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CROWS LANDING
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CROWS LANDING
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FINAL REPORT

on

EVALUATION OF THE LT$^{3®}$ SYSTEM FOR THE REMEDIATION OF HYDROCARBON-CONTAMINATED SOIL

at

NAVAL AUXILIARY LANDING FIELD
CROWS LANDING, CALIFORNIA

by

Tom Torres and Jeffery C. Heath
Naval Civil Engineering Laboratory (NCEL)
and
Say Kee Ong, William Piispanen, Greg L. Headington,
Curtis Bridges and Jeffrey L. Means
Battelle Memorial Institute

to

NAVAL CIVIL ENGINEERING LABORATORY
PORT HUENEME, CALIFORNIA

March, 1992

BATTELLE
505 King Avenue
Columbus, Ohio 43201-2693

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Executive Summary

As part of the Navy's Installation Restoration and Hazardous Waste Minimization programs and ongoing research in assessing and developing new and innovative technologies, the Navy has evaluated a low temperature thermal treatment process to decontaminate soils containing petroleum hydrocarbons. Demonstration of the effectiveness of the low temperature thermal treatment process was performed by Weston Services, Inc., (WSI) with their LT$^{3®}$ system. The demonstration site was a fire-fighting pit at the Naval Auxiliary Landing Field (NALF), Crows Landing, California. The soil in the pit was contaminated with petroleum hydrocarbons. Some soil contaminated with jet-fuel from a plane crash site was also processed.

WSI began mobilizing the LT$^{3®}$ system on March 12, 1991 and began processing contaminated soil on March 25, 1991. All contaminated soil was thermally treated by April 27, 1991. Demobilization of the site began on May 6, 1991. By May 17, 1991, WSI had completed the backfilling of the pit and had demobilized from the site.

The on-site demonstration of the LT$^{3®}$ system was successfully completed without many problems, and was within the specified schedule. Some of the problems encountered included stoppage of the LT$^{3®}$ system due to potential lightning hazards and highly moist untreated soil due to rain which slowed down the processing of the hydrocarbon-contaminated soil in the first two weeks of the on-site demonstration. An 8-inch steel water main which was originally assumed to be present on the other side of the road from the fire-fighting pit was unearthed within the fire-fighting pit causing some delay in the excavation and backfilling of the pit. A rupture on one of the LT$^{3®}$ processor's hot-oil lines also stopped the LT$^{3®}$ temporarily.

All contaminated soils from the fire-fighting pit and plane crash site was excavated and treated with the LT$^{3®}$ system. The processing capacity of the LT$^{3®}$ system averaged about 7.3 tons/hour for an 8-hour work day. The nominal capacity of the LT$^{3®}$ system is 8 tons/hour. A total of 1,403 tons was processed by the LT$^{3®}$ system. The average soil temperature in the processor was 410°F with an average residence time of 22 minutes. A total of eight untreated soil samples were collected randomly throughout the treatment period. Total petroleum hydrocarbons (TPH) concentrations of the untreated soil samples range from non-detect levels to as high as 97 mg/kg. The mean TPH concentration of the untreated soil samples was 52 $\pm$ 32 mg/kg (mean $\pm$ standard deviation). The mean TPH concentrations of treated soil was 12 $\pm$ 9 mg/kg with TPH concentrations ranging from non-detect levels to 25 mg/kg. A total of eighteen treated soil samples were collected randomly throughout the treatment period. The mean TPH concentration of the untreated and treated soils were found to be statistically different indicating that the contaminated soil has been treated. Based on the mean TPH concentrations, the average removal efficiency of TPH was estimated to be about 77 percent. Soil samples taken from around the pit and in the treatment area after demobilization indicated that the contaminated soil has been removed.

Most of the purgeable organics in the untreated and treated soils were less than or equal to the detection limit. Some constituents such as acetone, methylene chloride and 2-butanone were detected in the treated soil. From the limited data on soil nutrients, total phosphorus and nitrate - nitrogen concentration were found to be statistically the same before and after treatment. Other constituents such as sulfate and potassium were the same before and after treatment.

Semi-volatiles present in the stack emissions from the activated carbon columns were generally polynuclear aromatic hydrocarbons such as diethylphthalate, phenanthrene, naphthalene and fluoranthene. Concentrations of these compounds were low (in the microgram per cubic meters range). Volatiles present in the stack gases were also low (in the microgram per cubic meters range) with dichlorodifluoromethane and chloromethane being some of the more commonly measured organic compounds. Overall the concentration levels of volatiles and semivolatiles in the stack gas were below any Occupational Safety and Health Administration (OSHA) regulatory limits indicating that the LT^{3}® system did not appear to produce stack gases that were of significant health concern. Throughout the site demonstration air emissions from the LT^{3}® system complied with the regulatory limit of less than 10 ppm of TPH. Concentration of aromatics in the condensate/treated water was less than 1 ppm.

The total cost for the treatment of the contaminated soils at NALF Crows Landing was $415 per ton. The total cost include permitting, mobilization, excavation, soil treatment, backfilling, demobilization, soil and stack sampling, progress reports and associated Navy's oversight cost. The cost was for a small volume of soil and would be lower for the treatment of a larger volume of soil due to economics of scale.

Cost of treatment of the contaminated soils excluding excavation and owner's cost such as permitting and soil sampling and Navy's oversight cost was $268 per ton. The cost estimate for this project is within the estimate provided in the literature and is competitive with other remedial technologies such as on-site incineration which ranges from $500 - $1,500 per ton. Off-site incineration is estimated to cost approximately $1,800 per ton. Cost estimates cited do not include excavation/backfilling and owner's costs such as permitting.

Based on this study and other documented studies, the low temperature thermal treatment process is an effective technology in the decontamination of soils contaminated with volatiles and semi-volatiles such as gasoline and jet fuel. This technology is cost effective and should be seriously considered as a treatment option for gasoline and jet fuel contaminated soil. To demonstrate the effectiveness of this technology further, the Navy should consider testing the low temperature thermal treatment process for the remediation of PCB-contaminated soils and organics - contaminated sediments found at various Naval facilities.

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1.0 INTRODUCTION

The Navy is required under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA) to clean up hazardous substances that were released in the past and to minimize the generation of hazardous waste at Naval facilities. These laws further provide for research, development, and demonstration of methods to remediate and reduce the toxicity of hazardous waste substances in the environment.

As part of the Navy's Installation Restoration and Hazardous Waste Minimization programs and ongoing research in assessing and developing new and innovative technologies, the Navy has evaluated a low temperature thermal treatment process to decontaminate soils containing volatile organic compounds (VOCs). The objective was to remediate the soil to nonhazardous levels as specified by U.S. Environmental Protection Agency (EPA) and California regulations for hazardous waste.

In a typical low temperature thermal treatment process, heat is applied to the contaminated soil in order to volatilize the organic contaminants. Heat is transferred to the soil from a heat source (e.g., propane burners) either directly, by externally heating a rotating cylinder

containing contaminated material, or indirectly, by circulating hot oil through the thermal processors. Temperatures in the processors range between 450°F to 850°F and do not exceed the operating combustion temperatures of incinerators. The stripped organic contaminants are captured by condensation and disposed/treated off-site. The off-gas is further treated by either destroying the organics in an afterburner or adsorbing them onto activated carbon.

Demonstration of the effectiveness of a low temperature thermal treatment process was performed by Weston Services, Inc (WSI) with their WSI LT$^{3®}$ system. The demonstration site was at the Naval Auxiliary Landing Field (NALF), Crows Landing, California. Soils contaminated with fuels from fire fighting operations were treated by this system to determine its effectiveness.

In this report, the objectives of this study are outlined in Section 2.0. A description of the contaminated site at NALF Crows Landing and WSI LT$^{3®}$ system are presented in Sections 3.0 and 4.0, respectively. Section 5.0 summarizes all site activities including soil and air emission sampling. Data from this study are analyzed and presented in Section 6.0. A cost analysis for the treatment of hydrocarbon-contaminated soil for this site is given in Section 7.0.

2.0 OBJECTIVES OF THE DEMONSTRATION

The objective of this project was to evaluate the effectiveness of the WSI LT$^{3®}$ treatment process in remediating hydrocarbon-contaminated soils at NALF, Crows Landing, California. In this project, Battelle served as a third-party consultant to the Naval Civil Engineering Laboratory (NCEL) by providing analytical and technical assistance in evaluating the on-site demonstration of the WSI LT$^{3®}$ system.

This project included several specific tasks that were executed by Battelle and WSI. For this project, WSI was a subcontractor to Battelle. WSI's scope of work included preparing the Site Work Plan, Site Health and Safety Plan and permitting documents for the field demonstration at NALF Crows Landing. WSI was responsible for developing the review package to regulatory agencies and for obtaining the required permits and variances for the

operation of the LT$^{3®}$ system at NALF, Crows Landing. A separate contract between NCEL and WSI provided the necessary funds for the mobilization, excavation, treatment, demobilization, and decontamination of the test site. Battelle's scope of work included preparation of Progress Reports, Sampling and Analysis Plan, On-scene Coordinators' Summary Report, and Engineering Evaluation/Cost Analysis Report. In addition, soil and stack emissions gas samples were collected by Battelle for analysis by California approved laboratories during the on-site demonstration.

3.0 BACKGROUND AND SITE DESCRIPTION

The site for the LT$^{3®}$ system demonstration system was the Naval Auxiliary Landing Field, Crows Landing in Stanislaus County, California (Figure 1). The hydrocarbon contaminated soil was located in an unlined fire-fighting pit near tanks 150 - 153 (Figure 2). From 1943 to 1987, this unlined pit was used for fire-fighting training. In a typical fire-fighting training exercise, about 200 to 300 gallons of JP-5 fuel mixed with some other types of wastes such as crankcase oil and solvents would be poured into the pit and ignited. The mixture would then be extinguished with water.

In 1987, a project was initiated by the Navy to replace the unlined pit with a lined pit. During excavation, soils contaminated with high concentrations of hydrocarbons were encountered and the project was halted. Excavated soil was stockpiled on plastic sheets along the west side of the excavation. In the same year, the Navy initiated an investigation to determine the type and extent of contamination present at the site (ERM-West, 1988).

Soil borings from the site investigation conducted by ERM-WEST, showed that the site consisted of a 4.5 feet-deep top layer of gravel, followed by a 10 feet-deep layer of dense sandy silty clay, a 25 feet-deep layer of silty clayey sand, and deeper layers of clay, silt and sand. Soil boring locations are shown in Figure 3. Soil samples from the borings were analyzed for total petroleum hydrocarbons (TPH) and benzene, toluene, ethylbenzene and xylene (BTEX) to define the extent of contamination in the vicinity of the fire-fighting training pit. A summary of the analytical results and regulatory limits is contained in Table I. High concentrations of

TABLE 1. CONCENTRATIONS OF ORGANIC COMPOUNDS DETECTED IN SOIL SAMPLES FROM THE FIRE-FIGHTING SITE (ERM-West, 1988)

Sample Boring ID/Depth (ft)	Total Petroleum Hydrocarbons[a] (ppm)	Benzene[b] (ppm)	Toluene[b] (ppm)	Xylenes[b] (ppm)
B1/3.5-4.0	5,400	<0.5	<0.5	<0.5
B2/3.5-4.0	<0.1	<0.0001	0.002	0.002
B3/4.5-5.0	<0.1	0.003	<0.001	<0.001
B3/8.5-9.0	<0.1	<0.001	<0.001	0.002
B9/4.5-5.0	<0.1	0.002	<0.001	<0.001
B10/2.5-3.5	<0.1	0.003	0.27	0.032
B11/3.0-3.5	1	<0.001	<0.001	<0.001
B11/8.5-9.0	280	0.002	0.011	<0.060
B11/12.5-13.0	<0.1	<0.001	0.014	<0.001
S1-S5 (Composite)	510	0.005	0.002	0.002
Regulatory level	100[c]	0.7[d]	100[d]	620[d]

[a] Total petroleum hydrocarbons determined by EPA Modified Method 8015 .

[b] Benzene, toluene, and xylenes determined by EPA Method 8020.

[c] Leaking Underground Fuel Tank Field Manual, California State LUFT Task Force, May 1988.

[d] The Designated Level Methodology for Waste Classification and Cleanup Level Determination, Appendix III, California RWQCB, CVR, September 1987.

Notes:

1. Borings B3 (5.0 to 8.5 feet), B4, B45, B6, B7, B8, B11 (3.5 to 8.5 feet), B12, B13, B14, B15 -- no organic compounds detected.

2. Well W1 groundwater -- no organic compounds detected.

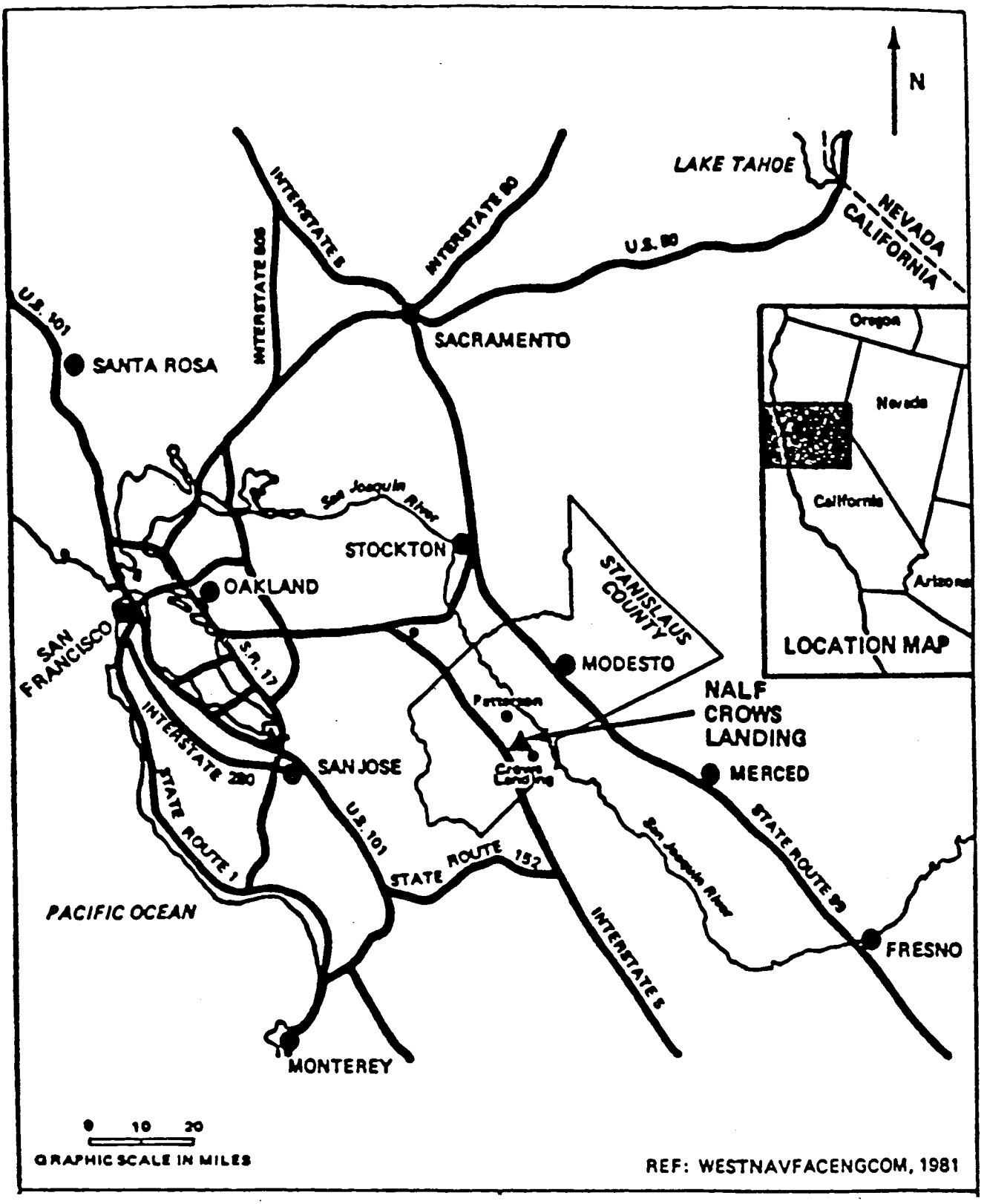


FIGURE 1. AREA MAP SHOWING THE LOCATION OF CROWS LANDING IN STANISLAUS COUNTY (WESTON SERVICES, INC., 1990)

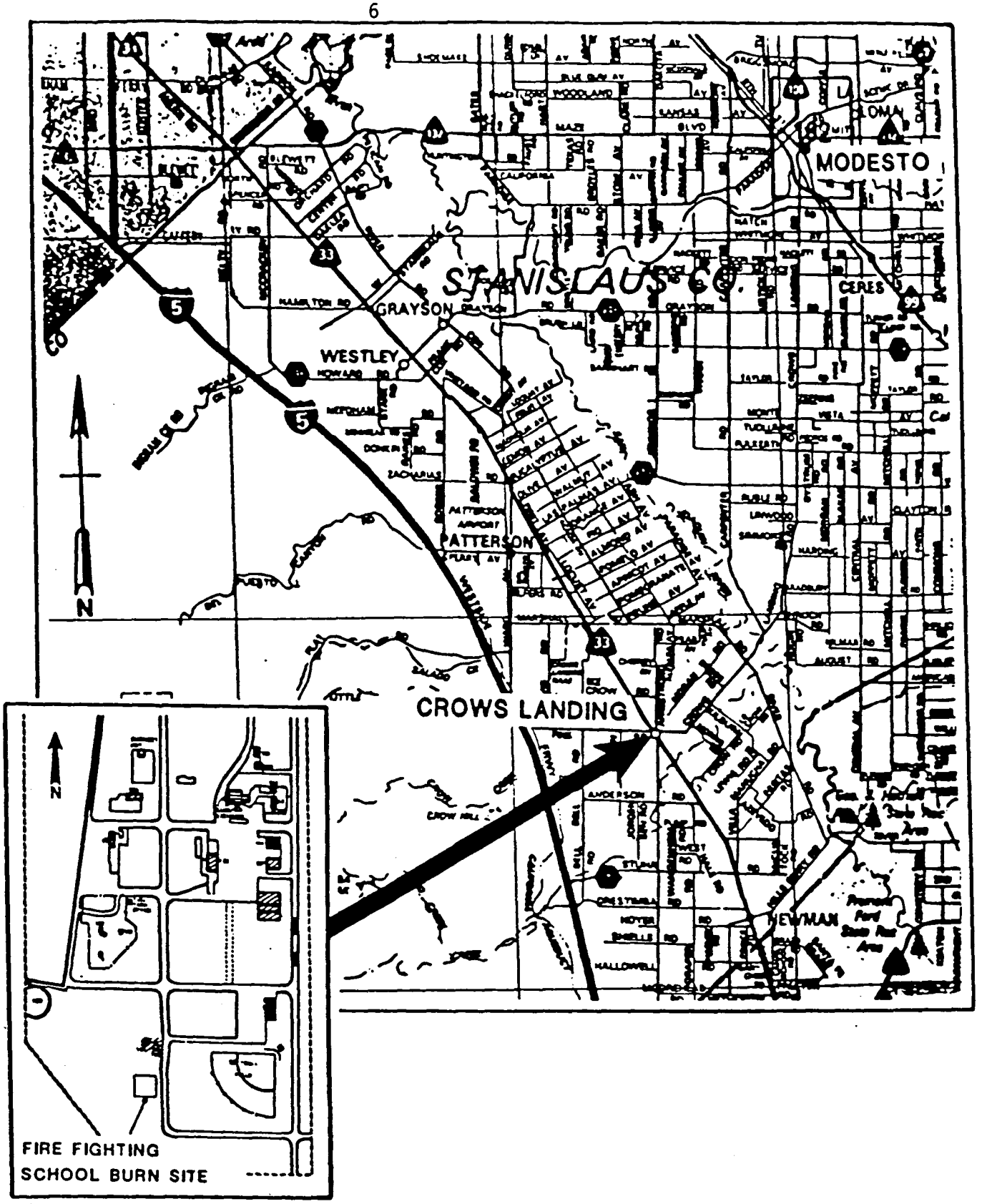


FIGURE 2. AREA MAP SHOWING THE LOCATION OF NALF CROWS LANDING AND THE FIRE-FIGHTING PIT (ERM-WEST, 1988)

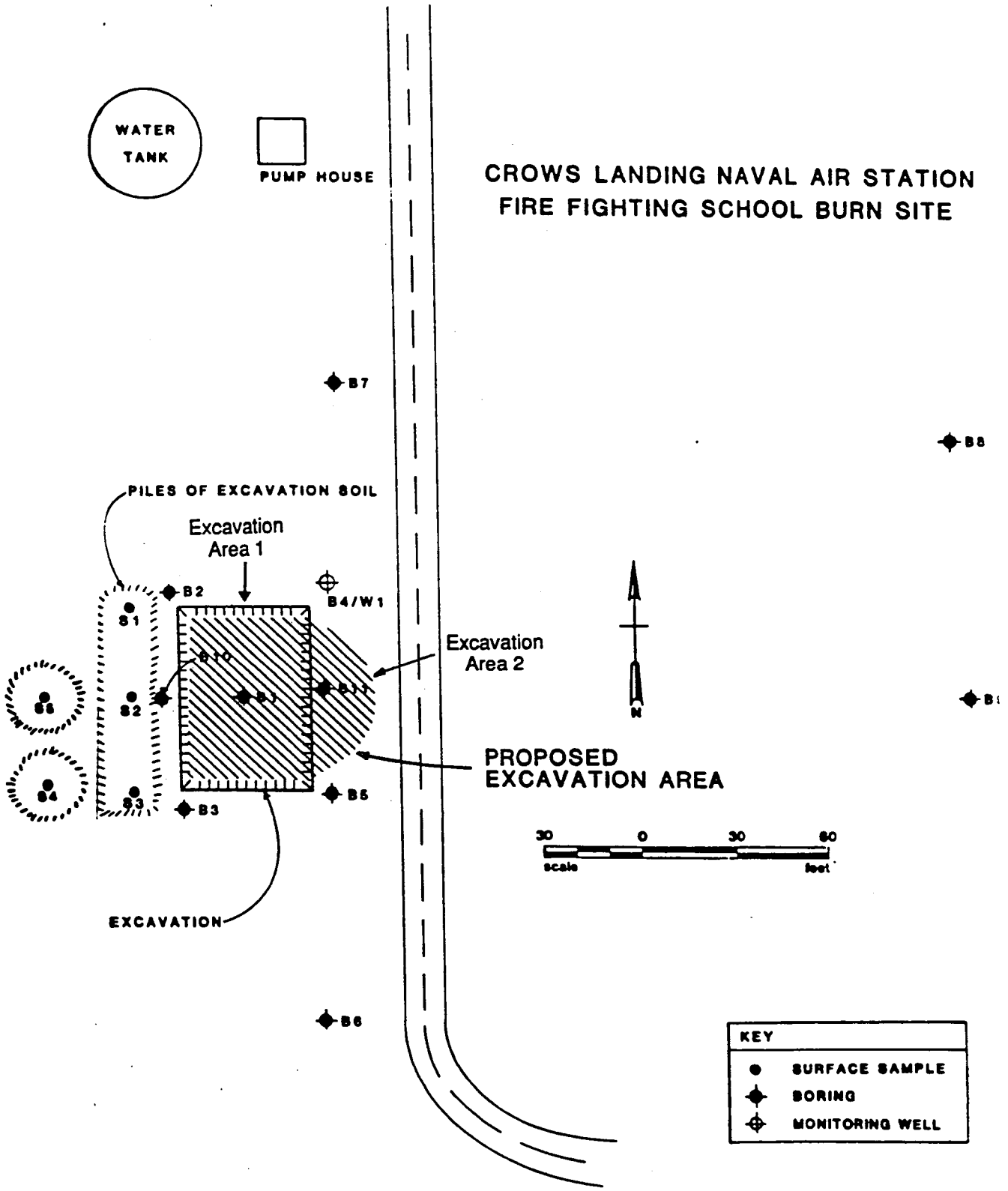


FIGURE 3. SITE BORING LOCATIONS AND APPROXIMATE AREA OF EXCAVATION (ERM-WEST, 1988)

TPH (up to 5,400 ppm) were found in the shallow soil of the pit. The contamination appeared to be restricted within the fire-fighting pit for the most part, and downward migration of organics was probably retarded by the near surface clay layer. Analysis of ground water samples indicated that there was no evidence of any groundwater contamination. The proposed area (shaded area) to be excavated and treated is shown in Figure 3 and can be visualized as consisting of two sections. Area 1 (rectangular area) was approximately 55 feet wide by 50 feet long. Soil for this section was excavated to a depth of 8 feet. The triangular shaped Area 2 was excavated to a depth of 12 feet. The volume of contaminated soil present at the site was estimated to be approximately 1250 cubic yds. (1,625 tons).

In addition to the soil from the fire-fighting pit, about 20 tons of soil from a plane crash site was also processed by the LT$^{3®}$ system. This soil was contaminated with jet-fuel and was stockpiled near the fighting pit.

4.0 DESCRIPTION OF LT$^{3®}$ SYSTEM

4.1 Introduction

WSI LT$^{3®}$ process is a technology that thermally volatilize volatile organic compounds (VOCs) from contaminated soil without heating the soil matrix to combustion temperatures (WSI, 1990).

Contaminated soils are heated to approximately 400°F to evaporate the VOCs from the soil in the thermal processor, which is an indirect heat exchanger. The organic vapors are processed through two condensers in series to remove organic compounds and are then finally treated by carbon adsorption, before being discharged to the atmosphere. The LT$^{3®}$ system has a nominal treatment capacity of about 16,000 lbs/hour or 8 tons/hr (WSI, 1990).

A schematic diagram of the LT$^{3®}$ process is shown in Figure 4. Figure 5 is a picture of the LT$^{3®}$ system. The LT$^{3®}$ process equipment is mounted on three tractor trailer beds for transportation and operation to a site. A brief description of the equipment is contained in the following subsections.

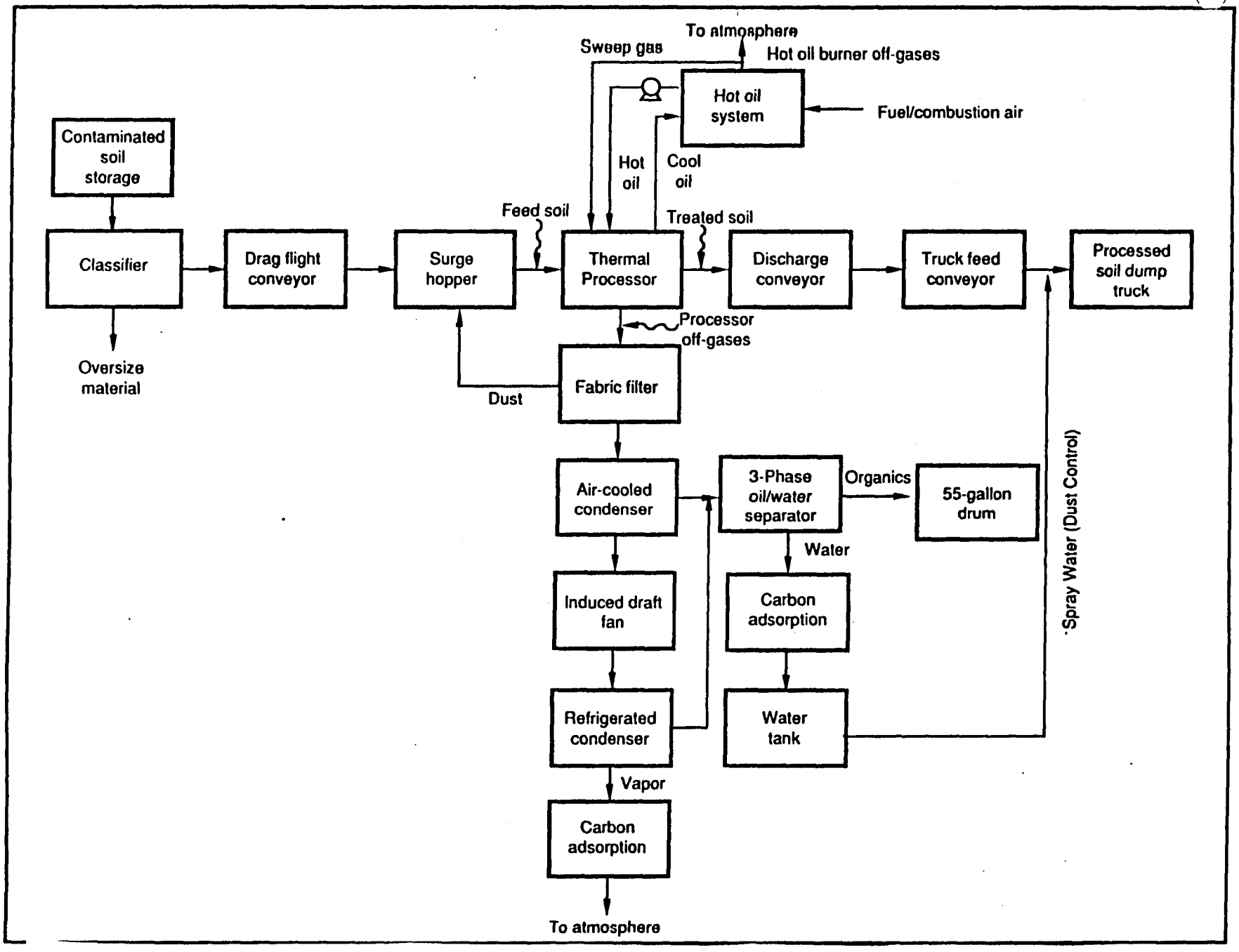


FIGURE 4. SCHEMATIC DIAGRAM OF LT3® PROCESS (WESTON SERVICES, INC., 1990)

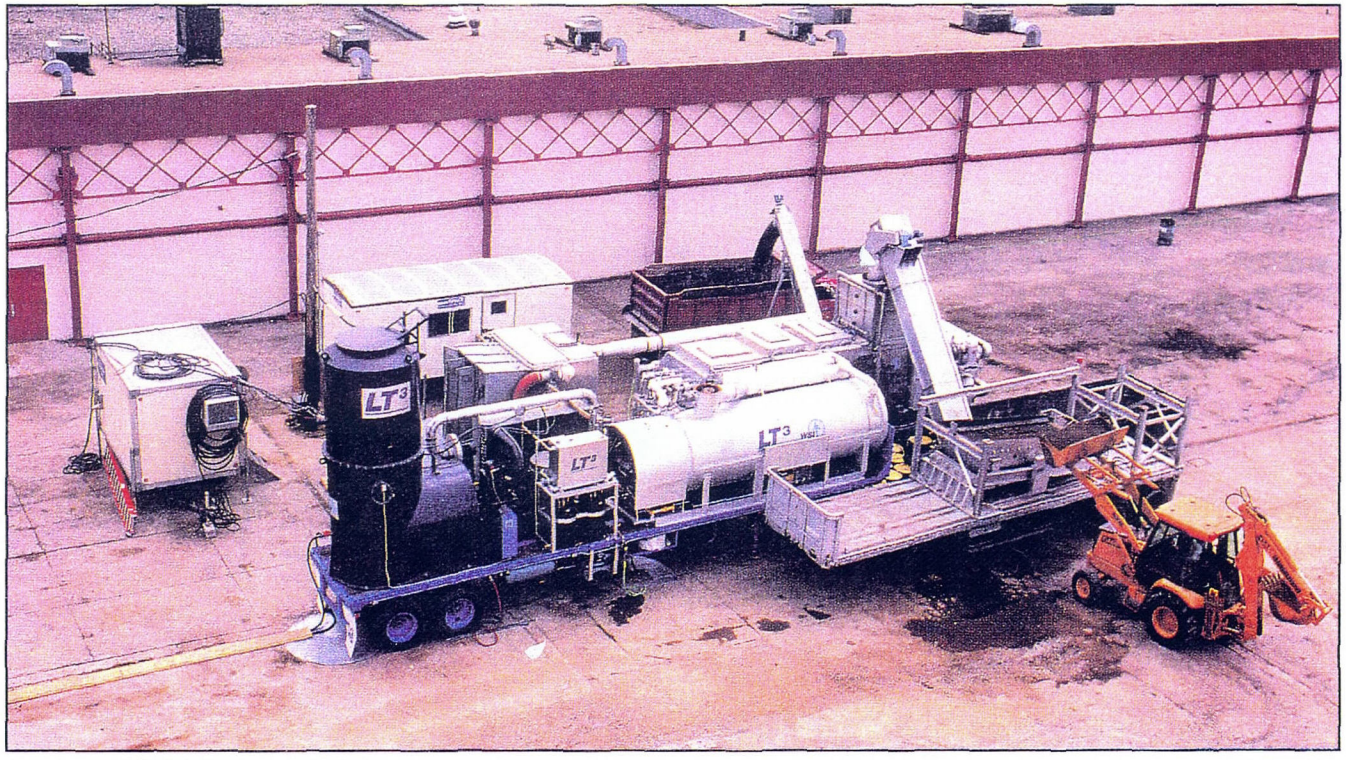


FIGURE 5. LT3® SYSTEM AT SPRINGFIELD, ILLINOIS (JOHNSON AND COSMOS, 1989)

4.2 Soil Treatment System

Contaminated soil is transported to the LT$^{3®}$ system by a front-end loader onto a weighing scale where the weight of each soil load is recorded. Soil is then deposited directly onto a power shredding device. Soil with a top size of less than 2 inches passes through the shredder into the feed conveyor. Oversized material is removed, stockpiled on and covered with plastic sheets for treatment and backfilling. The oversized material is not processed through the LT$^{3®}$ system. Soil is then transported by a drag conveyor into a surge hopper located above the thermal processor.

The screws of the thermal processor extend into the bottom of the surge hopper, withdrawing feed material to create a "live-bottom" effect. The surge hopper also provides a seal over the thermal processor to minimize air infiltration.

The thermal processor consists of two jacketed troughs, each with four assembled intermeshed screw conveyors in a piggyback fashion. Each screw conveyor is 18 inches in diameter and runs the entire length of the trough, which is 20 feet long. Soil is carried across the upper trough by the screws and drops to the lower trough via gravity. The soil is moved in the opposite direction across the second trough and then exits the processor at the same end that it entered.

The shafts and flights of the screw conveyors and the trough jackets are hollow to allow circulation of a heat transfer fluid (viz., hot oil). The function of each screw conveyor are to move soil forward through the processor, and to thoroughly mix the material, and to provide indirect contact between the heat transfer fluid and soil.

Residence time is adjusted by varying the rotational speed of the screws while soil temperature in the thermal processor is adjusted by varying the hot oil temperature setting. The heat transfer fluid is pumped through the screw shafts, flights, and trough jackets by a centrifugal pump. The heat transfer fluid used is Dowtherm® HT, produced by Dow Chemical.

A draft, created by an induced-draft (ID) fan, is maintained in the processor to allow the vapors to be removed. A portion of the combustion gases released from the hot oil system is used as sweep gas in the thermal

processor. Sweep gas is introduced to maintain an exhaust gas temperature of about 300°F to avoid contaminant condensation.

Soil is discharged from the thermal processor via a horizontal screw-conveyor system into a second screw conveyor, called a conditioner. Water-spray nozzles are installed in the conditioner housing to cool the discharge material and to minimize fugitive dust emissions. Processed soil is then returned to the excavated site or used as fill material for other sites.

4.3 Emission Control System

The emission control system consists of the following contact devices: fabric filter; air-cooled condenser; refrigerated condenser; and activated carbon adsorption.

The fabric filter is of the jet-pulse design, where pulses of air are periodically applied to remove dust that has accumulated on the bags. Dust is collected in two collection bins from which it manually removed on a daily basis and combined with the contaminated soil for reprocessing. The temperature of the gases exiting the fabric filter is approximately 300°F. The exhaust gas from the fabric filter is drawn into an air-cooled condenser by the ID fan. Cooling (ambient) air is blown across the condenser tubes and the exhaust gases are cooled to approximately 125°F. Water vapor and condensable organics from the exhaust gas are removed. Condenser off-gases are then directed to the second refrigerated condenser.

The refrigerated condenser further lowers the temperature and moisture content of the exhaust gases from the air-cooled condenser, thereby reducing the water and organic loading on the vapor-phase carbon system. Circulating glycol/water solution from a refrigerator indirectly cools the process gas to 61°F. Water vapor and organic compounds condense from the gas at a rate of 0.2 gallons per minute (gpm). The exhaust gas is then reheated to 70°F by three electric resistance heaters. The relative humidity of the exiting gas is approximately 50 percent, preventing further condensation in the process piping, and optimizing the activated carbon adsorption efficiency.

