12/2001	PM	27.48
NP 12	6	09/12/2001	AM	27.60
NP 12	6	09/13/2001	PM	27.50
NP 12	6	09/13/2001	AM	28.20
NP 12	6	09/14/2001	AM	28.03
NP 12	6	09/17/2001	AM	27.98
NP 12	6	09/18/2001	AM	27.97
NP 12	6	09/19/2001	AM	27.61
NP 12	6	09/19/2001	AM	28.39
NP 12	6	09/21/2001	NA	28.17
NP 12	6	09/24/2001	AM	28.07
NP 12	6	09/25/2001	AM	27.98
NP 12	6	09/26/2001	AM	28.05
NP 12	6	09/27/2001	AM	28.44
NP 12	6	09/28/2001	AM	27.70
NP 12	6	10/01/2001	AM	27.99
NP 12	6	10/02/2001	AM	27.88
NP 12	6	10/03/2001	NA	28.30

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 12	6	10/09/2001	NA	27.73
NP 12	6	10/11/2001	NA	27.98
NP 12	6	10/23/2001	NA	27.99
NP 12	7	08/30/2001	NA	27.53
NP 12	7	09/06/2001	NA	27.09
NP 12	7	09/11/2001	PM	27.36
NP 12	7	09/11/2001	AM	27.87
NP 12	7	09/12/2001	AM	27.43
NP 12	7	09/12/2001	PM	27.58
NP 12	7	09/13/2001	AM	27.35
NP 12	7	09/13/2001	PM	27.75
NP 12	7	09/14/2001	AM	27.47
NP 12	7	09/17/2001	AM	27.55
NP 12	7	09/18/2001	AM	27.94
NP 12	7	09/19/2001	AM	27.16
NP 12	7	09/21/2001	NA	26.93
NP 12	7	09/24/2001	AM	27.45
NP 12	7	09/24/2001	AM	27.50
NP 12	7	09/25/2001	AM	26.77
NP 12	7	09/26/2001	AM	27.50
NP 12	7	09/27/2001	AM	27.20
NP 12	7	09/28/2001	AM	27.16
NP 12	7	10/01/2001	AM	27.28
NP 12	7	10/02/2001	AM	27.32
NP 12	7	10/03/2001	NA	27.26
NP 12	7	10/09/2001	NA	27.55
NP 12	7	10/11/2001	NA	27.52
NP 12	7	10/23/2001	NA	27.61
NP 13	1	09/06/2001	NA	7.94
NP 13	1	09/11/2001	AM	10.43
NP 13	1	09/11/2001	PM	12.85

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 13	1	09/12/2001	AM	12.57
NP 13	1	09/12/2001	PM	12.86
NP 13	1	09/13/2001	AM	12.86
NP 13	1	09/13/2001	PM	13.40
NP 13	1	09/14/2001	AM	13.00
NP 13	1	09/17/2001	AM	12.17
NP 13	1	09/18/2001	AM	12.27
NP 13	1	09/19/2001	PM	12.13
NP 13	1	09/19/2001	AM	12.28
NP 13	1	09/21/2001	NA	11.61
NP 13	1	09/24/2001	AM	11.79
NP 13	1	09/25/2001	AM	11.02
NP 13	1	09/26/2001	AM	11.63
NP 13	1	09/27/2001	AM	11.24
NP 13	1	09/28/2001	AM	11.42
NP 13	1	10/01/2001	AM	11.19
NP 13	1	10/02/2001	AM	11.08
NP 13	1	10/03/2001	NA	11.53
NP 13	1	10/09/2001	NA	11.16
NP 13	1	10/11/2001	NA	11.31
NP 13	1	10/23/2001	NA	10.73
NP 13	2	09/06/2001	NA	4.95
NP 13	2	09/11/2001	AM	4.95
NP 13	2	09/11/2001	PM	5.18
NP 13	2	09/12/2001	AM	5.77
NP 13	2	09/12/2001	PM	5.84
NP 13	2	09/13/2001	AM	8.23
NP 13	2	09/13/2001	PM	8.26
NP 13	2	09/14/2001	AM	10.25
NP 13	2	09/17/2001	AM	8.39
NP 13	2	09/18/2001	AM	8.21

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 13	2	09/19/2001	PM	7.82
NP 13	2	09/19/2001	AM	7.95
NP 13	2	09/21/2001	NA	7.67
NP 13	2	09/24/2001	AM	7.28
NP 13	2	09/25/2001	AM	7.28
NP 13	2	09/26/2001	AM	7.38
NP 13	2	09/27/2001	AM	7.37
NP 13	2	09/28/2001	AM	7.31
NP 13	2	10/01/2001	AM	7.10
NP 13	2	10/02/2001	AM	6.99
NP 13	2	10/03/2001	NA	7.43
NP 13	2	10/09/2001	NA	6.97
NP 13	2	10/11/2001	NA	6.57
NP 13	2	10/23/2001	NA	6.46
NP 13	3	09/06/2001	NA	18.83
NP 13	3	09/11/2001	PM	18.41
NP 13	3	09/11/2001	AM	18.73
NP 13	3	09/12/2001	AM	18.13
NP 13	3	09/12/2001	PM	18.47
NP 13	3	09/13/2001	PM	21.50
NP 13	3	09/13/2001	AM	21.68
NP 13	3	09/14/2001	AM	22.43
NP 13	3	09/17/2001	AM	22.59
NP 13	3	09/18/2001	AM	22.31
NP 13	3	09/19/2001	AM	22.26
NP 13	3	09/19/2001	PM	22.37
NP 13	3	09/21/2001	NA	22.51
NP 13	3	09/24/2001	AM	21.98
NP 13	3	09/25/2001	AM	21.76
NP 13	3	09/26/2001	AM	21.56
NP 13	3	09/27/2001	AM	21.23

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 13	3	09/28/2001	AM	21.35
NP 13	3	10/01/2001	AM	20.84
NP 13	3	10/02/2001	AM	20.82
NP 13	3	10/03/2001	NA	20.97
NP 13	3	10/09/2001	NA	20.54
NP 13	3	10/11/2001	NA	20.34
NP 13	3	10/23/2001	NA	19.81
NP 13	4	09/06/2001	NA	13.96
NP 13	4	09/11/2001	AM	13.47
NP 13	4	09/11/2001	PM	13.81
NP 13	4	09/12/2001	AM	13.77
NP 13	4	09/12/2001	PM	13.95
NP 13	4	09/13/2001	AM	14.52
NP 13	4	09/13/2001	PM	14.79
NP 13	4	09/14/2001	AM	17.19
NP 13	4	09/17/2001	AM	17.62
NP 13	4	09/18/2001	AM	17.34
NP 13	4	09/19/2001	PM	17.50
NP 13	4	09/19/2001	AM	17.59
NP 13	4	09/21/2001	NA	17.64
NP 13	4	09/24/2001	AM	17.11
NP 13	4	09/25/2001	AM	17.03
NP 13	4	09/26/2001	AM	16.94
NP 13	4	09/27/2001	AM	16.89
NP 13	4	09/28/2001	AM	17.03
NP 13	4	10/01/2001	AM	16.45
NP 13	4	10/02/2001	AM	16.45
NP 13	4	10/03/2001	NA	16.11
NP 13	4	10/09/2001	NA	15.52
NP 13	4	10/11/2001	NA	15.51
NP 13	4	10/23/2001	NA	14.53

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 13	5	09/06/2001	NA	23.08
NP 13	5	09/11/2001	PM	23.69
NP 13	5	09/11/2001	AM	23.92
NP 13	5	09/12/2001	PM	23.48
NP 13	5	09/12/2001	AM	23.49
NP 13	5	09/13/2001	AM	23.46
NP 13	5	09/13/2001	PM	23.82
NP 13	5	09/14/2001	AM	23.05
NP 13	5	09/17/2001	AM	23.28
NP 13	5	09/18/2001	AM	22.75
NP 13	5	09/19/2001	AM	22.97
NP 13	5	09/19/2001	PM	23.44
NP 13	5	09/21/2001	NA	23.42
NP 13	5	09/24/2001	AM	23.65
NP 13	5	09/25/2001	AM	23.66
NP 13	5	09/26/2001	AM	23.23
NP 13	5	09/27/2001	AM	23.41
NP 13	5	09/28/2001	AM	23.13
NP 13	5	10/01/2001	AM	23.41
NP 13	5	10/02/2001	AM	23.67
NP 13	5	10/03/2001	NA	23.41
NP 13	5	10/09/2001	NA	23.48
NP 13	5	10/11/2001	NA	23.74
NP 13	5	10/23/2001	NA	23.51
NP 13	6	09/06/2001	NA	27.53
NP 13	6	09/11/2001	AM	26.88
NP 13	6	09/11/2001	PM	28.04
NP 13	6	09/12/2001	AM	27.42
NP 13	6	09/12/2001	PM	27.76
NP 13	6	09/13/2001	AM	27.60
NP 13	6	09/13/2001	PM	28.23