The remaining organics from the exhaust gases exiting the refrigerated condenser are treated with two vapor-phase activated carbon columns. Each column contains approximately 1,800 pounds of granular

activated carbon and is capable of handling gas flows of up to 1,000 scfm. The vapor-phase carbon columns are operated in parallel to allow isolation and access to one column while the other is on-line. The gases exiting the vapor-phase carbon columns may contain total hydrocarbon concentrations of up to 3 ppm by volume.

The exhaust gas from the vapor-phase carbon columns is continuously monitored for total hydrocarbon (THC) concentration. If the THC concentration in the exhaust gas exceeds 10 ppm (by volume) the carbon will be considered "spent" and an alarm will be activated. The THC concentration in the exhaust gas is measured with a T.U.M. Heated Total Hydrocarbon Analyzer Model VE7.

4.4 Condensate Handling System

Liquid exiting both condensers is collected and pumped to a 3-phase oil-water separator. The oil-water separator operates by gravity. It consists of a 50-gallon vessel that allows the light and heavy insoluble organics to separate from the water. The light organic phase is removed by a skimmer and weir. The heavy organic phase is removed through a manual drain at the bottom of the vessel. The organic phases removed from the oil-water separator are stored in 55-gallon drums for off-site disposal in a permitted facility. The water phase flows out of the separator and is directed to two aqueous-phase carbon adsorption columns in series, for removal of soluble organics. The liquid stream between the two aqueous-phase carbon columns of the condensate treatment unit is routinely sampled to detect breakthrough in the first carbon column. The aqueous-phase carbon columns are considered "spent" if the THC concentration exceeds 100 ppm. THC concentration in treated water is measured manually using a Hanby Test Kit. Should breakthrough occur, the first aqueous-phase carbon column will be bypassed while the carbon is replaced. After leaving the aqueous-phase carbon columns, the water from the columns is stored in a treated water tank. If the THC in the treated water exceeds 100 ppm,the treated water will be recycled to the aqueous-phase carbon system for further treatment. Water is withdrawn from the treated water tank and is sprayed on the treated soil for dust control. No water is discharged from the process.

5.0 SITE AND SAMPLING ACTIVITIES

5.1 Site Activities

A chronology of the major events relating to the field demonstration of the LT$^{3®}$ system is presented in Table 2. WSI's report on site activities is given in Appendix A.

An air quality permit to operate the LT$^{3®}$ system was granted by the Stanislaus County Department of Environmental Resources, Air Pollution Control District on November 30, 1990. The requirements of this air permit were that the VOC emissions should not exceed more than 32 lbs/day and the TPH concentration should not exceed 10 ppm (by volume). On March 1, 1991 the Navy received approval of the Work Plan from the California Regional Water Quality Control Board, Central Valley Region. A clean-up goal of less than 100 mg/kg of TPH in the decontaminated soil was established. The Navy also received approval of the Work Plan from the Stanislaus County Department of Environmental Resources on March 4, 1991. Approval letters and permits are included in Appendix B.

WSI began mobilizing the LT$^{3®}$ system on March 12, 1991 and processing of stockpiled contaminated soil and soil from a plane crash site started on March 25, 1991. Heavy rains during the last week of March and the first week of April slowed the processing. Processing was stopped at least once during this rainy period due to potential lightning hazards. The excessive rain also created soil handling problems and reduced the soil feed rates.

A rupture on one of the processor's hot-oil lines on April 2, 1991 stopped the LT$^{3®}$ temporarily. Spills from the hot-oil line contaminated some soil around the LT$^{3®}$ system area. Fresh dirt was placed over the contaminated soil to isolate the spill until removal for treatment.

Excavation of the fire fighting pit was initiated on April 6, 1991 and was completed by April 25, 1991. Due to the rain in the first week of April, the pit was filled with water. Excavated soil from the pit was wet and the initial batch of excavated soil was laid out on the ground to reduce the moisture before feeding it into the LT$^{3®}$ system. In the process of excavating the pit, an 8-inch steel water main was unearthed on April 11, 1991. The

TABLE 2. CHRONOLOGY OF EVENTS RELATING TO THE LT3® FIELD DEMONSTRATION

Date	Events
30 November 1990	- WSI received the air quality permit to operate the LT3® system from the Stanislaus County Department of Environmental Resources Air Pollution Control District.
25 February 1991	- An informational letter describing the remediation events that would occur at Crows Landing NALF was sent to the contiguous property owners by U.S. Navy.
1 March 1991	- Navy received approval of the Work Plan from the California Regional Water Quality Control Board.
4 March 1991	- Navy received approval of the Work Plan from the Stanislaus County Department of Environmental Resources.
12 March 1991	- WSI began mobilization of LT3® equipment at Crows Landing NALF fire training pit area.
22 March 1991	- WSI completed LT3® mobilization.
25 March 1991	- WSI began LT3® processing of stockpiled soil.
27 March 1991	- Battelle conducted collection of stack sample #1. WSI processed stockpiled soil from the crash site.
28 March 1991	- Battelle conducted collection of stack sample #2. WSI processed stockpiled soil from the crash site.
29 March 1991	- Battelle conducted collection of stack sample #3. WSI processed soil previously excavated and stockpiled from the fire training pit.
5 April 1991	- WSI completed processing of the stockpiled soil.
6 April 1991	- WSI completed processing of the stockpiled soil from crash site.
6 April 1991	- WSI began fire training pit excavation and soil processing.

TABLE 2. CHRONOLOGY OF EVENTS RELATING TO THE LT$^{3®}$ FIELD DEMONSTRATION (Continued)

Date	Events
27 April 1991	- WSI completed LT$^{3®}$ processing of the fire training pit soil.
6 & 7 May 1991	- WSI began decontamination procedures by removing approximately four to six inches of the soil in the contaminated soil stockpile area and soil surrounding the shredder and feed conveyor.
8 May 1991	- WSI processed the soil removed from decontamination activities and completed decontamination activities.
9 May 1991	- WSI began demobilization activities.
13 May 1991	- WSI began structural backfill operations.
17 May 1991	- WSI completed structural backfill and demobilization activities.

water main runs in a north-south direction about 4 feet below the ground level and about 10 feet from the East wall of the pit. The water main had originally been assumed to be present on the other side of the road. Temporary supports were provided for the water main so that excavation of the pit could continue (Figure 6).

WSI completed processing the excavated soil from the fire fighting pit on April 27, 1991. Decontamination procedures were initiated on May 6 and 7, 1991 when four to six inches of soil in the contaminated soil stockpile area and soil surrounding the shredder and feed conveyor were removed and processed by the LT$^{3®}$ system. The area (around and under the processor trailer) where the hot oil has been spilled was excavated to a depth of 12 to 16 inches to ensure that the contaminated soil was removed. A total of approximately 59 tons of soils was excavated during the decontamination activities for processing by the LT$^{3®}$ system.

Demobilization of the LT$^{3®}$ system was initiated on May 9, 1991 and by May 17, 1991, WSI completed the demobilization and backfilling of the fighting pit with clean dirt after providing proper structural support for the water main. Treated soil from the fire fighting pit and crash site were stockpiled on plastic sheet near the pit awaiting final disposal.

There were no reportable accidents and/or injuries during the field demonstration of the LT$^{3®}$ system at NALF Crows Landing.

5.2 Sampling Activities

The sampling and analysis activities can be broadly divided into six categories:

1) Initial background sampling
2) Sampling and analysis of untreated soil
3) Sampling and analysis of treated soil
4) Sampling to assess the effect of heat on the nutrients and classification of the soil

FIGURE 6. VIEW OF THE EXCAVATED PIT AND THE WATER MAIN

5) Sampling of soil around the excavated area, thermal processor and contaminated stockpile area to ensure that the site was completely decontaminated

6) Sampling of stack emissions from the LT$^{3®}$ system.

The Sampling and Analysis Plan for this project is given in Appendix C. Table 3 lists the analyses performed, test methods used, mass/volume of samples collected, and the California approved laboratories where the analyses were performed. VOC and nutrient analyses were performed at Enseco-CRL, Ventura, California. VOC analysis were for Total Petroleum Hydrocarbon (TPH) using California DHS LUFT Method; benzene, toluene, ethylbenzene and xylenes (BTEX) using EPA Method 8020 and purgeable organics using EPA Method 8240. Nutrient analysis included percent moisture, nitrate-nitrogen, total phosphorus, iron, potassium and sulfate. Soil was classified by the Unified Soil Classification Method (ASTM D422-63/ASTM D4318-64). Soil classification was performed by Woodward-Clyde, Pleasant Hill Soil Laboratory, California. Analysis of the adsorbent traps from stack sampling was performed by Mid-Pacific Laboratory, Mountain View, California.

All on-site and sampling activities were recorded in the field log book. Soil samples were collected using either a stainless steel shovel or stainless steel spoons. All soil samples were placed in EPA-approved wide-mouthed glass bottles. Each sample bottle was completely filled with soil to eliminate as much free air space as possible. All bottles were labeled accordingly, placed in plastic bags, and secured before storing them on ice in chest-type coolers. Chain-of-custody forms accompanied all sample shipments to the analytical laboratories. A list of soil samples collected during the on-site demonstration is presented in Table 4.

5.2.1 Background Sampling

The purpose of the background samples is to establish the concentrations of TPH and BTEX in uncontaminated soil. A total of four background samples was collected (Table 4). Two samples (Crow-1 and Crow-2) were collected from the area where the treated soil would be stored. One sample (Crow-9) was taken from around the shredder (material feed) area, and

TABLE 3. ANALYTICAL METHODS AND LABORATORIES

Analysis	Test Method	Laboratory	Sample Size (mL)
Soil Samples			
BTEX	Method 8020	Enseco-CRL	120*
Total Petroleum Hydrocarbon (TPH)	CA DHS LUFT	Enseco-CRL	120*
Purgeable Organics	Method 8240	Enseco-CRL	120*
Available Nutrients:			120*+
Nitrate-Nitrogen	Method 300.0	Enseco-CRL	
Total Phosphorus	Method 365.1	Enseco-CRL	
Potassium	Method 7610	Enseco-CRL	
Iron	Method 7380	Enseco-CRL	
Sulfate-sulfur	Method 300.0	Enseco-CRL	
Percent Moisture	--	Enseco-CRL	
Unified Soil Classification	ASTM D422-63/ASTM D4318-84	Woodward-Clyde	5 kg
Stack Sampling			
Stack Gas Velocity	Method 2	Battelle (on-site)	--
Low Boiling Volatile Organic Compounds	VOST (EPA-600/8-84-007)	Mid-Pacific	3.5 m^3
Semi Volatile Organic Compounds	Modified Method 5	Mid-Pacific	0.006 m^3

* Duplicate samples were collected for archival purposes; + one 120 mL sample for nutrient analysis.

TABLE 4. LIST OF SOIL SAMPLES COLLECTED DURING THE LT$^{3®}$ SYSTEM DEMONSTRATION

Sample #	Date Sampled	Analysis	Location/Notes
Background Samples			
Crow-1-AB	3/20/91	TPH & BTEX	Area where untreated soil was stockpiled
Crow-2-AB	3/20/91	TPH & BTEX	"
Crow-3-AB	3/20/91	TPH & BTEX	About 3,000 feet from firefighting pit.
Crow-9-AB	3/25/91	TPH & BTEX	Area around LT$^{3®}$ system
Crow-9-BB	3/25/91	Purgeable Organics	"
Untreated Soil			
Crow-10-AU	4/3/91	TPH & BTEX	Feed Conveyor
Crow-10-BU	4/3/91	Purgeable Organic	"
Crow-10-CU	4/3/91	Nutrients	"
Crow-16-AU	3/2/91	TPH & BTEX	"
Crow-18-AU	3/27/91	TPH & BTEX	"
Crow-19-CT	3/27/91	TPH & BTEX	"
Crow-20-AU	4/5/91	TP & BTEX	"
Crow-22-AU	4/8/91	Purgeable	"
Crow-22-CU	4/8/91	Nutrients	Feed Conveyor
Crow-24-AU	4/22/91	TPH & BTEX	"
Crow-24-BU	4/22/91	Purgeable Organics	"
Crow-24-CU	4/22/91	Nutrients	"
Crow-26-AU	4/10/91	TPH & BTEX	"
Crow-28-AU	4/24/91	TPH & BTEX	"

TABLE 4. LIST OF SOIL SAMPLES COLLECTED DURING THE LT$^{3®}$ SYSTEM DEMONSTRATION (Continued)

Sample #	Date Sampled	Analysis	Location/Notes
Treated Soil			
Crow-11-AT	4/3/91	TPH & BTEX	Conditioner Housing
Crow-11-BT	4/3/91	Purgeable Organics	"
Crow-11-CT	4/3/91	Nutrients	"
Crow-12-AT	3/27/91	TPH & BTEX	Conditioner Housing, initial consecutive samples
Crow-13-AT	3/27/91	TPH & BTEX	"
Crow-14-AT	3/27/91	TPH & BTEX	"
Crow-17-AT	3/29/91	TPH & BTEX	Conditioner Housing
Crow-19-AT	3/27/91	TPH & BTEX	"
Crow-19-BT	3/27/91	Purgeable Organics	"
Crow-21-AT	3/27/91	TPH & BTEX	"
Crow-23-AT	4/8/91	TPH & BTEX	"
Crow-23-BT	4/8/91	Purgeable Organics	"
Crow-23-CT	4/8/92	Nutrients	"
Crow-25-AT	4/22/91	TPH & BTEX	"
Crow-25-BT	4/22/91	Purgeable Organics	"
Crow-25-CT	4/22/91	Nutrients	"
Crow-26-AT	4/10/91	TPH & BTEX	"
Crow-29-AT	4/24/91	TPH & BTEX	"
Crow-29-BT	4/24/91	Purgeable Organics	"

TABLE 4. LIST OF SOIL SAMPLES COLLECTED DURING THE LT$^{3®}$ SYSTEM DEMONSTRATION (Continued)

Sample #	Date Sampled	Analysis	Location/Notes
Crow-29-CT	4/24/91	Nutrients	"
Crow-30-AT	4/25/91	TPH & BTEX	Treated Soil Stockpile
Crow-31-AT	4/25/91	TPH & BTEX	"
Crow-32-AT	4/25/91	TPH & BTEX	"
Crow-33-AT	4/25/91	TPH & BTEX	"
Crow-34-AT	4/25/91	TPH & BTEX	"
Crow-35-AT	4/25/91	TPH & BTEX	"
Crow-36-AT	4/25/91	TPH & BTEX	"
Fire-Fighting Pit			
Crow-4-AB	6/3/91	TPH & BTEX	North Wall of Pit
Crow-4-BB	4/3/91	Purgeable Organics	"
Crow-5-AB	4/3/91	TPH & BTEX	South Wall of Pit
Crow-5-BB	4/3/91	Purgeable Organics	"
Crow-6-AB	4/3/91	TPH & BTEX	Bottom of Pit of Rectangular Section
Crow-6-BB	4/3/91	Purgeable Organics	"
Crow-7-AB	4/5/91	TPH & BTEX	East Wall of Pit
Crow-7-BB	4/5/91	Purgeable Organics	"
Crow-8-AB	4/26/91	TPH & BTEX	West Wall of Pit
Crow-8-BB	4/26/91	Purgeable Organics	"

TABLE 4. LIST OF SOIL SAMPLES COLLECTED DURING THE LT$^{3®}$ SYSTEM DEMONSTRATION (Continued)

Sample #	Date Sampled	Analysis	Location/Notes
Crow-8.1-AB	4/26/91	TPH & BTEX	West Wall of Pit (Apex of Triangular Section)
Crow-8.2-AB	4/26/91	TPH & BTEX	Bottom of Pit of Triangular Section
Demobilization			
Crow-37-AT	5/13/91	TPH & BTEX	Around LT^3 System
Crow-38-AT	5/13/91	TPH & BTEX	"
Crow-39-AT	5/13/91	TPH & BTEX	Untreated Soil Stockpile area
Crow-40-AT	5/13/91	TPH & BTEX	"

one sample (Crow-3) was taken near the end of the runway about 3000 feet away from the fire-fighting pit. All samples were surface samples from the top three inches. Locations of the samples are given in Figure 7. All samples were tested for TPH and BTEX using the California DHS LUFT Method and U.S. EPA Method 8020, respectively. In addition, one of the four samples (Crow-9-BB) was analyzed for purgeable organics using Method 8240.

5.2.2 Untreated Soil Samples

During the operation of the LT$^{3®}$ system, untreated soil samples were collected randomly from the feed conveyor. Over the length of the treatment period, a total of eight untreated samples were taken. Table 4 lists the sampling dates and sample numbers for samples that were taken for this activity. All samples were analyzed for TPH and BTEX. In addition, four of the eight samples were tested for purgeable organics using EPA Method 8240.

5.2.3 Treated Soil Samples

This sampling activity can be divided into three stages. In the first stage, a total of three samples (Crow-12, Crow-13 and Crow-14) was taken consecutively every hour during the initial operation of the LT$^{3®}$ system. Treated soil samples were collected from the conditioner housing and were shipped immediately to the laboratory so that analytical results could be received within 48 hours. This sampling stage was to ensure that the treated soil was within acceptable regulatory limits; failing which, corrective actions such as varying residence time and temperature of the LT$^{3®}$ system could be taken. If the treated soil samples had not met the regulatory limits, the treated soil would have been reprocessed by the LT$^{3®}$ system. After this initial sampling stage, the second stage consisted of collecting treated soil samples from the conditioner housing throughout the length of the treatment period. A total of nine soil samples (see Table 4) were collected during the operation of the LT$^{3®}$ system. For the third sampling event, an additional seven (Crow-30 to Crow-36) samples were randomly collected from the treated soil stockpile. Figure 8 gives the location and depths from which the samples were taken.

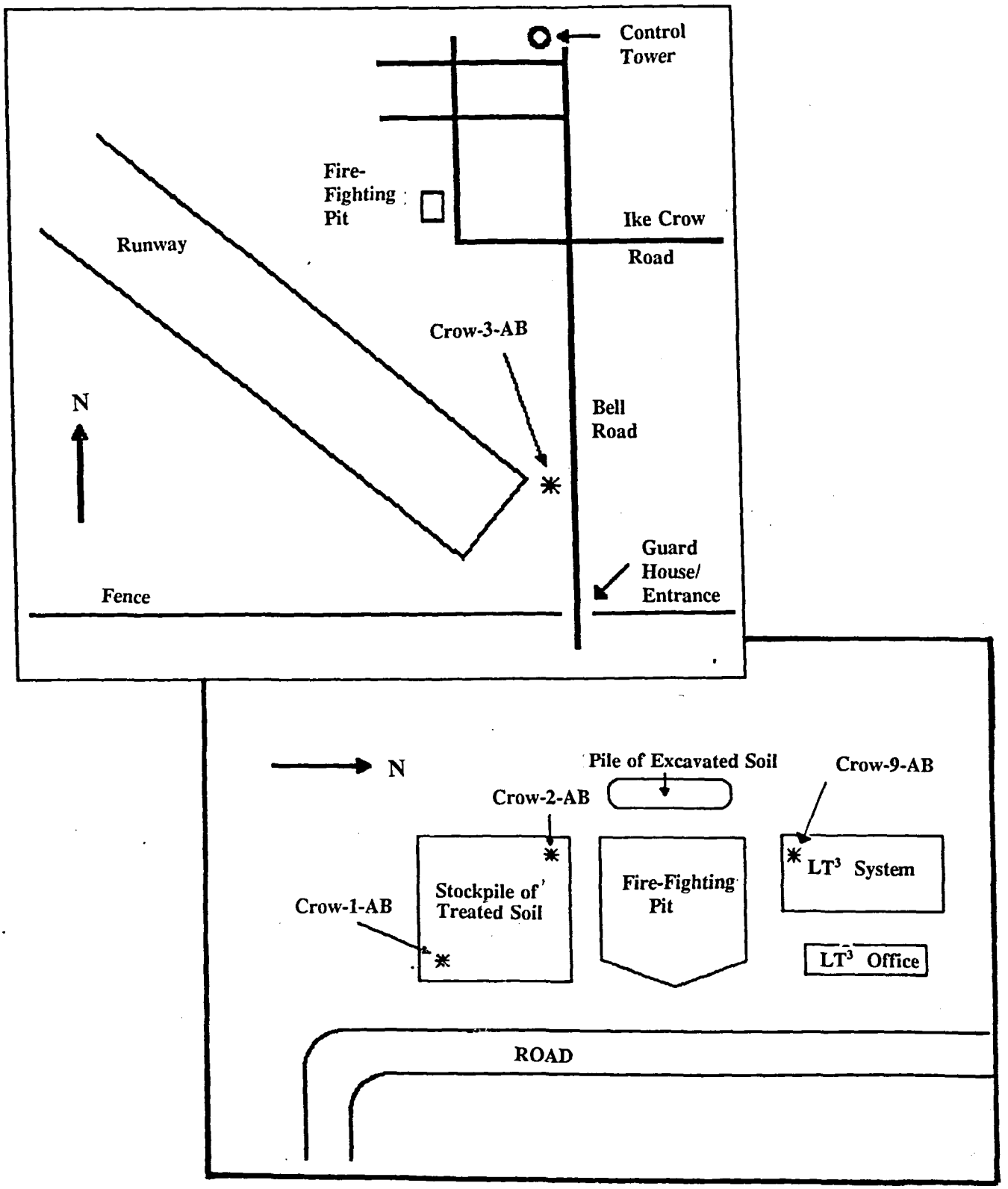


FIGURE 7. LOCATION OF BACKGROUND SAMPLES

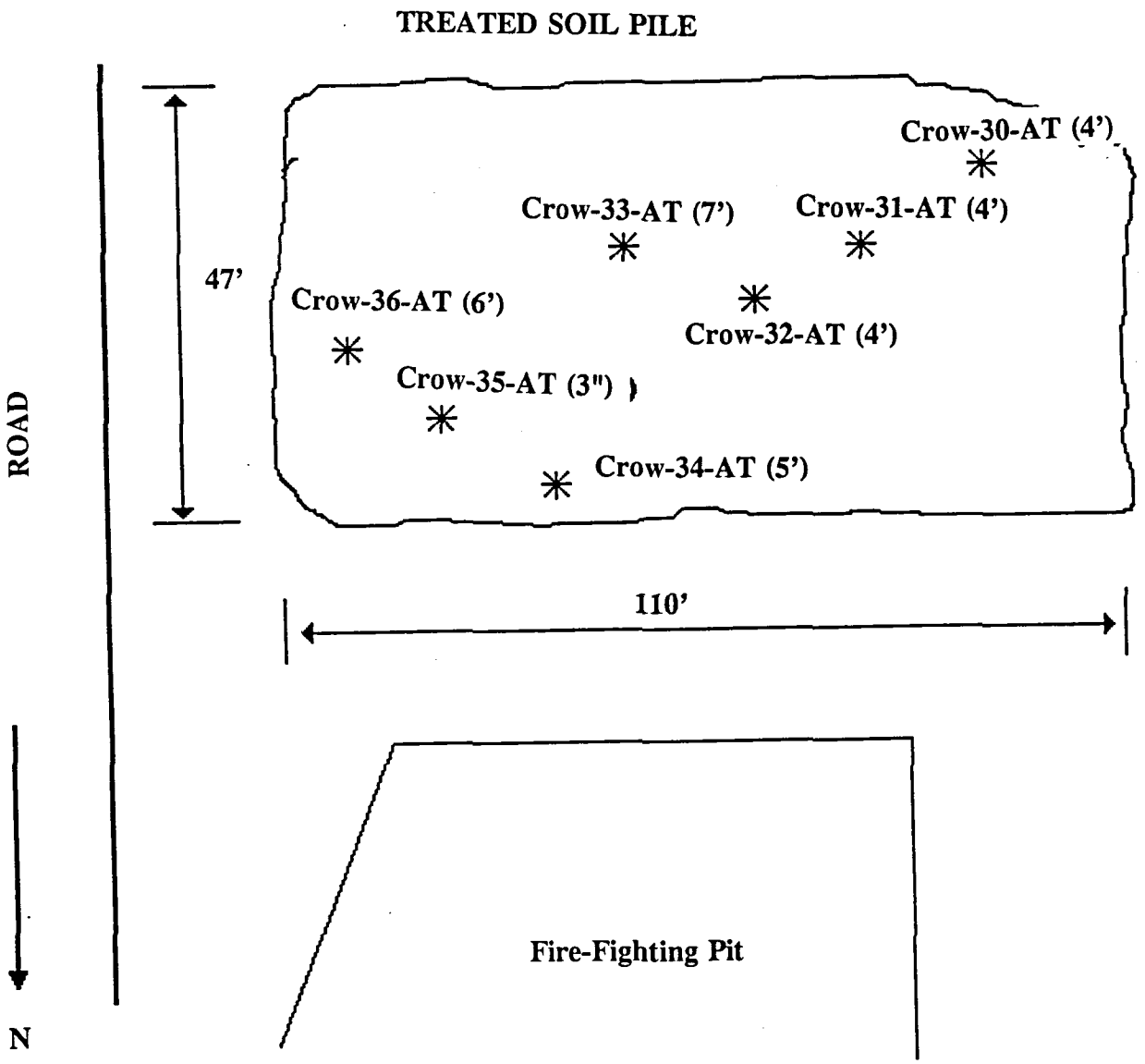


FIGURE 8. LOCATION OF SAMPLES TAKEN FROM THE TREATED SOIL STOCKPILE (NUMBERS IN BRACKET ARE THE DEPTH SOIL SAMPLES WERE TAKEN)

5.2.4 Nutrients Samples

Three samples each before and after treatment were taken to assess the effect of the thermal treatment on the physical-chemical and nutrients properties of the soil. Samples were analyzed for percent moisture content and soil nutrients such as total nitrogen, total phosphorus, potassium, iron, and total sulfur. For this sampling activity, treated samples were taken from the conditioner housing, about 20 minutes after the untreated samples were collected from the feed conveyor to the thermal processor. It was assumed that the treated and untreated soil samples were from the same batch of soil. Also, treated and untreated soils were collected and classified by the Unified Soil Classification system. Samples for classification were collected on two different days and composited. Each composite sample was about 5 kg.

5.2.5 Sampling During and After Demobilization

The purpose of this sampling was to ensure that all contaminated soil used for this field demonstration had been treated and no hazardous materials used in the treatment process had been spilled at the site.

A total of eight samples were taken from the excavated pit to ensure that all the contaminated soil was removed from the pit. Two samples were collected from the bottom of the pit and five samples were taken from the walls of the pit. Samples from the walls were collected at about 3 to 4 feet from the bottom of the pit, corresponding to two thirds of the depth of the pit from ground level. Figure 9 illustrates where the samples were taken.

In addition to the above samples, two samples were collected from the scrapped area where the untreated soil were stockpiled and two samples were collected from around the thermal processor trailer area. All samples were taken after the top soil was removed.

5.2.6 Stack Emissions Sampling

Three (3) stack emissions tests were conducted on the outlet of the activated carbon column on three (3) consecutive days. Triplicates were collected for each test method. The tests conducted were:

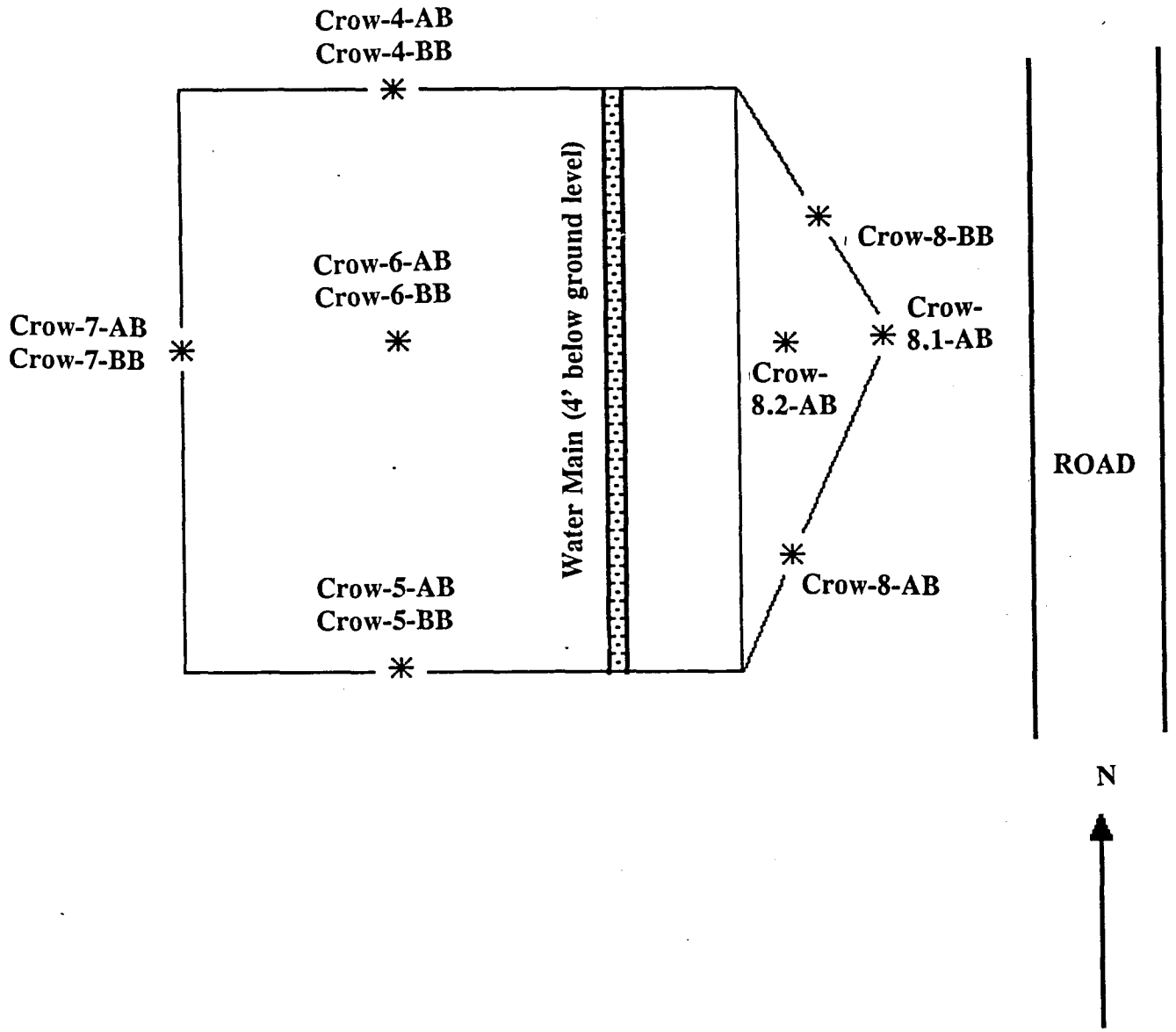


FIGURE 9. LOCATION OF SAMPLES TAKEN FROM THE FIRE-FIGHTING PIT

- preliminary velocity traverse by pitot tube (EPA method 2)
- volatile organic sampling train (VOST) for low boiling organics (scan plus 10 peak identification)
- EPA Modified Method 5 (MM5) for semi volatile organics (total organics plus identification of PAHs)

Prior to sampling on site, all equipment was calibrated at Battelle following EPA QA procedures. All sampling data was recorded on standard record sheets. Sampling was conducted according to standard EPA methods or established protocols. All samples were treated according to chain-of-custody procedures. Analyses of the VOST tubes and adsorbent traps for MM5 were conducted by Mid-Pacific Laboratory.

6.0 DATA ANALYSIS

6.1 On site Treatment

A total of 1,403 tons including 58.2 tons of soil were treated over the five-week demonstration period. Soils treated were from the excavated soil from fire fighting training pit, soil from the plane crash site and soil from the decontamination activity at the end of the demonstration. The actual amount of soil treated exceeded the original contract estimate of 1,315 tons. Mass of soil from the plane crash site was approximately 20 tons. A summary of the daily treatment rate is given in Table 5.

In the first two weeks of the site demonstration, the processing rate of the LT^{3}® system averaged approximately 3.8 tons/hour based on a 8-hour work day. The nominal processing rate of the LT® system is 8 tons/hour. The reasons for the lower processing rate in the first two weeks were the occasional work stoppage due to possible lightning hazards and materials handling problems as the clayey soil was highly moist due to the rain. In the remaining three weeks of the site demonstration, the LT^{3}® system on several occasions (e.g., April 9) achieved a processing rate that was higher than the nominal processing rate. Overall, the average processing rate of the LT^{3}® System was 7.3 tons/hour which is slightly lower than the nominal processing rate.

TABLE 5. SUMMARY OF DAILY TREATMENT RATE FOR THE LT^3 SYSTEM

	Daily (tons)	Cumulative (tons)
MARCH		
25	21.7	21.7
26	0.0	21.7
27	47.7	69.4
28	13.0	82.4
29	21.1	103.5
30	XXX	103.5
31	XXX	103.5
APRIL		
1	55.0	158.5
2	0.0	158.5
3	25.6	184.1
4	0.0	184.1
5	80.7	264.8
6	70.6	335.4
7	XXX	335.4
8	80.0	415.4
9	80.0	495.4
10	67.9	563.3
11	60.6	623.8
12	XXX	623.8
13	75.9	699.7
14	XXX	699.7
15	62.8	762.5
16	32.4	794.9
17	XXX	794.9
18	82.2	877.1
19	81.8	958.9

TABLE 5. SUMMARY OF DAILY TREATMENT RATE FOR THE LT^3 SYSTEM (Continued)

20	XXX	958.9
21	80.2	1039.1
22	76.6	1115.7
23	23.1	1138.8
24	42.2	1181.0
25	0.0	1181.0
26	96.8	1277.8
27	65.8	1343.6
MAY		
8	58.9	1402.5

XXX - Rest Day/non-production.

The average soil temperature in the processor was 410°F with an average residence time of about 22 minutes. These operating conditions were within the nominal design residence time of 20 to 60 minutes and maximum operating temperature of 450°F for the LT^{3}® system (Johnson and Cosmos, 1989; Weston, 1990).

The continuous emission monitoring (CEM) system monitored the THC level in the stack from the outlet of the vapor-phase carbon columns. On April 11, 1991, after 12 days of running the LT^{3}® system, the THC reading was 9 ppm. The activated carbon column was taken out of service and a spare carbon unit was automatically placed on line. A total of 4,400 lbs of granular carbon was consumed for the whole project. THC in the stack gases was consistently less than 10 ppm as required by the air permit during the field demonstration.

A total of 46,560 gallons of condensate was collected by the condensing units. Of the 46,560 gallons of the condensate collected, 35 gallons of petroleum by-products were collected in the 3-phase separator. The separated petroleum by-products were transported to REMCO, a waste oil recycling facility, in Richmond, California. As the petroleum by-products were non-hazardous, a manifest was not required. Documents for the disposal of the petroleum by-products are enclosed in Appendix A. The remaining 46,525 gallons condensate was treated by two in-line liquid-phase carbon units. The treated water was subsequently used for soil quenching. THC concentration in the treated waste was less than 1 ppm. Water analysis for THC was conducted using a Hanby field test kit (Hanby Incorporated, Houston, Texas).

Based on the mass of soil treated and the volume of separated petroleum by-products, the average level of contamination of the soil is estimated to be approximately 80 mg/kg. The density of the petroleum by-products was assumed to be 0.75 kg/m^3. Actual contamination levels would be slightly higher as low levels of the petroleum by-products would be present in the condensate and stack gases.

6.2 Soil Treatment

6.2.1 Treatment Efficiency of LT$^{3®}$ System

Table 6 summarizes the TPH and BTEX analysis for the background samples. All samples contained TPH and BTEX below or equal to detection limits.

Table 7 and Table 8 summarize the analysis of untreated and treated samples, respectively. Untreated samples analyzed gave variable results ranging from non-detect levels to 97 mg/kg of TPH. This variation may be attributed to several reasons. The first few feet of soil that were originally excavated in 1987 were possibly the more heavily contaminated soil (see soil boring data of Table 1). Since then some of the VOCs may have volatilized or biodegraded from the stockpile after being left in the open. It is also possible that the downward transport of VOCs was restricted by the dense silty-clay layer present at about 4.5 feet below ground level. This limits the vertical contamination of the pit. During excavation, darker shades (grayish-green) of soil were observed, especially for soil around the water main, suggesting that channelling or preferential pathways for the movement of hydrocarbons was occurring. This could have resulted in non uniform contamination of the soil in the pit. Furthermore, the computed mean hydrocarbons concentration in the untreated soil is approximately 80 mg/kg (Section 6.1) which is of the same magnitude as the measured mean TPH concentration of 52 $\pm$ 32 mg/kg (average $\pm$ standard deviation). These comparable concentrations indicate that the above assumptions made with regards to the non-uniform contamination of the pit are valid. The mean TPH concentration of untreated soil was calculated by using only data that were above the non-detect levels (Table 7). If non-detect levels are considered in the computation and are assumed to be at zero concentration, then the mean TPH concentration is 26 $\pm$ 35 mg/kg.

Another possible reason is that the extent and level of contamination in the fire-fighting pit may be less than perceived. The level of contamination was based on a single soil boring in the center of the fire-fighting pit. It is plausible that contamination in other areas of the pit may be less than the concentrations found in this single soil boring. It is

TABLE 6. BACKGROUND SAMPLES AROUND THE TREATMENT SITE BEFORE OPERATION OF LT$^{3®}$ SYSTEM

Sample #	Date Sampled	TPH* as Gasoline (mg/kg)	Benzene* (mg/kg)	Toluene* (mg/kg)	Ethyl* Benzene (mg/kg)	Xylenes, Total (mg/kg)
Crow-1-AB	3/20/91	ND	ND	ND	ND	ND
Crow-2-AB	3/20/91	ND	ND	ND	ND	ND
Crow-3-AB	3/20/91	ND	ND	ND	ND	ND
Crow-9-AB	3/25/91	1	ND	ND	ND	0.031
Blank**	--	ND	ND	ND	ND	ND

* TPH measured using CA DHS Luft Method, BTEX using U.S. EPA Method 8020.

** Blank tested for each batch of sampling sent for analysis (see Appendix A for analytical results from laboratory).

ND Not detected, reporting limits (mg/kg) one TPH - 1; Benzene - 0.005; Toluene - 0.005, Xylene - 0.015, Ethylbenzene - 0.005.

TABLE 7. RANDOM SAMPLES OF UNTREATED SOIL TAKEN BEFORE LT3® TREATMENT

Sample #	Date Sampled	TPH* as Gasoline (mg/kg)	Benzene* (mg/kg)	Toluene* (mg/kg)	Ethyl* Benzene (mg/kg)	Xylenes, Total (mg/kg)
Crow-10-Au	4/3/91	ND	ND	ND	ND	ND
Crow-16-Au	3/29/91	36	ND	ND	ND	ND
Crow-18-Au	3/27/91	50	ND	ND	ND	ND
Crow-20-Au	4/5/91	24	ND	ND	ND	ND
Crow-22-Au	4/8/91	ND	ND	ND	ND	ND
Crow-24-Au	4/22/91	ND	ND	ND	ND	ND
Crow-26-Au	4/10/91	97	ND	0.10	0.80	0.49
Crow-28-Au	4/24/91	ND	ND	ND	ND	ND
Blank**	--	ND	ND	ND	ND	ND
Mean***		52	ND	0.10	0.80	0.49
Standard Deviation		32	--	--	--	--
Mean+		26	--	--	--	--
Standard Deviation		35	--	--	--	--

* TPH measured using CA DHS Luft Method, BTEX using U.S. EPA Method 8020.

** Blank tested for each batch of sampling sent for analysis (see Appendix A for analytical results from laboratory).

*** Only for data above the non-detect levels.

\+ Non-detect levels taken as zero in the computation of the mean and standard deviation.

ND Not detected, reporting limits (mg/kg) one TPH - 1; Benzene - 0.005; Toluene - 0.005, Xylene - 0.015, Ethylbenzene - 0.005.

TABLE 8. RANDOM SAMPLES OF TREATED SOIL TAKEN DURING OPERATION OF LT3® SYSTEM

Sample #	Date Sampled	TPH* as Gasoline (mg/kg)	Benzene* (mg/kg)	Toluene* (mg/kg)	Ethyl* Benzene (mg/kg)	Xylenes, Total (mg/kg)
Crow-11-AT	4/3/91	ND	ND	ND	ND	ND
Crow-12-AT	3/27/91	4	ND	0.027	ND	ND
Crow-13-AT	3/27/91	21	ND	0.078	ND	ND
Crow-14-AT	3/27/91	17	ND	0.14	ND	ND
Crow-17-AT	3/29/91	25	ND	0.012	ND	ND
Crow-19-AT	3/27/91	16	ND	0.044	ND	ND
Crow-21-AT	4/5/92	ND	ND	ND	ND	ND
Crow-23-AT	4/8/91	ND	ND	ND	ND	ND
Crow-25-AT	4/22/91	ND	ND	ND	ND	ND
Crow-26-AT	4/10/91	4	ND	ND	ND	ND
Crow-29-AT	4/24/91	ND	ND	ND	ND	ND
Crow-30-AT	4/25/91	ND	ND	0.006	ND	ND
Crow-31-AT	4/25/91	ND	ND	0.013	ND	ND
Crow-32-AT	4/25/91	1	ND	ND	ND	ND
Crow-33-AT	4/25/91	ND	ND	ND	ND	ND
Crow-34-AT	4/25/91	ND	ND	ND	ND	ND
Crow-35-AT	4/25/91	5	ND	0.007	ND	ND
Crow-36-AT	4/25/91	ND	ND	0.008	ND	ND
Blank**	--	ND	ND	ND	ND	ND
Mean***		12	ND	0.037	ND	ND
Standard Deviation		9	--	0.043	--	--
Mean*		5	--	--	--	--
Standard Deviation		8	--	--	--	--

* TPH measured using CA DHS Luft Method, BTXE using U.S. EPA Method 8020.

** Blank tested for each batch of sampling sent for analysis (see Appendix A for analytical results from laboratory).

*** Only for data above the non-detect levels.

ND Not detected, reporting limits (mg/kg) one TPH - 1; Benzene - 0.005; Toluene - 0.005, Xylene - 0.015, Ethylbenzene - 0.005.

\+ Non-detect levels taken as zero in the computation of the mean and standard deviation.

difficult to assess the quality of ERM-West soil boring data but for this study, all soil samples were collected under good quality control requirements and were analyzed using approved standard testing methods.

TPH concentrations of treated soil samples range from non-detect levels to 25 mg/kg. Trace levels of toluene of up to 0.14 mg/kg were detected in the treated soil. All the treated soil samples tested had TPH levels that were less than the California Water Quality Control Board requirements of 100 mg/kg. The mean TPH concentrations in treated soil are 12 $\pm$ 9 mg/kg (if non-detect levels are excluded) and 5 $\pm$ 8 mg/kg (if non-detect levels are included as zero concentration). Based on these mean TPH concentrations, the removal efficiency is approximately 77 percent (excluding non-detect values) and 58 percent (including non-detect values).

As the mean concentration of both treated and untreated soils were less than 100 mg/kg, the student's t test was applied to determine whether the mean concentration of the untreated and treated soil samples were statistically different. Table 9 presents the statistical analysis. Since the computed t values at 10 percent level of significance were greater than the t values obtained from statistical tables, the mean concentration of the treated soil is significantly different from the untreated soil. This would imply that the TPH concentrations in the untreated soil have been reduced and treatment of the soil has occurred.

Purgeable organics data for treated and untreated soil samples are given in Table 10. Table 10 lists only the organics that were above detection limit. A complete listing of organic compounds is given in the laboratory report in Appendix E. Organic compounds most frequently detected in the treated soil were methylene chloride, acetone, 2-butanone and toluene. The highest concentration of acetone measured was 0.990 mg/kg while 2-butanone was approximately 0.3 mg/kg. Some halogenated compounds such as 1,1,1-trichloroethane and trichloroethene were also detected at levels equal to 15 and 18 μg/kg, respectively. However, benzene and xylene measured by Method 8240 were all below or equal to the detection limit as measured in the samples analyzed with Method 8020. The presence of acetone and methylene chloride could be due to contamination during shipment or analysis as these compounds are common solvents used in laboratories for extraction purposes. Blanks tested showed traces of methylene chloride (Appendix E).

TABLE 9. STATISTICAL ANALYSIS ON THE MEAN TPH CONCENTRATIONS OF UNTREATED AND TREATED SOIL SAMPLES USING STUDENTS'S t TEST

Untreated Soil	Treated Soil

If non-detects are considered

$\bar{x}_u = 52$	$\bar{x}_t = 26$
$S_u = 32$	$S_t = 35$
$N_u = 4$	$N_t = 8$

$$S_c^2 = 363.9$$

$$S_d = 11.7$$

$$t = 3.33$$

At 10 percent level of significance and with 12 degrees of freedom, t_T is equal to 1.782. Since $t > t_T$, there is a significant difference between the TPH mean concentrations of the two soil samples.

If non-detects are considered

$\bar{x}_u = 26$	$\bar{x}_T = 5$
$S_u = 35$	$S_T = 8$
$N_u = 8$	$N_T = 18$

$$S_c^2 = 402.6$$

$$S_d = 8.7$$

$$t = 2.41$$

At 10 percent level of significance and with 24 degrees of freedom, t_T is equal to 1.782. Since $t > t_T$, there is a significant difference between the TPH mean concentrations of the two soil samples.

$\bar{x}$ = Mean
S = Standard Deviation
N = Number of Samples
U,T = Subscript (untreated, treated)
t = Computed Student's t variable
t_T = Student's t variable from statistical tables
S_d = Standard deviation of the difference of the means

$$= S_c \sqrt{\frac{1}{n_u} + \frac{1}{n_T}}$$

S_c^2 = Combined variance

$$= \frac{S_u^2 (n_u - 1) + S_T^2 (n_T - 1)}{(n_u - 1) + (n_T - 1)}$$

TABLE 10. PURGEABLE ORGANICS ANALYSIS (EPA METHOD 8240) FOR VARIOUS SOIL SAMPLES (TABLE REPORTS ANALYTE ABOVE DETECTION LIMIT, SEE APPENDIX E FOR COMPLETE LIST OF ANALYTES ANALYZED)

Sample #	Date Sampled	Parameter	Concentration (μg/kg)
Background Soil			
Crow-9-BB	March 25, 1991	All analytes	$\leq$ detection limit
Untreated Soil Samples			
Crow-10-BU	March 29, 1991	Methylene Chloride	5.6
Crow-19-CT	March 27, 1991	Acetone	57
		2-Butanone	29
		Toluene	35
Crow-22-BU	April 8, 1991	All analytes	$\leq$ detection limit
Crow-24-BU	April 22, 1991	Methylene Chloride	6.7
Treated Soil Samples			
Crow-11-BT	March 29, 1991	Methylene Chloride	6.7
		Acetone	75
		Toluene	8.0
Crow-17-BT	March 29, 1991	Methylene Chloride	130
		Acetone	800
		2-Butanone	310
Crow-19-BT	March 27, 1991	All analytes	$\leq$ detection limit
Crow-23-BT	April 8, 1991	All analytes	$\leq$ detection limit

TABLE 10. PURGEABLE ORGANICS ANALYSIS (EPA METHOD 8240) FOR VARIOUS SOIL SAMPLES (TABLE REPORTS ANALYTE ABOVE DETECTION LIMIT, SEE APPENDIX E FOR COMPLETE LIST OF ANALYTES ANALYZED) (Continued)

Sample #	Date Sampled	Parameter	Concentration (μg/kg)
Crow-25-BT	April 22, 1991	Methylene Chloride	38
		Acetone	990
		2-Butanone	200
Crow-39-BT	April 24, 1991	Methylene Chloride	8.5
		Acetone	27
		Carbon disulfide	37
Fire-Fighting Pit (Untreated Samples)			
Crow-04-BB	April 3, 1991	All analytes	≤ detection limit
Crow-05-BB	March 29, 1991	Methylene Chloride	5.2
Crow-06-BB	March 29, 1991	Toluene	6.2
Crow-07-BB	April 5, 1991	All analytes	≤ detection limit
Crow-08-BB	April 26, 1991	Methylene Chloride	7.6
		Acetone	97
		1,1,1 Trichloroethane	15
		Trichloroethene	18
		Xylenes, Total	11

6.2. Effect of Temperature on Soil Nutrients and Moisture

Table 11 summarizes the data for the nutrients in the soil before and after low thermal treatment. An assumption made here is that the untreated and treated samples were taken from the same batch of soil that were thermally treated by the LT$^{3®}$ system. If this assumption is true then a comparison of the analytical data, shows that statistically there was no difference in the concentration of nitrate-nitrogen and total phosphorus before and after treatment. Most nutritional elements are generally associated with organic matter. Combustion below 460°F mineralized these nutritional elements making them more easily available for plant growth (Giovannini et al., 1990). Comparison of percent moisture contents before and after treatment cannot be made since the treated soil were sprayed with water before leaving the conditioner housing. The other nutrients tested showed insignificantly small changes after treatment.

The treated and untreated soil were classified using the Unified Soil Classification System. The particle size analysis and the plasticity index for both soils are presented in Figures 10 and 11. Both soils were classified as CL or lean clay. However, untreated soil can be classified further as sandy lean clay indicating that the soil contains > 30 percent of plus No. 200 sieve soil. For the treated soil, the classification is lean clay with sand indicating that the soil contains 15 to 29 percent of plus No. 200 sieve soil. As the difference between the two soil is not much, it can be stated that the thermal treatment did not affect the particle size distribution of the soil. The slight change in the plus No. 200 size could be due to some crushing effect as the soil is pushed through the LT$^{3®}$ system.

6.2.3 Soil Samples During and After Demobilization

TPH and BTEX concentrations in soil samples taken from the pit indicated that all the contaminated soil had been excavated and treated by the LT$^{3®}$ system (Table 12). TPH concentrations of soil samples were all less than 100 mg/kg. Most of the purgeable organics in the soil samples from the pit were below detection limit (Table 10). Again as in the treated soil, some methylene chloride and acetone were detected at 0.01 and 0.1 mg/kg,

TABLE 11. SOIL NUTRIENTS AND MOISTURE BEFORE AND AFTER LOW TEMPERATURE THERMAL TREATMENT OF SOIL

Sample #	Date Sampled	Moisture (%)	Iron (mg/kg) EPA 7380	Potassium (mg/kg) EPA 7610	Sulfate (mg/kg) EPA 300.0	Nitrate(N) (mg/kg) EPA 300.0	Phosphorus, Total (P) (mg/kg) EPA 365.1
Untreated Soil							
Crow-10-Cu	4/3/91	15	25,000	420	120	12	ND
Crow-22-Cu	4/8/91	12	20,000	74	100	2.3	84
Crow-24-Cu	6/22/91	12	22,000	1600	250	3.5	37
Blank**	--	--	ND	ND	ND	ND	ND
Mean	--	13	22,300	698	160	5.9	61
Standard Deviation	--	2	2,500	800	80	5.3	33
Treated Soil							
Crow-11-CT	4/3/91	12+	25,000	360	100	9.0	1.1
Crow-23-CT	4/8/91	10+	20,000	160	220	7.2	89
Crow-25-CT	4/22/91	7.4+	22,000	1500	250	0.97	12
Blank**	--	--	ND	ND	ND	ND	ND
Mean	--	9.8	22,300	670	190	5.7	34
Standard Deviation	--	2.3	2,500	720	80	4.2	48

** Blank tested for each batch of samples sent for analysis (see Appendix A for analytical results from laboratory)

ND - Not detected, reporting limits (mg/kg) are: Iron - 1, nitrate - 1, potassium - 1, sulfate - 10, phosphorus, total (P) - 0.25.

+ - After quenching with water.

TABLE 12. SAMPLES TAKEN FROM VARIOUS LOCATIONS IN THE EXCAVATED PIT

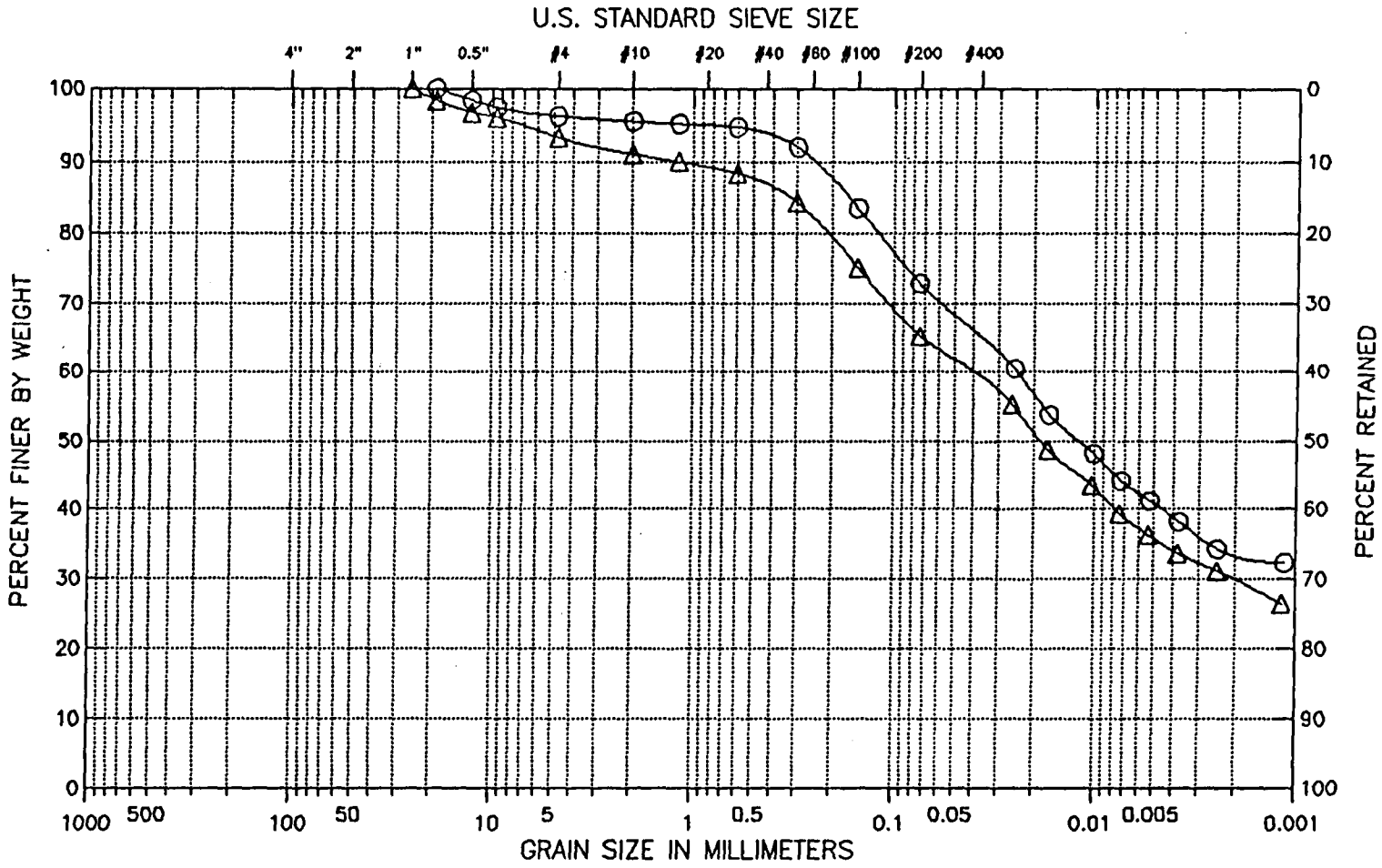
Sample #	Date Sampled	TPH* as Gasoline (mg/kg)	Benzene* (mg/kg)	Toluene* (mg/kg)	Ethyl Benzene* (mg/kg)	Xylenes, Total (mg/kg)
Crow-4-AB	4/3/91	ND	ND	ND	ND	ND
Crow-5-AB	6/3/91	ND	ND	ND	ND	ND
Crow-6-AB	4/3/91	ND	ND	ND	ND	ND
Crow-7-AB	4/5/91	ND	ND	ND	ND	ND
Crow-8-AB	4/26/91	ND	ND	0.006	ND	ND
Crow-8.1-AB	4/26/91	ND	ND	ND	ND	ND
Crow-8.2-AB	4/26/91	ND	ND	ND	ND	ND
Blank**	--	ND	ND	ND	ND	ND

* TPH measured using CA DHS Luft Method, BTXE using U.S. EPA Method 8020.

** Blank tested for each batch of sampling sent for analysis (see Appendix A for analytical results from laboratory).

ND Not detected, reporting limits (mg/kg) one TPH - 1; Benzene - 0.005; Toluene - 0.005, Xylene - 0.015, Ethylbenzene - 0.005.

Project : BATTELLE
Project No.: 91C0402A
Location: CROWS LANDING
Date : Tue May 07 1991

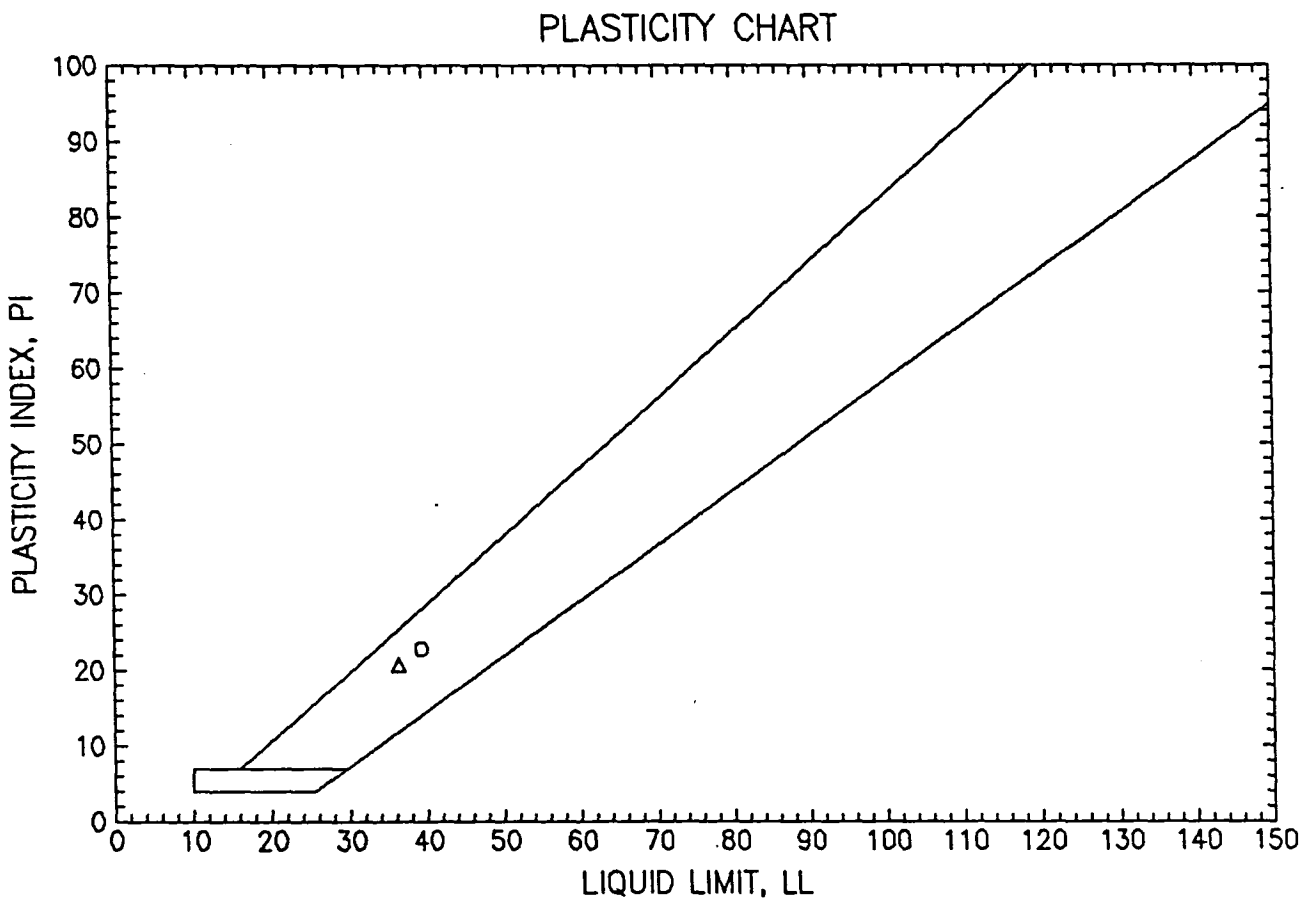


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Symbol	Boring No.	Sample No.	Depth	Filename	Classification / Description	
-O-	15-SC	TREATED		TREATED	CL	lean clay with sand
-Δ-	15-SC	UNTREATED		UNTREAT	CL	Sandy lean clay

FIGURE 10. PARTICLE SIZE ANALYSIS OF UNTREATED AND TREATED SOIL SAMPLES

Project : BATTELLE
Project No. : 91C0402A
Location : CROWS LANDING
Date : Tue May 07 1991



Symbol	Boring No.	Sample No.
O	15-SC	TREATED
Δ	15-SC	UNTREATED

FIGURE 11. PLASTICITY INDEX OF UNTREATED AND TREATED SOIL SAMPLES

respectively. It can be concluded that all the contaminated soil from the pit was excavated and treated by the LT³® system. From the analytical data, the soil taken from the pit at the end of the demonstration was less than the clean-up level of 100 mg/kg.

The two soil samples (Crow-37-AT and Crow-38-AT) taken in the area where the LT³® system was located showed low levels of TPH and BTEX (Table 13) that were similar to background levels.

Samples (Crow-39-AT and Crow-40-AT) taken in the area where the untreated soils were stockpiled were found to have traces of TPH. These results show that some of the hydrocarbons may have leached from the untreated soil into the ground. However, TPH levels of these two samples were comparable to the thermally treated soil. Results from this sampling activity indicate that contaminated soil around the demonstration area were removed and treated.

6.2.4 Stack Sampling

Samples of the vented exhaust gas were sampled by Modified Method 5 (MM5) for semivolatile organics and Volatile Organic Sampling Train (VOST) for light hydrocarbon species. Samples which were collected are described in Tables 14 and 15. All samples were collected in the field and shipped directly to Mid-Pacific Environmental Laboratory under chain-of-custody procedures. Results of analyses were provided by Mid-Pacific Environmental Laboratories directly to Battelle. The data is attached as an Appendix F.

6.2.4.1 Semivolatile Results

MM5 train samples were analyzed for semivolatile compounds according to EPA Method 0010 and EPA Method 8270. Surrogate spikes were included for recovery efficiencies, and a blank field train was analyzed for background levels of the compounds.

The blank train showed the minimum detectable levels (between 10 and 50 μg) for all compounds except di-n-octyl-phthalate. Surrogate recoveries were in the range of 43 to 54 percent for the blank train.

TABLE 13. SOIL SAMPLES TAKEN FOR VARIOUS LOCATIONS AT TREATMENT SITE AFTER DEMOBILIZATION

Sample #	Date Sampled	TPH* as Gasoline (mg/kg)	Benzene* (mg/kg)	Toluene* (mg/kg)	Ethyl* Benzene (mg/kg)	Xylenes, Total (mg/kg)
Crow-37-AT	5/13/91	ND	ND	0.005	ND	ND
Crow-38-AT	5/18/91	1	ND	0.011	ND	ND
Crow-39-AT	5/18/91	16	ND	0.060	ND	0.020
Crow-40-AT	5/13/91	5	ND	0.037	ND	ND
Blank**	--	ND	ND	ND	ND	ND

* TPH measured using CA DHS Luft Method, BTXE using U.S. EPA Method 8020.

** Blank tested for each batch of sampling sent for analysis (see Appendix A for analytical results from laboratory).

ND Not detected, reporting limits (mg/kg) one TPH - 1; Benzene - 0.005; Toluene - 0.005, Xylene - 0.015, Ethylbenzene - 0.005.

TABLE 14. MODIFIED METHOD 5 SAMPLES DESCRIPTION

Date	Sample No.	Process Feed lb/hr	Stack Volumetric Rate (acfm)	Average Gas Temp. (°F)	Volume of Sample dscf (m^3)
3/27/91	CL-01	10,233	253	90	122.80 (3.478)
3/28/91	CL-02	4,024	251	88	132.04 (3.739)
3/29/91	CL-03	7,153	212	78	110.72 (3.136)
3/28/91	CL-BL	-	-	-	Blank Train

acfm - Actual cubic feet per minute.
dscf - Dry standard cubic feet.

TABLE 15. VOLATILE ORGANIC SAMPLING TRAIN (VOST) SAMPLES DESCRIPTION

Date	Sample No. +	Time of Sample	Total Sample Volume (Liters)
3/27/91	VOST-1	14:15 - 16:50	61.45
3/27/91	Blank-1	13:00	0
3/28/91	VOST-2	10:55 - 13:20	59.45
3/29/91	VOST-3	8:25 - 10:50	60.21
3/29/91	Blank-2	10:15	0

+ Sample includes the following tube numbers:

VOST-1: CL-01-T, CL-01-TC
CL-02-T, CL-02-TC
CL-03-T, CL-03-TC

Blank-1: CL-01-BT, CL-01-BTC

VOST-2: CL-11-T, CL-11-TC
CL-12-T, CL-12-TC
CL-13-T, CL-13-TC

VOST-3: CL-21-T, CL-21-TC
CL-22-T, CL-22-TC
CL-23-T, CL-23-TC

Blank-2: CL-23-BT, CL-23-BTC

(Field Blank: Crow-44-T, Crow-44-TC).

For the three MM5 samples, diethylphthalate was found above detection limits in the March 27 and 28 samples, and phenanthrene was found above detection limits in the March 27 and 29 samples. Naphthalene and fluoranthane were each found above detection limits in the March 27 sample. The concentrations are reported in Table 16 for each identified sample. Of all the compounds identified, phenanthrene which is a polycyclic aromatic hydrocarbon is probably the most significant. However, the concentration of phenanthrene is approximately ten percent of the regulatory limit. Based on this air emission sampling and if the air emission control system is operated properly, the LT^{3}® system appears not to produce any air emissions of significant health concerns.

6.2.4.2 Volatile Organic Results

The analytical results of the VOST analysis were reported for the Method 5040 protocol and these data for each pair of tubes are included in the Appendix G. Results were also compiled for the 10 most prominent Tentatively Identified Compounds (TIC), and the concentrations for these 10 most prominent TIC are reported in the Appendix G. The data from these two analyses are reported in Table 17 as air concentrations for compounds above blank values. The commonly detected volatiles in these samples are dichlorodifluoromethane and chloromethane in the micrograms per cubic meter range. Values for acetone and methylene chloride for samples taken March 28 and 29 are not reported due to known contamination of these solvents in the VOST train. Therefore only the acetone value for March 27 is considered representative. Methylene chloride was not detected on March 27.

Overall, the levels of volatiles were below any OSHA regulatory limits. Even applying a health safety factor of x 1,000 would not cause any exceedance of levels. It does appear that the March 27 samples had a slightly higher number of compounds detected. The air emission sampling operator noted that the process feed flow rate was not steady. This may account for the detection of other compounds such as decane, xylenes, C8 and C9 hydrocarbons.

TABLE 16. STACK CONCENTRATIONS OF SEMIVOLATILE ORGANICS BY MODIFIED METHOD 5

Sample No.	Date	Diethylphthalate ($\mu g/m^3$)	Phenanthrene ($\mu g/m^3$)	Naphthalene ($\mu g/m^3$)	Fluoranthene ($\mu g/m^3$)
CL-1	March 27	12	20	6.9	2.9
CL-2	March 28	11	<2.7	<2.7	<2.7
CL-3	March 29	<3.2	22	<3.2	5.1
Regulatory Limit*		5,000	200	50,000	NR

* OSHA level for 8-hour average weighted exposure.

NR is not OSHA regulated.

TABLE 17. STACK CONCENTRATIONS OF VOLATILE ORGANICS BY VOST METHOD

Test Date	Tube Nos.	Compounds	Concentration ($\mu g/m^3$)	Regulatory Limit ($\mu g/m^3$)*
March 27	CL-01	Dichlorodifluoromethane	12	4,950,000
March 27	CL-01	1,1,2 Trichloro-1,2,2-trifluoromethane	7.8	7,600,000
March 27	CL-01	C8 hydrocarbon	1.2	NR
March 27	CL-01	C9 hydrocarbon	1.4	NR
March 27	CL-01	Ethylmethyl benzene isomer	4.0	NR
March 27	CL-01	Trimethyl benzene	2.1	125,000
March 27	CL-01	Decane	2.5	NR
March 27	CL-01	Ethylmethyl benzene isomer	6.8	NR
March 27	CL-01	Chloromethane	0.59	NR
March 27	CL-01	Acetone	3.9	1,800,000
March 27	CL-01	Carbon disulfide	1.7	12,000
March 17	CL-01	2 Butanone	1.0	590,000
March 27	CL-01	Toluene	2.7	375,000
March 27	CL-01	Ethylbenzene	1.6	435,000
March 27	CL-01	Xylenes	14	435,000
March 27	CL-01	Trichlorofluoromethane	3.0	NR
March 27	CL-02	Dichlorodifluoromethane	1.7	495,000
March 27	CL-02	Tetrahydrofuran	1.5	590,000
March 27	CL-02	Acetone	2.0	1,800,000
March 27	CL-02	Carbon disulfide	2.9	12,000
March 27	CL-02	Trichlorofluoromethane	1.4	NR

TABLE 17. STACK CONCENTRATIONS OF VOLATILE ORGANICS BY VOST METHOD (Continued)

Test Date	Tube Nos.	Compounds	Concentration ($\mu g/m^3$)	Regulatory Limit ($\mu g/m^3$)*
March 27	CL-03	Dichlorodiflurometh ane	1.9	495,000
March 27	CL-03	Chloromethane	1.0	NR
March 27	CL-03	Carbon disulfide	1.9	12,000
March 28	CL-11	Dichlorodifluoromethane	4.1	495,000
March 28	CL-11	Chloromethane	29	NR
March 28	CL-11	Carbon disulfide	4.1	12,000
March 28	CL-11	Toluene	1.2	375,000
March 28	CL-12	Dichlorodifluoromethane	5.5	495,000
March 28	CL-12	Chloromethane	35	NR
March 28	CL-12	Carbon disulfide	0.80	12,000
March 29	CL-13	Chloromethane	52	NR
March 29	CL-21	Dichlorodifluoromethane	84	495,000
March 29	CL-21	Benzaldehyde	1.2	NR
March 29	CL-21	Chloromethane	24	NR
March 29	CL-21	Carbon disulfide	2.5	12,000
March 29	CL-21	Trichlorofluoromethane	1.2	NR

TABLE 17. STACK CONCENTRATIONS OF VOLATILE ORGANICS BY VOST METHOD (Continued)

Test Date	Tube Nos.	Compounds	Concentration ($\mu g/m^3$)	Regulatory Limit ($\mu g/m^3$)*
March 29	CL-22	Dichlorodifluoromethane	2.3	495,000
March 29	CL-22	Chloromethane	36	NR

* Regulatory Limit specified by OSHA Title 29 CFR, Part 1910.1000 as 8-hour average weighted exposure.

NR is not regulated compound.

6.2.7 Quality Assurance and Quality Control of Air Sampling

Copies of all test data sheets, calibration records, and chain of custody forms are included in the Appendix H of this report. All field sampling followed standard EPA protocols and included leak checks as required. For the three MM5 tests the leak checks were 0.02 cfm at the highest vacuum. Isokinetics were calculated for each of the three MM5 tests and were all less or equal to ± 10 percent variation.

Blank samples were included for all tests and complete analyses are included in the analytical reports. No problems were encountered in the blank sample analyses except for the occurrence of di-n-octyl-phthalate in the MM5 blank.

The analytical laboratory included surrogate recovery standards in all samples. For the MM5 samples, surrogate recoveries ranged from a low of 34 percent (2,4,6-tribromophenol) to a high of 84 percent (2 fluorobiphenyl). Average sample surrogate recovery was 55 percent which was similar to the method blank recovery of 52 percent. For the VOST analysis, surrogate recoveries were higher with a low value of 73 percent and a high of 127 percent. Average VOST surrogate recovery was 92 percent. All recoveries were within acceptable limits.

7.0 COST ANALYSIS AND RECOMMENDATIONS

The total cost to treat the soil with the LT$^{3®}$ system was $582,378. This total cost included both WSI's and Battelle's scope of work and any Navy's cost for the oversight and management of this project. A summary of the breakdown costs required to conduct the LT$^{3®}$ demonstration at NALF Crow Landing is given in Table 18. The cost elements in WSI's scope of work includes additional costs for diesel fuel to run the site generator and structural backfilling required because of the water main. Based on a total treated mass of 1,403 tons, the unit cost is $415 per ton.