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 13	6	09/14/2001	AM	27.35
NP 13	6	09/17/2001	AM	27.48
NP 13	6	09/18/2001	AM	27.65
NP 13	6	09/19/2001	PM	27.79
NP 13	6	09/19/2001	AM	28.04
NP 13	6	09/21/2001	NA	27.49
NP 13	6	09/24/2001	AM	27.66
NP 13	6	09/25/2001	AM	27.87
NP 13	6	09/26/2001	AM	27.66
NP 13	6	09/27/2001	AM	27.58
NP 13	6	09/28/2001	AM	28.12
NP 13	6	10/01/2001	AM	27.50
NP 13	6	10/02/2001	AM	27.55
NP 13	6	10/03/2001	NA	27.83
NP 13	6	10/09/2001	NA	27.97
NP 13	6	10/11/2001	NA	27.42
NP 13	6	10/23/2001	NA	27.78
NP 13	7	09/06/2001	NA	25.42
NP 13	7	09/11/2001	PM	26.45
NP 13	7	09/11/2001	AM	26.50
NP 13	7	09/12/2001	AM	25.83
NP 13	7	09/12/2001	PM	26.36
NP 13	7	09/13/2001	AM	25.79
NP 13	7	09/13/2001	PM	26.09
NP 13	7	09/14/2001	AM	25.74
NP 13	7	09/17/2001	AM	25.48
NP 13	7	09/18/2001	AM	26.27
NP 13	7	09/19/2001	AM	25.77
NP 13	7	09/19/2001	PM	25.84
NP 13	7	09/21/2001	NA	25.72
NP 13	7	09/24/2001	AM	25.47

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 13	7	09/25/2001	AM	25.40
NP 13	7	09/26/2001	AM	25.23
NP 13	7	09/27/2001	AM	25.61
NP 13	7	09/28/2001	AM	26.04
NP 13	7	10/01/2001	AM	25.45
NP 13	7	10/02/2001	AM	26.14
NP 13	7	10/03/2001	NA	26.09
NP 13	7	10/09/2001	NA	25.89
NP 13	7	10/11/2001	NA	25.62
NP 13	7	10/23/2001	NA	25.83
NP 14	1	09/06/2001	NA	16.07
NP 14	1	09/11/2001	AM	20.15
NP 14	1	09/11/2001	PM	20.72
NP 14	1	09/12/2001	AM	20.57
NP 14	1	09/12/2001	PM	21.11
NP 14	1	09/13/2001	AM	20.87
NP 14	1	09/13/2001	PM	21.52
NP 14	1	09/14/2001	AM	21.36
NP 14	1	09/17/2001	AM	20.54
NP 14	1	09/18/2001	AM	21.02
NP 14	1	09/19/2001	PM	20.87
NP 14	1	09/19/2001	AM	20.92
NP 14	1	09/21/2001	NA	20.78
NP 14	1	09/24/2001	AM	20.48
NP 14	1	09/25/2001	AM	20.77
NP 14	1	09/26/2001	AM	20.91
NP 14	1	09/27/2001	AM	21.10
NP 14	1	09/28/2001	AM	21.36
NP 14	1	10/01/2001	AM	20.75
NP 14	1	10/02/2001	AM	20.76
NP 14	1	10/03/2001	NA	20.61

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 14	1	10/09/2001	NA	20.63
NP 14	1	10/11/2001	NA	20.69
NP 14	1	10/23/2001	NA	20.41
NP 14	2	09/06/2001	NA	7.86
NP 14	2	09/11/2001	PM	8.52
NP 14	2	09/11/2001	AM	8.76
NP 14	2	09/12/2001	AM	8.85
NP 14	2	09/12/2001	PM	9.19
NP 14	2	09/13/2001	AM	9.32
NP 14	2	09/13/2001	PM	9.65
NP 14	2	09/14/2001	AM	11.89
NP 14	2	09/17/2001	AM	11.51
NP 14	2	09/18/2001	AM	11.62
NP 14	2	09/19/2001	PM	11.54
NP 14	2	09/19/2001	AM	11.55
NP 14	2	09/21/2001	NA	11.66
NP 14	2	09/24/2001	AM	11.55
NP 14	2	09/25/2001	AM	11.44
NP 14	2	09/26/2001	AM	11.37
NP 14	2	09/27/2001	AM	11.36
NP 14	2	09/28/2001	AM	11.53
NP 14	2	10/01/2001	AM	11.25
NP 14	2	10/02/2001	AM	11.22
NP 14	2	10/03/2001	NA	11.64
NP 14	2	10/09/2001	NA	11.04
NP 14	2	10/11/2001	NA	11.08
NP 14	2	10/23/2001	NA	10.90
NP 14	3	09/06/2001	NA	22.43
NP 14	3	09/11/2001	AM	23.45
NP 14	3	09/11/2001	PM	23.51
NP 14	3	09/12/2001	AM	22.69

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 14	3	09/12/2001	PM	23.24
NP 14	3	09/13/2001	PM	23.89
NP 14	3	09/13/2001	AM	24.04
NP 14	3	09/14/2001	AM	24.01
NP 14	3	09/17/2001	AM	24.27
NP 14	3	09/18/2001	AM	24.26
NP 14	3	09/19/2001	AM	24.34
NP 14	3	09/19/2001	PM	24.65
NP 14	3	09/21/2001	NA	24.44
NP 14	3	09/24/2001	AM	23.87
NP 14	3	09/25/2001	AM	24.06
NP 14	3	09/26/2001	AM	24.34
NP 14	3	09/27/2001	AM	24.43
NP 14	3	09/28/2001	AM	24.61
NP 14	3	10/01/2001	AM	24.69
NP 14	3	10/02/2001	AM	24.68
NP 14	3	10/03/2001	NA	24.27
NP 14	3	10/09/2001	NA	24.51
NP 14	3	10/11/2001	NA	24.41
NP 14	3	10/23/2001	NA	24.26
NP 14	4	09/06/2001	NA	18.43
NP 14	4	09/11/2001	AM	18.35
NP 14	4	09/11/2001	PM	18.53
NP 14	4	09/12/2001	PM	18.45
NP 14	4	09/12/2001	AM	18.78
NP 14	4	09/13/2001	AM	19.21
NP 14	4	09/13/2001	PM	19.30
NP 14	4	09/14/2001	AM	20.23
NP 14	4	09/17/2001	AM	19.84
NP 14	4	09/18/2001	AM	20.19
NP 14	4	09/19/2001	PM	19.63

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 14	4	09/19/2001	AM	20.13
NP 14	4	09/21/2001	NA	19.78
NP 14	4	09/24/2001	AM	19.70
NP 14	4	09/25/2001	AM	19.06
NP 14	4	09/26/2001	AM	19.52
NP 14	4	09/27/2001	AM	19.07
NP 14	4	09/28/2001	AM	19.67
NP 14	4	10/01/2001	AM	19.22
NP 14	4	10/02/2001	AM	19.51
NP 14	4	10/03/2001	NA	19.20
NP 14	4	10/09/2001	NA	19.08
NP 14	4	10/11/2001	NA	19.40
NP 14	4	10/23/2001	NA	19.50
NP 14	5	09/06/2001	NA	24.68
NP 14	5	09/11/2001	AM	24.51
NP 14	5	09/11/2001	PM	24.76
NP 14	5	09/12/2001	AM	24.64
NP 14	5	09/12/2001	PM	25.23
NP 14	5	09/13/2001	AM	24.57
NP 14	5	09/13/2001	PM	24.63
NP 14	5	09/14/2001	AM	24.81
NP 14	5	09/17/2001	AM	24.56
NP 14	5	09/18/2001	AM	24.81
NP 14	5	09/19/2001	PM	24.68
NP 14	5	09/19/2001	AM	25.01
NP 14	5	09/21/2001	NA	24.94
NP 14	5	09/24/2001	AM	24.85
NP 14	5	09/25/2001	AM	24.95
NP 14	5	09/26/2001	AM	24.72
NP 14	5	09/27/2001	AM	24.08
NP 14	5	09/28/2001	AM	24.79