The cost analysis cited in the engineering evaluation study (Gavaskar et al, 1990), $80 to $350 per ton for the treatment of hydrocarbon-contaminated soils using the low temperature thermal treatment system does not include excavation and owner's cost such as permitting and progress reports,

TABLE 18. COST DETAILS FOR THE DEMONSTRATION OF THE LT$^{3®}$ SYSTEM

Activity	Costs
Permitting	43,987
Mobilization	75,000
Excavation	25,000
Soil Treatment	260,000
Backfilling	21,251
Demobilization	19,340
Stack Emission Testing	46,000
Sampling & Analysis (including laboratory analysis, sampling, and analysis plan)	40,800
Progress Reports, Final Report and Engineering Evaluation Report	16,000
Navy Oversight Cost	35,000
GRAND TOTAL	582,378

soil and stack emissions sampling and oversight cost. If these three items are excluded, the cost of treatment is $375,591. The cost per ton is then about $268 which is within the range of cost cited in the engineering evaluation study. The unit cost will be lower for the treatment of a larger volume of soil or for a higher throughput of the LT$^{3®}$ system.

In comparison to other treatment/disposal technologies (Gavaskar et. al., 1990) the low temperature thermal treatment technology is cost competitive. Cost estimates for on-site incineration range from $500 to $1500 per ton. Off-site incineration is estimated to cost approximately $1,800 per ton. Cost estimates cited do not include excavation/backfilling and owner's cost (Gavaskar et al., 1990).

This study has shown that the LT$^{3®}$ system is an effective technology in the decontamination of hydrocarbon-contaminated soil even for soils with low TPH concentrations. Other studies (EPRI, 1988; Weston, 1990 and de Percin 1991) also showed that the low temperature thermal treatment process was effective in the treatment of soils contaminated with volatiles and semi-volatiles such as gasoline and jet fuel. In fact, there are commercially available units that are specially built to remediate gasoline-contaminated soil from gasoline stations. Further testing of the low temperature thermal treatment process for this type of contamination is therefore not necessary.

Other types of contamination of interest to the Navy that may be decontaminated by the low temperature thermal treatment process are soils contaminated with higher boiling points organics such as PCB-contaminated soils and organics-contaminated sediments. Boiling points of PCBs range from 500°F to 650°F (Montgomery and Welkom, 1990). These boiling point temperatures are higher than the maximum achievable soil temperature with the LT$^{3®}$ system. However, there are other vendors with similar systems with a higher attainable soil temperature in the range of 500 to 600°F that may be able to remediate these types of contamination. With the current level of understanding and success in the treatment of soils contaminated with volatile and semi-volatiles with the low temperature thermal treatment process, it is possible that this technology can also be a cost effective technology for the decontamination of PCB-contaminated soils.

8.0 CONCLUSIONS

The on-site demonstration of the $LT^{3®}$ system was successfully completed without many problems, and, was within the specified schedule. Rainy weather in the first two weeks resulted in work stoppage due to potential lightning hazards and slowed down the processing of contaminated soil due to the high moisture content. An 8-inch steel water main which was assumed to be present on the other side of the road of the fire-fighting pit was unearthed within the pit, causing delay in the excavation and backfilling of the pit. A rupture on one of the $LT^{3®}$ processor's hot-oil line also stopped the LT^3 temporarily.

All contaminated soils from the fire-fighting pit was excavated and treated with the $LT^{3®}$ system. The processing capacity of the $LT^{3®}$ system averaged about 7.3 tons per hour for an 8-hour work day. A total of 1,403 tons of soil was processed by the $LT^{3®}$ system. The average soil temperature in the processor was 410°F with an average residence time of 22 minutes.

A total of eight untreated soil samples were collected randomly throughout the treatment period. Total petroleum hydrocarbons (TPH) concentrations of the untreated soil samples range from non-detect levels to as high as 97 mg/kg. The mean TPH concentration of the untreated soil samples was 52 $\pm$ 32 mg/kg (mean $\pm$ standard deviation). The mean TPH concentrations of treated soil was 12 $\pm$ 9 mg/kg with TPH concentrations ranging from non-detect levels to 25 mg/kg. A total of eighteen treated soil samples were collected randomly throughout the treatment period. The mean TPH concentration of the untreated and treated soils were found to be statistically different indicating that the contaminated soil has been treated. Based on the mean TPH concentrations, the average removal efficiency of TPH was estimated to be about 77 percent. Soil samples taken from around the pit and in the treatment area after demobilization indicated that all of the contaminated soil has been removed.

Most of the purgeable organics in the untreated and treated soil were less than or equal to the detection limit. Some constituents such as acetone, methylene chloride and 2-butanone were detected in the treated soil. From the limited data on soil nutrients, total phosphorus and nitrate-nitrogen concentrations were found to be statistically the same before and after

thermal treatment. Other constituents such as sulfate and potassium were the same before and after treatment.

Semi-volatiles present in the stack emissions from the activated carbon columns were generally polynuclear aromatic hydrocarbons such as diethylphthalate, phenanthrene, naphthalene and fluoranthene. Concentrations of these compounds were low (in the microgram per cubic meters range). Volatiles present in the stack gases were also low (in the microgram per cubic meters range) with dichlorodifluoromethane and chloromethane being some of the more commonly measured organic compounds. Overall the concentration levels of volatile and semivolatiles in the stack gas were below any OSHA regulatory limits indicating that the LT^{3}® system did not appear to produce stack gases that were of significant health concern. Throughout the site demonstration air emissions from the LT^{3}® system complied with the regulatory limit of less 10 ppm of TPH. Concentration of aromatics in the condensate was less than 1 ppm.

The total cost of treatment of the hydrocarbon-contaminated soil at NALF Crows Landing was $415 per ton. The total cost include permitting mobilization and demobilization, excavation and backfilling, soil treatment, soil and stack sampling, report writing and Navy's oversight cost.

Cost of treatment of the contaminated soils excluding excavation and owner's cost such as permitting and soil sampling and Navy's oversight cost was $268 per ton. This cost was for a small volume of soil and would be lower for the treatment of a larger volume of soil due to economics of scale. The cost estimate for this project is within the estimate provided in the literature and is competitive with other remedial technologies such as on-site incineration which ranges from $500 - $1,500 per ton.

In summary, this study shows that the LT^{3}® system is an effective technology in the decontamination of hydrocarbon-contaminated soil even for soils that have low TPH concentrations. The LT^{3}® system was reliable and the cost of operation was within budget. The LT^{3}® system operated at a slightly lower processing rate than the nominal rate but were within the operating conditions for soil temperature and residence time. For the study the cost of treatment for the decontamination of hydrocarbon-contaminated soil showed that the LT^{3}® system can be competitive.

This study together with other documented studies demonstrate that the low temperature thermal treatment process is an effective technology in

remediating soils contaminated with volatile and semi-volatile organics such as gasoline and jet fuel. Further testing of the low temperature thermal technology on this type of contamination is not necessary. Application of the low temperature thermal treatment process on other types of contamination that may be of interest to the Navy are PCB-contaminated soil and organics-contaminated sediments found at some Naval facilities. Successful demonstration of the low temperature thermal treatment process in treating these types of contamination at a reasonable cost will provide the Navy with an additional treatment alternative to the presently accepted treatment options such as incineration.

9.0 REFERENCES

California State LUFT Task Force. Leaking Underground Fuel Tank Field Manual. May 1988, State of California.

de Percin, P.R. 1991. Thermal Desorption Attainable Remediation Level. Proceedings of the Seventeenth Annual RREL Hazardous Waste Research Symposium, EPA/600/9-91/002, U.S. EPA, Washington, DC.

ERM-WEST. Report on Site Investigation, Naval Auxiliary Landing Field, Crows Landing Fire Fighting School, Crows Landing, California. November 1988.

Gavaskar, A., Ong, S.K., and Means, J.L., 1990. Engineering Evaluation/ Cost Analysis (EE/CA) for the Removal and/or Treatment of Soils Contaminated with Hydrocarbons at the U.S. Naval Auxiliary Landing Field (NALF), Crows Landing, California. Report submitted by Battelle to Naval Civil Engineering Laboratory, Port Hueneme, California.

Giovannini, G., Lucchesi, S., Giachetti, M., Petruzzelli, G. 1990. Thermal Clean-up of Contaminated Soil: The Effect on Soil Characteristics in Proc. Environtech Vienna, International Society for Environmental Protection, Vienna, Austria.

Johnson, N.P., and Cosmos, M.G., 1989. Thermal Treatment Technologies for Haz Waste Remediation. Pollution Engineering, 22(10).

Montgomery, J. H., and L. M. Welkom. 1990. Groundwater Chemicals Desk Reference. Lewis Publisher, Inc. Chelsea, MI.

Roy F. Weston, Inc. (Weston). 1990. Demonstration of Thermal Stripping of JP-4 and Other VOCs from Soils at Tinker AFB, Oklahoma City, Oklahoma. Report Prepared for U.S. Army Toxic and Hazardous Materials Agency. Aberdeen Proving Ground, MD.

The Designated Level Methodology for Waste Classification and Clean-up Level Determination, Appendix 111, California RWQCB, CVR, September 1987.

Weston Services, Inc. (WSI). 1990. Work Plan for the Demonstration of the LT$^{3®}$ System at NACF Crows Landing, Weston Services Inc., West Chester, PA.

APPENDIX A

WSI ON-SITE REPORT

Weston Services, Inc.
Weston Way
West Chester, Pennsylvania 19380
(215) 692-3030

22 May 1991

Battelle
505 King Avenue
Columbus, OH 43201

W.O. #8097-00-01

Attention: Mr. Say Kee Ong

Subject: Crows Landing NALF
NCEL Contract No N62742-87-C-3053

Dear Mr. Ong:

Enclosed is the summary report you have requested for the Crows Landing Naval Auxiliary Landing Field (NALF) project. This summary report also satisfies the final deliverable requirements due to Battelle in accordance with the letter from Battelle to Weston Services, Inc. (WSI) dated 23 July 1990.

Introduction

WESTON'S U.S. patented LT^{3}® process is a technology that provides evaporation of volatile organic compounds (VOCs) from contaminated soil without heating the soil matrix to combustion temperatures.

The basis of the LT^{3}® technology is the thermal processor, an indirect heat exchanger used to dry and heat contaminated soils. Heating the soils to approximately 400°F evaporates or strips the VOCs from the soil. The organic vapors are then processed through two condensers in series to remove organic compounds. The vapor stream is then treated by carbon adsorption.

The LT^{3}® is divided into three main areas of emphasis: soil treatment, emissions control, and water treatment. The LT^{3}® process equipment is mounted on three tractor trailer beds for transportation and operation. The unit is suitable for highway transport and may be mobilized to a site location.

There were no significant modifications to the LT^{3}® system during the Crows Landing NALF project.

Schedule of Events

Listed below is a chronology of events relating to the LT^{3}® field demonstration.

30 November 1990 - WSI received the air quality permit to operate the LT^{3}® system from the Stanislaus County Department of Environmental Resources Air Pollution Control District.

25 February 1991 - An informational letter describing the remediation events that will occur at Crows Landing NALF was sent to the contiguous property owners by U.S. Navy.

1 March 1991 - WSI received approval of the Work Plan by California Regional Water Quality Control Board.

4 March 1991 - WSI received approval of the Work Plan by Stanislaus County Department of Environmental Resources.

12 March 1991 - WSI began mobilization of LT^{3}® equipment at Crows Landing NALF fire training pit area.

22 March 1991 - WSI completed LT^{3}® mobilization.

25 March 1991 - WSI began LT^{3}® processing of stockpiled soil.

27 March 1991 - Battelle began stack sampling. WSI continued processing stockpiled soil through the LT^{3}® system.

28 March 1991 - Battelle conducted stack sample #2. WSI processed stockpiled soil from the crash site.

29 March 1991 - Battelle conducted stack sample #3. WSI processed soil excavated from the fire training pit.

5 April 1991 - WSI completed processing of the stockpiled soil.

6 April 1991 - WSI completed processing of the stockpiled soil from crash site.

6 April 1991 - WSI began fire training pit excavation and the soil processing.

25 April 1991 - WSI completed the fire training pit excavation.

27 April 1991 - WSI completed LT^{3}® processing of the fire training pit soil.

6 & 7 May 1991 - WSI began decontamination procedures by removing approximately four to six inches of the soil in the contaminated soil staging area and soil surrounding the shredder and feed conveyor.

8 May 1991 - WSI processed the soil removed from decontamination activities and completed decontamination activities.

9 May 1991 - WSI began demobilization activities.

13 May 1991 - WSI began structural backfill operations.

17 May 1991 - WSI completed structural backfill and demobilization activities.

Problems Encountered

- Heavy rains during the month of March and first week of April slowed soil processing. The excessive rain created material handling problems and decreased the soil feed rates.
- On 11 April 1991 an 8-inch steel water main was unearthed. The water main was previously unidentified by the Crows Landing Public Works Department. The water main was temporarily shored while excavation and processing continued.

Accidents or Injuries

There were no reportable accidents or injuries during the field demonstration at Crows Landing NALF.

Decontamination Activities

Upon completion of the soil remediation, approximately four to six inches of soil in the contaminated soil staging area, and soil surrounding the clay shredder and feed system was excavated and processed. Excavation was performed using a Case 580 hydraulic excavator.

Soil that was contaminated during a rupture in one of the processors hot oil lines was manually excavated for treatment. The soil was excavated to a depth of 12 to 16 inches to ensure the contaminated soil was removed. The soil was excavated from under the processor trailer. The decontamination was completed prior to demobilization activities.

Soils excavated during decontamination activities, 58.82 tons, were processed in the LT³® system prior to the commencement of demobilization activities.

Air Monitoring Data

The on-site Health and Safety Air Monitoring Log is contained in Attachment 1. Ambient air sampling was performed using an HnU photoionization detector (PID) and a Gastector CGI, combustible gas indicator (CGI).

Analytical Results

Field analysis for total petroleum hydrocarbons (TPH) was performed using the Hanby Environmental Test Kit for petroleum hydrocarbons. The Hanby Test Kit is a colormetric system with an accuracy of ± 5 parts per million (ppm) and was used for quantification purposes only. The field log is included in Attachment 2.

Emissions Data

During the field demonstration at Crows Landing NALF, 4,400 pounds of granular vapor phase carbon was consumed. The carbon was supplied by the Calgon Corporation located in Pittsburgh, Pa.

The highest THC reading recorded by the continuous emissions monitoring (CEM) system, was 9 ppm. The reading occurred on 11 April 1991 at 1045 a.m. The carbon unit was automatically taken out of service by the LT³® electrical interlocks to the CEM. A fresh spare carbon unit was automatically placed on line.

During demobilization activities, the carbon units were returned to Calgon Corporation for regeneration.

Weston Services, Inc.

Condensate

During the field demonstration, 46,560 gallons of condensate was collected by both condensing units. From the 46,560 gallons of condensate collected, 35 gallons of petroleum by-products were collected in the 3 phase separator.

The separated petroleum by-products were transported to a waste oil recycling facility in Modesto, CA. The remaining 46,525 gallons of condensate was treated by two in-line liquid phase carbon units. The treated water was subsequently used for soil quenching.

Soil Quantity

A summary of the soil treated on a daily basis is included in Attachment 3.

Cost Summary

Listed below is a summary of the costs required to conduct the LT³® demonstration at Crows Landing NALF. This breakdown reflects additional costs for diesel fuel and structural backfill previously submitted to the Navy as Change Orders.

Permitting	43,897
Mobilization	75,000
Excavation	25,000
Treatment	260,000
Backfill and grading	21,251
Demobilization	19,340
TOTAL	$444,488

The summary costs listed above reflects all applicable fees, profits and overhead costs, which is predetermined and established in the contract.

Should you have any questions or require further clarification on this summary, please contact me at (215) 430-7318.

Very truly yours,

WESTON SERVICES, INC.

James R. Irey

James R. Irey
Project Manager

JRI/dec

Att.

cc: M.G. Cosmos
T.M. Forden

WESTON
MANAGERS DESIGNERS/CONSULTANTS
1 WESTON WAY
WEST CHESTER, PA 19380-1449
PHONE 215-692-3030
FAX 215 430-3174

10 March 1992

Mr. Say Kee Ong
Battelle Memorial Institute
505 King Avenue
Columbus, Ohio 43201

Reference: Crows Landing Auxiliary Naval Air Station
W.O.#: 8097-00-01

Dear Mr. Ong:

As a follow-up to our recent telephone conversations, I am forwarding you the following information concerning the Low Temperature Thermal Treatment (LT^3) operations at Crows Landing Auxiliary Naval Air Station.

Resulting from the processing and thermal treatment of approximately 1,400 tons of soil, approximately thirty-five (35) gallons of oily liquid waste was collected in the LT^3 three-phase separator. The waste consisted of an oil/water emulsion. The wastes were collected and drummed in 17H DOT approved containers for future disposal.

In addition and as a result of an oil line leak which occured on the LT^3, approximately sixty (60) gallons of Dow HT heat transfer oil spilled into a collection sump located beneath the processor. Due to the nature of and makeup of the oil, the oil could not be reused in the LT^3 hot oil system. The oil was collected and drummed in 17H DOT approved containers for disposal.

These wastes, along with fourteen drums of soil removed from the LT^3 processor during an overhaul of the processing unit, were sent to Gibson Oil Company, for recycling as road base material. The soil removed from the LT^3 processor during the major overhaul of the system was residual soil which accumulates within the processor during normal operations. It is WESTON's standard procedure to dispose of the soil and heat transfer oil in this manner for environmental liability purposes.

Based on best available analytical data obtained from the Material Safety Data Sheets for the Dow HT fluid and the analytical data from the Remedial Investigation (RI) soil sampling, the soil and oil could be disposed (recycled) in California as a non-hazardous waste. A waste profile analysis was completed for the waste which included the MSDS for the heat transfer oil and the analytical data from the RI.

WESTON

Upon acceptance, the fourteen 17H 30-gallon drums of soil and 2 17H 55-gallon drums of oil waste was transported to Gibson Oil for recycling. The heat transfer fluid and the oil/water emulsion was combined for more cost effective disposal.

Because of the small quantity of material for disposal and since WESTON is not a large generator of waste in California, WESTON was required to use a brokerage firm to handle the waste. WESTON obtained the services of Remedial Environmental Marketing Company (REMCO) to supply the required services. On 29 October 1991, upon completion of the overhaul of the LT^3 processing unit, the drums of soil and oil were picked up by REMCO and transported to Gibson Oil for disposal as road base material. WESTON chose to wait until overhaul operations of the LT^3 processor were complete before disposal of the waste since small quantities of soil were continually collected during the overhaul operation. On 11 November 1992 the waste was processed through the Gibson Oil facility and recycled into road base material.

I have enclosed a copy of the disposal certificate for you use.

Should you have any questions or require clarification on this matter, please contact me at (815) 273-4653.

Very truly yours,

James R. Irey

James R. Irey
Project Manager

JRI

Enclosure

cc: M. Cosmos

WESTON
MANAGERS DESIGNERS CONSULTANTS
1 WESTON WAY
WEST CHESTER, PA 19380-1449
PHONE 215-692-3030
FAX 215 430 3124

10 March 1992

Mr. Say Kee Ong
Battelle Memorial Institute
505 King Avenue
Columbus, Ohio 43201

Re: Reorganization

Dear Mr. Ong:

We are pleased to inform you of a reorganization at Roy F. Weston, Inc. (WESTON). In order to better serve the needs of our clients we have merged the operations of Weston Services, Inc. into the Design and Applied Technology Division (DATD) of WESTON. This merger will enhance our ability to offer our clients innovative, timely, and cost effective solutions. You can expect to continue to receive the same high level of service with no delay or disruption in the performance of the project because of this merger.

Although this merger will streamline operations, there is no change in responsibility for performance of this contract. WESTON will continue to be responsible for performance of all contractual obligations.

WESTON looks forward to continuing to serve your needs.

Very truly yours,

ROY F. WESTON, INC.

James R Irey

James R. Irey
Project Manager

JRI/jjp

CERTIFICATE OF REMEDIATION OF HYDROCARBON CONTAMINATED SOILS

SUPPLIER:
Weston Services, Inc.
1 Weston Way - Building 9-1
West Chester, Pa. 19380

GENERATOR:
Same

CERTIFICATE #: 91 - 0072 JOB #: 91 - 0072

In accordance with Title 22 CDOHS, REMCO has accepted and has caused 16 drums of H.C. soil to be recycled under the guidelines of federal, state, and local laws and regulations. The H.C. soil was received 10 / 29 /1991. In receiving and processing the H.C. soil and in providing this certificate, REMCO has relied upon and is relying upon (a) the representation of the generator that the H.C. soil does not contain any materials classified as, and is not classified as "Hazardous Waste" under the applicable provisions of federal and California law and has been managed and may be treated as other than Hazardous Waste, and (b) the generator has independent written certifications from applicable governmental agencies of certified independent testing laboratories that the H.C. soil does not contain any materials classified as, and is not classified as, "Hazardous Waste" under said applicable law.

REMCO shall indemnify, defend and hold harmless the generator from and against any enforcement actions by any governmental authority in the event that any of the representations by REMCO set forth in this certificate are materially inaccurate. Provided however that this indemnity shall be limited to a maximum of the amount paid to REMCO by the generator for processing this H.C. soil.

By: [signature]

R E M C O

Recycling for the future
2717 Goodrick Ave.
Richmond, Ca 94804
(510) 237-5866

Date: 3 / 10 / 92

Remco
2717 Goodrick Ave.
Richmond, CA 94801
Recycling for the Future

Please fill-in completely all areas that apply to your material. This is an application, not an approval!

GENERATOR Weston Services Inc.

FACILITY ADDRESS ~~[illegible]~~ Bldg. 411, Hunters Point
San Francisco, CA 94124

MAILING ADDRESS One Weston Way, Bldg. 9-1
West Chester, PA 19380 TELEPHONE (215) 430-3189

TECHNICAL CONTACT ~~Alan~~ Jim Talbot TITLE Project Manager

BOE# _____ EPA I.D.# _____

TRANSPORTER Eight Ball Trucking STATE# _____

CONTACT Linda Dow TITLE Dispatcher

TELEPHONE 415.233.3063 EPA I.D.# _____

NAME OF WASTE A: Heat Transfer Oil (Dow) B: TPH contaminated Soil < 5 ppm

ACTIVITY PRODUCING WASTE _____

IS THIS WASTE NON-HAZARDOUS BY TITLE 22, C.C.R., ARTICLE 11? ☑ YES ☐ NO

IF YES, THIS PROFILE CERTIFIES THAT STATE OF CALIFORNIA NON-HAZARDOUS PROPERTIES ARE BASED ON CERTIFIED LABORATORY ANALYSES AND/OR GENERATOR KNOWLEDGE OF GENERATION PROCESS AND WASTESTREAM CONTAMINANTS.

IS THIS WASTE A RCRA TCLP WASTE? ☐ YES ☒ NO

IF YES, WASTE MUST ARRIVE AT FACILITY WITH A HAZARDOUS WASTE MANIFEST INCLUDING A COMPLETED BOX I WITH EPA CODES.

TO THE BEST OF MY KNOWLEDGE, I CERTIFY THAT THE ABOVE INFORMATION IS TRUE AND CORRECT.

(X) [signature] Project Manager 10/25/91
SIGNATURE TITLE DATE

FACILITY DECISION

ACCEPT _____ REJECT _____

BY _____ DATE _____

Subcontract # 54049

AGREEMENT

This agreement is between Remedial Environmental Marketing Company, Inc., a California corporation, ("REMCO") and Weston Services, Inc. ("Supplier"). The parties agree as follows:

REMCO arranges for the transportation and disposal of certain non-hazardous materials. Supplier presently has an agreement with _____, hereinafter referred to as "Generator." If Supplier and Generator are the same, then all references herein to Generator shall be deemed to refer to, and be binding upon, Supplier.

REMCO has a contract with Gibson Oil ("Recycler") located at Bakersfield, Calif, which, through REMCO, provides a termination site for disposal of certain non-hazardous materials. Supplier hereby engages REMCO's services in the transportation and disposal of the materials.

1. The term of this agreement shall be from 10-29, 1991, to 11-15, 1991.

2. Supplier and Generator have hydrocarbon saturated soil or other recyclable material ("material") which Supplier and REMCO believe is suitable for use by Recycler. Supplier agrees to provide approximately n/a tons of material during the term of this agreement for REMCO'S transportation and delivery to Recycler's plant. Supplier shall supply not less than n/a tons and no more than n/a tons of material each n/a. Supplier shall provide REMCO with a schedule for deliveries of the material to Recycler's plant. Supplier, in arranging and scheduling the transportation and delivery of the material, agrees to abide by REMCO'S reasonable directions and instructions for preparation, pick-up, transportation and delivery of the material to Recycler's plant.

3. Supplier shall pay to REMCO a fee of $ see below per ton of material delivered to and accepted by Recycler. Supplier shall also pay to REMCO the reasonable costs of any additional preparation required by Recycler, and for the costs of weighing the material. Payments due REMCO shall be net 15 days. Any payment not paid when due shall bear interest at the rate of 1.5% per month (18% APR) on the average daily balance until paid.

4. REMCO will arrange for the transportation and delivery of the material to Recycler's plant. As a prior condition and before transportation of the material, Supplier will furnish to REMCO a California certified laboratory analysis of the subject material indicating the hydrocarbon content of the material and confirming the absence of hazardous and toxic content. The parties agree that prior to any delivery of the material to Recycler, Recycler may sample and analyze such portions of the material to determine its suitability for Recycler's use.

Other terms:
@ 80.50 per drum of soil
@ 500.00 per drum of fluid

The undersigned hereby agree to the terms and provisions hereof, INCLUDING THE TERMS ON THE REVERSE HEREOF, which are a part of this agreement and binding on each party. Executed on 10-29, 1991, at Richmond, California.

Supplier:
Weston Services Inc
1 Weston Way - Building 9-1
West Chester, PA 19380

By [signature]
Title

REMCO, Inc.
2717 Goodrick Avenue
Richmond, CA 94804

Job # 91-0072

By [signature]
Title

6. Subject to Recycler and REMCO's consent, Supplier may, within ten (10) days of the expiration of the term hereof, extend this agreement for a like term by giving written notice thereof to REMCO, on the same terms and conditions except that the fee for each ton of material disposed of during said extended term shall be mutually agreed upon by Supplier and REMCO.

7. Supplier agrees that nothing in this agreement shall be construed to obligate Recycler or REMCO to accept any material which contains toxic or other non-conforming matter, or which is unsuitable for Recycler's use. Non-conforming matter means any designated waste or other material which shall increase the risk or hazard to human health or to the environment incidental to the handling, transportation, use or disposal of such matter.

8. Supplier represents and agrees that the material shall conform to the laboratory analysis provided to REMCO and Recycler, and that the material shall be in such condition that without additional preparation, it may be used by Recycler with its existing equipment and production process, to produce a toxin-free product.

9. Should Recycler advise REMCO at any time that its samples and tests disclose that the material does not conform to the certified laboratory analysis provided by Supplier, or in the event Recycler confirms that the material is not otherwise suitable for its use, Supplier agrees that REMCO or Recycler may reject the material and require that Supplier arrange for the removal, transportation and disposal of the rejected material, at Supplier's sole cost.

10. In the event that additional preparation of the material is required, following such notice of such fact from Recycler to REMCO, REMCO shall promptly notify Supplier. Supplier may elect to either retransport the material and perform the additional preparation at its point of origin, or request that REMCO handle such preparation on site. In addition to the fees described in paragraph 3 of this agreement, Supplier agrees that any and all costs of said preparation shall be born by Supplier. The parties agree that "additional preparation" shall mean the removal of any deleterious materials, such as metal, wood chunks, plastic, or any foreign materials which would be harmful to the recycling process or the production of a toxin-free product." If such additional preparation is done by Recycler, Supplier shall be responsible for the removal and disposal of the deleterious and foreign materials from Recycler's site or plant.

11. The material shall remain the property and responsibility of Supplier, until delivery to and acceptance of the material by Recycler. Acceptance or testing by REMCO and Recycler of portions of the material during the term hereof shall not modify or limit Supplier's obligation to deliver material conforming to this agreement and the analysis sent by Supplier to REMCO as described in paragraph 4. Supplier agrees that REMCO may, at its sole discretion, arrange for transportation and return of any non-conforming matter or material to Generator or the site of its initial location. Supplier agrees that, in the event Recycler rejects any portion of the material as non-conforming, or otherwise will not issue a certificate of remediation for such material or any portion thereof, any long term liability and ownership of the rejected or non-conforming material or matter shall be that of Supplier.

12. Supplier agrees that all handling, reprocessing, and preparation of the material, whether by the Supplier or by Generator, and all other actions taken by Supplier and Generator as set forth herein shall be in compliance with all applicable federal, state, county or other local laws, ordinances and regulations.

13. The parties' relationship under this agreement shall be that of independent contractors, and nothing in this agreement shall be construed to constitute REMCO, Supplier, Recycler, or any of them or their employees or subcontractors, as an agent, a venture or partner of the other.

14. Any controversy or claim arising out of or relating to the terms of this agreement shall be settled by arbitration in accordance with the rules of the American Arbitration Association, and judgment on the award rendered by the arbitrator or arbitrators may be entered into any court having jurisdiction.

15. In the event Recycler rejects all or any portion of the material and Supplier refuses or fails to retake possession, custody, or control thereof, that act, omission or failure will injure REMCO in an amount that will be extremely difficult to determine and fix. Therefore, it is fixed in an amount of $3.00 per ton per day of materials which Supplier refuses or fails to receive or dispose of as described herein. Supplier agrees to pay said sum to REMCO on demand, as liquidated damages. Nothing herein shall be construed to obligate REMCO to possess, dispose or manage any portion of such rejected or non-conforming material.

16. Supplier hereby agrees to indemnify and hold REMCO harmless from and against any and all liability, losses, damages, claims, costs or expenses (including reasonable attorneys' fees), which directly or indirectly arise out of Supplier's performance of its duties hereunder, or that of its agents and employees.

17. Neither this agreement nor any rights, duties or obligations hereunder may be assigned by Supplier without the prior written consent of REMCO.

18. This agreement supercedes any and all other agreements between the parties and may be modified only by an instrument in writing. Each party to this agreement acknowledges that no representations, inducements, promises, or agreements, orally or otherwise, have been made which are not embodied herein.

19. If any action at law or in equity, or if any arbitration, is necessary to enforce or interpret the terms of this agreement, the prevailing party shall be entitled to reasonable attorneys' fees and costs, in addition to any other relief to which the party may be entitled.

20. Supplier agrees that REMCO's contract, business, or account with Recycler constitutes confidential and proprietary information of REMCO, and that Supplier has access to confidential information concerning REMCO's business, including the method, process and location for disposal of the material and that this constitutes REMCO's trade secret. Supplier agrees that it shall not disclose said trade secret directly or indirectly to any other person or use it in any way during the term of this agreement or at any time thereafter, except as is required in the course of its obligations under this agreement.

21. The failure of any party at any time to require performance by the other party of any provision hereof, will not affect in any way the full right to require such performance at any time thereafter. Nor shall the waiver by either party of a breach of any provision be taken or held to be a waiver of the provision itself.

22. This agreement may be executed in several counterparts and all such executed counterparts shall constitute a single agreement.

23. Any provisions of this agreement which may be prohibited by law, or otherwise held invalid, shall be ineffective only to the extent of such prohibition or invalidity and shall not invalidate or render ineffective the remaining provisions of this agreement.

25. This agreement shall be governed by and construed in accordance with the laws of the State of California.

2717 Goodrick Ave.
Richmond, CA 94804

HD Remco

Phone (415) 237-5866
FAX (415) 529-2483

Weston Services Inc.
1 Weston Way - Building 9-1
West Chester, PA 19380

INVOICE

DATE	NUMBER	PAGE	DUE DATE
10.29.91		1	11-13-91

SHIP VIA	FOB	TERMS	YOUR ORDER
8-Ball Trucking	S.F.	50% down, balance [illegible]	[illegible]

SALESMAN	DESCRIPTION	QUANTITY	UNIT PRICE	AMOUNT
	Drums of petroleum contaminated soil	[illegible]	[illegible]	[illegible]
	Drums of dow-therm H.T. fluid	2	9	500 00	1,500

SUBTOTAL	[illegible]
SALES TAX	
FREIGHT	
TOTAL	$7,000.00

Weston Services, Inc.

ATTACHMENT 1

AIR MONITORING LOG

HEALTH AND SAFETY LOG
CROWS LANDING NALF
AIR MONITORING
8097-00-00

DATE	TIME	BACK-GRD	HOT ZONE SAMPLE LOC.	HOT ZONE	CGI	REMARKS
3/25/91	0800	1.2 ppm	N.W corner of pit	2.9	OK	
3/26/91						No work
3/27/91	0730	1.1	NW. Corner stockpile	5.9	ok	ND on Benzene Dreggertube
3/28/91	0715	0.9	middle of Stockpile	2.8	ok	ND on Dregger Tube
4/1/91	0730	0.9	middle of west wall 2' deep	1.8	OK	No dregger
4/2/91						No Intrusive work
4/3/91	1400	0.6	Excavated soil from west wall pit	1.3	ok	Excavation only in pm
4/4/91	1300	0.6	Excavated soil from pit	1.2	ok	Intrusive work in pm only
4/4/91	1800	0.6	Excavation from west wall area	37.0	OK	ND on Dregger tube for benzene
4/5/91	0600	0.5	Excavation from west wall area	36.0	ok	ND on Benzene dreggertube
4/6/91	0900	0.6	stockpiled soil area	19.00	ok	ND on Benzene dregger tube
4/8/91	0700	0.6	Stockpiled soil area	5.3	ok	ND on dregger tube
4/9/91	0630	0.7	stockpile area	1.5	OK	ND Dregger.
4/10/91	0700	0.6	Stockpile area	1.5	OK	ND on Dregger
4/10/91	0705	0.6	Pit area	1.5	ok	ND on dregger
4/11/91	1255	0.5	Pit area	.25	O.K.	ND on dregger
4/11/91	1300	0.5	Stockpile	.75	O.K	No Dregger
4/12/91	1000	0.5	Stockpile	0.9	ok	No Dregger
4/13/91			No work		ok	Paint day no work
4/14/91	0730	0.5	Stockpile	0.8	ok	No Dregger
4/15/91	0700	0.5	Stockpile	0.9	ok	No Dregger
4/16/91	0630	0.6	Stockpile	0.8	ok	No Dregger
4/16/91	0640	0.6	Excavation	1.2	ok	ND on Dregger tube
4/17/91	0830	0.6	No intrusive work	0.6	OK	No Dregger
4/18/91	0745	0.5	Excavation	0.9	OK	No Dregger
4/19/91	0630	0.5	Excavation area	0.8	ok	" "
4/20/91	No intrusive work					
4/21/91	0700	0.5	Excavation area	0.9	OK	No Dregger
4/22/91	0715	0.6	Excavation area	0.8	OK	No Dregger
4/23/91	0635	0.5	Excavation Pit	0.7	OK	No Dregger
4/24/91	0615	0.5	" "	0.6	"	"
4/25/91	0930	0.5	Excavation pit	0.7	"	"

Weston Services, Inc.

ATTACHMENT 2

FIELD SAMPLING LOG

FIELD SAMPLING LOG
CROWS LANDING NALF

HANBY FIELD TEST KIT FOR AROMATICS

SAMPLE NUMBER	DATE	TIME	LOCATION	MATRIX	RESULTS (ppm)
1	4-05-91	1500	Stock pile	S	<10.0
2	4-05-91	1600	Stockpile	S	<10.0
3	4-05-91	0630	Ash conditioner	S	<5.0
4	4-05-91	0700	Treated water Tank	W	<1.0
5	4-06	0630	Ash discharge conditioner	S	<5.0
6	4-07	1230	Ash discharge conditioner	S	<5.0
7	4-08	1115	Ash discharge cond.	S	<5.0
8	4-09	11:35	Treated water Tank	W	<1.0
9	4-10	0930	Ash discharge conditioner	S	<5.0
10	4-11	0715	Ash discharge conditioner	S	<5.0
11	4-13	1430	Treated water Tank	W	<1.0
12	4-15	1400	Ash conditioner	S	<1.0
13	4-16	700	Ash conditioner	S	<1.0
14	4-17	905	Ash cond. disc.	S	<5.0
15	4-18	1420	Treated H_2O Tank	W	<1.0
16	4-19	1000	Treated water tank	W	<1.0
17	4-20	0900	Ash conditioner discharge	S	<5.0
18	4-21	1545	Treated water Tank	W	<1.0
19	4-22	1210	Ash cond. dis.	S	<5.0
20	4-23	0910	Ash conditioner	S	<1.0
21	4-24	0630	Ash conditioner	S	<1.0
22	4-25	0800	Treated water Tank	W	<1.0
23	4-26	8:15	Ash conditioner discharge	S	<1.0
24	4-27	7:30	Ash conditioner discharge	S	<1.0

Weston Services, Inc.

ATTACHMENT 3

DAILY PRODUCTION SUMMARY

CROWS LANDING PRODUCTION SUMMARY

PRODUCTION SUMMARY, TONS		
	DAILY	*CUMULATIVE*
MARCH		
25	21.7	21.7
26	0.0	21.7
27	47.7	69.4
28	13.0	82.4
29	21.1	103.5
30	XXX	103.5
31	XXX	103.5
APRIL		
1	55.0	158.5
2	0.0	158.5
3	25.6	184.1
4	0.0	184.1
5	80.7	264.8
6	70.6	335.4
7	XXX	335.4
8	80.0	415.4
9	80.0	495.4
10	67.9	563.3
11	60.6	623.8
12	XXX	623.8
13	75.9	699.7
14	XXX	699.7
15	62.8	762.5
16	32.4	794.9
17	XXX	794.9
18	82.2	877.1
19	81.8	958.9
20	XXX	958.9
21	80.2	1039.1
22	76.6	1115.7
23	23.1	1138.8
24	42.2	1181.0
25	0.0	1181.0
26	96.8	1277.8
27	65.8	1343.6
MAY		
8	58.9	1402.5

APPENDIX B

AIR PERMITS AND CORRESPONDENCE WITH REGULATORY AGENCIES

Stanislaus County

Department of Environmental Resources

Air Pollution Control District

1716 Morgan Road
Modesto, California 95351
(209) 525-4152

AUTHORITY TO CONSTRUCT
THERMAL TREATMENT SYSTEM (LT3)

GRANT ON: November 30, 1990 PERMIT NO. : 6-077-01

PREPARED BY: CHRISTOPHER A. COLLINS

APPLICANT: Roy F. Weston, Inc.,/Naval Auxiliary Landing Field
Crows Landing, CA

EQUIPMENT DESCRIPTION :
Low Temperature Thermal Treatment System (LT3) with emission control equipment - Baghouse, Condenser, Hot Oil Heater, Carbon Adsorption System and Continuous Emission Monitoring System.

CONDITIONS: See Attached For Conditions

A/C Issue Period From 11-30-90 to 11-30-92
Notify APCD Engineer at (209) 525 4152 when completed.

Approval or denial of the permit to operate the above equipment will be made after inspection to determine if equipment is constructed in accordance with plans and if equipment is in compliance with APCD regulations. It is the applicant's responsibility to comply with laws of other governmental agencies which are applicable to equipment constructed. This A/C shall expire 2 years from date of issuance unless it is renewed.

CC : Stanislaus County Building Department

CONDITIONS

1. In the event of air pollution control equipment failure, the operator shall immediately curtail any additional input of contaminated soil.

2. In the event that monitoring or test data shows emissions from the LT3 exceed any emission limitation conditions of this Authority to Construct, Weston will take immediate corrective action to bring the LT3 's emissions within these limitations. This may include a reduction in process weight.

3. The baghouse shall be equipped a pressure differential gauge to indicate the pressure drop across the bags. The gauge shall be maintained in good working condition at all times.

4. Collected particulate matter shall be disposed of in a manner which prevents entrainment of material into the ambient air.

5. Particulate matter emissions shall not exceed 0.1 grains/scf in concentration.

6. A log shall be maintained in recording daily amounts of soil loaded into system in cubic yards per hour. It shall also contain emissions from stack in pounds per hour and PPM. This log shall be made available to the inspector upon request.

7. The carbon adsorption system shall be equipped with an alarm system to indicate when the carbon canisters are spent.

8. Carbon canisters shall be replaced when the THC concentration exceeds 10 ppm.

9. Operation of this equipment must be conducted in compliance with all data and specifications submitted with the application under which this permit is issued unless otherwise noted below. Gas must not contain any chlorinated organic vapors.

10. Volatile Organic Compounds emissions from this system shall not exceed 32 lbs/day.

11. Continuous emission monitoring equipment shall be installed in the exhaust stack to measure the following emissions on a dry basis:

    a) Carbon Monoxide
    b) Carbon Dioxide
    c) Oxygen
    d) Total Hydrocarbons

These monitors shall be in operation at all times during operation of the LT3 system. Performance standards and quality assurance characteristics of these monitors shall be Air Resource Board and Environmental Protection Agency approved. This data shall be made available to the District upon request.

12. The LT3 shall be permitted operate 24 hours per day maximum. This shall be continuous operation.

13. This unit will require a California Department of Health and Safety permit or a variance to operate from that department.

14. An equipment break down form must be submitted if any emission control equipment breaks down. This form must be fill out in accordance will Stanislaus County Rule 110.

STATE OF CALIFORNIA PETE WILSON, Governor

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD—
CENTRAL VALLEY REGION
3443 ROUTIER ROAD, SUITE A
SACRAMENTO, CA 95827-3098
PHONE: (916) 361-5600
FAX: (916) 361-5600

1 March 1991

Mr. Thomas Torres
Civil Engineering Laboratory
Naval Construction Battalion Company
Pt. Hueneme, California 93043

LOW TEMPERATURE THERMAL TREATMENT (LT^3) DEMONSTRATION PROJECT NAVAL AUXILIARY LANDING FIELD (NALF), CROWS LANDING, STANISLAUS COUNTY

We have completed our review of the *Work Plan (LT^3) Demonstration Project Naval Auxiliary Landing Field Crows Landing, California*. The thermal destruction of the total petroleum hydrocarbon contamination in the soils appears to be an effective soils remediation method and should be effective in the fire-fighting training area (FTA) cleanup.

Based on the information we have received on the LT^3 process, we can conditionally approve the proposed residual TPH level in the treated soils of 100 ppm as a not to exceed value after treatment. However, we can not approve the proposed method of treated soil disposal until the below comments are addressed. An unconditional approval of the cleanup/treatment level can be given once it is demonstrated that the proposed disposal locations of the treated soil does not pose a potential threat to ground or surface waters of the state. If it cannot be shown that the proposed 100 ppm will be adequately attenuated at the proposed disposal locations, then a lower cleanup level will have to be achieved.

General Comments

1. To determine the correct treatment level for contaminated soil will depend upon the ultimate disposal location of the treated soil. For instance, if the treated soil from the LT^3 process is to go back into the excavation it originated from, it must be demonstrated that the levels of contamination that remain in the treated soil will not have the potential to impact ground water. One method that can be used to demonstrate whether a contaminated soil has the potential for impacting ground water is to perform an environmental fate analysis as outlined in the *Designated Level Methodology For Waste Classification and Cleanup Level Determination* (Designated Level Methodology) prepared by the Central Valley Regional Water Quality Control Board. I have attached a copy of the latest updated version. Treated soils that have residual contamination of any kind in them and are proposed for disposal at other than at a waste disposal facility approved for accepting those wastes, must have an environmental fate analyses performed for the disposal location and for each of the contamination compounds in the soils.

Specific Comments

1. Figure 1-1 NALF Crows Landing Soil Boring Locations: What is the depth to ground water found in

the monitoring well adjacent the site? Was there any TPH or other contamination found in the ground water and what is the direction of ground water flow?

2. Table 1-1 Concentrations of Organic Compounds: The values shown as the regulatory cleanup values on the table are incorrect. The actual cleanup or treatment levels will have to be determined by the Designated Level Methodology. In footnote 'd' of the table it states that the values were obtained from Appendix III of the Regional Board's *Designated Level Methodology for Waste Classification and Cleanup Level Determinations*. Unfortunately, in the Appendix III examples an average site attenuation value of 100 fold was assumed which may not be applicable to the proposed NALF disposal locations.

3. Section 5.3 Excavation: It states the oversized materials will be decontaminated using a high-pressure washer. How will the decontamination water be handled and kept from entering surface or ground waters?

4. Section 5.4 LT³ System Operation: How frequent are sample and analyses going to be performed on the feed and processed soils? The proposed sampling and analyses methods together with frequencies must be provided.

5. Section 5.5 Soil Backfilling: The proposed disposal of treated soil is back into the excavated hole it came from. If residual contamination remains in the soil after treatment it must be demonstrated that it will not have any impacts on ground water beneath the site.

The above comments were developed strictly based on the LT³ Work Plan. However, through recent correspondence and telephone conversations between yourself and the County of Stanislaus it is now proposed that NALF Crows Landing will use the treated soils as road bed material or will use it in shallow fills. No matter where the treated soils are disposed of it will be necessary to demonstrate that no potential impacts will occur to ground or surface waters as a result.

If you require any additional information please give me a call at 916-301-5742.

Michael H. Mosbacher, P.E.
Project Engineer

atch

cc Mr. Robert Fourte, County of Stanislaus Environmental Health, Modesto
Mr. Steven Chao, US Naval Facilities West Div., San Bruno
Mr. Dave Wang, DHS/Toxics Croydon Wy, Sacramento

Stanislaus County

Department of Environmental Resources

1716 Morgan Road
Modesto, California 95351-5894
FAX# (209) 525-4163
(209)
525-4150

March 4, 1991

Mr. Tom Torres
Naval Civil Engineering Laboratory
Port Hueneme, CA 93043

Dear Mr. Torres:

Re: Contamination Site - Former Burn Pit, Naval Auxiliary Landing Field, Crowslanding

The Hazardous Materials Division has reviewed the Work Plan for the excavation and treatment of petroleum hydrocarbon contaminated soils at the above contamination site. Based on the available information, the treatment and disposal methods proposed to address the contaminated soil are acceptable to the Division.

It is our understanding the contaminated soil will be excavated to the limit of contamination, as defined by the subsurface investigation, and treated in a mobile low temperature thermal treatment unit. Cleanup levels proposed for the treatment unit are less than 100 parts per million petroleum hydrocarbons with non-detectable levels of volatile aromatic hydrocarbons.

The excavation cavity would be backfilled with clean fill. Treated material would be used as surficial fill onsite.

Thank you for involving the Hazardous Materials Division in this interesting and innovative cleanup program. Do not hesitate to contact me if we can be of additional assistance.

ROBERT FOURT
GEOLOGIST
Hazardous Materials Division

sd

APPENDIX C

SAMPLING AND ANALYSIS PLAN

DRAFT PLAN

SAMPLING AND ANALYSIS OF UNTREATED AND TREATED SOIL AND LT^3 UNIT STACK EMISSION

at

Naval Auxiliary Landing Field
Crows Landing, CA

to

NAVAL CIVIL ENGINEERING LABORATORY
PORT HUENEME, CA

October 11, 1990

by

Say Kee Ong
William Piispanen
William Baytos
Jeffrey L. Means

BATTELLE
505 King Avenue
Columbus, OH 43201

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DRAFT PLAN

SAMPLING AND ANALYSIS OF UNTREATED AND TREATED SOIL AND LT^3 UNIT STACK EMISSION

at

Naval Auxiliary Landing Field
Crows Landing, CA

to

NAVAL CIVIL ENGINEERING LABORATORY
PORT HUENEME, CA

October 9, 1990

1.0 INTRODUCTION

Typical fire training at the Fire Fighting School at the Naval Auxiliary Field Landing, Crows Landing include filling an unlined pit with JP-5 fuel mixed with other types of wastes such as crankcase oil, solvents, cooking grease, and transmission fluid, igniting these liquids and extinguishing the flames with water. The unlined 41-foot by 60-foot pit had been used for fire fighting training for approximately 25 years. There are no records to account for the frequency of fires nor the types of fuels used at the site. In 1987, the Navy proposed installing a concrete pit to replace the unlined pit to prevent off-site migration of unburned fuels. Contaminated soil was encountered during excavation at a depth of 2 feet. Upon encountering the contaminated soil, the excavation was terminated and excavated soils were stockpiled on plastic sheeting along the west side of the excavation.

A site investigation initiated by the Navy indicated that the soil in the pit was contaminated to levels as high as 5,400 ppm of total petroleum hydrocarbons (TPH) (ERM West, 1988). However, soils outside the pit showed low contamination and there was no groundwater contamination. Approximately 1,250 cubic yards (1,625 tons) of contaminated soil (TPH > 100 ppm) is present at the site. The contaminated soil at Crows Landing does not meet the recommended State agencies' regulatory guideline of 100 ppm for TPH.

As part of the Navy's Installation Restoration and Hazardous Waste Minimization programs, the Navy has proposed to test and evaluate a low temperature thermal treatment process to treat the contaminated soils at Crows Landing under Environmental Protection Agency (EPA) and California waste disposal rules and regulations. The low temperature thermal technology selected for field demonstration and evaluation was the LT^3 process of Weston Services, Inc.

The purpose of this sampling and analysis plan is to outline procedures for sampling and analyzing the contaminated soil, treated soil, and stack emissions of the LT^3 unit. The objective of this plan is to evaluate the effectiveness of the Weston LT^3 process to treat soils contaminated with volatile hydrocarbons and to determine the effect of the treatment process on the physical and nutrient properties of the soil. This sample and analysis plan discusses the following:

- Sampling program for contaminated and treated soil, including sampling procedures, locations and number of samples, and analytical requirements (Section 2.0)
- Sampling program for stack emissions, including sampling procedures, locations and number of samples, and analytical requirements (Section 3.0)
- Chemical analysis plans including the types and numbers of analyses to be conducted (Sections 2.0 and 3.0)
- The statistical design of the sampling program (Section 4.0)
- Quality assurance/quality control measures for both sampling and analysis, including documentation, record keeping, and internal quality control checks (Section 5.0)
- Health and safety considerations related to the sampling including a discussion of the primary health hazards, proposed control measures and work practices, key sampling personnel, and plans in the event of an emergency (Section 6.0).

2.0 SAMPLING PROGRAM FOR CONTAMINATED AND TREATED SOIL

2.1 Sampling Design for Soils

The sampling and analysis plan for contaminated and treated soils is divided into four events. The four events are

(1) Sampling and analysis of untreated soil before treatment and after excavation

(2) Sampling and analysis of the initial batch of treated soil

(3) Sampling and analysis of treated soil from the treated soil pile

(4) Sampling and analysis of soil samples taken from the excavated site and the area around the treatment unit.

2.1.1 Sampling Event 1: Sampling and Analysis of Untreated Soil

Contaminated soil will be excavated and placed on plastic sheets. To reduce volatilization of hydrocarbons, the excavated pile of contaminated soil will be covered with plastic sheets. The untreated soil will then be fed into a shredder. Classified material measuring less than 2 inches will be fed into the LT^3 unit using a feed conveyor. Oversized material (larger than 2 inches) is not processed by the LT^3 system. Soil samples that pass through the shredder will be collected for analysis. A total of eight samples will be collected along with one blind replicate over the 3-week period of the LT^3 operation. A sample each will be collected on alternate days. Three samples will be analyzed for benzene, toluene, xylene, and ethyl benzene (BTX & E) using method 8020; for TPH using method 8015; for purgeable organics using method 8240; for percent moisture; and for available soil nutrients including nitrate-nitrogen, phosphorus, potassium, iron, and sulfate-sulfur. The other five samples will be tested for BTX & E and TPH only. The particle size distribution analysis of a soil sample will be determined using the Unified Soil Classification System.

Soil samples from the untreated pile will provide the baseline and initial hydrocarbon concentrations for evaluating the effectiveness of the low temperature thermal unit.

2.1.2 Sampling Event 2: Sampling and Analysis of the Initial Batch of Treated Soil

In this sampling event, three samples will be collected and analyzed to determine and ensure that the treatment process is working satisfactorily in the field. This event will take place during the first few days of the contaminated soil treatment in the field. The soil will be analyzed for BTX & E using method 8020 and for TPH using method 8015.

The anticipated plan for this sampling event is to collect the first sample within the first 2 hours of the initial throughput of the treated soil and to collect two subsequent samples every hour thereafter.

2.1.3 Sampling Event 3: Sampling and Analysis of Treated Soil Pile

The treated soil will be collected and placed in a pile. A few days before the treatment is completed, 17 samples and 2 blind replicates will be randomly collected from the pile of treated soil. Collection of samples will be based on a simple random sampling scheme where the pile is schematically divided into a grid with equal surface areas. The treated soil pile is approximately 5 feet high with a relatively flat top and covers an area 40 feet by 20 feet. Samples will be obtained at approximately 2½ feet deep or about mid-depth in the pile. All soil samples will be tested for BTX & E and TPH. Five soil samples will be tested for purgeable organics and three soil samples will be tested for available nutrients and percent moisture. The particle size distribution analysis of a soil sample will be determined using the Unified Soil Classification System.

Collection of samples will be based on a simple random sampling scheme where the pile is schematically divided into a grid with equal surface areas. Further details of the sampling design are given in Section 4.0.

2.1.4 Sampling Event 4: Sampling and Analysis of Soils from the Excavated Site and Near the Treatment Unit

Soil samples will be collected from areas where the untreated soil was excavated and stored, and from the area where the treatment unit was located. The purpose of this sampling is to evaluate whether all the contaminated soil was treated and to verify that no hazardous materials were spilled by the treatment contractor. A total of 10 soil samples will be collected for this event and analyzed for BTX & E using method 8020, for TPH using method 8015, and for purgeable organics using method 8240. We anticipate collecting five soil samples from the excavated area and five soil samples from the area where the treatment unit is located.

Volatile Organic Carbon (VOC) emissions will be monitored during excavation and LT^3 operation with an Organic Vapor Analyzer (OVA) by Weston Services, Inc.

In all of the above sampling events, representatives from the appropriate government agencies and from the Navy will be permitted to witness the sampling and split samples will be provided if requested.

2.2 Sample Analysis

Table 1 list the analytical methods and the number of samples to be analyzed for each sampling event. Soil samples will be analyzed by Pace Laboratories, Novato, California, a California-certified laboratory.

2.3 Sample Collection Methods

Each sample will be collected using either a stainless steel sand auger or a stainless steel shovel. Special attention will be paid to prevent the puncture of the plastic ground liner underlying the soil pile. Soil samples for the analysis of volatile organic compounds will not be composited. Each sample will be placed in an EPA-approved, precleaned 8-ounce wide-mouthed glass bottles. Each bottle will be completely filled with soil samples to eliminate as much free airspace as possible. The bottles will be immediately labeled. Split samples will be collected as follows:

TABLE 1. NUMBER OF SAMPLES AND ANALYTICAL METHODS FOR EACH SAMPLING EVENT

Sampling Event Analytical Methods	1	2	3	4
BTX&E Method 8020	8	3	15	10
TPH Method 8015	8	3	15	10
Purgeable Organics Method 8240	3	-	5	10
Available Nutrients:				
Nitrate-nitrogen	3	-	3	-
Phosphorus	3	-	3	-
Potassium	3	-	3	-
Iron	3	-	3	-
Sulfate-sulfur	3	-	3	-
Percent Moisture	3	-	3	-
Unified Soil Classification	1	-	1	-

Sampling events:

1 - Untreated soil
2 - Initial batch of treated soil
3 - Treated soil
4 - Soils near treatment unit and excavated area

Sample "A" - two 120-mL sample for analysis of volatile organic compounds

Sample "B" - two 120-mL samples for analysis of available nutrients and moisture content

Sample "C" - two 120-mL sample for archival.

About 5 kilograms of soil will be collected for classification using the Unified Soil Classification System.

2.4 Sample Handling, Storage, and Blanks

All sample bottles will be precleaned, 8-ounce widemouthed bottles with screw-type lids and teflon liners. All sample bottles will be placed in plastic bags and stored on ice in ice chest-type coolers both during storage at the site and during shipment. Field blanks will be included at a frequency of every six samples collected.

All sampling equipment will be either stainless steel, polyethylene, or teflon-lined. The sampling devices will be cleaned between each sample by cleaning and brushing off excess materials, washing in phosphate-free detergent solution, and rinsing with tap water, distilled water, and methanol before being air-dried.

2.5 Sample Labeling and Record Keeping

Each bottle will be labeled with a unique number coded to the grid location followed by a letter code from A to C. A description of the sample will be entered in the permanent laboratory record book and on each bottle label. The information to be recorded in the laboratory notebook shall include the following:

- Sample number
- Grid location (matrix number)
- Sample date and time (day/month/year, hour)
- Observations (moisture, color, unusual odors)

- Collection method
- Sampler name(s).

All sample bottles will be placed in plastic bags and then securely sealed after label information and sample identification are checked and entered on standard chain-of-custody forms. Each laboratory will receive a separate custody form and shipping inventory. Samples will be designated for use as follows:

- Sample A to a certified California laboratory for analysis of volatile organic compounds
- Sample B to a certified California laboratory for analysis of available nutrients and moisture content
- Sample C to Battelle in Columbus, Ohio, for archival.

3.0 STACK EMISSIONS SAMPLING AND ANALYSIS

3.1 Stack Emissions Sampling Design

The off-gases of the low temperature thermal treatment process are treated by condensing the organics through an air-cooled and a refrigerated condenser before final treatment with activated carbon adsorption. The exhaust gas from the stacks of the activated carbon will be analyzed by a one-time sampling event. Three stack emissions tests will be performed on three consecutive days according to U.S. EPA protocols. These tests will be performed after the results of the soil sampling Event 2 of Section 2.1.2 are known.

3.2 Sample Collection and Analysis Methods

A total of three test methods will be employed to characterize the off-gas in the stack emissions of the LT^3 unit. Each method will be conducted in triplicate. These methods include measuring the stack gas velocity using EPA method 2, the low boiling volatile organics using the volatile organic sampling train (VOST) technique, and the semivolatile organics using the

modified method 5. A gas sampling port will be provided by Weston Services, Inc., and will be located on a straight length of the stack exhaust equal to 10 pipe diameters of the stack.

3.2.1 Stack Velocity and Volumetric Flow Rate Measurements

The stack gas velocity, measured using the EPA method 2 procedure, is determined from the velocity head measurement using a type S Pitot tube and from the gas density at a given temperature. The volumetric flow rate is calculated from the average gas velocity and stack cross-sectional area. This measurement will be made prior to sampling for organics.

3.2.2 Low Boiling Volatile Organic Compounds

The VOST protocol (EPA-600/8-84-007) is used for measuring low boiling (30°C) volatile organic compounds. The field sampling equipment to be used is the NuTech model 280 VOST sampling train or equivalent. Stack gas is drawn through a series of two cartridges of adsorbents where the organic compounds are concentrated. The first cartridge contains Tenax resin while the second contains Tenax resin filled over with some granular petroleum charcoal. The sampling flow rate is adjusted to 0.5 liters per minute and runs for about 40 minutes. This step is repeated three times, so that three pairs of adsorbent cartridges are exposed over a 120-minute sampling period for one test. The Tenax cartridges are furnished and subsequently analyzed by a certified laboratory. The analytical method utilizes purge-and-trap gas chromatography/mass spectrometry (GC/MS) analysis following thermal desorption of sorbent cartridges. This analysis will provide a chromatogram scan of organic compounds with identification of 10 peaks. One blank set of samples will be collected before and after the sampling program for background corrections.

3.2.3 Semivolatile Organic Compounds

Collection of semivolatile organic compounds for analysis will be performed using the modified method 5 (proposed EPA method 23) sampling

system. The sampling equipment to be used is the NuTech model 2010 or equivalent. The gas sample is passed through a sampling train consisting of a heated glass-lined probe, a heated filter, and an ice water-cooled trap packed with an adsorbent XAD-2 resin. The semivolatile organic compounds are extracted from the combined adsorbent resin and the trapped particulate matter using an organic solvent and then later separated using gas capillary chromatography. Compound identification is by mass spectrometry. Quantification is by carbon number equivalent comparison with a standard library. One field blank sample will be collected during this sampling run to determine background levels of contamination.

3.3 Sample Handling

Sampling handling and preservation during the test will follow the protocol as specified in the quality assurance procedures for each method. All samples will be recovered and handled in an area outside of the work area designated for sample handling. Precleaned tools, utensils, and containers will be used. All solvents will be delivered using either teflon wash bottles or glass volumetric glassware. The VOST cartridges are stored and shipped on dry ice before and after sample collection and will be delivered to a certified laboratory upon collection of the three runs.

The samples collected in XAD-2 adsorbent resins, filter, and solvent washes using the modified method 5 will be stored on ice and returned to Battelle, Columbus, Ohio for extraction and analysis. Solvents used for recovery will be distilled in glass grade or equivalent containers and a blank of each solvent will be included for control purposes.

3.4 Sample Labeling and Record Keeping

Each sample will be labeled with a unique number and with a description of the sample entered in the permanent laboratory record book and on each bottle or container label. The information to be recorded in the laboratory notebook shall include the following:

- Sample number

- Sample date and time (day/month/year, hour)
- Observations (moisture, color, unusual odors)
- Collection method
- Sampler name(s).

All resin cartridges come with their own cap devices and will be securely sealed after removal from sampling systems. The label information and sample identification will be checked and entered on standard chain-of-custody forms. Samples will be protected against moisture and damage as required for packing. Each laboratory will receive a separate chain-of custody form and shipping inventory.

4.0 STATISTICAL DESIGN FOR TREATED SOIL SAMPLING

Sampling and analysis must be responsive to both regulatory requirements and scientific objectives. In report SW-846, entitled "Test Methods for Evaluating Solid Waste," EPA identified the important elements of a sampling plan for solid wastes and a statistical approach based on the scientific objectives. The statistical design for the present study will address relevant issues such as sampling accuracy and precision and simple random sampling, as given in SW-846.

4.1 Approach

The treated soil pile is estimated to be approximately 5 feet high covering an area of 40 feet by 20 feet. The treated soil can be assumed to be randomly heterogenous with regards to its chemical characteristics, allowing a simple random sampling procedure to be adopted. Simple random sampling is a sampling design that divides the population into units and a suitable number of samples is randomly selected from the population.

4.2 Selection of Grids

For this simple random sampling approach, the pile is subdivided into square grids. The grid size selected is based on the area required to collect the samples. The number of grids is based on a "rule of thumb" of 20 x N grids where N is the number of samples. The number of samples that will be collected from the treated soil pile is N = 15. Therefore, the number of grids required is 300, giving a grid size of 1.5 feet x 1.5 feet. The number of grids and grid size will change accordingly if the dimensions of the treated soil pile are different from that stated in Section 4.1.

4.3 Sampling

Random sampling will then be used to select the grids for sample collection from the treated soil pile. The grids will be numbered consecutively starting from the left corner of the north end of the pile. The first 15 numbers drawn from a random number table that correspond to a grid number will constitute the grids used to collect soil samples from the treated soil pile. Samples will be taken at a depth of approximately 2½ feet or about mid-depth into the pile from the center of the grid. For the analysis of volatiles, a single core sample will be used, while a composite may be used for the analysis of available nutrients. These samples will be numbered and labeled accordingly as described in Section 2.5.

4.4 Analysis of Data

Data from each sampling event will be composited and the means, variances, and confidence intervals will be used to characterize the untreated and treated pile.

5.0 QUALITY ASSURANCE/QUALITY CONTROL PLAN

The following items are the essential elements of quality assurance/quality control (QA/QC) for this program:

Project Coordination. The study will be under the direction of Dr. S. K. Ong of Battelle. Dr. Ong, the Project Leader, will be responsible for daily activities and coordination throughout the sampling and analysis program. Dr. Ong will also review all data and laboratory record book entries. Dr. Ong will convey any problems directly to the client Project Engineer, Mr. Tom Torres of the Naval Civil Engineering Laboratory, for corrective action as required.

Sampling Procedures. These are discussed in Sections 2.0 and 3.0. Any variation or exceptions will be documented in laboratory record books.

Sample Custody. All sample inventories will be entered on standard chain-of-custody forms. All sample bottles will be secured with chain-of-custody tape between collection time and receipt at laboratories. Laboratories will follow standard chain-of-custody control of samples.

Calibration. Laboratory analytical calibration will be required according to each instrument's standard procedure and will include linear dynamic range calibrations.

Analytical Procedures. Methods referenced for analysis will be used as specified. Any deviations or variations will be documented.

Data Reduction and Reporting. All analytical data will be reduced by the laboratory conducting the analysis and reported to the Project Leader. Data should include the complete field sample number and assigned laboratory numbers, any observations or problems, limits of detection for method of analysis, and concentration per mass of sample analyzed. Standard data forms or permanent record copies will be maintained for analytical traceability.

Internal Quality Control Checks. One blind replicate sample per approximately every eight samples are included to assess (1) the homogeneity of samples and (2) reproducibility of the analytical data.

Performance of System Audits. Audits are not anticipated for this program unless reported data are incomplete.

Preventive Maintenance. Field and laboratory equipment will be maintained in clean, workable condition.

Procedures to Assess Data. All field records will be reviewed by the Project Leader or his designee. Sample inventories, chain-of-custody forms, and sample labels will be checked by a second person prior to shipment. Data will be reviewed for completeness by the Project Leader.

Corrective Action. Any inadequacies or errors will be noted and communicated to the responsible person (i.e., person signing forms or records) for explanation as required. Any errors or corrections must be initialed and dated after a single line-through. No errors are to be corrected by tape erasing, white-out, or obliteration. All entries will be legible or corrected to legible.

6.0 HEALTH AND SAFETY CONSIDERATIONS RELATED TO SAMPLING

6.1 Job Hazard Analysis

6.1.1 Primary Health Hazards

The contaminated soil from the fire fighting pit contains a variety of organic compounds:

- Total Petroleum Hydrocarbon (TPH) up to 5,400 ppm
- Benzene up to 0.5 ppm
- Toluene up to 0.5 ppm
- Xylene up to 0.5 ppm.

The most significant of these in terms of possible health effects are TPH and benzene.

The primary potential health hazards associated with exposure to the chemical substances identified in detectable concentrations are provided in Table 2. Applicable employee 8-hour permissible exposure limits and threshold limit values (TLVs) are also indicated in Table 2 where available. The applicable permissible exposure limits (PELs) are defined by the United States Department of Labor, Occupational Safety and Health Administration (OSHA), in the volume identified in the Code of Federal Regulations (CFR), Title 29, Labor, Section 1910.1000, or other appropriate section.

The TLVs listed are recommended by the American Conference of Governmental Industrial Hygienists (ACGIH). TLVs refer to airborne concentrations of substances and represent conditions during which it is believed that nearly all workers may be repeatedly exposed, 8 hours per day, day after day, for a 40-year working lifetime, without adverse effect.

TABLE 2. PRIMARY HEALTH HAZARDS AND EXPOSURE LIMITS FOR CHEMICAL SUBSTANCES DETECTED ON SUBJECT SITE

Compound	Federal OSHA Exposure Limit (TLV-TWA) (ppm)	ACGIH TLV (ppm)	Primary Health Hazard
Total Petroleum Hydrocarbons	300*	300*	Dizziness, drowsiness, irritated eyes.
Benzene	1	10	Irritated eyes and nose, headache, nausea, fatigue carcinogenic.
Toluene	100+	100	Irritated eyes and nose, nausea, affects liver and central nervous system
Xylene	100+	100+	Irritated eyes and nose, nausea, affects liver and central nervous system

* Limit based on gasoline.

+ Short-term exposure limit (STEL) for these two compounds is 150 ppm.

Because of a wide variation in individual susceptibility, however, a small percentage of workers may experience discomfort to chemical substances at concentrations equal to or below TLV. A still smaller percentage of persons may be affected more seriously from exposures at or below TLV due to aggravation of a pre-existing condition or the development of an occupational illness. TLVs are based on the best available information from industrial experience, from experimental human and animal studies, and when possible from a combination of the three sources.

The time-weighted average TLV, or TLV-TWA, represents a time-weighted average exposure for an 8-hour work day, 40-hour work week. The majority of TLVs are expressed as TLV-TWAs. Certain substances have a "skin" notation following the TLV which implies that the overall exposure to a substance is enhanced by skin, mucous membrane, and/or eye exposure. Some substances have a ceiling value designated by the letter "C." Ceiling values should not be exceeded at any time during the work day.

6.1.2 Potential Safety Hazards at Site

Potential Safety Hazard	Required Control Measure(s)
Flying particulate	Goggles and/or safety glasses shall be worn.
Objects striking foot	Boots shall have steel-reinforced toes.
Slips, trips, falls	Attempts shall be made to minimize slips, trips, and falls by providing clear footing.
Noise	Ear plugs/ear muffs will be worn as warranted by noise level determinations.
Exposure of organic compounds from contaminated and treated pile	Disposable gloves, coveralls, and boot covers will be worn when sampling the contaminated and treated pile.
Emissions from contaminated pile	A VOC emissions action level of 50 ppm will be set. An OVA will be available to monitor the excavated area and the excavated pile. If the

VOC exceeds 50 ppm above background levels for 5 minutes, work will be interrupted until the VOC level returns to background concentrations.

6.1.3 Anticipated Weather Conditions

The anticipated weather conditions at Crows Landing, California, during the proposed work time schedule is expected to include temperatures ranging from approximately the mid 40s°F to the mid 70s°F, with a possibility of light wind and rain.

6.1.4 Key Personnel and Responsibilities

- Mr. Gregory L. Headington, Senior Research Technician, has more than 10 years of field sampling experience and will be responsible for the sampling of soil and stack emission (VOST protocol). Experience/training includes involvement in numerous field sampling programs and satisfactory completion of the 40-hour Hazardous Waste Training Course plus 8-hour refresher courses.

- Dr. Say Kee Ong, Project Leader, will be responsible for supervision, record keeping, and chain-of-custody. His experience includes subsurface soil sampling, soil gas sampling and analysis, and laboratory skills in the analysis of physico-chemical properties of soils.

- Mr. William Baytos, Research Scientist, has been involved in several major programs involving stack emission measurements for various government agencies and industries. He has conducted stack emissions for at least 30 different electric utility plants and industries such as lead smelters and ammunition manufacturers.

- Mr. Curtis Bridges, Senior Research Technician, has experience in field sampling will be involved in stack sampling, sample packing, and inventory management.

6.2 Risk Assessment Summary

The sampling will involve only minimal disturbance to the excavated area, treated pile, and the stack emission of the activated carbon column. No

risk to the communities at or near the site or to the environment is anticipated as a result of the collection of the samples. The source of exposure to the workers will be from organic vapors when emptying the sampling device, the compositing of the samples, and filling of the sample bottles. The total organic vapor exposure as a result of these activities is not expected to approach the concentration limits of an 8-hour, time-weighted average as listed in Table 2.

6.3 Personal Protective Equipment

Based upon the risk assessment that exposure to vapor concentrations of hydrocarbons during the collection of the samples will be below the applicable threshold limit values, Level D personal protective equipment shall be worn by all persons entering the work site. The Level D equipment includes the following:

- Coveralls
- Steel-toed boots
- Gloves
- Safety glasses

In addition, Level C equipment shall be available in the event that upgrading of the protection level is required. This equipment will include outer disposable coveralls; chemical-protective gloves and boots; and negative pressure, NIOSH-approved cartridge respirators, in addition to Level D equipment. Level C personal protective equipment will be donned if unusual odors are detected or if any irritation of the eyes, nose, or throat is detected.

6.4 Work Practices

The workers will remain upwind of all activities that are expected to result in the potential release of airborne contaminants. This includes

emptying the sampling device, compositing the sample, and filling the sample bottles.

No eating, drinking, chewing of gum or tobacco, or smoking will be permitted in the work area.

Any skin contact with contaminated or potentially contaminated surfaces, samples, or equipment shall be avoided.

Removal of materials from protective clothing or equipment by blowing, shaking, or any other means that could disperse contaminated materials is prohibited.

6.5 Decontamination

All disposable materials, including disposable gloves, paper towels, etc., will be placed in appropriately marked containers (e.g., plastic bags) and disposed of as nonhazardous waste. Sampling equipment will be decontaminated with paper towels and by three wipe-downs with damp paper towels at the conclusion of the sampling.

6.6 Emergency Plans

The Points-of-Contact at the NALF, Cross Landing in the event of an emergency are as follows:

Del Puerto Hospital, Patterson -	(209) 892-8781
Patterson Ambulance Service -	(800) 841-2626 or (209) 838-7093
National Response Center -	(800) 924-8802
EPA, Emergency Response Section -	(415) 974-7511
Poison Control Center -	(800) 342-9293
Chemtrec (24 hours) -	(800) 424-9300
Department of Health Services, Modesto -	(209) 576-6460
Safety Officer - NALF Contact Petty Officer Whitmore	(415) 966-5386
Base Security - NALF -	(209) 837-4781
Fire Department - NALF -	(209) 837-4781
Officer-in-Charge, NALF -	(209) 837-4781

Mr. Steve Chao - WESTDIV/NAVFAC -	(415) 244-2551
NCEL Contact, Mr. Tom Torres	(805) 982-1658
Battelle Contact, Dr. Jeffrey Means	(614) 424-5442
Dr. Say Kee Ong	(614) 424-3958
Weston Services, Inc., Mr. Mike Cosmos	(215) 430-7423
Ms. Andrea Cohen	(215) 344-3445

The emergency care medical facility nearest the subject site is Del Puerto Hospital located at 9th and E. Streets, Patterson, California. The police, fire department, paramedics, and ambulance may be reached via telephone by dialing 911.

These telephone numbers shall be posted at the worksite.