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 14	5	10/01/2001	AM	24.41
NP 14	5	10/02/2001	AM	24.94
NP 14	5	10/03/2001	NA	25.01
NP 14	5	10/09/2001	NA	24.74
NP 14	5	10/11/2001	NA	24.78
NP 14	5	10/23/2001	NA	24.70
NP 14	6	09/06/2001	NA	27.68
NP 14	6	09/11/2001	PM	27.57
NP 14	6	09/11/2001	AM	27.66
NP 14	6	09/12/2001	AM	27.67
NP 14	6	09/12/2001	PM	28.27
NP 14	6	09/13/2001	PM	27.73
NP 14	6	09/13/2001	AM	28.16
NP 14	6	09/14/2001	AM	28.17
NP 14	6	09/17/2001	AM	28.23
NP 14	6	09/18/2001	AM	27.51
NP 14	6	09/19/2001	PM	27.28
NP 14	6	09/19/2001	AM	27.38
NP 14	6	09/21/2001	NA	27.92
NP 14	6	09/24/2001	AM	27.84
NP 14	6	09/25/2001	AM	27.43
NP 14	6	09/26/2001	AM	27.32
NP 14	6	09/27/2001	AM	27.50
NP 14	6	09/28/2001	AM	27.66
NP 14	6	10/01/2001	AM	27.94
NP 14	6	10/02/2001	AM	27.64
NP 14	6	10/03/2001	NA	27.85
NP 14	6	10/09/2001	NA	27.65
NP 14	6	10/11/2001	NA	27.18
NP 14	6	10/23/2001	NA	27.58
NP 14	7	09/06/2001	NA	26.18

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 14	7	09/11/2001	AM	26.55
NP 14	7	09/11/2001	PM	26.87
NP 14	7	09/12/2001	PM	26.46
NP 14	7	09/12/2001	AM	26.49
NP 14	7	09/13/2001	PM	26.14
NP 14	7	09/13/2001	AM	26.56
NP 14	7	09/14/2001	AM	26.84
NP 14	7	09/17/2001	AM	26.71
NP 14	7	09/18/2001	AM	26.70
NP 14	7	09/19/2001	AM	26.61
NP 14	7	09/19/2001	PM	26.65
NP 14	7	09/21/2001	NA	26.58
NP 14	7	09/24/2001	AM	26.61
NP 14	7	09/25/2001	AM	26.32
NP 14	7	09/26/2001	AM	27.01
NP 14	7	09/27/2001	AM	26.39
NP 14	7	09/28/2001	AM	26.55
NP 14	7	10/01/2001	AM	27.20
NP 14	7	10/02/2001	AM	26.60
NP 14	7	10/03/2001	NA	25.97
NP 14	7	10/09/2001	NA	27.08
NP 14	7	10/11/2001	NA	26.62
NP 14	7	10/23/2001	NA	26.82
NP 15	1	09/06/2001	NA	11.77
NP 15	1	09/11/2001	AM	12.66
NP 15	1	09/11/2001	PM	12.75
NP 15	1	09/12/2001	AM	12.32
NP 15	1	09/12/2001	PM	12.68
NP 15	1	09/13/2001	AM	12.52
NP 15	1	09/13/2001	PM	12.56
NP 15	1	09/14/2001	AM	12.27

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 15	1	09/17/2001	AM	12.24
NP 15	1	09/18/2001	AM	12.02
NP 15	1	09/19/2001	AM	12.40
NP 15	1	09/19/2001	AM	16.86
NP 15	1	09/21/2001	NA	16.69
NP 15	1	09/24/2001	AM	16.12
NP 15	1	09/25/2001	AM	16.12
NP 15	1	09/26/2001	AM	16.37
NP 15	1	09/27/2001	AM	15.91
NP 15	1	09/28/2001	AM	15.62
NP 15	1	10/01/2001	AM	15.91
NP 15	1	10/02/2001	AM	18.42
NP 15	1	10/03/2001	NA	17.75
NP 15	1	10/09/2001	NA	18.18
NP 15	1	10/11/2001	NA	17.56
NP 15	1	10/23/2001	NA	16.82
NP 15	2	09/06/2001	NA	9.63
NP 15	2	09/11/2001	PM	9.94
NP 15	2	09/11/2001	AM	9.97
NP 15	2	09/12/2001	PM	9.73
NP 15	2	09/12/2001	AM	9.84
NP 15	2	09/13/2001	PM	9.50
NP 15	2	09/13/2001	AM	9.76
NP 15	2	09/14/2001	AM	10.03
NP 15	2	09/17/2001	AM	10.01
NP 15	2	09/18/2001	AM	9.79
NP 15	2	09/19/2001	AM	9.63
NP 15	2	09/19/2001	AM	9.96
NP 15	2	09/21/2001	NA	10.14
NP 15	2	09/24/2001	AM	10.14
NP 15	2	09/25/2001	AM	10.32

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 15	2	09/26/2001	AM	10.32
NP 15	2	09/27/2001	AM	10.27
NP 15	2	09/28/2001	AM	10.57
NP 15	2	10/01/2001	AM	10.39
NP 15	2	10/02/2001	AM	14.78
NP 15	2	10/03/2001	NA	14.44
NP 15	2	10/09/2001	NA	15.60
NP 15	2	10/11/2001	NA	14.07
NP 15	2	10/23/2001	NA	13.58
NP 15	3	09/06/2001	NA	13.63
NP 15	3	09/11/2001	PM	13.41
NP 15	3	09/11/2001	AM	13.70
NP 15	3	09/12/2001	AM	13.59
NP 15	3	09/12/2001	PM	13.72
NP 15	3	09/13/2001	PM	13.46
NP 15	3	09/13/2001	AM	13.48
NP 15	3	09/14/2001	AM	13.76
NP 15	3	09/17/2001	AM	13.47
NP 15	3	09/18/2001	AM	13.80
NP 15	3	09/19/2001	AM	13.23
NP 15	3	09/19/2001	AM	13.71
NP 15	3	09/21/2001	NA	13.77
NP 15	3	09/24/2001	AM	13.96
NP 15	3	09/25/2001	AM	13.70
NP 15	3	09/26/2001	AM	13.52
NP 15	3	09/27/2001	AM	14.04
NP 15	3	09/28/2001	AM	13.93
NP 15	3	10/01/2001	AM	13.56
NP 15	3	10/02/2001	AM	15.27
NP 15	3	10/03/2001	NA	15.55
NP 15	3	10/09/2001	NA	19.10

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 15	3	10/11/2001	NA	18.71
NP 15	3	10/23/2001	NA	15.70
NP 15	4	09/06/2001	NA	18.44
NP 15	4	09/11/2001	PM	17.82
NP 15	4	09/11/2001	AM	18.02
NP 15	4	09/12/2001	AM	17.88
NP 15	4	09/12/2001	PM	18.12
NP 15	4	09/13/2001	PM	17.87
NP 15	4	09/13/2001	AM	18.12
NP 15	4	09/14/2001	AM	17.94
NP 15	4	09/17/2001	AM	17.97
NP 15	4	09/18/2001	AM	18.11
NP 15	4	09/19/2001	AM	17.61
NP 15	4	09/19/2001	AM	18.01
NP 15	4	09/21/2001	NA	17.88
NP 15	4	09/24/2001	AM	17.92
NP 15	4	09/25/2001	AM	18.22
NP 15	4	09/26/2001	AM	18.00
NP 15	4	09/27/2001	AM	17.95
NP 15	4	09/28/2001	AM	17.86
NP 15	4	10/01/2001	AM	17.67
NP 15	4	10/02/2001	AM	17.99
NP 15	4	10/03/2001	NA	18.44
NP 15	4	10/09/2001	NA	19.12
NP 15	4	10/11/2001	NA	19.02
NP 15	4	10/23/2001	NA	18.78
NP 15	5	09/06/2001	NA	20.02
NP 15	5	09/11/2001	PM	19.58
NP 15	5	09/11/2001	AM	19.74
NP 15	5	09/12/2001	PM	19.41
NP 15	5	09/12/2001	AM	20.02