7.0 REFERENCES

ERM-West. Report on Site Investigation Naval Auxiliary Landing, Field Crows Landing Fire Fighting School, Crows Landing, California. Prepared for Dept. of Navy, Western Division Naval Facilities Engineering Command. November 1988.

APPENDIX D

SOIL SAMPLES DATA (TPH & BTEX AND NUTRIENTS)

Battelle
Columbus Laboratories

CHAIN OF CUSTODY RECORD

Form No. 01
V-91108008

Proj. No. G9860-9101

Project Title: CROWS LANDING

SAMPLERS: (Signature) Duncan L. Headington

DATE	TIME	SEQ. NO.	CART. NO.	SAMPLE I.D.	SAMPLE TYPE (√) TPH-G PLUS BTEX	Container No.	Number of Containers	Remarks
20MAR91	0940	—	—	CROW-1-AB	✓		2	
20MAR91	1000	—	—	CROW-2-AB	✓		2	
20MAR91	1110	—	—	CROW-3-AB	✓		2	

Received chilled & sealed

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Duncan L Headington	20MAR91 1330				
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature) 3/21/91 1000	Date/Time	Remarks TO: ENSECO-CRL/VENTURA PO Z6237 STANDARD TURNAROUND	

ATTN. LEO RAAB

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Battelle
Columbus Laboratories

Form No. 02

CHAIN OF CUSTODY RECORD

Proj. No. 79860-9101

Project Title: CROWS LANDING

SAMPLERS: (Signature) Curtis Bridge

DATE	TIME	SEQ. NO.	CART. NO.	SAMPLE I.D.	TPH + BTEX (G)	PURGEABLE ORGANICS (8240)	Container No.	Number of Containers	Remarks
25 MAR 91	1204			CROW-9-AB	✓			2	STD. TURNAROUND
25 MAR 91	1204			CROW-9-BB		✓		2	STD. TURNAROUND
									Recieved chilled & intact

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Duane L Hardy	26 MAR 91 1050				

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)

Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks
		[illegible]	3/27/91 1030	SHIP TO ENSECO-CRL/VENTURA ATT. LEO RAAB

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1a

Battelle
Columbus Laboratories

CHAIN OF CUSTODY RECORD

Form No. 03 ( )
V-9108803

Proj. No. G9860 9/01
Project Title: CROWS LANDING

SAMPLERS: (Signature) Curtis Bridges

DATE	TIME	SEQ. NO.	CART. NO.	SAMPLE I.D.	TPH-G	BTEX (Purgeable Organics) (8240)	Container No.	Number of Containers	Remarks
27 Mar. 91	1400			CROW-19-AT	✓			2	STD. TURNAROUND
27 Mar. 91	1300			CROW-18-AU	✓			2	" "
27 Mar. 91	1300			CROW-19-CT		✓		1	
27 Mar. 91	1400			CROW-19-BT		✓		1	STD. TURNAROUND
27 Mar. 91	1400			CROW-12-AT	✓			2	24 HOUR TURNAROUND
27 Mar. 91	1500			CROW-13-AT	✓			2	24 HOUR TURNAROUND
27 Mar. 91	1600			CROW-14-AT	✓			2	24 HOUR TURNAROUND

Chilled & seals intact

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Curtis Bridges	27 March 1710				
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks	
		W. Edwards	8/29/91 1000	SHIP TO ENSECO-CRL/VENTURA ATT. LEO RAAB PO Z 6237	

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Battelle
Columbus Laboratories

CHAIN OF CUSTODY RECORD

Form No. 67

Nitrate-Nitrogen, % Moisture, Phosphorus Total, Potassium, Total, Sulfate-Sulfur

Proj. No. D-4860-9101

Project Title: CROWS LANDING

SAMPLER(S) (Signature): Curtis Bridges

SAMPLE TYPE (√): TPH-G, BTEX, PURGEABLE ORGANICS (VOA), NITRATE

DATE	TIME	SEQ. NO.	CART. NO.	SAMPLE I.D.	TPH-G BTEX	PURGEABLE ORGANICS (VOA)	NITRATE	Container No.	Number of Containers	Remarks
29 March	0920			CROW-16-AU	✓				2	STD. TURNAROUND
29 March	0930			CROW-17-AT	✓				2	STD. TURNAROUND
29 March	0930			CROW-17-BT		✓			1*	STD. TURNAROUND
03 APR.	1015			CROW-4-AB	✓				2	
03 APR.	1015			CROW-4-BB		✓			2	
03 APR.	1030			CROW-5-AB	✓				2	
03 APR.	1030			CROW-5-BB		✓			2	
03 APR.	1045			CROW-6-AB	✓				2	
03 APR.	1045			CROW-6-BB		✓			2	
03 APR	1245			CROW-10-AU	✓				2	
03 APR.	1245			CROW-10-BU		✓			2	
03 APR.	1245			CROW-10-CU			✓		2	
03 APR.	1310			CROW-11-AT	✓				2	
03 APR.	1310			CROW-11-BT		✓			2	
03 APR.	1310			CROW-11-CT			✓		2	STD. TURNAROUND

* Received chilled & sealed (w/ black tape)

* 2 samples for Crow 17-B were delivered to Enseco

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Curtis Bridges	03 APR 1430				
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks	
		[illegible]	4/4/91 1000	TO: ENSECO-CRL/VENTURA ATT: LEO RAAB	

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Battelle
Columbus Laboratories

CHAIN OF CUSTODY RECORD

Form No. 08

V-9109519

Proj. No. G-9860 9101

Project Title: CROWS LANDING

SAMPLERS: (Signature) Curtis Bridges

DATE	TIME	SEQ. NO.	CART. NO.	SAMPLE I.D.	TPH + BTEX	Purgeable Chlorinated Solvents 8240	Container No.	Number of Containers	Remarks
05 APRIL	1030			CROW-7-AB	✓			2	STD TURNAROUND
05 APRIL	1030			CROW-7-BB		✓		2	
05 APRIL	1115			CROW-20-AU	✓			2	
05 APRIL	1115			CROW-21-AT	✓			2	STD. TURNAROUND

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
C. Bridges	05 April ~~1300~~ 1300				

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)

Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks
			4/6/91 1200	ENSECO-CRL / VENTRA ATTN. LEO RAAB

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Battelle
Columbus Laboratories

CHAIN OF CUSTODY RECORD

Form No. 09

Proj. No. G9860 9101

Project Title: CROW-LANDING

SAMPLERS: (Signature) Curtis Bridges

SAMPLE TYPE (✓): TPH + BTEX; ORGANIC CARBON; NUTRIENTS (N, PHOSPHORUS - TOTAL, Potassium, IRON, Sulfate - sulfur, % MOISTURE)

DATE	TIME	SEQ. NO.	CART. NO.	SAMPLE I.D.	TPH + BTEX	ORGANIC CARBON	NUTRIENTS	Container No.	Number of Containers	Remarks
08 APR	1015			CROW-22-AU	✓				2	STD. TURNAROUND
08 APR	1015			CROW-22-BU		✓			2	STD. TURNAROUND
08 APR	1015			CROW-22-CU			✓		2	STD. TURNAROUND
08 APR	1025			CROW-23-AT	✓				2	STD. TURNAROUND
08 APR	1025			CROW-23-BT		✓			2	STD. TURNAROUND
08 APR	1025			CROW-23-CT			✓		2	STD. TURNAROUND

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Curtis Bridges	08 APR 1140				
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks	
		[illegible]	4/9/91 930	ATTN LEO RAAS ENSECO-CRL/VENTURA	

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Battelle
Columbus Laboratories

CHAIN OF CUSTODY RECORD

Form No. 10

V-9110104

Proj. No.	Project Title
G9860 9101	CROWS LANDING

SAMPLERS: (Signature) Tom Torres

DATE	TIME	SEQ. NO.	CART. NO.	SAMPLE I.D.	SAMPLE TYPE (√) GAS TPH + BTEX	Container No.	Number of Containers	Remarks
4-10-91	1230			CROW-26-AU	✓		2	STD. TURNAROUND
4-10-91	1230			CROW-26-AT	✓		2	STD. TURNAROUND

*recieved w/ black tape around lids as a sealer

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
	4-10-90 1230				

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)

Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks
			4/4/91 1030	ATTN. LEO RAAB ENSECO-CRL/VENTURA

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Battelle
Columbus Laboratories

CHAIN OF CUSTODY RECORD

Form No. 770 V-9111503

Proj. No. G-9860 9101

Project Title: CROWS LANDING

SAMPLERS: (Signature) Curtis Bridges

SAMPLE TYPE (√): TPH + BTEX; PURGEABLE ORGANICS; NUTRIENTS: PHOSPHORUS - TOTAL, POTASSIUM, IRON, SULFATE - SULFUR, % MOISTURE

DATE	TIME	SEQ. NO.	CART. NO.	SAMPLE I.D.	TPH + BTEX	PURGEABLE ORGANICS	NUTRIENTS	Container No.	Number of Containers	Remarks
22 APR 91	1330			CROW-24-A4	✓				2	REF.
22 APR	1330			CROW-24-B4		✓			2	REF.
22 APR	1330			CROW-24-C4			✓		2	REF.
22 APR	1330			CROW-25-AT	✓				2	REF.
22 APR	1330			CROW-25-BT		✓			2	REF.
22 APR.91	1330			CROW-25-CT			✓		2	REF.
24 APR.91	1300			CROW-28-A4	✓				2	REF.
24 APR.91	1300			CROW-29-AT	✓				2	REF.
24 APR.91	1300			CROW-29-BT		✓			2	REF.
				All Samples received chilled & sealed with black electricians tape						

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Curtis Bridges	24 APR. 1345				
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks	
		M Edward	4/25/91 1100	ENSECO - CRL / VENTURA PO Z 6237 STANDARD TURNAROUND ATT. LEO RAAB	

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ATT. 2 to XMTL

Battelle
Columbus Laboratories

CHAIN OF CUSTODY RECORD

Form No. 120

V-9111607

Proj. No. G-9860 9101

Project Title: CROWS LANDING

SAMPLERS: (Signature) Curtis Bridges

DATE	TIME	SEQ. NO.	CART. NO.	SAMPLE I.D.	Gas TPH-BTEX	Container No.	Number of Containers *	Remarks
25 APR 91	1130			CROW-30-AT	✓		2	24 HR TURNAROUND
25 APR 91	1145			CROW-31-AT	✓		2	24 HR TURNAROUND
25 APR 91	1205			CROW-32-AT	✓		2	24 HR TURNAROUND
25 APR 91	1215			CROW-33-AT	✓		2	24 HR TURNAROUND
25 APR 91	1220			CROW-34-AT	✓		2	24 HR TURNAROUND
25 APR 91	1225			CROW-35-AT	✓		2	24 HR TURNAROUND
25 APR 91	1245			CROW-36-AT	✓		2	24 HR TURNAROUND

* 1 of 2 containers wrapped black electrical tape 4/26 JLL

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Curtis Bridges	25 APR 91 1420				
Relinquished by: (Signature)	**Date/Time**	**Received by: (Signature)**	**Relinquished by: (Signature)**	**Date/Time**	**Received by: (Signature)**
Relinquished by: (Signature)	**Date/Time**	**Received for Laboratory by: (Signature)**	**Date/Time**	**Remarks**	
		J Lovelace	4/26/91 3:15 PM	PO Z6237	ENSECO-CRL / VENTURA

Page 1 of 1

ATT: LEO ROAIS

Battelle
Columbus Laboratories

CHAIN OF CUSTODY RECORD

Form No. 130

V-9111703

Proj. No. G 9860 9101

Project Title: CROWS LANDING

SAMPLERS: (Signature) Curtis Bridges

DATE	TIME	SEQ. NO.	CART. NO.	SAMPLE I.D.	TPH + BTEX	HALOGENATED ORGANICS											Container No.	Number of Containers	Remarks
26 APR. 91	1000			CROW-8-AB	✓													2	24 HOUR TURNAROUND
26 APR 91	1000			CROW-8-BB		✓	26 April 91											2	~~[illegible]~~
26 APR. 91	1000			CROW-8.1-AB	✓													2	24 HOUR TURNAROUND
26 APR 91	1000			CROW-8.2-AB	✓													2	24 HOUR TURNAROUND

STANDARD TURNAROUND

Sealed in Black electrical tape

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Curtis Bridges	26 APR 91				

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)

Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks
		J. Lovelace	4-29-91 10:00 AM	ENSECO-CAL / VENTURA PO Z 6237

Page 1 of 1

ATTN. L. R99D

Form No. V7106

Battelle
Columbus Laboratories

CHAIN OF CUSTODY RECORD

Proj. No.: G 9860-9101

Project Title: CROWS LANDING

SAMPLERS: (Signature)

DATE	TIME	SEQ. NO.	CART. NO.	SAMPLE I.D.	TPH-BTEX	Container No.	Number of Containers	Remarks
5-13-91				CROW-37-AT	✓		2	NORMAL TURNAROUND
				CROW-38-AT	✓		2	NORMAL TURNAROUND
				CROW-39-AT	✓		2	NORMAL TURNAROUND
				CROW-40-AT	✓		2	NORMAL TURNAROUND

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
[illegible]	5-17-91				

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)

Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks
		[illegible]	5/14/91 1550	

Page ____ of ____

Recorded 4/29

Enseco
A Corning Company

Recorded 7/1

Enseco - CRL
2810 Bunsen Ave. Unit A • Ventura, CA 93003
(805) 650-0546 • FAX: (805) 650-0756

5-APR-91

Battelle
505 King Avenue
Columbus, OH 43201-2693
ATTN: Mr. Greg Headington

Analysis No.: V-9108008-001/003
Date Sampled: 20-MAR-1991
Date Sample Rec'd: 21-MAR-1991
Project: CROW'S LANDING PROJECT #G-9860-9101

Enclosed with this letter is the report on the chemical, biological and/or physical analyses on the samples from ANALYSIS NO: V-9108008-001/003 shown above.

The samples were received by CRL in a chilled state, intact and with the chain-of custody record attached.

Note that ND means not detected at the reporting limit (RL) expressed. The detection limit is the reporting limit raised to reflect the dilution factor of the sample.

Solid samples are reported on "as received" basis.

J Lovelace
Reviewed

Approved

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This report pertains only to the samples investigated and does not necessarily apply to other apparently identical or similar materials. This report is submitted for the exclusive use of the client to whom it is addressed. Any reproduction of this report or use of this Laboratory's name for advertising or publicity purposes without authorization is prohibited

Enseco
A Corning Company

Laboratory Report

Battelle
505 King Avenue
Columbus, OH 43201
ATTN: Greg Headington

Analysis No.: V-9108008-001/003
Date Sampled: 20-MAR-1991
Date Sample Rec'd: 21-MAR-1991
Date Analyzed: 3-APR-1991
27-MAR-1991
Sample Type: SOLID

Project: Crow's Landing Project #G-9860-9101

Sample ID	TPH as Gasoline mg/kg CA DHS LUFT	Benzene mg/kg EPA 8020	Toluene mg/kg EPA 8020	Ethyl Benzene mg/kg EPA 8020	Xylenes, Total mg/kg EPA 8020
Crow-1-AB	ND(1)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)
Crow-2-AB	ND(1)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)
Crow-3-AB	ND(1)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)
Blank	ND(1)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)

Enseco
A Corning Company

Recorded 7/1/91

Enseco - CRL
2810 Bunsen Ave. Unit A • Ventura, CA 93003
(805) 650-0546 • FAX: (805) 650-0756

11-APR-91

Battelle
505 King Avenue
Columbus, OH 43201-2693
ATTN: Mr. Greg Headington

Analysis No.: V-9108603-001/002
Date Sampled: 25-MAR-1991
Date Sample Rec'd: 27-MAR-1991
Project: CROW'S LANDING
Project #G9860-9101

Enclosed with this letter is the report on the chemical, biological and/or physical analyses on the samples from ANALYSIS NO: V-9108603-001/002 shown above.

The samples were received by CRL in a chilled state, intact and with the chain-of custody record attached.

Note that ND means not detected at the reporting limit (RL) expressed. The detection limit is the reporting limit raised to reflect the dilution factor of the sample.

Solid samples are reported on "as received" basis.

J Lovelace
Reviewed

Approved

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Laboratory Report

Battelle
505 King Avenue
Columbus, OH 43201
ATTN: Greg Headington

Analysis No.: V-9108603-001/001
Date Sampled: 25-MAR-1991
Date Sample Rec'd: 27-MAR-1991
Date Analyzed: 4-APR-1991
2-APR-1991
Sample Type: SOIL

Project: Crow's Landing Project #G9860-9101

Sample ID	TPH as Gasoline mg/kg CA DHS LUFT	Benzene mg/kg EPA 8020	Toluene mg/kg EPA 8020	Ethyl Benzene mg/kg EPA 8020	Xylenes, Total mg/kg EPA 8020
Crow-9-AB	1	ND(0.005)	ND(0.005)	ND(0.005)	0.031
Blank	ND(1)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)

Enseco
A Corning Company

Laboratory Report

Battelle
505 King Avenue
Columbus, OH 43201
ATTN: Greg Headington

Analysis No.: V-9108603-002/002
Date Sampled: 25-MAR-1991
Date Sample Rec'd: 27-MAR-1991
Date Analyzed: 10-APR-1991
Sample Type: SOIL

Project: Crow's Landing Project #G9860-9101

Sample ID	EPA 8240
	EPA 8240
Crow-9-BB	ATTACHED
Blank	

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Recorder for AT

Enseco - CRL
2810 Bunsen Ave. Unit A • Ventura, CA 93003
(805) 650-0546 • FAX: (805) 650-0756

22-APR-91

Battelle
505 King Avenue
Columbus, OH 43201-2693
ATTN: Mr. Greg Headington

Analysis No.: V-9108803-001/007
Date Sampled: 27-MAR-1991
Date Sample Rec'd: 29-MAR-1991
Project: CROW'S LANDING PROJECT #G9860-9101

Enclosed with this letter is the report on the chemical, biological and/or physical analyses on the samples from ANALYSIS NO: V-9108803-001/007 shown above.

The samples were received by CRL in a chilled state, intact and with the chain-of custody record attached.

Note that ND means not detected at the reporting limit (RL) expressed. The detection limit is the reporting limit raised to reflect the dilution factor of the sample.

Solid samples are reported on "as received" basis.

G Lovelace
Reviewed

Approved

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Laboratory Report

Battelle
505 King Avenue
Columbus, OH 43201
ATTN: Greg Headington

Analysis No.: V-9108803-001/007
Date Sampled: 27-MAR-1991
Date Sample Rec'd: 29-MAR-1991
Date Analyzed: 10-APR-1991
19-APR-1991
29-MAR-1991
Sample Type: SOIL

Project: Crow's Landing Project #G9860-9101

Sample ID	TPH as Gasoline mg/kg CA DHS LUFT	TPH as Gasoline mg/kg CA DHS LUFT	EPA 8240 EPA 8240
Crow-19-AT		16 *	
Crow-18-AU	50 *		
Crow-19-CT			ATTACHED
Crow-19-BT			ATTACHED
Crow-12-AT	4 *		
Crow-13-AT	21 *		
Crow-14-AT	17 *		
Blank	ND(1)	ND(1)	

Atypical of Gasoline. Value includes higher-boiling hydrocarbons.

Enseco
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Laboratory Report

Battelle
505 King Avenue
Columbus, OH 43201
ATTN: Greg Headington

Analysis No.: V-9108803-001
Date Sampled: 27-MAR-1991
Date Sample Rec'd: 29-MAR-1991
Sample Type: SOIL
Date Prepared: 2-APR-1991
Prep Method: EPA 5030 By: JG
Date Analyzed: 2-APR-1991 By: JG

Project: Crow's Landing Project #G9860-9101
Sample ID: Crow-19-AT

Volatile Aromatic Hydrocarbons (EPA 8020)

Units: mg/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL
Benzene	ND	0.005	ND	.005
Toluene	0.044	0.005	ND	.005
Ethyl Benzene	ND	0.005	ND	.005
Xylenes, Total	ND	0.015	ND	.015

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Laboratory Report

Battelle
505 King Avenue
Columbus, OH 43201
ATTN: Greg Headington

Analysis No.: V-9108803-002
Date Sampled: 27-MAR-1991
Date Sample Rec'd: 29-MAR-1991
Sample Type: SOIL
Date Prepared: 2-APR-1991
Prep Method: EPA 5030 By: JG
Date Analyzed: 2-APR-1991 By: JG

Project: Crow's Landing Project #G9860-9101
Sample ID: Crow-18-AU

Volatile Aromatic Hydrocarbons (EPA 8020)

Units: mg/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL
Benzene	ND	0.005	ND	.005
Toluene	ND	0.005	ND	.005
Ethyl Benzene	ND	0.005	ND	.005
Xylenes, Total	ND	0.015	ND	.015

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Laboratory Report

Battelle
505 King Avenue
Columbus, OH 43201
ATTN: Greg Headington

Analysis No.: V-9108803-005
Date Sampled: 27-MAR-1991
Date Sample Rec'd: 29-MAR-1991
Sample Type: SOIL
Date Prepared: 29-MAR-1991
Prep Method: EPA 5030 By: JG
Date Analyzed: 29-MAR-1991 By: JG

Project: Crow's Landing Project #G9860-9101
Sample ID: Crow-12-AT

Volatile Aromatic Hydrocarbons (EPA 8020)

Units: mg/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL
Benzene	ND	0.005	ND	.005
Toluene	0.027	0.005	ND	.005
Ethyl Benzene	ND	0.005	ND	.005
Xylenes, Total	ND	0.015	ND	.015

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Laboratory Report

Battelle
505 King Avenue
Columbus, OH 43201
ATTN: Greg Headington

Analysis No.: V-9108803-006
Date Sampled: 27-MAR-1991
Date Sample Rec'd: 29-MAR-1991
Sample Type: SOIL
Date Prepared: 29-MAR-1991
Prep Method: EPA 5030 By: JG
Date Analyzed: 29-MAR-1991 By: JG

Project: Crow's Landing Project #G9860-9101
Sample ID: Crow-13-AT

Volatile Aromatic Hydrocarbons (EPA 8020)

Units: mg/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL
Benzene	ND	0.005	ND	.005
Toluene	0.078	0.005	ND	.005
Ethyl Benzene	ND	0.005	ND	.005
Xylenes, Total	ND	0.015	ND	.015

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Laboratory Report

Battelle
505 King Avenue
Columbus, OH 43201
ATTN: Greg Headington

Analysis No.: V-9108803-007
Date Sampled: 27-MAR-1991
Date Sample Rec'd: 29-MAR-1991
Sample Type: SOIL
Date Prepared: 29-MAR-1991
Prep Method: EPA 5030 By: JG
Date Analyzed: 29-MAR-1991 By: JG

Project: Crow's Landing Project #G9860-9101
Sample ID: Crow-14-AT

Volatile Aromatic Hydrocarbons (EPA 8020)

Units: mg/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL
Benzene	ND	0.005	ND	.005
Toluene	0.14	0.005	ND	.005
Ethyl Benzene	ND	0.005	ND	.005
Xylenes, Total	ND	0.015	ND	.015

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Enseco - CRL
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(805) 650-0546 • FAX: (805) 650-0756

23-APR-91

Battelle
505 King Avenue
Columbus, OH 43201-2693
ATTN: Mr. Greg Headington

Analysis No.: V-9109404-001/015
Date Sampled: 29-MAR-1991/03-APR-1991
Date Sample Rec'd: 4-APR-1991
Project: CROW'S LANDING PROJECT #G-9860-9101

Enclosed with this letter is the report on the chemical, biological and/or physical analyses on the samples from ANALYSIS NO: V-9109404-001/015 shown above.

The samples were received by CRL in a chilled state, intact and with the chain-of custody record attached.

Note that ND means not detected at the reporting limit (RL) expressed. The detection limit is the reporting limit raised to reflect the dilution factor of the sample.

Solid samples are reported on "as received" basis.

G Lovelace
Reviewed

Approved

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Laboratory Report

Battelle
505 King Avenue
Columbus, OH 43201
ATTN: Greg Headington

Analysis No.: V-9109404-001/015
Date Sampled: 29-MAR-1991
3-APR-1991
Date Sample Rec'd: 4-APR-1991
Date Analyzed: 5-APR-1991
6-APR-1991
12-APR-1991
23-APR-1991
Sample Type: SOIL

Project: Crow's Landing Project #G-9860-9101

Sample ID	Benzene mg/kg EPA 8020	Toluene mg/kg EPA 8020	Ethyl Benzene mg/kg EPA 8020	Xylenes, Total mg/kg EPA 8020	Iron mg/kg EPA 7380
Crow-16-AU	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)	
Crow-17-AT	ND(0.005)	0.012	ND(0.005)	ND(0.015)	
Crow-04-AB	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)	
Crow-05-AB	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)	
Crow-06-AB	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)	
Crow-10-AU	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)	
Crow-10-CU					25000
Crow-11-AT	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)	
Crow-11-CT					25000
Blank	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)	ND(1)

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Laboratory Report

Battelle
505 King Avenue
Columbus, OH 43201
ATTN: Greg Headington

Analysis No.: V-9109404-001/015
Date Sampled: 29-MAR-1991
3-APR-1991
Date Sample Rec'd: 4-APR-1991
Date Analyzed: 10-APR-1991
15-APR-1991
12-APR-1991
Sample Type: SOIL

Project: Crow's Landing Project #G-9860-9101

Sample ID	Nitrate (N) mg/kg EPA 300.0	TPH as Gasoline mg/kg CA DHS LUFT
Crow-16-AU		36 *
Crow-17-AT		25 *
Crow-04-AB		ND(1)
Crow-05-AB		ND(1)
Crow-06-AB		ND(1)
Crow-10-AU		ND(1)
Crow-10-CU	12	
Crow-11-AT		ND(1)
Crow-11-CT	9.0	
Blank	ND(1)	ND(1)

Atypical of Gasoline. Value includes higher-boiling hydrocarbons.

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A Corning Company

Laboratory Report

Battelle
505 King Avenue
Columbus, OH 43201
ATTN: Greg Headington

Analysis No.: V-9109404-003/015
Date Sampled: 29-MAR-1991
3-APR-1991
Date Sample Rec'd: 4-APR-1991
Date Analyzed: 17-APR-1991
16-APR-1991
10-APR-1991
12-APR-1991
Sample Type: SOIL

Project: Crow's Landing Project #G-9860-9101

Sample ID	Potassium mg/kg EPA 7610	Moisture % % MOISTURE	Sulfate mg/kg EPA 300.0	Phosphorus-Total (P) mg/kg EPA 365.1	EPA 8240 EPA 8240
Crow-17-BT					ATTACHED
Crow-04-BB					ATTACHED
Crow-05-BB					ATTACHED
Crow-06-BB					ATTACHED
Crow-10-BU					ATTACHED
Crow-10-CU	420	15	120	ND(0.25)	
Crow-11-BT					ATTACHED
Crow-11-CT	360	12	100	1.1	
Blank	ND(1)	ND()	ND(10)	ND(0.25)	

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Enseco - CRL
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(805) 650-0546 • FAX: (805) 650-0756

23-APR-91

Battelle
505 King Avenue
Columbus, OH 43201-2693
ATTN: Mr. Greg Headington

Analysis No.: V-9109519-001/004
Date Sampled: 5-APR-1991
Date Sample Rec'd: 6-APR-1991
Project: CROW'S LANDING PROJECT #G-9860-9101

Enclosed with this letter is the report on the chemical, biological and/or physical analyses on the sample from ANALYSIS NO: V-9109519-001/004 shown above.

The samples were received by CRL in a chilled state, intact and with the chain-of custody record attached.

Note that ND means not detected at the reporting limit (RL) expressed. The detection limit is the reporting limit raised to reflect the dilution factor of the sample.

Solid samples are reported on "as received" basis.

Reviewed

Approved

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Enseco
A Corning Company

Laboratory Report

Battelle
505 King Avenue
Columbus, OH 43201
ATTN: Greg Headington

Analysis No.: V-9109519-001/004
Date Sampled: 5-APR-1991
Date Sample Rec'd: 6-APR-1991
Date Analyzed: 12-APR-1991
16-APR-1991
17-APR-1991
18-APR-1991
Sample Type: SOIL

Project: Crow's Landing Project #G-9860-9101

Sample ID	TPH as Gasoline mg/kg CA DHS LUFT	Benzene mg/kg EPA 8020	Toluene mg/kg EPA 8020	Ethyl Benzene mg/kg EPA 8020	Xylenes, Total mg/kg EPA 8020
Crow-7-AB	ND(1)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)
Crow-20-AU	24 *	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)
Crow-21-AT	ND(1)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)
Blank	ND(1)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)

Atypical of Gasoline. Chromatogram indicates a hydrocarbon pattern similar to a petroleum naphtha such as Paint Thinner.

Enseco
A Corning Company

Laboratory Report

Battelle
505 King Avenue
Columbus, OH 43201
ATTN: Greg Headington

Analysis No.: V-9109519-002/002
Date Sampled: 5-APR-1991
Date Sample Rec'd: 6-APR-1991
Date Analyzed: 22-APR-1991
Sample Type: SOIL

Project: Crow's Landing Project #G-9860-9101

Sample ID	EPA 8240
	EPA 8240
Crow-7-BB	ATTACHED
Blank	

6

Enseco
A Corning Company

Enseco - CRL
2810 Bunsen Ave. Unit A • Ventura, CA 93003
(805) 650-0546 • FAX: (805) 650-0756

29-APR-91

Battelle
505 King Avenue
Columbus, OH 43201-2693
ATTN: Mr. Greg Headington

Analysis No.: V-9110104-001/002
Date Sampled: 10-APR-1991
Date Sample Rec'd: 11-APR-1991
Project: CROW'S LANDING - G-9860-9101

Enclosed with this letter is the report on the chemical, biological and/or physical analyses on the samples from ANALYSIS NO: V-9110104-001/002 shown above.

The samples were received by CRL in a chilled state, intact and with the chain-of custody record attached.

Note that ND means not detected at the reporting limit (RL) expressed. The detection limit is the reporting limit raised to reflect the dilution factor of the sample.

Solid samples are reported on "as received" basis.

Reviewed

Approved

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A Corning Company

Laboratory Report

Battelle
505 King Avenue
Columbus, OH 43201
ATTN: Greg Headington

Analysis No.: V-9110104-001/002
Date Sampled: 10-APR-1991
Date Sample Rec'd: 11-APR-1991
Date Analyzed: 24-APR-1991
18-APR-1991
Sample Type: SOIL

Project: Crow's Landing - G-9860-9101

Sample ID	TPH as Gasoline mg/kg CA DHS LUFT	Benzene mg/kg EPA 8020	Toluene mg/kg EPA 8020	Ethyl Benzene mg/kg EPA 8020	Xylenes, Total mg/kg EPA 8020
Crow-26-AU	97 *	ND(0.1)	0.10	0.80	0.49
Crow-26-AT	4	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)
Blank	ND(1)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)

Atypical of Gasoline. Value includes higher-boiling hydrocarbons.

Enseco
A Corning Company

Laboratory Report

Battelle
505 King Avenue
Columbus, OH 43201
ATTN: Greg Headington

Analysis No.: V-9111607-001/007
Date Sampled: 25-APR-1991
Date Sample Rec'd: 26-APR-1991
Date Analyzed: 29-APR-1991
27-APR-1991
26-APR-1991
28-APR-1991
Sample Type: SOIL

Project: Crows Landing

Sample ID	TPH as Gasoline mg/kg CA DHS LUFT	Benzene mg/kg EPA 8020	Toluene mg/kg EPA 8020	Ethyl Benzene mg/kg EPA 8020	Xylenes, Total mg/kg EPA 8020
Crow-30-AT	ND(1)	ND(0.005)	0.006	ND(0.005)	ND(0.015)
Crow-31-AT	ND(1)	ND(0.005)	0.013	ND(0.005)	ND(0.015)
Crow-32-AT	ND(1)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)
Crow-33-AT	ND(1)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)
Crow-34-AT	ND(1)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)
Crow-35-AT	2	ND(0.005)	0.007	ND(0.005)	ND(0.015)
Crow-36-AT	ND(1)	ND(0.005)	0.008	ND(0.005)	ND(0.015)
Blank	ND(1)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)

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2-MAY-91

AMENDED REPORT

Analysis No.: V-9111607-001/007
Date Sampled: 25-APR-1991
Date Sample Rec'd: 16-APR-1991
Project: CROWS LANDING

Battelle
505 King Avenue
Columbus, OH 43201-2693
ATTN: Mr. Gregg Headington

Enclosed with this letter is the report on the chemical, biological and/or physical analyses on the samples from ANALYSIS NO: V-9111607-001/007 shown above.

The samples were received by CRL in a chilled state, intact and with the chain-of custody record attached.

Note that ND means not detected at the reporting limit (RL) expressed. The detection limit is the reporting limit raised to reflect the dilution factor of the sample.

Solid samples are reported on "as received" basis.

Reviewed

Approved

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Laboratory Report

Battelle
505 King Avenue
Columbus, OH 43201
ATTN: Greg Headington

Analysis No.: V-9111607-001/007
Date Sampled: 25-APR-1991
Date Sample Rec'd: 26-APR-1991
Date Analyzed: 29-APR-1991
27-APR-1991
26-APR-1991
28-APR-1991
Sample Type: SOIL

Project: Crows Landing

Sample ID	TPH as Gasoline mg/kg CA DHS LUFT	Benzene mg/kg EPA 8020	Toluene mg/kg EPA 8020	Ethyl Benzene mg/kg EPA 8020	Xylenes, Total mg/kg EPA 8020
Crow-30-AT	ND(1)	ND(0.005)	0.006	ND(0.005)	ND(0.015)
Crow-31-AT	ND(1)	ND(0.005)	0.013	ND(0.005)	ND(0.015)
Crow-32-AT	1	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)
Crow-33-AT	ND(1)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)
Crow-34-AT	ND(1)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)
Crow-35-AT	5	ND(0.005)	0.007	ND(0.005)	ND(0.015)
Crow-36-AT	ND(1)	ND(0.005)	0.008	ND(0.005)	ND(0.015)
Blank	ND(1)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)

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2-MAY-91

Battelle
505 King Avenue
Columbus, OH 43201-2693
ATTN: Mr. Greg Headington

Analysis No.: V-9109911-001/006
Date Sampled: 8-APR-1991
Date Sample Rec'd: 9-APR-1991
Project: CROWS LANDING G-9860-9101

Enclosed with this letter is the report on the chemical, biological and/or physical analyses on the samples from ANALYSIS NO: V-9109911-001/006 shown above.

The samples were received by CRL in a chilled state, intact and with the chain-of custody record attached.

Note that ND means not detected at the reporting limit (RL) expressed. The detection limit is the reporting limit raised to reflect the dilution factor of the sample.

-Solid samples are reported on "as received" basis.

Reviewed

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Laboratory Report

Battelle
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Columbus, OH 43201
ATTN: Greg Headington

Analysis No.: V-9109911-001/006
Date Sampled: 8-APR-1991
Date Sample Rec'd: 9-APR-1991
Date Analyzed: 16-APR-1991
12-APR-1991
Sample Type: SOIL

Project: Crow Landing G-9860-9101

Sample ID	Nitrate (N) mg/kg EPA 300.0	TPH as Gasoline mg/kg CA DHS LUFT
Crow-22-AU		ND(1)
Crow-22-CU	2.3	
Crow-23-AT		ND(1)
Crow-23-CT	7.2	
Blank	ND(1.0)	ND(1)

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Columbus, OH 43201
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Analysis No.: V-9109911-001/006
Date Sampled: 8-APR-1991
Date Sample Rec'd: 9-APR-1991
Date Analyzed: 16-APR-1991
23-APR-1991
Sample Type: SOIL

Project: Crow Landing G-9860-9101

Sample ID	Benzene mg/kg EPA 8020	Toluene mg/kg EPA 8020	Ethyl Benzene mg/kg EPA 8020	Xylenes, Total mg/kg EPA 8020	Iron mg/kg EPA 7380
Crow-22-AU	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)	
Crow-22-CU					20000
Crow-23-AT	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)	
Crow-23-CT					20000
Blank	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)	ND(1)

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Laboratory Report

Battelle
505 King Avenue
Columbus, OH 43201
ATTN: Greg Headington

Analysis No.: V-9109911-002/006
Date Sampled: 8-APR-1991
Date Sample Rec'd: 9-APR-1991
Date Analyzed: 1-MAY-1991
17-APR-1991
16-APR-1991
12-APR-1991
29-APR-1991
Sample Type: SOIL

Project: Crow Landing G-9860-9101

Sample ID	Potassium mg/kg EPA 7610	Moisture % % MOISTURE	Sulfate mg/kg EPA 300.0	Phosphorus-Total (P) mg/kg EPA 365.1	EPA 8240 EPA 8240
Crow-22-BU					ATTACHED
Crow-22-CU	74	12	100	84	
Crow-23-BT					ATTACHED
Crow-23-CT	160	10	220	89	
Blank	ND(1)	ND()	ND(10)	ND(0.25)	

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16-MAY-91

Battelle
505 King Avenue
Columbus, OH 43201-2693
ATTN: Mr. Greg Headington

Analysis No.: V-9111503-001/008
Date Sampled: 22/24-APR-1991
Date Sample Rec'd: 25-APR-1991
Project: CROW'S LANDING - G-9860-9101

Enclosed with this letter is the report on the chemical, biological and/or physical analyses on the samples from ANALYSIS NO: V-9111503-001/008 shown above.