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 15	5	09/13/2001	AM	19.81
NP 15	5	09/13/2001	PM	19.83
NP 15	5	09/14/2001	AM	19.57
NP 15	5	09/17/2001	AM	20.06
NP 15	5	09/18/2001	AM	20.19
NP 15	5	09/19/2001	AM	19.43
NP 15	5	09/19/2001	AM	19.60
NP 15	5	09/21/2001	NA	19.52
NP 15	5	09/24/2001	AM	19.52
NP 15	5	09/25/2001	AM	19.32
NP 15	5	09/26/2001	AM	19.99
NP 15	5	09/27/2001	AM	19.40
NP 15	5	09/28/2001	AM	19.56
NP 15	5	10/01/2001	AM	19.55
NP 15	5	10/02/2001	AM	19.23
NP 15	5	10/03/2001	NA	19.54
NP 15	5	10/09/2001	NA	19.73
NP 15	5	10/11/2001	NA	19.91
NP 15	5	10/23/2001	NA	19.78
NP 15	6	09/06/2001	NA	26.78
NP 15	6	09/11/2001	AM	26.70
NP 15	6	09/11/2001	PM	26.73
NP 15	6	09/12/2001	PM	26.41
NP 15	6	09/12/2001	AM	27.06
NP 15	6	09/13/2001	AM	26.66
NP 15	6	09/13/2001	PM	26.89
NP 15	6	09/14/2001	AM	26.40
NP 15	6	09/17/2001	AM	26.90
NP 15	6	09/18/2001	AM	26.82
NP 15	6	09/19/2001	AM	26.52
NP 15	6	09/19/2001	AM	26.81

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 15	6	09/21/2001	NA	26.66
NP 15	6	09/24/2001	AM	26.58
NP 15	6	09/25/2001	AM	26.44
NP 15	6	09/26/2001	AM	26.48
NP 15	6	09/27/2001	AM	27.05
NP 15	6	09/28/2001	AM	26.77
NP 15	6	10/01/2001	AM	26.57
NP 15	6	10/02/2001	AM	26.52
NP 15	6	10/03/2001	NA	26.77
NP 15	6	10/09/2001	NA	26.50
NP 15	6	10/11/2001	NA	26.68
NP 15	6	10/23/2001	NA	26.71
NP 15	7	09/06/2001	NA	27.97
NP 15	7	09/11/2001	AM	27.59
NP 15	7	09/11/2001	PM	27.97
NP 15	7	09/12/2001	AM	27.46
NP 15	7	09/12/2001	PM	27.78
NP 15	7	09/13/2001	PM	27.39
NP 15	7	09/13/2001	AM	27.70
NP 15	7	09/14/2001	AM	27.77
NP 15	7	09/17/2001	AM	27.08
NP 15	7	09/18/2001	AM	27.42
NP 15	7	09/19/2001	AM	27.14
NP 15	7	09/19/2001	AM	27.43
NP 15	7	09/21/2001	NA	27.38
NP 15	7	09/24/2001	AM	27.30
NP 15	7	09/25/2001	AM	27.77
NP 15	7	09/26/2001	AM	27.04
NP 15	7	09/27/2001	AM	27.83
NP 15	7	09/28/2001	AM	27.82
NP 15	7	10/01/2001	AM	27.97

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 15	7	10/02/2001	AM	27.80
NP 15	7	10/03/2001	NA	27.45
NP 15	7	10/09/2001	NA	27.38
NP 15	7	10/11/2001	NA	27.95
NP 15	7	10/23/2001	NA	27.73
NP 16	1	09/06/2001	NA	11.26
NP 16	1	09/17/2001	AM	11.26
NP 16	1	09/18/2001	AM	11.20
NP 16	1	09/19/2001	AM	11.31
NP 16	1	09/19/2001	AM	13.40
NP 16	1	09/21/2001	NA	14.06
NP 16	1	09/24/2001	AM	13.85
NP 16	1	09/25/2001	AM	13.57
NP 16	1	09/26/2001	AM	13.86
NP 16	1	09/27/2001	AM	13.91
NP 16	1	09/28/2001	AM	13.84
NP 16	1	10/01/2001	AM	13.66
NP 16	1	10/02/2001	AM	20.79
NP 16	1	10/03/2001	NA	20.33
NP 16	1	10/09/2001	NA	20.53
NP 16	1	10/11/2001	NA	20.53
NP 16	1	10/23/2001	NA	20.25
NP 16	2	09/06/2001	NA	10.09
NP 16	2	09/17/2001	AM	10.43
NP 16	2	09/18/2001	AM	10.54
NP 16	2	09/19/2001	AM	10.26
NP 16	2	09/19/2001	AM	10.43
NP 16	2	09/21/2001	NA	10.79
NP 16	2	09/24/2001	AM	10.80
NP 16	2	09/25/2001	AM	10.75
NP 16	2	09/26/2001	AM	10.70

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 16	2	09/27/2001	AM	10.41
NP 16	2	09/28/2001	AM	10.49
NP 16	2	10/01/2001	AM	10.57
NP 16	2	10/02/2001	AM	15.80
NP 16	2	10/03/2001	NA	15.17
NP 16	2	10/09/2001	NA	17.23
NP 16	2	10/11/2001	NA	15.17
NP 16	2	10/23/2001	NA	14.45
NP 16	3	09/06/2001	NA	10.76
NP 16	3	09/17/2001	AM	10.40
NP 16	3	09/18/2001	AM	10.57
NP 16	3	09/19/2001	AM	10.52
NP 16	3	09/19/2001	AM	10.74
NP 16	3	09/21/2001	NA	10.59
NP 16	3	09/24/2001	AM	10.94
NP 16	3	09/25/2001	AM	10.77
NP 16	3	09/26/2001	AM	10.86
NP 16	3	09/27/2001	AM	11.03
NP 16	3	09/28/2001	AM	10.74
NP 16	3	10/01/2001	AM	10.76
NP 16	3	10/02/2001	AM	16.42
NP 16	3	10/03/2001	NA	16.19
NP 16	3	10/09/2001	NA	19.23
NP 16	3	10/11/2001	NA	18.82
NP 16	3	10/23/2001	NA	14.80
NP 16	4	09/06/2001	NA	20.27
NP 16	4	09/17/2001	AM	20.10
NP 16	4	09/18/2001	AM	20.43
NP 16	4	09/19/2001	AM	19.99
NP 16	4	09/19/2001	AM	20.03
NP 16	4	09/21/2001	NA	20.13

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 16	4	09/24/2001	AM	19.96
NP 16	4	09/25/2001	AM	20.05
NP 16	4	09/26/2001	AM	19.42
NP 16	4	09/27/2001	AM	20.14
NP 16	4	09/28/2001	AM	19.75
NP 16	4	10/01/2001	AM	19.90
NP 16	4	10/02/2001	AM	19.77
NP 16	4	10/03/2001	NA	19.74
NP 16	4	10/09/2001	NA	21.06
NP 16	4	10/11/2001	NA	21.42
NP 16	4	10/23/2001	NA	20.86
NP 16	5	09/06/2001	NA	21.17
NP 16	5	09/17/2001	AM	21.25
NP 16	5	09/18/2001	AM	21.06
NP 16	5	09/19/2001	AM	21.12
NP 16	5	09/19/2001	AM	21.26
NP 16	5	09/21/2001	NA	21.20
NP 16	5	09/24/2001	AM	21.33
NP 16	5	09/25/2001	AM	21.31
NP 16	5	09/26/2001	AM	21.13
NP 16	5	09/27/2001	AM	21.10
NP 16	5	09/28/2001	AM	21.37
NP 16	5	10/01/2001	AM	21.19
NP 16	5	10/02/2001	AM	20.76
NP 16	5	10/03/2001	NA	21.30
NP 16	5	10/09/2001	NA	21.13
NP 16	5	10/11/2001	NA	21.47
NP 16	5	10/23/2001	NA	21.02
NP 16	6	09/06/2001	NA	27.83
NP 16	6	09/17/2001	AM	27.88
NP 16	6	09/18/2001	AM	27.73