The samples were received by CRL in a chilled state, intact and with the chain-of custody record attached.

Note that ND means not detected at the reporting limit (RL) expressed. The detection limit is the reporting limit raised to reflect the dilution factor of the sample.

Solid samples are reported on "as received" basis.

Reviewed

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Battelle
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ATTN: Greg Headington

Analysis No.: V-9111503-001/008
Date Sampled: 22-APR-1991
24-APR-1991
Date Sample Rec'd: 25-APR-1991
Date Analyzed: 29-APR-1991
3-MAY-1991
Sample Type: SOIL

Project: Crow's Landing - G-9860-9101

Sample ID	Nitrate (N) mg/kg EPA 300.0	TPH as Gasoline mg/kg CA DHS LUFT
Crow-24-AU		ND(1)
Crow-24-CU	3.5	
Crow-25-AT		ND(1)
Crow-25-CT	0.97	
Crow-28-AU		ND(1)
Crow-29-AT		ND(1)
Blank	ND(0.5)	ND(1)

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Battelle
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ATTN: Greg Headington

Analysis No.: V-9111503-001/008
Date Sampled: 22-APR-1991
24-APR-1991
Date Sample Rec'd: 25-APR-1991
Date Analyzed: 29-APR-1991
3-MAY-1991
8-MAY-1991
Sample Type: SOIL

Project: Crow's Landing - G-9860-9101

Sample ID	Benzene mg/kg EPA 8020	Toluene mg/kg EPA 8020	Ethyl Benzene mg/kg EPA 8020	Xylenes, Total mg/kg EPA 8020	Iron mg/kg EPA 7380
Crow-24-AU	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)	
Crow-24-CU					22000
Crow-25-AT	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)	
Crow-25-CT					22000
Crow-28-AU	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)	
Crow-29-AT	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)	
Blank	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)	ND(1)

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Laboratory Report

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ATTN: Greg Headington

Analysis No.: V-9111503-002/009
Date Sampled: 22-APR-1991
24-APR-1991
Date Sample Rec'd: 25-APR-1991
Date Analyzed: 13-MAY-1991
6-MAY-1991
1-MAY-1991
3-MAY-1991
9-MAY-1991
Sample Type: SOIL

Project: Crow's Landing - G-9860-9101

Sample ID	Potassium mg/kg EPA 7610	Moisture % % MOISTURE	Sulfate mg/kg EPA 300.0	Phosphorus-Total (P) mg/kg EPA 365.1	EPA 8240 EPA 8240
Crow-24-BU					ATTACHED
Crow-24-CU	1600	12	250	37	
Crow-25-BT					ATTACHED
Crow-25-CT	1500	7.4	250	12	
Crow-29-BT					ATTACHED
Blank	ND(1)	ND()	ND(10)	ND(0.25)	

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16-MAY-91

Battelle
505 King Avenue
Columbus, OH 43201-2693
ATTN: Mr. Greg Headington

Analysis No.: V-9111703-001/004
Date Sampled: 26-APR-1991
Date Sample Rec'd: 27-APR-1991
Project: CROW'S LANDING PROJECT I.D.
PROJECT I.D. #G-9860-9101

Enclosed with this letter is the report on the chemical, biological and/or physical analyses on the samples from ANALYSIS NO: V-9111703-001/004 shown above.

The samples were received by CRL in a chilled state, intact and with the chain-of custody record attached.

Note that ND means not detected at the reporting limit (RL) expressed. The detection limit is the reporting limit raised to reflect the dilution factor of the sample.

Solid samples are reported on "as received" basis.

Reviewed

Approved

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Laboratory Report

Battelle
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ATTN: Greg Headington

Analysis No.: V-9111703-001/004
Date Sampled: 26-APR-1991
Date Sample Rec'd: 27-APR-1991
Date Analyzed: 29-APR-1991
Sample Type: SOIL

Project: Crow's Landing Project I.D. #G-9860-9101

Sample ID	TPH as Gasoline mg/kg CA DHS LUFT	Benzene mg/kg EPA 8020	Toluene mg/kg EPA 8020	Ethyl Benzene mg/kg EPA 8020	Xylenes, Total mg/kg EPA 8020
Crow-8-AB	ND(1)	ND(0.005)	0.006	ND(0.005)	ND(0.015)
Crow-8.1-AB	ND(1)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)
Crow-8.2-AB	1	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)
Blank	ND(1)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)

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Laboratory Report

Battelle
505 King Avenue
Columbus, OH 43201
ATTN: Greg Headington

Analysis No.: V-9111703-002/002
Date Sampled: 26-APR-1991
Date Sample Rec'd: 27-APR-1991
Date Analyzed: 15-MAY-1991
Sample Type: SOIL

Project: Crow's Landing Project I.D. #G-9860-9101

Sample ID	EPA 8240
	EPA 8240
Crow-8-BB Blank	ATTACHED

12

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23-MAY-91

Battelle
505 King Avenue
Columbus, OH 43201-2693
ATTN: Mr. Greg Headington

Analysis No.: V-9113406-001/004
Date Sampled: 13-MAY-1991
Date Sample Rec'd: 14-MAY-1991
Project: CROW'S LANDING
PROJECT #G-9860-9101

Enclosed with this letter is the report on the chemical, biological and/or physical analyses on the samples from ANALYSIS NO: V-9113406-001/004 shown above.

The samples were received by CRL in a chilled state, intact and with the chain-of custody record attached.

Note that ND means not detected at the reporting limit (RL) expressed. The detection limit is the reporting limit raised to reflect the dilution factor of the sample.

Solid samples are reported on "as received" basis.

Reviewed

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Laboratory Report

Battelle
505 King Avenue
Columbus, OH 43201
ATTN: Greg Headington

Analysis No.: V-9113406-001/004
Date Sampled: 13-MAY-1991
Date Sample Rec'd: 14-MAY-1991
Date Analyzed: 17-MAY-1991
20-MAY-1991
21-MAY-1991
Sample Type: SOIL

Project: Crow's Landing Project #G-9860-9101

Sample ID	TPH as Gasoline mg/kg CA DHS LUFT	Benzene mg/kg EPA 8020	Toluene mg/kg EPA 8020	Ethyl Benzene mg/kg EPA 8020	Xylenes, Total mg/kg EPA 8020
Crow-37-AT	ND(1)	ND(0.005)	0.005	ND(0.005)	ND(0.015)
Crow-38-AT	1	ND(0.005)	0.011	ND(0.005)	ND(0.015)
Crow-39-AT	16 *	ND(0.005)	0.060	ND(0.005)	0.020
Crow-40-AT	5	ND(0.005)	0.037	ND(0.005)	ND(0.015)
Blank	ND(1)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.015)

Atypical of Gasoline. Value includes higher-boiling hydrocarbons.

APPENDIX E

SOIL SAMPLES DATA (PURGEABLE ORGANICS)

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Enseco - CRL
7440 Lincoln Way • Garden Grove, CA 92641
(714) 898-6370 • (213) 598-0458 • (800) LAB-1-CRL
FAX: (714) 891-5917

April 13, 1991

ENSECO CRL VENTURA
2810 BUNSEN AVE., UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109504-001/008
Date Sampled: 29-MAR/3-APR-1991
Date Sample Rec'd: 5-APR-1991
Project: (V-9109404) BATELLE/CROW'S LANDING

Enclosed with this letter is the report on the chemical and physical analyses on the samples from ANALYSIS NO: G-9109504-007/008 shown above.

The samples were received by CRL in a chilled state, intact and with the chain-of-custody record attached.

Note that ND means not detected at the reporting limit expressed. The reporting limit is raised to reflect the dilution factor of the sample.

Solid samples are reported on "as received" basis.

Reviewed

Approved

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109504-001
Date Sampled: 29-MAR-1991
Date Sample Rec'd: 5-APR-1991
Sample Type: SOLID
Date Prepared: 9-APR-1991
Prep Method: EPA 5030 By: JC
Date Analyzed: 9-APR-1991 By: JC

Project: (V-9109404) BATELLE/CROW'S LANDING
Sample ID: (V-9109404-003) CROW-17-BT

Purgeable Organics, EPA 8240

Units: ug/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL	FN
Chloromethane	ND	50	ND	10	
Bromomethane	ND	50	ND	10	
Vinyl Chloride	ND	50	ND	10	
Chloroethane	ND	50	ND	10	
Methylene Chloride	130	25	5.1	5	#
Acetone	800	50	ND	10	
Carbon Disulfide	ND	25	ND	5	
Trichlorofluoromethane	ND	25	ND	5	
1,1-Dichloroethene	ND	25	ND	5	
1,1-Dichloroethane	ND	25	ND	5	
Total 1,2-Dichloroethene	ND	25	ND	5	
Chloroform	ND	25	ND	5	
1,2-Dichloroethane	ND	25	ND	5	
2-Butanone	310	50	ND	10	
1,1,1-Trichloroethane	ND	25	ND	5	
Carbon Tetrachloride	ND	25	ND	5	
Vinyl Acetate	ND	50	ND	10	
Bromodichloromethane	ND	25	ND	5	
1,2-Dichloropropane	ND	25	ND	5	
cis-1,3-Dichloropropene	ND	25	ND	5	
Trichloroethene	ND	25	ND	5	
Dibromochloromethane	ND	25	ND	5	
1,1,2-Trichloroethane	ND	25	ND	5	
Benzene	ND	25	ND	5	
trans-1,3-Dichloropropene	ND	25	ND	5	
2-Chloroethylvinyl ether	ND	50	ND	10	
Bromoform	ND	25	ND	5	
4-Methyl-2-pentanone	ND	50	ND	10	
2-Hexanone	ND	50	ND	10	
Tetrachloroethene	ND	25	ND	5	
1,1,2,2-Tetrachloroethane	ND	25	ND	5	
Toluene	ND	25	ND	5	
Chlorobenzene	ND	25	ND	5	
Ethylbenzene	ND	25	ND	5	

Analyte associated with sample processing and analysis in the lab environment. An acceptable method blank must contain less than five times the reporting limit of this analyte for this method.

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Laboratory Report

ENSECO CRL VENTURA
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VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109504-001
Date Sampled: 29-MAR-1991
Date Sample Rec'd: 5-APR-1991
Sample Type: SOLID
Date Prepared: 9-APR-1991
Prep Method: EPA 5030 By: JC
Date Analyzed: 9-APR-1991 By: JC

Project: (V-9109404) BATELLE/CROW'S LANDING
Sample ID: (V-9109404-003) CROW-17-BT

Purgeable Organics, EPA 8240

Units: ug/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL
Styrene	ND	25	ND	5
Xylenes, Total	ND	25	ND	5

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109504-001
Date Sampled: 29-MAR-1991
Date Sample Rec'd: 5-APR-1991
Sample Type: SOLID

Project: (V-9109404) BATELLE/CROW'S LANDING

Purgeable Organics, EPA 8240 Surrogate Summary

Date	Parameter (Method)	Percent Recovery	Acceptable Range
9-APR-1991	1,2 DICHLOROETHANE-D4 (EPA 8240)	97	70-135
9-APR-1991	TOLUENE-D8 (EPA 8240)	100	69-138
9-APR-1991	BROMOFLUOROBENZENE (EPA 8240)	98	60-137

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ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109504-002
Date Sampled: 3-APR-1991
Date Sample Rec'd: 5-APR-1991
Sample Type: SOLID
Date Prepared: 8-APR-1991
Prep Method: EPA 5030 By: JC
Date Analyzed: 8-APR-1991 By: JC

Project: (V-9109404) BATELLE/CROW'S LANDING
Sample ID: (V-9109404-005) CROW-04-BB

Purgeable Organics, EPA 8240

Units: ug/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL
Chloromethane	ND	10	ND	10
Bromomethane	ND	10	ND	10
Vinyl Chloride	ND	10	ND	10
Chloroethane	ND	10	ND	10
Methylene Chloride	ND	5	ND	5
Acetone	ND	10	ND	10
Carbon Disulfide	ND	5	ND	5
Trichlorofluoromethane	ND	5	ND	5
1,1-Dichloroethene	ND	5	ND	5
1,1-Dichloroethane	ND	5	ND	5
Total 1,2-Dichloroethene	ND	5	ND	5
Chloroform	ND	5	ND	5
1,2-Dichloroethane	ND	5	ND	5
2-Butanone	ND	10	ND	10
1,1,1-Trichloroethane	ND	5	ND	5
Carbon Tetrachloride	ND	5	ND	5
Vinyl Acetate	ND	10	ND	10
Bromodichloromethane	ND	5	ND	5
1,2-Dichloropropane	ND	5	ND	5
cis-1,3-Dichloropropene	ND	5	ND	5
Trichloroethene	ND	5	ND	5
Dibromochloromethane	ND	5	ND	5
1,1,2-Trichloroethane	ND	5	ND	5
Benzene	ND	5	ND	5
trans-1,3-Dichloropropene	ND	5	ND	5
2-Chloroethylvinyl ether	ND	10	ND	10
Bromoform	ND	5	ND	5
4-Methyl-2-pentanone	ND	10	ND	10
2-Hexanone	ND	10	ND	10
Tetrachloroethene	ND	5	ND	5
1,1,2,2-Tetrachloroethane	ND	5	ND	5
Toluene	ND	5	ND	5
Chlorobenzene	ND	5	ND	5
Ethylbenzene	ND	5	ND	5
Styrene	ND	5	ND	5
Xylenes, Total	ND	5	ND	5

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109504-002
Date Sampled: 3-APR-1991
Date Sample Rec'd: 5-APR-1991
Sample Type: SOLID

Project: (V-9109404) BATELLE/CROW'S LANDING

Purgeable Organics, EPA 8240 Surrogate Summary

Date	Parameter (Method)	Percent Recovery	Acceptable Range
8-APR-1991	1,2 DICHLOROETHANE-D4 (EPA 8240)	96	70-135
8-APR-1991	TOLUENE-D8 (EPA 8240)	110	69-138
8-APR-1991	BROMOFLUOROBENZENE (EPA 8240)	99	60-137

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109504-003
Date Sampled: 29-MAR-1991
Date Sample Rec'd: 5-APR-1991
Sample Type: SOLID
Date Prepared: 8-APR-1991
Prep Method: EPA 5030 By: JC
Date Analyzed: 8-APR-1991 By: JC

Project: (V-9109404) BATELLE/CROW'S LANDING
Sample ID: (V-9109404-007) CROW-05-BB

Purgeable Organics, EPA 8240

Units: ug/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL
Chloromethane	ND	10	ND	10
Bromomethane	ND	10	ND	10
Vinyl Chloride	ND	10	ND	10
Chloroethane	ND	10	ND	10
Methylene Chloride	5.2	5	ND	5
Acetone	ND	10	ND	10
Carbon Disulfide	ND	5	ND	5
Trichlorofluoromethane	ND	5	ND	5
1,1-Dichloroethene	ND	5	ND	5
1,1-Dichloroethane	ND	5	ND	5
Total 1,2-Dichloroethene	ND	5	ND	5
Chloroform	ND	5	ND	5
1,2-Dichloroethane	ND	5	ND	5
2-Butanone	ND	10	ND	10
1,1,1-Trichloroethane	ND	5	ND	5
Carbon Tetrachloride	ND	5	ND	5
Vinyl Acetate	ND	10	ND	10
Bromodichloromethane	ND	5	ND	5
1,2-Dichloropropane	ND	5	ND	5
cis-1,3-Dichloropropene	ND	5	ND	5
Trichloroethene	ND	5	ND	5
Dibromochloromethane	ND	5	ND	5
1,1,2-Trichloroethane	ND	5	ND	5
Benzene	ND	5	ND	5
trans-1,3-Dichloropropene	ND	5	ND	5
2-Chloroethylvinyl ether	ND	10	ND	10
Bromoform	ND	5	ND	5
4-Methyl-2-pentanone	ND	10	ND	10
2-Hexanone	ND	10	ND	10
Tetrachloroethene	ND	5	ND	5
1,1,2,2-Tetrachloroethane	ND	5	ND	5
Toluene	ND	5	ND	5
Chlorobenzene	ND	5	ND	5
Ethylbenzene	ND	5	ND	5
Styrene	ND	5	ND	5
Xylenes, Total	ND	5	ND	5

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2810 Bunsen Ave. Unit A • Ventura, CA 93003
(805) 650-0546 • FAX: (805) 650-0756

30-APR-91

Battelle
505 King Avenue
Columbus, OH 43201-2693
ATTN: Mr. Greg Headington

Analysis No.: V-9111607-001/007
Date Sampled: 25-APR-1991
Date Sample Rec'd: 26-APR-1991
Project: CROWS LANDING

Enclosed with this letter is the report on the chemical, biological and/or physical analyses on the samples from ANALYSIS NO: V-9111607-001/007 shown above.

The samples were received by CRL in a chilled state, intact and with the chain-of custody record attached.

Note that ND means not detected at the reporting limit (RL) expressed. The detection limit is the reporting limit raised to reflect the dilution factor of the sample.

Solid samples are reported on "as received" basis.

Reviewed

Approved

The Report Cover Letter is an integral part of this report.
This report pertains only to the samples investigated and does not necessarily apply to other apparently identical or similar materials. This report is submitted for the exclusive use of the client to whom it is addressed. Any reproduction of this report or use of this Laboratory's name for advertising or publicity purposes without authorization is prohibited.

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109504-003
Date Sampled: 29-MAR-1991
Date Sample Rec'd: 5-APR-1991
Sample Type: SOLID

Project: (V-9109404) BATELLE/CROW'S LANDING

Purgeable Organics, EPA 8240 Surrogate Summary

Date	Parameter (Method)	Percent Recovery	Acceptable Range
8-APR-1991	1,2 DICHLOROETHANE-D4 (EPA 8240)	102	70-135
8-APR-1991	TOLUENE-D8 (EPA 8240)	113	69-138
8-APR-1991	BROMOFLUOROBENZENE (EPA 8240)	103	60-137

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109504-004
Date Sampled: 29-MAR-1991
Date Sample Rec'd: 5-APR-1991
Sample Type: SOLID
Date Prepared: 8-APR-1991
Prep Method: EPA 5030 By: JC
Date Analyzed: 8-APR-1991 By: JC

Project: (V-9109404) BATELLE/CROW'S LANDING
Sample ID: (V-9109404-009) CROW-06-BB

Purgeable Organics, EPA 8240

Units: ug/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL
Chloromethane	ND	10	ND	10
Bromomethane	ND	10	ND	10
Vinyl Chloride	ND	10	ND	10
Chloroethane	ND	10	ND	10
Methylene Chloride	ND	5	ND	5
Acetone	ND	10	ND	10
Carbon Disulfide	ND	5	ND	5
Trichlorofluoromethane	ND	5	ND	5
1,1-Dichloroethene	ND	5	ND	5
1,1-Dichloroethane	ND	5	ND	5
Total 1,2-Dichloroethene	ND	5	ND	5
Chloroform	ND	5	ND	5
1,2-Dichloroethane	ND	5	ND	5
2-Butanone	ND	10	ND	10
1,1,1-Trichloroethane	ND	5	ND	5
Carbon Tetrachloride	ND	5	ND	5
Vinyl Acetate	ND	10	ND	10
Bromodichloromethane	ND	5	ND	5
1,2-Dichloropropane	ND	5	ND	5
cis-1,3-Dichloropropene	ND	5	ND	5
Trichloroethene	ND	5	ND	5
Dibromochloromethane	ND	5	ND	5
1,1,2-Trichloroethane	ND	5	ND	5
Benzene	ND	5	ND	5
trans-1,3-Dichloropropene	ND	5	ND	5
2-Chloroethylvinyl ether	ND	10	ND	10
Bromoform	ND	5	ND	5
4-Methyl-2-pentanone	ND	10	ND	10
2-Hexanone	ND	10	ND	10
Tetrachloroethene	ND	5	ND	5
1,1,2,2-Tetrachloroethane	ND	5	ND	5
Toluene	6.2	5	ND	5
Chlorobenzene	ND	5	ND	5
Ethylbenzene	ND	5	ND	5
Styrene	ND	5	ND	5
Xylenes, Total	ND	5	ND	5

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109504-004
Date Sampled: 29-MAR-1991
Date Sample Rec'd: 5-APR-1991
Sample Type: SOLID

Project: (V-9109404) BATELLE/CROW'S LANDING

Purgeable Organics, EPA 8240 Surrogate Summary

Date	Parameter (Method)	Percent Recovery	Acceptable Range
8-APR-1991	1,2 DICHLOROETHANE-D4 (EPA 8240)	98	70-135
8-APR-1991	TOLUENE-D8 (EPA 8240)	100	69-138
8-APR-1991	BROMOFLUOROBENZENE (EPA 8240)	93	60-137

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109504-005
Date Sampled: 29-MAR-1991
Date Sample Rec'd: 5-APR-1991
Sample Type: SOLID
Date Prepared: 8-APR-1991
Prep Method: EPA 5030 By: JC
Date Analyzed: 8-APR-1991 By: JC

Project: (V-9109404) BATELLE/CROW'S LANDING
Sample ID: (V-9109404-011) CROW-10-BU

Purgeable Organics, EPA 8240

Units: ug/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL
Chloromethane	ND	10	ND	10
Bromomethane	ND	10	ND	10
Vinyl Chloride	ND	10	ND	10
Chloroethane	ND	10	ND	10
Methylene Chloride	5.6	5	ND	5
Acetone	ND	10	ND	10
Carbon Disulfide	ND	5	ND	5
Trichlorofluoromethane	ND	5	ND	5
1,1-Dichloroethene	ND	5	ND	5
1,1-Dichloroethane	ND	5	ND	5
Total 1,2-Dichloroethene	ND	5	ND	5
Chloroform	ND	5	ND	5
1,2-Dichloroethane	ND	5	ND	5
2-Butanone	ND	10	ND	10
1,1,1-Trichloroethane	ND	5	ND	5
Carbon Tetrachloride	ND	5	ND	5
Vinyl Acetate	ND	10	ND	10
Bromodichloromethane	ND	5	ND	5
1,2-Dichloropropane	ND	5	ND	5
cis-1,3-Dichloropropene	ND	5	ND	5
Trichloroethene	ND	5	ND	5
Dibromochloromethane	ND	5	ND	5
1,1,2-Trichloroethane	ND	5	ND	5
Benzene	ND	5	ND	5
trans-1,3-Dichloropropene	ND	5	ND	5
2-Chloroethylvinyl ether	ND	10	ND	10
Bromoform	ND	5	ND	5
4-Methyl-2-pentanone	ND	10	ND	10
2-Hexanone	ND	10	ND	10
Tetrachloroethene	ND	5	ND	5
1,1,2,2-Tetrachloroethane	ND	5	ND	5
Toluene	ND	5	ND	5
Chlorobenzene	ND	5	ND	5
Ethylbenzene	ND	5	ND	5
Styrene	ND	5	ND	5
Xylenes, Total	ND	5	ND	5

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109504-005
Date Sampled: 29-MAR-1991
Date Sample Rec'd: 5-APR-1991
Sample Type: SOLID

Project: (V-9109404) BATELLE/CROW'S LANDING

Purgeable Organics, EPA 8240 Surrogate Summary

Date	Parameter (Method)	Percent Recovery	Acceptable Range
8-APR-1991	1,2 DICHLOROETHANE-D4 (EPA 8240)	115	70-135
8-APR-1991	TOLUENE-D8 (EPA 8240)	119	69-138
8-APR-1991	BROMOFLUOROBENZENE (EPA 8240)	110	60-137

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109504-006
Date Sampled: 29-MAR-1991
Date Sample Rec'd: 5-APR-1991
Sample Type: SOLID
Date Prepared: 8-APR-1991
Prep Method: EPA 5030 By: JC
Date Analyzed: 8-APR-1991 By: JC

Project: (V-9109404) BATELLE/CROW'S LANDING
Sample ID: (V-9109404-014) CROW-11-BT

Purgeable Organics, EPA 8240

Units: ug/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL
Chloromethane	ND	10	ND	10
Bromomethane	ND	10	ND	10
Vinyl Chloride	ND	10	ND	10
Chloroethane	ND	10	ND	10
Methylene Chloride	6.7	5	ND	5
Acetone	75	10	ND	10
Carbon Disulfide	ND	5	ND	5
Trichlorofluoromethane	ND	5	ND	5
1,1-Dichloroethene	ND	5	ND	5
1,1-Dichloroethane	ND	5	ND	5
Total 1,2-Dichloroethene	ND	5	ND	5
Chloroform	ND	5	ND	5
1,2-Dichloroethane	ND	5	ND	5
2-Butanone	ND	10	ND	10
1,1,1-Trichloroethane	ND	5	ND	5
Carbon Tetrachloride	ND	5	ND	5
Vinyl Acetate	ND	10	ND	10
Bromodichloromethane	ND	5	ND	5
1,2-Dichloropropane	ND	5	ND	5
cis-1,3-Dichloropropene	ND	5	ND	5
Trichloroethene	ND	5	ND	5
Dibromochloromethane	ND	5	ND	5
1,1,2-Trichloroethane	ND	5	ND	5
Benzene	ND	5	ND	5
trans-1,3-Dichloropropene	ND	5	ND	5
2-Chloroethylvinyl ether	ND	10	ND	10
Bromoform	ND	5	ND	5
4-Methyl-2-pentanone	ND	10	ND	10
2-Hexanone	ND	10	ND	10
Tetrachloroethene	ND	5	ND	5
1,1,2,2-Tetrachloroethane	ND	5	ND	5
Toluene	8.0	5	ND	5
Chlorobenzene	ND	5	ND	5
Ethylbenzene	ND	5	ND	5
Styrene	ND	5	ND	5
Xylenes, Total	ND	5	ND	5

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109504-006
Date Sampled: 29-MAR-1991
Date Sample Rec'd: 5-APR-1991
Sample Type: SOLID

Project: (V-9109404) BATELLE/CROW'S LANDING

Purgeable Organics, EPA 8240 Surrogate Summary

Date	Parameter (Method)	Percent Recovery	Acceptable Range
8-APR-1991	1,2 DICHLOROETHANE-D4 (EPA 8240)	114	70-135
8-APR-1991	TOLUENE-D8 (EPA 8240)	132	69-138
8-APR-1991	BROMOFLUOROBENZENE (EPA 8240)	118	60-137

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109504-001/008
Date Sampled: 29-MAR-1991
3-APR-1991
Date Sample Rec'd: 5-APR-1991
Sample Type: SOLID

Project: (V-9109404) BATELLE/CROW'S LANDING

Matrix Spike/Matrix Spike Duplicate Report

Sample Number	Parameter (Method)	Units	Observed Concentration Sample	MS	MSD	Amt. Spiked	% Recovery MS	MSD	Avg.	% RPD
9109504-008	PHOSPHORUS (EPA 365.2)	mg/kg	1.1	1.4	1.3	.4	N/C	N/C	N/C	N/C
9109423-007	1,1-DICHLOROETHENE (EPA 8240)	ug/kg	ND	49.1	45.9	50.0	98	92	95	7
9109423-007	TRICHLOROETHENE (EPA 8240)	ug/kg	ND	51.4	47.0	50.0	103	94	98	9
9109423-007	BENZENE (EPA 8240)	ug/kg	ND	47.9	43.5	50.0	96	87	91	10
9109423-007	TOLUENE (EPA 8240)	ug/kg	ND	49.0	44.6	50.0	98	89	94	9
9109423-007	CHLOROBENZENE (EPA 8240)	ug/kg	ND	52.1	46.9	50.0	104	94	99	11

N/C = Not Calculated; Recovery of the compound spiked into the sample was not calculated due to a high existing concentration in the sample. Non-representative recoveries may result when the native sample concentration exceeds twice the spike level due, in part, to sample heterogeneity.

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Matrix Spike/Matrix Spike Duplicate Report Cross-Reference

QC Batch	Date	Parameter (Method)	Sample Nos.
9109423-007	6-APR-1991	1,1-DICHLOROETHENE (EPA 8240)	G-9109504-001
			G-9109504-002
			G-9109504-003
			G-9109504-004
			G-9109504-005
			G-9109504-006
	6-APR-1991	TRICHLOROETHENE (EPA 8240)	G-9109504-001
			G-9109504-002
			G-9109504-003
			G-9109504-004
			G-9109504-005
			G-9109504-006
	6-APR-1991	BENZENE (EPA 8240)	G-9109504-001
			G-9109504-002
			G-9109504-003
			G-9109504-004
			G-9109504-005
			G-9109504-006
	6-APR-1991	TOLUENE (EPA 8240)	G-9109504-001
			G-9109504-002
			G-9109504-003
			G-9109504-004
			G-9109504-005
			G-9109504-006
	6-APR-1991	CHLOROBENZENE (EPA 8240)	G-9109504-001
			G-9109504-002
			G-9109504-003
			G-9109504-004
			G-9109504-005
			G-9109504-006
9109504-008	10-APR-1991	PHOSPHORUS (EPA 365.2)	G-9109504-007
			G-9109504-008

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109504-001/008
Date Sampled: 29-MAR-1991
3-APR-1991
Date Sample Rec'd: 5-APR-1991
Sample Type: SOLID

Project: (V-9109404) BATELLE/CROW'S LANDING

Laboratory Control Sample Report

QC Batch	Parameter (Method)	Amt. Spiked	Units	Avg. Spike Recov.	Acceptable Range	Rel. Pct. Diff.	Acceptable Range
L91100025	PHOSPHORUS (EPA 365.2)	.2	mg/kg	100.	80-120	10.	20
L91098024	1,1-DICHLOROETHENE (EPA 8240)	50.0	ug/kg	91.	30-151	1.	36
L91098024	TRICHLOROETHENE (EPA 8240)	50.0	ug/kg	95.	36-150	2.	33
L91098024	BENZENE (EPA 8240)	50.0	ug/kg	88.	32-150	2.	35
L91098024	TOLUENE (EPA 8240)	50.0	ug/kg	90.	34-151	5.	34
L91098024	CHLOROBENZENE (EPA 8240)	50.0	ug/kg	98.	33-151	1.	35

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Laboratory Control Sample Report Cross-Reference

QC Batch	Date	Parameter (Method)	Sample Nos.
L91098024	6-APR-1991	1,1-DICHLOROETHENE (EPA 8240)	G-9109504-001
			G-9109504-002
			G-9109504-003
			G-9109504-004
			G-9109504-005
			G-9109504-006
		TRICHLOROETHENE (EPA 8240)	G-9109504-001
			G-9109504-002
			G-9109504-003
			G-9109504-004
			G-9109504-005
			G-9109504-006
		BENZENE (EPA 8240)	G-9109504-001
			G-9109504-002
			G-9109504-003
			G-9109504-004
			G-9109504-005
			G-9109504-006
		TOLUENE (EPA 8240)	G-9109504-001
			G-9109504-002
			G-9109504-003
			G-9109504-004
			G-9109504-005
			G-9109504-006
		CHLOROBENZENE (EPA 8240)	G-9109504-001
			G-9109504-002
			G-9109504-003
			G-9109504-004
			G-9109504-005
			G-9109504-006
L91100025	10-APR-1991	PHOSPHORUS (EPA 365.2)	G-9109504-007
			G-9109504-008

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Enseco - CRL
7440 Lincoln Way • Garden Grove, CA 92641
(714) 898-6370 • (213) 598-0458 • (800) LAB-1-CRL
FAX: (714) 891-5917

April 9, 1991

ENSECO CRL VENTURA
2810 BUNSEN AVE., UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9108808-001/001
Date Sampled: 25-MAR-1991
Date Sample Rec'd: 29-MAR-1991
Project: (V-9108603) BATELLE/CROW'S LANDING PROJECT #G9860-9101

Enclosed with this letter is the report on the chemical and physical analyses on the sample from ANALYSIS NO: G-9108808-001/001 shown above.

The sample was received by CRL in a chilled state, intact and with the chain-of-custody record attached.

Note that ND means not detected at the reporting limit expressed. The reporting limit is raised to reflect the dilution factor of the sample.

Solid sample is reported on "as received" basis.

Reviewed

Approved

The Report Cover Letter is an integral part of this report.
This report pertains only to the samples investigated and does not necessarily apply to other apparently identical or similar materials. This report is submitted for the exclusive use of the client to whom it is addressed. Any reproduction of this report or use of this Laboratory's name for advertising or publicity purposes without authorization is prohibited.

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9108808-001
Date Sampled: 25-MAR-1991
Date Sample Rec'd: 29-MAR-1991
Sample Type: SOLID
Date Prepared: 2-APR-1991
Prep Method: EPA 5030 By: LR
Date Analyzed: 2-APR-1991 By: LR

Project: (V-9108603) BATELLE/CROW'S LANDING PROJECT #G9860-9101
Sample ID: (V-9108603-002) CROW-9-88

Purgeable Organics, EPA 8240

Units: ug/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL
Chloromethane	ND	10	ND	10
Bromomethane	ND	10	ND	10
Vinyl Chloride	ND	10	ND	10
Chloroethane	ND	10	ND	10
Methylene Chloride	ND	5	ND	5
Acetone	ND	10	ND	10
Carbon Disulfide	ND	5	ND	5
Trichlorofluoromethane	ND	5	ND	5
1,1-Dichloroethene	ND	5	ND	5
1,1-Dichloroethane	ND	5	ND	5
Total 1,2-Dichloroethene	ND	5	ND	5
Chloroform	ND	5	ND	5
1,2-Dichloroethane	ND	5	ND	5
2-Butanone	ND	10	ND	10
1,1,1-Trichloroethane	ND	5	ND	5
Carbon Tetrachloride	ND	5	ND	5
Vinyl Acetate	ND	10	ND	10
Bromodichloromethane	ND	5	ND	5
1,2-Dichloropropane	ND	5	ND	5
cis-1,3-Dichloropropene	ND	5	ND	5
Trichloroethene	ND	5	ND	5
Dibromochloromethane	ND	5	ND	5
1,1,2-Trichloroethane	ND	5	ND	5
Benzene	ND	5	ND	5
trans-1,3-Dichloropropene	ND	5	ND	5
2-Chloroethylvinyl ether	ND	10	ND	10
Bromoform	ND	5	ND	5
4-Methyl-2-pentanone	ND	10	ND	10
2-Hexanone	ND	10	ND	10
Tetrachloroethene	ND	5	ND	5
1,1,2,2-Tetrachloroethane	ND	5	ND	5
Toluene	ND	5	ND	5
Chlorobenzene	ND	5	ND	5
Ethylbenzene	ND	5	ND	5
Styrene	ND	5	ND	5
Xylenes, Total	ND	5	ND	5

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9108808-001
Date Sampled: 25-MAR-1991
Date Sample Rec'd: 29-MAR-1991
Sample Type: SOLID

Project: (V-9108603) BATELLE/CROW'S LANDING PROJECT #G9860-9101

Purgeable Organics, EPA 8240 Surrogate Summary

Date	Parameter (Method)	Percent Recovery	Acceptable Range
2-APR-1991	1,2 DICHLOROETHANE-D4 (EPA 8240)	96	70-135
2-APR-1991	TOLUENE-D8 (EPA 8240)	106	69-138
2-APR-1991	BROMOFLUOROBENZENE (EPA 8240)	85	60-137

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9108808-001
Date Sampled: 25-MAR-1991
Date Sample Rec'd: 29-MAR-1991
Sample Type: SOLID

Project: (V-9108603) BATELLE/CROW'S LANDING PROJECT #G9860-9101

Matrix Spike/Matrix Spike Duplicate Report

Sample Number	Parameter (Method)	Units	Observed Concentration Sample	MS	MSD	Amt. Spiked	% Recovery MS	MSD	Avg.	% RPD
9108112-011	1,1-DICHLOROETHENE (EPA 8240)	ug/kg	ND	42.9	40.3	50.0	86	81	83	6
9108112-011	TRICHLOROETHENE (EPA 8240)	ug/kg	ND	41.7	40.8	50.0	83	82	83	2
9108112-011	BENZENE (EPA 8240)	ug/kg	ND	40.0	39.2	50.0	80	78	79	2
9108112-011	TOLUENE (EPA 8240)	ug/kg	ND	40.7	39.0	50.0	81	78	80	4
9108112-011	CHLOROBENZENE (EPA 8240)	ug/kg	ND	44.2	42.1	50.0	88	84	86	5

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Matrix Spike/Matrix Spike Duplicate Report Cross-Reference

QC Batch	Date	Parameter (Method)	Sample Nos.
9108112-011	29-MAR-1991	1,1-DICHLOROETHENE (EPA 8240)	G-9108808-001
	29-MAR-1991	TRICHLOROETHENE (EPA 8240)	G-9108808-001
	29-MAR-1991	BENZENE (EPA 8240)	G-9108808-001
	29-MAR-1991	TOLUENE (EPA 8240)	G-9108808-001
	29-MAR-1991	CHLOROBENZENE (EPA 8240)	G-9108808-001

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9108808-001
Date Sampled: 25-MAR-1991
Date Sample Rec'd: 29-MAR-1991
Sample Type: SOLID

Project: (V-9108603) BATELLE/CROW'S LANDING PROJECT #G9860-9101

Laboratory Control Sample Report

QC Batch	Parameter (Method)	Amt. Spiked	Units	Avg. Spike Recov.	Acceptable Range	Rel. Pct. Diff.	Acceptable Range
L91086021	1,1-DICHLOROETHENE (EPA 8240)	50.0	ug/kg	82.	30-151	11.	36
L91086021	TRICHLOROETHENE (EPA 8240)	50.0	ug/kg	81.	36-150	3.	33
L91086021	BENZENE (EPA 8240)	50.0	ug/kg	97.	32-150	8.	35
L91086021	TOLUENE (EPA 8240)	50.0	ug/kg	86.	34-151	4.	34
L91086021	CHLOROBENZENE (EPA 8240)	50.0	ug/kg	92.	33-151	8.	35

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Laboratory Control Sample Report Cross-Reference

QC Batch	Date	Parameter (Method)	Sample Nos.
L91086021	25-MAR-1991	1,1-DICHLOROETHENE (EPA 8240)	G-9108808-001
		TRICHLOROETHENE (EPA 8240)	G-9108808-001
		BENZENE (EPA 8240)	G-9108808-001
		TOLUENE (EPA 8240)	G-9108808-001
		CHLOROBENZENE (EPA 8240)	G-9108808-001

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FAX: (714) 891-5917

April 18, 1991

ENSECO CRL VENTURA
2810 BUNSEN AVE., UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109208-001/002
Date Sampled: 27-MAR-1991
Date Sample Rec'd: 2-APR-1991
Project: (V-9108803) BATTELLE/CROW'S LANDING PROJECT #G9860-9101

Enclosed with this letter is the report on the chemical and physical analyses on the sample from ANALYSIS NO: G-9109208-001/002 shown above.