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 16	6	09/19/2001	AM	27.98
NP 16	6	09/19/2001	AM	28.17
NP 16	6	09/21/2001	NA	27.92
NP 16	6	09/24/2001	AM	28.05
NP 16	6	09/25/2001	AM	28.12
NP 16	6	09/26/2001	AM	27.96
NP 16	6	09/27/2001	AM	27.96
NP 16	6	09/28/2001	AM	28.13
NP 16	6	10/01/2001	AM	27.45
NP 16	6	10/02/2001	AM	27.80
NP 16	6	10/03/2001	NA	28.11
NP 16	6	10/09/2001	NA	28.17
NP 16	6	10/11/2001	NA	27.84
NP 16	6	10/23/2001	NA	28.43
NP 16	7	09/06/2001	NA	28.28
NP 16	7	09/17/2001	AM	28.00
NP 16	7	09/18/2001	AM	27.94
NP 16	7	09/19/2001	AM	28.06
NP 16	7	09/19/2001	AM	28.10
NP 16	7	09/21/2001	NA	27.83
NP 16	7	09/24/2001	AM	27.80
NP 16	7	09/25/2001	AM	28.39
NP 16	7	09/26/2001	AM	27.96
NP 16	7	09/27/2001	AM	28.05
NP 16	7	09/28/2001	AM	28.43
NP 16	7	10/01/2001	AM	28.01
NP 16	7	10/02/2001	AM	27.73
NP 16	7	10/03/2001	NA	28.05
NP 16	7	10/09/2001	NA	27.63
NP 16	7	10/11/2001	NA	27.85
NP 16	7	10/23/2001	NA	28.30

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 17	1	09/06/2001	NA	11.17
NP 17	1	09/17/2001	AM	13.61
NP 17	1	09/18/2001	AM	13.91
NP 17	1	09/19/2001	AM	13.80
NP 17	1	09/19/2001	AM	14.09
NP 17	1	09/21/2001	NA	13.85
NP 17	1	09/24/2001	AM	13.51
NP 17	1	09/25/2001	AM	13.77
NP 17	1	09/26/2001	AM	13.85
NP 17	1	09/27/2001	AM	13.34
NP 17	1	10/02/2001	AM	13.18
NP 17	1	10/03/2001	NA	13.09
NP 17	2	09/06/2001	NA	9.23
NP 17	2	09/17/2001	AM	9.10
NP 17	2	09/18/2001	AM	9.64
NP 17	2	09/19/2001	AM	9.45
NP 17	2	09/19/2001	AM	9.60
NP 17	2	09/21/2001	NA	9.57
NP 17	2	09/24/2001	AM	9.46
NP 17	2	09/25/2001	AM	9.55
NP 17	2	09/26/2001	AM	9.48
NP 17	2	09/27/2001	AM	9.06
NP 17	2	10/02/2001	AM	9.53
NP 17	2	10/03/2001	NA	9.31
NP 17	3	09/06/2001	NA	11.75
NP 17	3	09/17/2001	AM	11.04
NP 17	3	09/18/2001	AM	11.18
NP 17	3	09/19/2001	AM	10.95
NP 17	3	09/19/2001	AM	11.13
NP 17	3	09/21/2001	NA	11.02
NP 17	3	09/24/2001	AM	10.67

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 17	3	09/25/2001	AM	11.10
NP 17	3	09/26/2001	AM	10.73
NP 17	3	09/27/2001	AM	11.18
NP 17	3	10/02/2001	AM	10.61
NP 17	3	10/03/2001	NA	10.62
NP 17	4	09/06/2001	NA	25.29
NP 17	4	09/17/2001	AM	24.92
NP 17	4	09/18/2001	AM	25.08
NP 17	4	09/19/2001	AM	25.23
NP 17	4	09/19/2001	AM	25.50
NP 17	4	09/21/2001	NA	25.16
NP 17	4	09/24/2001	AM	25.26
NP 17	4	09/25/2001	AM	25.03
NP 17	4	09/26/2001	AM	25.92
NP 17	4	09/27/2001	AM	24.80
NP 17	4	10/02/2001	AM	25.37
NP 17	4	10/03/2001	NA	25.19
NP 17	5	09/06/2001	NA	22.35
NP 17	5	09/17/2001	AM	21.72
NP 17	5	09/18/2001	AM	21.79
NP 17	5	09/19/2001	AM	22.04
NP 17	5	09/19/2001	AM	22.33
NP 17	5	09/21/2001	NA	22.26
NP 17	5	09/24/2001	AM	22.18
NP 17	5	09/25/2001	AM	22.97
NP 17	5	09/26/2001	AM	22.20
NP 17	5	09/27/2001	AM	22.42
NP 17	5	10/02/2001	AM	22.31
NP 17	5	10/03/2001	NA	22.00
NP 17	6	09/06/2001	NA	27.68
NP 17	6	09/17/2001	AM	26.97

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 17	6	09/18/2001	AM	27.43
NP 17	6	09/19/2001	AM	27.52
NP 17	6	09/19/2001	AM	27.76
NP 17	6	09/21/2001	NA	27.24
NP 17	6	09/24/2001	AM	27.48
NP 17	6	09/25/2001	AM	27.50
NP 17	6	09/26/2001	AM	27.35
NP 17	6	09/27/2001	AM	27.75
NP 17	6	10/02/2001	AM	27.35
NP 17	6	10/03/2001	NA	27.51
NP 17	7	09/06/2001	NA	28.20
NP 17	7	09/17/2001	AM	27.95
NP 17	7	09/18/2001	AM	27.60
NP 17	7	09/19/2001	AM	27.58
NP 17	7	09/19/2001	AM	28.21
NP 17	7	09/21/2001	NA	28.15
NP 17	7	09/24/2001	AM	27.48
NP 17	7	09/25/2001	AM	28.04
NP 17	7	09/26/2001	AM	28.30
NP 17	7	09/27/2001	AM	27.95
NP 17	7	10/02/2001	AM	28.04
NP 17	7	10/03/2001	NA	27.70
NP 18	1	09/06/2001	NA	20.17
NP 18	1	09/17/2001	AM	20.17
NP 18	1	09/18/2001	AM	20.40
NP 18	1	09/19/2001	AM	20.15
NP 18	1	09/19/2001	AM	20.36
NP 18	1	09/21/2001	NA	20.22
NP 18	1	09/24/2001	AM	20.26
NP 18	1	09/25/2001	AM	19.82
NP 18	1	09/26/2001	AM	19.83

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 18	1	09/27/2001	AM	20.02
NP 18	1	10/02/2001	AM	20.39
NP 18	1	10/03/2001	NA	20.85
NP 18	2	09/06/2001	NA	24.68
NP 18	2	09/17/2001	AM	24.22
NP 18	2	09/18/2001	AM	24.46
NP 18	2	09/19/2001	AM	24.24
NP 18	2	09/19/2001	AM	24.63
NP 18	2	09/21/2001	NA	24.36
NP 18	2	09/24/2001	AM	24.43
NP 18	2	09/25/2001	AM	24.31
NP 18	2	09/26/2001	AM	24.47
NP 18	2	09/27/2001	AM	24.90
NP 18	2	10/02/2001	AM	24.38
NP 18	2	10/03/2001	NA	24.66
NP 18	3	09/06/2001	NA	14.43
NP 18	3	09/17/2001	AM	14.26
NP 18	3	09/18/2001	AM	14.04
NP 18	3	09/19/2001	AM	13.74
NP 18	3	09/19/2001	AM	14.10
NP 18	3	09/21/2001	NA	14.24
NP 18	3	09/24/2001	AM	14.06
NP 18	3	09/25/2001	AM	14.00
NP 18	3	09/26/2001	AM	13.99
NP 18	3	09/27/2001	AM	13.84
NP 18	3	10/02/2001	AM	13.23
NP 18	3	10/03/2001	NA	13.36
NP 18	4	09/06/2001	NA	22.83
NP 18	4	09/17/2001	AM	22.47
NP 18	4	09/18/2001	AM	22.54
NP 18	4	09/19/2001	AM	22.58

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 18	4	09/19/2001	AM	22.61
NP 18	4	09/21/2001	NA	22.78
NP 18	4	09/24/2001	AM	22.39
NP 18	4	09/25/2001	AM	22.36
NP 18	4	09/26/2001	AM	22.61
NP 18	4	09/27/2001	AM	22.29
NP 18	4	10/02/2001	AM	22.75
NP 18	4	10/03/2001	NA	22.65
NP 18	5	09/06/2001	NA	20.28
NP 18	5	09/17/2001	AM	20.38
NP 18	5	09/18/2001	AM	20.27
NP 18	5	09/19/2001	AM	20.31
NP 18	5	09/19/2001	AM	20.33
NP 18	5	09/21/2001	NA	20.10
NP 18	5	09/24/2001	AM	20.07
NP 18	5	09/25/2001	AM	20.22
NP 18	5	09/26/2001	AM	20.39
NP 18	5	09/27/2001	AM	20.45
NP 18	5	10/02/2001	AM	20.40
NP 18	5	10/03/2001	NA	20.24
NP 18	6	09/06/2001	NA	27.44
NP 18	6	09/17/2001	AM	28.18
NP 18	6	09/18/2001	AM	27.73
NP 18	6	09/19/2001	AM	27.57
NP 18	6	09/19/2001	AM	27.59
NP 18	6	09/21/2001	NA	27.54
NP 18	6	09/24/2001	AM	27.68
NP 18	6	09/25/2001	AM	27.31
NP 18	6	09/26/2001	AM	27.63
NP 18	6	09/27/2001	AM	27.21
NP 18	6	10/02/2001	AM	27.35

Table F-1 (continued)
Soil Moisture Data

Well ID	Depth (feet bgs)	Date	AM/PM	Soil Moisture (percent by volume)
NP 18	6	10/03/2001	NA	27.39
NP 18	7	09/06/2001	NA	27.89
NP 18	7	09/17/2001	AM	27.93
NP 18	7	09/18/2001	AM	28.08
NP 18	7	09/19/2001	AM	27.45
NP 18	7	09/19/2001	AM	27.91
NP 18	7	09/21/2001	NA	27.94
NP 18	7	09/24/2001	AM	28.30
NP 18	7	09/25/2001	AM	28.24
NP 18	7	09/26/2001	AM	27.90
NP 18	7	09/27/2001	AM	27.98
NP 18	7	10/02/2001	AM	28.20
NP 18	7	10/03/2001	NA	28.37

NA denotes not applicable
bgs denotes below ground surface

APPENDIX G
ONE-MONTH PERFORMANCE MONITORING SAMPLE RESULTS

List of Tables

Table G-1
Manganese Concentrations in Soil – One-Month Performance Monitoring

Sample Number	Location	Depth (feet bgs)	Manganese (mg/kg)
TS25L-S-120/121	NP 5 Cell C	0 to 2	2360
TS25L-S-122	NP 5 Cell C	2 to 4	369
TS25L-S-114	NP 6 Cell C	0 to 2	3310
TS25L-S-115	NP 6 Cell C	0 to 2 (duplicate)	3490
TS25L-S-116	NP 6 Cell C	2 to 4	213
TS25L-S-117/118	NP 7 Cell C	0 to 2	1260
TS25L-S-119	NP 7 Cell C	2 to 4	174
TS25L-S-124	NP 8 Cell C	0 to 2	3650
TS25L-S-125	NP 8 Cell C	2 to 4	231
TS25L-S-100/101	NP 9 Cell E	0 to 2	2140
TS25L-S-102	NP 9 Cell E	2 to 4	198
TS25L-S-094	NP 10 Cell E	0 to 2	562
TS25L-S-095	NP 10 Cell E	2 to 4	217
TS25L-S-104	NP 11 Cell E	0 to 2	2140
TS25L-S-105	NP 11 Cell E	2 to 4	500
TS25L-S-097/098	NP 12 Cell E	0 to 2	2360
TS25L-S-099	NP 12 Cell E	2 to 4	1340
TS25L-S-087/088	NP 13 Cell F	0 to 2	380
TS25L-S-089	NP 13 Cell F	2 to 4	133
TS25L-S-091	NP 14 Cell F	0 to 2	211
TS25L-S-092	NP 14 Cell F	2 to 4	215
TS25L-S-093	NP 14 Cell F	2 to 4 (duplicate)	262
TS25L-S-106/107	NP 15 Cell D	0 to 2	330
TS25L-S-109	NP 15 Cell D	2 to 4	128
TS25L-S-111	NP 16 Cell D	0 to 2	290
TS25L-S-112	NP 16 Cell D	2 to 4	178

mg/kg denotes milligrams per kilogram
bgs denotes below ground surface

Table G-2
Summary of Polynuclear Aromatic Hydrocarbon Analytical Results with Benzo(a)Pyrene Equivalents Test Cells – One-Month Performance Monitoring

Sample ID	TS25L-S-120		TS25L-S-121		TS25L-S-122		TS25L-S-113		TS25L-S-114		TS25L-S-115	
Sample Location	NP5-CELL C		NP5-CELL C		NP5-CELL C		NP6-CELL C		NP6-CELL C		NP6-CELL C	
Sample Depth (feet bgs)	0-1		1-2		2-4		0-1		0-2		0-2 duplicate	
Sample Collection Date	10/23/2001		10/23/2001		10/23/2001		10/23/2001		10/23/2001		10/23/2001	
Parameter	Result (μg/kg)		Result (μg/kg)		Result (μg/kg)		Result (μg/kg)		Result (μg/kg)		Result (μg/kg)	
PAHs (EPA 8270-SIM)												
Naphthalene	700		1400		150	J	490		290	J	430	
2-Methylnaphthalene	320	U	230	J	300	U	300	U	320	U	320	U
Acenaphthylene	760		1500		260	J	870		380		600	
Acenaphthene	440		620		300	U	220	J	320	U	190	J
Fluorene	360		590		300	U	390		320	U	320	J
Phenanthrene	5700		13000		1600		6400		2400		4000	
Anthracene	710		2600		380		840		380		560	
Fluoranthene	9800		21000		2600		8000		5200		6500	
Pyrene	17000		40000		4600		14000		9100		11000	
Benzo(a)anthracene	4500		11000		1200		4000		2400		3000	
Chrysene	5200		13000		1400		4000		2800		3600	
Benzo(b)fluoranthene	8600		20000		1300		5400		4800		5200	
Benzo(k)fluoranthene	320	U	350	U	860		300	U	320	U	320	U
Benzo(a)pyrene	6600		15000		1600		4800		3400		3900	
Indeno(1,2,3-cd)pyrene	5400		12000		1200		3300		2800		3100	
Dibenz(a,h)anthracene	1200		2200		300	U	760		550		630	
Benzo(g,h,i)perylene	7100		15000		1800		4300		3600		4100	
Benzo(a)pyrene - Equivalents*	9660		21520		2280		6840		4960		5670	

Table G-2 (continued)
Summary of Polynuclear Aromatic Hydrocarbon Analytical Results with Benzo(a)Pyrene Equivalents Test Cells – One-Month Performance Monitoring

Sample ID	TS25L-S-116		TS25L-S-117		TS25L-S-118		TS25L-S-119		TS25L-S-123		TS25L-S-124	
Sample Location	NP6-CELL C		NP7-CELL C		NP7-CELL C		NP7-CELL C		NP8-CELL C		NP8-CELL C	
Sample Depth (feet bgs)	2-4		0-1		1-2		2-4		0-1		0-2	
Sample Collection Date	10/23/2001		10/23/2001		10/23/2001		10/23/2001		10/23/2001		10/23/2001	
Parameter	Result (µg/kg)		Result (µg/kg)		Result (µg/kg)		Result (µg/kg)		Result (µg/kg)		Result (µg/kg)	
PAHs (EPA 8270-SIM)												
Naphthalene	40000		250	J	880		290	U	1100		640	
2-Methylnaphthalene	9200		310	U	310	U	290	U	330		310	U
Acenaphthylene	39000		410		1400		260	J	2200		840	
Acenaphthene	33000		170	J	380		210	J	660		270	J
Fluorene	24000		180	J	530		290	U	1200		280	J
Phenanthrene	240000		2400		9600		1400		18000		5900	
Anthracene	74000		450		2100		570		2100		780	
Fluoranthene	180000		3600		18000		2500		18000		10000	
Pyrene	240000		7200		39000		4300		28000		17000	
Benzo(a)anthracene	56000		1800		9100		1200		7100		4500	
Chrysene	79000		2100		9700		1600		8400		5400	
Benzo(b)fluoranthene	71000		2800		13000		1400		10000		8200	
Benzo(k)fluoranthene	300	U	310	U	310	U	830		300	U	310	U
Benzo(a)pyrene	70000		2600		12000		1600		8200		6200	
Indeno(1,2,3-cd)pyrene	39000		1700		8100		1200		5700		5200	
Dibenz(a,h)anthracene	8400		350		1600		290	U	1300		1200	
Benzo(g,h,i)perylene	49000		2400		10000		1500		7200		6700	
Benzo(a)pyrene - Equivalents*	95090		3590		16640		2280		11800		9200	

Table G-2 (continued)
Summary of Polynuclear Aromatic Hydrocarbon Analytical Results with Benzo(a)Pyrene Equivalents Test Cells – One-Month Performance Monitoring

Sample ID	TS25L-S-125		TS25L-S-100		TS25L-S-101		TS25L-S-102		TS25L-S-096		TS25L-S-094	
Sample Location	NP8-CELL C		NP9-CELL E		NP9-CELL E		NP9-CELL E		NP10-CELL E		NP10-CELL E	
Sample Depth (feet bgs)	2-4		0-1		1-2		2-4		0-1		0-2	
Sample Collection Date	10/23/2001		10/22/2001		10/22/2001		10/22/2001		10/22/2001		10/22/2001	
Parameter	Result (μg/kg)		Result (μg/kg)		Result (μg/kg)		Result (μg/kg)		Result (μg/kg)		Result (μg/kg)	
PAHs (EPA 8270-SIM)												
Naphthalene	1100		610		1500		210		92		160	
2-Methylnaphthalene	180	J	280	U	300	J	44		42	U	26	J
Acenaphthylene	4700		1200		2000		320		95		150	
Acenaphthene	1600		280	J	660		150		41	J	57	
Fluorene	490		340		670		150		38	J	54	
Phenanthrene	32000		6900		12000		2300		700		990	
Anthracene	3800		980		1500		390		120		150	
Fluoranthene	35000		12000		21000		4200		1300		1900	
Pyrene	56000		21000		44000		7000		1900		2900	
Benzo(a)anthracene	14000		5600		12000		1900		480		820	
Chrysene	13000		5900		13000		2400		610		1100	
Benzo(b)fluoranthene	17000		8000		15000		2900		650		1600	
Benzo(k)fluoranthene	300	U	280	U	6100		41	U	350		42	U
Benzo(a)pyrene	14000		7200		15000		2500		730		1200	
Indeno(1,2,3-cd)pyrene	9000		4700		12000		1700		600		1200	
Dibenz(a,h)anthracene	1700		790		2200		400		93		260	
Benzo(g,h,i)perylene	11000		6500		16000		2200		820		1500	
Benzo(a)pyrene - Equivalents*	19720		9830		21180		3560		1010		1830	

Table G-2 (continued)
Summary of Polynuclear Aromatic Hydrocarbon Analytical Results with Benzo(a)Pyrene Equivalents Test Cells – One-Month Performance Monitoring

Sample ID	TS25L-S-095		TS25L-S-103		TS25L-S-104		TS25L-S-105		TS25L-S-097		TS25L-S-098		TS25L-S-099	
Sample Location	NP10-CELL E		NP11-CELL E		NP11-CELL E		NP11-CELL E		NP12-CELL E		NP12-CELL E		NP12-CELL E	
Sample Depth (feet bgs)	2-4		0-1		0-2		2-4		0-1		1-2		2-4	
Sample Collection Date	10/22/2001		10/22/2001		10/22/2001		10/22/2001		10/22/2001		10/22/2001		10/22/2001	
Parameter	Result (µg/kg)		Result (µg/kg)		Result (µg/kg)		Result (µg/kg)		Result (µg/kg)		Result (µg/kg)		Result (µg/kg)	
PAHs (EPA 8270-SIM)														
Naphthalene	450		880		540		5100		330		260		520	
2-Methylnaphthalene	300	U	290	U	320	U	680		57		87		290	U
Acenaphthylene	840		1400		880		13000		320		390		1200	
Acenaphthene	290	J	320		230	J	4300		150		140		310	
Fluorene	180	J	260	J	310	J	5000		85		350		190	J
Phenanthrene	4000		7200		5600		62000		2100		4000		5100	
Anthracene	870		1100		810		11000		320		490		1300	
Fluoranthene	8400		17000		10000		74000		3800		4000		11000	
Pyrene	17000		28000		17000		120000		6100		6100		22000	
Benzo(a)anthracene	4700		7200		4300		32000		1700		1500		5900	
Chrysene	5600		8600		5000		30000		2700		2100		6700	
Benzo(b)fluoranthene	5700		9600		8600		43000		4200		2900		9200	
Benzo(k)fluoranthene	2100		3500		320	U	290	U	43	U	39	U	290	U
Benzo(a)pyrene	6200		10000		6900		39000		2600		1800		8500	
Indeno(1,2,3-cd)pyrene	4100		8900		5600		23000		2800		1500		5500	
Dibenz(a,h)anthracene	800		1600		1100		5600		480		300		1000	
Benzo(g,h,i)perylene	5900		12000		6600		31000		4000		1800		7400	
Benzo(a)pyrene - Equivalents*	8480		14220		9860		54440		3960		2700		11570	

**BaP equivalents calculated by giving "non-detect" entries half the value of the detection limit.*

µg/kg denotes microgram per kilogram *U denotes undetected* *J denotes estimation* *bgs denotes below ground surface*

PAH denotes polynuclear aromatic hydrocarbon *EPA denotes U.S. Environmental Protection Agency*

Table G-3
Summary of Polynuclear Aromatic Hydrocarbon Analytical Results with Benzo(a)Pyrene-Equivalents Control Cells – One-Month Performance Monitoring

Sample ID	TS25L-S-106		TS25L-S-107		TS25L-S-108		TS25L-S-109		TS25L-S-110	
Sample Location	NP15-CELL D		NP15-CELL D		NP15-CELL D		NP15-CELL D		NP16-CELL D	
Sample Depth (feet bgs)	0-1		1-2		1-2 duplicate		2-4		0-1	
Sample Collection Date	10/22/2001		10/22/2001		10/22/2001		10/22/2001		10/22/2001	
Parameter	Result (µg/kg)		Result (µg/kg)		Result (µg/kg)		Result (µg/kg)		Result (µg/kg)	
PAHs (EPA 8270-SIM)										
Naphthalene	3100		600		460		580		230	J
2-Methylnaphthalene	610		290	U	290	U	280	U	290	U
Acenaphthylene	8100		990		770		2300		420	
Acenaphthene	1500		440		230	J	320		290	U
Fluorene	3800		370		320		540		290	U
Phenanthrene	70000		6600		4700		14000		2100	
Anthracene	8300		740		600		3000		340	
Fluoranthene	84000		12000		8600		18000		4400	
Pyrene	120000		22000		16000		34000		7600	
Benzo(a)anthracene	27000		5300		4300		8400		2000	
Chrysene	30000		5500		4100		7600		2200	
Benzo(b)fluoranthene	43000		9100		6300		11000		3500	
Benzo(k)fluoranthene	290	U	290	U	290	U	280	U	290	U
Benzo(a)pyrene	37000		7500		5400		11000		2900	
Indeno(1,2,3-cd)pyrene	24000		5600		3700		6500		2200	
Dibenz(a,h)anthracene	5700		1300		780		1500		430	
Benzo(g,h,i)perylene	27000		7600		5200		7900		2900	
Benzo(a)pyrene - Equivalents*	52140		10810		7620		15110		4110	

Table G-3 (continued)
Summary of Polynuclear Aromatic Hydrocarbon Analytical Results with Benzo(a)Pyrene-Equivalents Control Cells – One-Month Performance Monitoring

Sample ID	TS25L-S-111		TS25L-S-112		TS25L-S-087		TS25L-S-088		TS25L-S-089	
Sample Location	NP16-CELL D		NP16-CELL D		NP13-CELL F		NP13-CELL F		NP13-CELL F	
Sample Depth (feet bgs)	0-2		2-4		0-1		1-2		2-4	
Sample Collection Date	10/22/2001		10/22/2001		10/22/2001		10/22/2001		10/22/2001	
Parameter	Result (µg/kg)		Result (µg/kg)		Result (µg/kg)		Result (µg/kg)		Result (µg/kg)	
PAHs (EPA 8270-SIM)										
Naphthalene	420		520		67		41	U	140	
2-Methylnaphthalene	290	U	280	U	37	U	41	U	25	J
Acenaphthylene	720		790		140		41	U	200	
Acenaphthene	220	J	290		33	J	41	U	110	
Fluorene	250	J	450		50		41	U	85	
Phenanthrene	3800		6200		900		110		2100	
Anthracene	560		2400		120		41	U	370	
Fluoranthene	7000		6800		1600		180		2500	
Pyrene	11000		12000		2400		300		4500	
Benzo(a)anthracene	3400		3300		550		140		1300	
Chrysene	3700		4200		770		180		1600	
Benzo(b)fluoranthene	6300		4300		720		220		1700	
Benzo(k)fluoranthene	290	U	280	U	530		41	U	38	U
Benzo(a)pyrene	5000		4100		830		190		1500	
Indeno(1,2,3-cd)pyrene	3700		2600		680		110		970	
Dibenz(a,h)anthracene	910		550		140		47		260	
Benzo(g,h,i)perylene	5000		3400		850		150		1200	
Benzo(a)pyrene - Equivalents*	7260		5680		1180		290		2160	

Table G-3 (continued)
Summary of Polynuclear Aromatic Hydrocarbon Analytical Results with Benzo(a)Pyrene-Equivalents Control Cells – One-Month Performance Monitoring

Sample ID	TS25L-S-090		TS25L-S-091		TS25L-S-092		TS25L-S-093	
Sample Location	NP14-CELL F		NP14-CELL F		NP14-CELL F		NP14-CELL F	
Sample Depth (feet bgs)	0-1		0-2		2-4		2-4 duplicate	
Sample Collection Date	10/22/2001		10/22/2001		10/22/2001		10/22/2001	
Parameter	Result (µg/kg)		Result (µg/kg)		Result (µg/kg)		Result (µg/kg)	
PAHs (EPA 8270-SIM)								
Naphthalene	110		160	J	7000		830	
2-Methylnaphthalene	38	U	280	U	560		300	U
Acenaphthylene	110		280	U	10000		2400	
Acenaphthene	37	J	280	U	2300		830	
Fluorene	34	J	280	U	4000		660	
Phenanthrene	670		390		49000		13000	
Anthracene	110		280	U	8300		2800	
Fluoranthene	1400		1000		44000		14000	
Pyrene	2400		1800		68000		31000	
Benzo(a)anthracene	600		560		14000		7200	
Chrysene	840		1100		17000		8000	
Benzo(b)fluoranthene	1300		1400		22000		9300	
Benzo(k)fluoranthene	38	U	620		300	U	300	U
Benzo(a)pyrene	970		800		22000		9400	
Indeno(1,2,3-cd)pyrene	1000		1300		13000		5500	
Dibenz(a,h)anthracene	130		260	J	2200		1200	
Benzo(g,h,i)perylene	1300		2000		16000		7000	
Benzo(a)pyrene - Equivalents*	1400		1400		29120		12820	

**BaP equivalents calculated by giving "non-detect" entries half the value of the detection limit.*

µg/kg denotes microgram per kilogram *U denotes undetected* *J denotes estimation* *bgs denotes below ground surface*

PAH denotes polynuclear aromatic hydrocarbon *EPA denotes U.S. Environmental Protection Agency*

Table G-4
Soil Oxidant Demand One-Month Performance Monitoring

Casing Number	Cell	Sample Interval (feet bgs)	Initial Solution ($KMnO_4$) (mg/L)	Oxidant Demand (g $KMnO_4$/kg Soil)	Average Demand
5	C	0-1	10000	14.77	22.62
5	C	0-1	20000	30.48	
6	C	0-1	10000	14.88	13.98
6	C	0-1	20000	30.60	
6	C	0-2	10000	14.65	
6	C	0-2	20000	29.72	
6	C	2-4	1000	-0.69	
6	C	2-4	2500	1.51	
6	C	2-4	5000	4.75	
6	C	2-4	10000	11.13	
6	C	2-4	20000	19.27	
7	C	0-1	20000	32.20	32.20
8	C	0-1	20000	30.54	14.87
8	C	0-2	10000	14.73	
8	C	0-2	20000	29.65	
8	C	2-4	1000	-0.67	
8	C	2-4	2500	1.87	
8	C	2-4	5000	5.93	
8	C	2-4	10000	12.54	
8	C	2-4	20000	24.38	
9	E	0-1	20000	30.45	30.45
10	E	0-1	20000	31.24	17.41
10	E	0-2	20000	31.17	
10	E	2-4	2500	1.61	
10	E	2-4	5000	5.31	
10	E	2-4	10000	12.51	
10	E	2-4	20000	22.59	

Table G-4 (continued)
Soil Oxidant Demand One-Month Performance Monitoring

Casing Number	Cell	Sample Interval (feet bgs)	Initial Solution ($KMnO_4$) (mg/L)	Oxidant Demand (g $KMnO_4$/kg Soil)	Average Demand
11	E	0-1	20000	31.41	16.88
11	E	0-2	10000	14.77	
11	E	0-2	20000	30.25	
11	E	2-4	2500	1.85	
11	E	2-4	5000	5.54	
11	E	2-4	10000	12.04	
11	E	2-4	20000	22.32	
12	E	0-1	20000	29.84	29.84
13	F	0-1	20000	31.24	31.24
14	F	0-1	20000	31.88	19.32
14	F	0-2	5000	6.28	
14	F	0-2	10000	14.12	
14	F	0-2	20000	24.07	
14	F	2-4	10000	14.03	
14	F	2-4	20000	25.56	
15	D	0-1	10000	14.69	20.81
15	D	0-1	20000	26.94	
16	D	2-4	1000	-0.67	15.18
16	D	2-4	2500	1.76	
16	D	2-4	5000	5.06	
16	D	2-4	10000	12.65	
16	D	2-4	20000	23.93	
16	D	0-1	20000	32.29	
16	D	0-2	20000	31.23	

$KMnO_4$ denotes potassium permanganate
mg/L denotes milligrams per liter
g denotes gram
kg denotes kilogram

Table G-5
Arsenic and Hexavalent Chromium Concentrations in Groundwater – One-Month Performance Monitoring

Sample Number	Location	Arsenic (µg/L)	Hexavalent Chromium (mg/L)
TS24L-GW-131	PZ 2 Cell D	9.6	ND < 0.01
TS24L-GW-128	PZ 3 Cell C	6.4	ND < 0.01
TS24L-GW-127	PZ 4 Cell E	6.6	ND < 0.01
TS24L-GW-126	PZ 5 northeast corner	6.5	ND < 0.01
TS24L-GW-129	PZ 6 northwest corner	15.3	ND < 0.01
TS24L-GW-130	PZ 7 southwest corner	14.4	ND < 0.01
TS24L-GW-132	PZ 8 southeast corner	17.1	ND < 0.01
TS24L-GW-133	PZ 8 (duplicate)	18.0	ND < 0.01

ND denotes non-detect
PZ denotes piezometer
mg/L denotes milligrams per liter
µg/L denotes micrograms per liter

APPENDIX H
CORE PHOTOGRAPHS

N00236.000472
ALAMEDA POINT
SSIC NO. 5090.3

APPENDIX H – CORE PHOTOGRAPHS IS CONTAINED IN ELECTRONIC FORMAT

TO VIEW THE DATA, CONTACT:

DIANE C. SILVA
RECORDS MANAGEMENT SPECIALIST
NAVAL FACILITIES ENGINEERING COMMAND SOUTHWEST
1220 PACIFIC HIGHWAY
SAN DIEGO, CA 92132

TELEPHONE: (619) 532-3676