The sample was received by CRL in a chilled state, intact and with the chain-of-custody record attached.

Note that ND means not detected at the reporting limit expressed. The reporting limit is raised to reflect the dilution factor of the sample.

Solid sample are reported on "as received" basis.

Reviewed

Approved

The Report Cover Letter is an integral part of this report.
This report pertains only to the samples investigated and does not necessarily apply to other apparently identical or similar materials. This report is submitted for the exclusive use of the client to whom it is addressed. Any reproduction of this report or use of this Laboratory's name for advertising or publicity purposes without authorization is prohibited.

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Laboratory Report

ENSECO CRL VENTURA
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VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109208-001
Date Sampled: 27-MAR-1991
Date Sample Rec'd: 2-APR-1991
Sample Type: SOLID
Date Prepared: 4-APR-1991
Prep Method: EPA 5030 By: GB
Date Analyzed: 4-APR-1991 By: GB

Project: (V-9108803) BATTELLE/CROW'S LANDING PROJECT #G9860-9101
Sample ID: (V-9108803-003) CROW-19-CT

Purgeable Organics, EPA 8240

Units: ug/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL
Chloromethane	ND	10	ND	10
Bromomethane	ND	10	ND	10
Vinyl Chloride	ND	10	ND	10
Chloroethane	ND	10	ND	10
Methylene Chloride	ND	5	ND	5
Acetone	57	10	ND	10
Carbon Disulfide	ND	5	ND	5
Trichlorofluoromethane	ND	5	ND	5
1,1-Dichloroethene	ND	5	ND	5
1,1-Dichloroethane	ND	5	ND	5
Total 1,2-Dichloroethene	ND	5	ND	5
Chloroform	ND	5	ND	5
1,2-Dichloroethane	ND	5	ND	5
2-Butanone	29	10	ND	10
1,1,1-Trichloroethane	ND	5	ND	5
Carbon Tetrachloride	ND	5	ND	5
Vinyl Acetate	ND	10	ND	10
Bromodichloromethane	ND	5	ND	5
1,2-Dichloropropane	ND	5	ND	5
cis-1,3-Dichloropropene	ND	5	ND	5
Trichloroethene	ND	5	ND	5
Dibromochloromethane	ND	5	ND	5
1,1,2-Trichloroethane	ND	5	ND	5
Benzene	ND	5	ND	5
trans-1,3-Dichloropropene	ND	5	ND	5
2-Chloroethylvinyl ether	ND	10	ND	10
Bromoform	ND	5	ND	5
4-Methyl-2-pentanone	ND	10	ND	10
2-Hexanone	ND	10	ND	10
Tetrachloroethene	ND	5	ND	5
1,1,2,2-Tetrachloroethane	ND	5	ND	5
Toluene	35	5	ND	5
Chlorobenzene	ND	5	ND	5
Ethylbenzene	ND	5	ND	5
Styrene	ND	5	ND	5
Xylenes, Total	ND	5	ND	5

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109208-001
Date Sampled: 27-MAR-1991
Date Sample Rec'd: 2-APR-1991
Sample Type: SOLID

Project: (V-9108803) BATTELLE/CROW'S LANDING PROJECT #G9860-9101

Purgeable Organics, EPA 8240 Surrogate Summary

Date	Parameter (Method)	Percent Recovery	Acceptable Range
4-APR-1991	1,2 DICHLOROETHANE-D4 (EPA 8240)	86	70-135
4-APR-1991	TOLUENE-D8 (EPA 8240)	98	69-138
4-APR-1991	BROMOFLUOROBENZENE (EPA 8240)	81	60-137

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109208-002
Date Sampled: 27-MAR-1991
Date Sample Rec'd: 2-APR-1991
Sample Type: SOLID
Date Prepared: 4-APR-1991
Prep Method: EPA 5030 By: GB
Date Analyzed: 4-APR-1991 By: GB

Project: (V-9108803) BATTELLE/CROW'S LANDING PROJECT #G9860-9101
Sample ID: (V-9108803-004) CROW-19-BT

Purgeable Organics, EPA 8240

Units: ug/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL	FN
Chloromethane	ND	50	ND	10	G
Bromomethane	ND	50	ND	10	G
Vinyl Chloride	ND	50	ND	10	G
Chloroethane	ND	50	ND	10	G
Methylene Chloride	ND	25	ND	5	G
Acetone	ND	50	ND	10	G
Carbon Disulfide	ND	25	ND	5	G
Trichlorofluoromethane	ND	25	ND	5	G
1,1-Dichloroethene	ND	25	ND	5	G
1,1-Dichloroethane	ND	25	ND	5	G
Total 1,2-Dichloroethene	ND	25	ND	5	G
Chloroform	ND	25	ND	5	G
1,2-Dichloroethane	ND	25	ND	5	G
2-Butanone	ND	50	ND	10	G
1,1,1-Trichloroethane	ND	25	ND	5	G
Carbon Tetrachloride	ND	25	ND	5	G
Vinyl Acetate	ND	50	ND	10	G
Bromodichloromethane	ND	25	ND	5	G
1,2-Dichloropropane	ND	25	ND	5	G
cis-1,3-Dichloropropene	ND	25	ND	5	G
Trichloroethene	ND	25	ND	5	G
Dibromochloromethane	ND	25	ND	5	G
1,1,2-Trichloroethane	ND	25	ND	5	G
Benzene	ND	25	ND	5	G
trans-1,3-Dichloropropene	ND	25	ND	5	G
2-Chloroethylvinyl ether	ND	50	ND	10	G
Bromoform	ND	25	ND	5	G
4-Methyl-2-pentanone	ND	50	ND	10	G
2-Hexanone	ND	50	ND	10	G
Tetrachloroethene	ND	25	ND	5	G
1,1,2,2-Tetrachloroethane	ND	25	ND	5	G
Toluene	ND	25	ND	5	G
Chlorobenzene	ND	25	ND	5	G
Ethylbenzene	ND	25	ND	5	G
Styrene	ND	25	ND	5	G
Xylenes, Total	ND	25	ND	5	G

G Reporting limit elevated due to sample matrix interference.

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Laboratory Report

ENSECO CRL VENTURA
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ATTN: MR. LEO RAAB

Analysis No.: G-9109208-002
Date Sampled: 27-MAR-1991
Date Sample Rec'd: 2-APR-1991
Sample Type: SOLID

Project: (V-9108803) BATTELLE/CROW'S LANDING PROJECT #G9860-9101

Purgeable Organics, EPA 8240 Surrogate Summary

Date	Parameter (Method)	Percent Recovery	Acceptable Range
4-APR-1991	1,2 DICHLOROETHANE-D4 (EPA 8240)	86	70-135
4-APR-1991	TOLUENE-D8 (EPA 8240)	101	69-138
4-APR-1991	BROMOFLUOROBENZENE (EPA 8240)	93	60-137

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Laboratory Report

ENSECO CRL VENTURA
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ATTN: MR. LEO RAAB

Analysis No.: G-9109208-001/002
Date Sampled: 27-MAR-1991
Date Sample Rec'd: 2-APR-1991
Sample Type: SOLID

Project: (V-9108803) BATTELLE/CROW'S LANDING PROJECT #G9860-9101

Matrix Spike/Matrix Spike Duplicate Report

Sample Number	Parameter (Method)	Units	Observed Concentration Sample	MS	MSD	Amt. Spiked	% Recovery MS	MSD	Avg.	% RPD
9107819-013	1,1-DICHLOROETHENE (EPA 8240)	ug/kg	ND	39.4	48.2	50.0	79	96	88	20
9107819-013	TRICHLOROETHENE (EPA 8240)	ug/kg	ND	41.6	48.7	50.0	83	97	90	16
9107819-013	BENZENE (EPA 8240)	ug/kg	ND	48.9	54.0	50.0	98	108	103	10
9107819-013	TOLUENE (EPA 8240)	ug/kg	ND	54.4	60.0	50.0	109	120	114	10
9107819-013	CHLOROBENZENE (EPA 8240)	ug/kg	ND	53.1	60.7	50.0	106	121	114	13

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Matrix Spike/Matrix Spike Duplicate Report Cross-Reference

QC Batch	Date	Parameter (Method)	Sample Nos.
9107819-013	3-APR-1991	1,1-DICHLOROETHENE (EPA 8240)	G-9109208-001
			G-9109208-002
	3-APR-1991	TRICHLOROETHENE (EPA 8240)	G-9109208-001
			G-9109208-002
	3-APR-1991	BENZENE (EPA 8240)	G-9109208-001
			G-9109208-002
	3-APR-1991	TOLUENE (EPA 8240)	G-9109208-001
			G-9109208-002
	3-APR-1991	CHLOROBENZENE (EPA 8240)	G-9109208-001
			G-9109208-002

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109208-001/002
Date Sampled: 27-MAR-1991
Date Sample Rec'd: 2-APR-1991
Sample Type: SOLID

Project: (V-9108803) BATTELLE/CROW'S LANDING PROJECT #G9860-9101

Laboratory Control Sample Report

QC Batch	Parameter (Method)	Amt. Spiked	Units	Avg. Spike Recov.	Acceptable Range	Rel. Pct. Diff.	Acceptable Range
L91095024	1,1-DICHLOROETHENE (EPA 8240)	50.0	ug/kg	87.	30-151	14.	36
L91095024	TRICHLOROETHENE (EPA 8240)	50.0	ug/kg	81.	36-150	4.	33
L91095024	BENZENE (EPA 8240)	50.0	ug/kg	92.	32-150	1.	35
L91095024	TOLUENE (EPA 8240)	50.0	ug/kg	92.	34-151	6.	34
L91095024	CHLOROBENZENE (EPA 8240)	50.0	ug/kg	98.	33-151	4.	35

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Laboratory Control Sample Report Cross-Reference

QC Batch	Date	Parameter (Method)	Sample Nos.
L91095024	4-APR-1991	1,1-DICHLOROETHENE (EPA 8240)	G-9109208-001
			G-9109208-002
		TRICHLOROETHENE (EPA 8240)	G-9109208-001
			G-9109208-002
		BENZENE (EPA 8240)	G-9109208-001
			G-9109208-002
		TOLUENE (EPA 8240)	G-9109208-001
			G-9109208-002
		CHLOROBENZENE (EPA 8240)	G-9109208-001
			G-9109208-002

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April 19, 1991

ENSECO CRL VENTURA
2810 BUNSEN AVE., UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109913-001
Date Sampled: 5-APR-1991
Date Sample Rec'd: 9-APR-1991
Project: (V-9109519) BATELLE/CROW'S LANDING #G-9860-9101

Enclosed with this letter is the report on the chemical and physical analyses on the sample from ANALYSIS NO: G-9109913-001 shown above.

The sample was received by CRL in a chilled state, intact and with the chain-of-custody record attached.

Note that ND means not detected at the reporting limit expressed. The reporting limit is raised to reflect the dilution factor of the sample.

Solid sample is reported on "as received" basis.

Reviewed

Approved

The Report Cover Letter is an integral part of this report.

This report pertains only to the samples investigated and does not necessarily apply to other apparently identical or similar materials. This report is submitted for the exclusive use of the client to whom it is addressed. Any reproduction of this report or use of this Laboratory's name for advertising or publicity purposes without authorization is prohibited

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109913-001
Date Sampled: 5-APR-1991
Date Sample Rec'd: 9-APR-1991
Sample Type: SOLID
Date Prepared: 13-APR-1991
Prep Method: EPA 5030 By: JC
Date Analyzed: 13-APR-1991 By: JC

Project: (V-9109519) BATELLE/CROW'S LANDING #G-9860-9101
Sample ID: (V-9109519-002) CROW-7-BB

Purgeable Organics, EPA 8240

Units: ug/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL
Chloromethane	ND	10	ND	10
Bromomethane	ND	10	ND	10
Vinyl Chloride	ND	10	ND	10
Chloroethane	ND	10	ND	10
Methylene Chloride	ND	5	ND	5
Acetone	ND	10	ND	10
Carbon Disulfide	ND	5	ND	5
Trichlorofluoromethane	ND	5	ND	5
1,1-Dichloroethene	ND	5	ND	5
1,1-Dichloroethane	ND	5	ND	5
Total 1,2-Dichloroethene	ND	5	ND	5
Chloroform	ND	5	ND	5
1,2-Dichloroethane	ND	5	ND	5
2-Butanone	ND	10	ND	10
1,1,1-Trichloroethane	ND	5	ND	5
Carbon Tetrachloride	ND	5	ND	5
Vinyl Acetate	ND	10	ND	10
Bromodichloromethane	ND	5	ND	5
1,2-Dichloropropane	ND	5	ND	5
cis-1,3-Dichloropropene	ND	5	ND	5
Trichloroethene	ND	5	ND	5
Dibromochloromethane	ND	5	ND	5
1,1,2-Trichloroethane	ND	5	ND	5
Benzene	ND	5	ND	5
trans-1,3-Dichloropropene	ND	5	ND	5
2-Chloroethylvinyl ether	ND	10	ND	10
Bromoform	ND	5	ND	5
4-Methyl-2-pentanone	ND	10	ND	10
2-Hexanone	ND	10	ND	10
Tetrachloroethene	ND	5	ND	5
1,1,2,2-Tetrachloroethane	ND	5	ND	5
Toluene	ND	5	ND	5
Chlorobenzene	ND	5	ND	5
Ethylbenzene	ND	5	ND	5
Styrene	ND	5	ND	5
Xylenes, Total	ND	5	ND	5

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109913-001
Date Sampled: 5-APR-1991
Date Sample Rec'd: 9-APR-1991
Sample Type: SOLID

Project: (V-9109519) BATELLE/CROW'S LANDING #G-9860-9101

Purgeable Organics, EPA 8240 Surrogate Summary

Date	Parameter (Method)	Percent Recovery	Acceptable Range
13-APR-1991	1,2 DICHLOROETHANE-D4 (EPA 8240)	96	70-135
13-APR-1991	TOLUENE-D8 (EPA 8240)	100	69-138
13-APR-1991	BROMOFLUOROBENZENE (EPA 8240)	99	60-137

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109913-001
Date Sampled: 5-APR-1991
Date Sample Rec'd: 9-APR-1991
Sample Type: SOLID

Project: (V-9109519) BATELLE/CROW'S LANDING #G-9860-9101

Matrix Spike/Matrix Spike Duplicate Report

Sample Number	Parameter (Method)	Units	Observed Concentration Sample	MS	MSD	Amt. Spiked	% Recovery MS	MSD	Avg.	% RPD
109308-001	1,1-DICHLOROETHENE (EPA 8240)	ug/kg	ND	62.3	67.2	50.0	124	134	129	7
109308-001	TRICHLOROETHENE (EPA 8240)	ug/kg	ND	51.9	50.8	50.0	103	101	102	2
109308-001	BENZENE (EPA 8240)	ug/kg	ND	70.5	67.2	50.0	141	134	137	4
109308-001	TOLUENE (EPA 8240)	ug/kg	ND	72.0	63.9	50.0	144	127	135	11
9109308-001	CHLOROBENZENE (EPA 8240)	ug/kg	ND	61.5	59.1	50.0	123	118	120	4

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Matrix Spike/Matrix Spike Duplicate Report Cross-Reference

QC Batch	Date	Parameter (Method)	Sample Nos.
9109308-001	9-APR-1991	1,1-DICHLOROETHENE (EPA 8240)	G-9109913-001
	9-APR-1991	TRICHLOROETHENE (EPA 8240)	G-9109913-001
	9-APR-1991	BENZENE (EPA 8240)	G-9109913-001
	9-APR-1991	TOLUENE (EPA 8240)	G-9109913-001
	9-APR-1991	CHLOROBENZENE (EPA 8240)	G-9109913-001

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9109913-001
Date Sampled: 5-APR-1991
Date Sample Rec'd: 9-APR-1991
Sample Type: SOLID

Project: (V-9109519) BATELLE/CROW'S LANDING #G-9860-9101

Laboratory Control Sample Report

QC Batch	Parameter (Method)	Amt. Spiked	Units	Avg. Spike Recov.	Acceptable Range	Rel. Pct. Diff.	Acceptable Range
L91101024	1,1-DICHLOROETHENE (EPA 8240)	50.0	ug/kg	88	30-151	4.	36
L91101024	TRICHLOROETHENE (EPA 8240)	50.0	ug/kg	99	36-150	5.	33
L91101024	BENZENE (EPA 8240)	50.0	ug/kg	96	32-150	6.	35
L91101024	TOLUENE (EPA 8240)	50.0	ug/kg	97	34-151	6.	34
L91101024	CHLOROBENZENE (EPA 8240)	50.0	ug/kg	95	33-151	1.	35

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Laboratory Control Sample Report Cross-Reference

QC Batch	Date	Parameter (Method)	Sample Nos.
L91101024	11-APR-1991	1,1-DICHLOROETHENE (EPA 8240)	G-9109913-001
		TRICHLOROETHENE (EPA 8240)	G-9109913-001
		BENZENE (EPA 8240)	G-9109913-001
		TOLUENE (EPA 8240)	G-9109913-001
		CHLOROBENZENE (EPA 8240)	G-9109913-001

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FAX: (714) 891-5917

April 30, 1991

ENSECO CRL VENTURA
2810 BUNSEN AVE., UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9110018-001/004
Date Sampled: 8-APR-1991
Date Sample Rec'd: 10-APR-1991
Project: (V-9109911) BATTELLE/CROW LANDING G-9860-9101

Enclosed with this letter is the report on the chemical and physical analyses on the samples from ANALYSIS NO: G-9110018-001/004 shown above.

The samples were received by CRL in a chilled state, intact and with the chain-of-custody record attached.

Note that ND means not detected at the reporting limit expressed. The reporting limit is raised to reflect the dilution factor of the sample.

Solid samples are reported on "as received" basis.

Reviewed

Approved

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Laboratory Report

ENSECO CRL VENTURA
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VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9110018-001
Date Sampled: 8-APR-1991
Date Sample Rec'd: 10-APR-1991
Sample Type: SOLID
Date Prepared: 17-APR-1991
Prep Method: EPA 5030 By: LR
Date Analyzed: 17-APR-1991 By: LR

Project: (V-9109911) BATTELLE/CROW LANDING G-9860-9101
Sample ID: (V-9109911-002) CROW-22-BU

Purgeable Organics, EPA 8240

Units: ug/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL
Chloromethane	ND	10	ND	10
Bromomethane	ND	10	ND	10
Vinyl Chloride	ND	10	ND	10
Chloroethane	ND	10	ND	10
Methylene Chloride	ND	5	ND	5
Acetone	ND	10	ND	10
Carbon Disulfide	ND	5	ND	5
Trichlorofluoromethane	ND	5	ND	5
1,1-Dichloroethene	ND	5	ND	5
1,1-Dichloroethane	ND	5	ND	5
Total 1,2-Dichloroethene	ND	5	ND	5
Chloroform	ND	5	ND	5
1,2-Dichloroethane	ND	5	ND	5
2-Butanone	ND	10	ND	10
1,1,1-Trichloroethane	ND	5	ND	5
Carbon Tetrachloride	ND	5	ND	5
Vinyl Acetate	ND	10	ND	10
Bromodichloromethane	ND	5	ND	5
1,2-Dichloropropane	ND	5	ND	5
cis-1,3-Dichloropropene	ND	5	ND	5
Trichloroethene	ND	5	ND	5
Dibromochloromethane	ND	5	ND	5
1,1,2-Trichloroethane	ND	5	ND	5
Benzene	ND	5	ND	5
trans-1,3-Dichloropropene	ND	5	ND	5
2-Chloroethylvinyl ether	ND	10	ND	10
Bromoform	ND	5	ND	5
4-Methyl-2-pentanone	ND	10	ND	10
2-Hexanone	ND	10	ND	10
Tetrachloroethene	ND	5	ND	5
1,1,2,2-Tetrachloroethane	ND	5	ND	5
Toluene	ND	5	ND	5
Chlorobenzene	ND	5	ND	5
Ethylbenzene	ND	5	ND	5
Styrene	ND	5	ND	5
Xylenes, Total	ND	5	ND	5

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9110018-001
Date Sampled: 8-APR-1991
Date Sample Rec'd: 10-APR-1991
Sample Type: SOLID

Project: (V-9109911) BATTELLE/CROW LANDING G-9860-9101

Purgeable Organics, EPA 8240 Surrogate Summary

Date	Parameter (Method)	Percent Recovery	Acceptable Range
17-APR-1991	1,2 DICHLOROETHANE-D4 (EPA 8240)	82	70-135
17-APR-1991	TOLUENE-D8 (EPA 8240)	94	69-138
17-APR-1991	BROMOFLUOROBENZENE (EPA 8240)	89	60-137

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9110018-002
Date Sampled: 8-APR-1991
Date Sample Rec'd: 10-APR-1991
Sample Type: SOLID
Date Prepared: 17-APR-1991
Prep Method: EPA 5030 By: LR
Date Analyzed: 17-APR-1991 By: LR

Project: (V-9109911) BATTELLE/CROW LANDING G-9860-9101
Sample ID: (V-9109911-005) CROW-23-BT

Purgeable Organics, EPA 8240

Units: ug/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL
Chloromethane	ND	10	ND	10
Bromomethane	ND	10	ND	10
Vinyl Chloride	ND	10	ND	10
Chloroethane	ND	10	ND	10
Methylene Chloride	ND	5	ND	5
Acetone	ND	10	ND	10
Carbon Disulfide	ND	5	ND	5
Trichlorofluoromethane	ND	5	ND	5
1,1-Dichloroethene	ND	5	ND	5
1,1-Dichloroethane	ND	5	ND	5
Total 1,2-Dichloroethene	ND	5	ND	5
Chloroform	ND	5	ND	5
1,2-Dichloroethane	ND	5	ND	5
2-Butanone	ND	10	ND	10
1,1,1-Trichloroethane	ND	5	ND	5
Carbon Tetrachloride	ND	5	ND	5
Vinyl Acetate	ND	10	ND	10
Bromodichloromethane	ND	5	ND	5
1,2-Dichloropropane	ND	5	ND	5
cis-1,3-Dichloropropene	ND	5	ND	5
Trichloroethene	ND	5	ND	5
Dibromochloromethane	ND	5	ND	5
1,1,2-Trichloroethane	ND	5	ND	5
Benzene	ND	5	ND	5
trans-1,3-Dichloropropene	ND	5	ND	5
2-Chloroethylvinyl ether	ND	10	ND	10
Bromoform	ND	5	ND	5
4-Methyl-2-pentanone	ND	10	ND	10
2-Hexanone	ND	10	ND	10
Tetrachloroethene	ND	5	ND	5
1,1,2,2-Tetrachloroethane	ND	5	ND	5
Toluene	ND	5	ND	5
Chlorobenzene	ND	5	ND	5
Ethylbenzene	ND	5	ND	5
Styrene	ND	5	ND	5
Xylenes, Total	ND	5	ND	5

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9110018-002
Date Sampled: 8-APR-1991
Date Sample Rec'd: 10-APR-1991
Sample Type: SOLID

Project: (V-9109911) BATTELLE/CROW LANDING G-9860-9101

Purgeable Organics, EPA 8240 Surrogate Summary

Date	Parameter (Method)	Percent Recovery	Acceptable Range
17-APR-1991	1,2 DICHLOROETHANE-D4 (EPA 8240)	90	70-135
17-APR-1991	TOLUENE-D8 (EPA 8240)	103	69-138
17-APR-1991	BROMOFLUOROBENZENE (EPA 8240)	98	60-137

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9110018-001/004
Date Sampled: 8-APR-1991
Date Sample Rec'd: 10-APR-1991
Sample Type: SOLID

Project: (V-9109911) BATTELLE/CROW LANDING G-9860-9101

Matrix Spike/Matrix Spike Duplicate Report

Sample Number	Parameter (Method)	Units	Observed Concentration Sample	MS	MSD	Amt. Spiked	% Recovery MS	MSD	Avg.	% RPD
9110018-003	PHOSPHORUS, AS PHOSPHORUS (EPA 365.2)	mg/kg	83.5	0.05	0.03	0.25	N/C	N/C	N/C	N/C
9109916-003	1,1-DICHLOROETHENE (EPA 8240)	ug/kg	ND	41.4	42.8	50.0	82	85	83	3
9109916-003	TRICHLOROETHENE (EPA 8240)	ug/kg	ND	40.0	39.7	50.0	80	79	79	0
9109916-003	BENZENE (EPA 8240)	ug/kg	ND	47.9	47.5	50.0	95	95	95	0
9109916-003	TOLUENE (EPA 8240)	ug/kg	ND	49.2	50.3	50.0	98	100	99	2
9109916-003	CHLOROBENZENE (EPA 8240)	ug/kg	ND	45.7	45.1	50.0	91	90	90	1

N/C = Not Calculated; Recovery of the compound spiked into the sample was not calculated due to a high existing concentration in the sample. Non-representative recoveries may result when the native sample concentration exceeds twice the spike level due, in part, to sample heterogeneity.

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Matrix Spike/Matrix Spike Duplicate Report Cross-Reference

QC Batch	Date	Parameter (Method)	Sample Nos.
9109916-003	15-APR-1991	1,1-DICHLOROETHENE (EPA 8240)	G-9110018-001
			G-9110018-002
	15-APR-1991	TRICHLOROETHENE (EPA 8240)	G-9110018-001
			G-9110018-002
	15-APR-1991	BENZENE (EPA 8240)	G-9110018-001
			G-9110018-002
	15-APR-1991	TOLUENE (EPA 8240)	G-9110018-001
			G-9110018-002
	15-APR-1991	CHLOROBENZENE (EPA 8240)	G-9110018-001
			G-9110018-002
9110018-003	24-APR-1991	PHOSPHORUS, AS PHOSPHORUS (EPA 365.2)	G-9110018-003
			G-9110018-004

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9110018-001/004
Date Sampled: 8-APR-1991
Date Sample Rec'd: 10-APR-1991
Sample Type: SOLID

Project: (V-9109911) BATTELLE/CROW LANDING G-9860-9101

Laboratory Control Sample Report

QC Batch	Parameter (Method)	Amt. Spiked	Units	Avg. Spike Recov.	Acceptable Range	Rel. Pct. Diff.	Acceptable Range
L91114031	PHOSPHORUS, AS PHOSPHORUS (EPA 365.2)	0.25	mg/kg	90	80-120	4.	20
L91109002	1,1-DICHLOROETHENE (EPA 8240)	50.0	ug/kg	86	30-151	4.	36
L91109002	TRICHLOROETHENE (EPA 8240)	50.0	ug/kg	92	36-150	11.	33
L91109002	BENZENE (EPA 8240)	50.0	ug/kg	89	32-150	16.	35
L91109002	TOLUENE (EPA 8240)	50.0	ug/kg	94	34-151	15.	34
L91109002	CHLOROBENZENE (EPA 8240)	50.0	ug/kg	88	33-151	17.	35

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Laboratory Control Sample Report Cross-Reference

QC Batch	Date	Parameter (Method)	Sample Nos.
L91109002	17-APR-1991	1,1-DICHLOROETHENE (EPA 8240)	G-9110018-001
			G-9110018-002
		TRICHLOROETHENE (EPA 8240)	G-9110018-001
			G-9110018-002
		BENZENE (EPA 8240)	G-9110018-001
			G-9110018-002
		TOLUENE (EPA 8240)	G-9110018-001
			G-9110018-002
		CHLOROBENZENE (EPA 8240)	G-9110018-001
			G-9110018-002
L91114031	24-APR-1991	PHOSPHORUS, AS PHOSPHORUS (EPA 365.2)	G-9110018-003
			G-9110018-004

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Enseco - CRL
7440 Lincoln Way • Garden Grove, CA 92641
(714) 898-6370 • (213) 598-0458 • (800) LAB-1-CRL
FAX: (714) 891-5917

May 13, 1991

ENSECO CRL VENTURA
2810 BUNSEN AVE., UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9111604-001/005
Date Sampled: 22/24-APR-1991
Date Sample Rec'd: 26-APR-1991
Project: (V-9111503) BATTELLE CROW'S LANDING - G-9860-9101

Enclosed with this letter is the report on the chemical and physical analyses on the samples from ANALYSIS NO: G-9111604-001/005 shown above.

The samples were received by CRL in a chilled state, intact and with the chain-of-custody record attached.

Note that ND means not detected at the reporting limit expressed. The reporting limit is raised to reflect the dilution factor of the sample.

Solid samples are reported on "as received" basis.

Reviewed

Approved

The Report Cover Letter is an integral part of this report.
This report pertains only to the samples investigated and does not necessarily apply to other apparently identical or similar materials. This report is submitted for the exclusive [illegible] Any reproduction of this report or use of this Laboratory's name for advertising or publicity purposes without authorization is prohibited.

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9111604-001
Date Sampled: 22-APR-1991
Date Sample Rec'd: 26-APR-1991
Sample Type: SOLID
Date Prepared: 3-MAY-1991
Prep Method: EPA 5030 By: JC
Date Analyzed: 3-MAY-1991 By: JC

Project: (V-9111503) BATTELLE/CROW'S LANDING - G-9860-9101
Sample ID: (V-9111503-002) CROW-24-BU

Purgeable Organics, EPA 8240

Units: ug/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL
Chloromethane	ND	10	ND	10
Bromomethane	ND	10	ND	10
Vinyl Chloride	ND	10	ND	10
Chloroethane	ND	10	ND	10
Methylene Chloride	6.7	5	ND	5
Acetone	ND	10	ND	10
Carbon Disulfide	ND	5	ND	5
Trichlorofluoromethane	ND	5	ND	5
1,1-Dichloroethene	ND	5	ND	5
1,1-Dichloroethane	ND	5	ND	5
Total 1,2-Dichloroethene	ND	5	ND	5
Chloroform	ND	5	ND	5
1,2-Dichloroethane	ND	5	ND	5
2-Butanone	ND	10	ND	10
1,1,1-Trichloroethane	ND	5	ND	5
Carbon Tetrachloride	ND	5	ND	5
Vinyl Acetate	ND	10	ND	10
Bromodichloromethane	ND	5	ND	5
1,2-Dichloropropane	ND	5	ND	5
cis-1,3-Dichloropropene	ND	5	ND	5
Trichloroethene	ND	5	ND	5
Dibromochloromethane	ND	5	ND	5
1,1,2-Trichloroethane	ND	5	ND	5
Benzene	ND	5	ND	5
trans-1,3-Dichloropropene	ND	5	ND	5
2-Chloroethylvinyl ether	ND	10	ND	10
Bromoform	ND	5	ND	5
4-Methyl-2-pentanone	ND	10	ND	10
2-Hexanone	ND	10	ND	10
Tetrachloroethene	ND	5	ND	5
1,1,2,2-Tetrachloroethane	ND	5	ND	5
Toluene	ND	5	ND	5
Chlorobenzene	ND	5	ND	5
Ethylbenzene	ND	5	ND	5
Styrene	ND	5	ND	5
Xylenes, Total	ND	5	ND	5

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9111604-001
Date Sampled: 22-APR-1991
Date Sample Rec'd: 26-APR-1991
Sample Type: SOLID

Project: (V-9111503) BATTELLE/CROW'S LANDING - G-9860-9101

Purgeable Organics, EPA 8240 Surrogate Summary

Date	Parameter (Method)	Percent Recovery	Acceptable Range
3-MAY-1991	1,2 DICHLOROETHANE-D4 (EPA 8240)	101	70-135
3-MAY-1991	TOLUENE-D8 (EPA 8240)	90	69-138
3-MAY-1991	BROMOFLUOROBENZENE (EPA 8240)	88	60-137

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9111604-002
Date Sampled: 22-APR-1991
Date Sample Rec'd: 26-APR-1991
Sample Type: SOLID
Date Prepared: 3-MAY-1991
Prep Method: EPA 5030 By: JC
Date Analyzed: 3-MAY-1991 By: JC

Project: (V-9111503) BATTELLE/CROW'S LANDING - G-9860-9101
Sample ID: (V-9111503-005) CROW-25-BT

Purgeable Organics, EPA 8240

Units: ug/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL	FN
Chloromethane	ND	50	ND	10	
Bromomethane	ND	50	ND	10	
Vinyl Chloride	ND	50	ND	10	
Chloroethane	ND	50	ND	10	
Methylene Chloride	38	25	5.4	5	#
Acetone	990	50	ND	10	
Carbon Disulfide	ND	25	ND	5	
Trichlorofluoromethane	ND	25	ND	5	
1,1-Dichloroethene	ND	25	ND	5	
1,1-Dichloroethane	ND	25	ND	5	
Total 1,2-Dichloroethene	ND	25	ND	5	
Chloroform	ND	25	ND	5	
1,2-Dichloroethane	ND	25	ND	5	
2-Butanone	200	50	ND	10	
1,1,1-Trichloroethane	ND	25	ND	5	
Carbon Tetrachloride	ND	25	ND	5	
Vinyl Acetate	ND	50	ND	10	
Bromodichloromethane	ND	25	ND	5	
1,2-Dichloropropane	ND	25	ND	5	
cis-1,3-Dichloropropene	ND	25	ND	5	
Trichloroethene	ND	25	ND	5	
Dibromochloromethane	ND	25	ND	5	
1,1,2-Trichloroethane	ND	25	ND	5	
Benzene	ND	25	ND	5	
trans-1,3-Dichloropropene	ND	25	ND	5	
2-Chloroethylvinyl ether	ND	50	ND	10	
Bromoform	ND	25	ND	5	
4-Methyl-2-pentanone	ND	50	ND	10	
2-Hexanone	ND	50	ND	10	
Tetrachloroethene	ND	25	ND	5	
1,1,2,2-Tetrachloroethane	ND	25	ND	5	
Toluene	ND	25	ND	5	
Chlorobenzene	ND	25	ND	5	
Ethylbenzene	ND	25	ND	5	

Analyte associated with sample processing and analysis in the lab environment. An acceptable method blank must contain less than five times the reporting limit of this analyte for this method.

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9111604-002
Date Sampled: 22-APR-1991
Date Sample Rec'd: 26-APR-1991
Sample Type: SOLID
Date Prepared: 3-MAY-1991
Prep Method: EPA 5030 By: JC
Date Analyzed: 3-MAY-1991 By: JC

Project: (V-9111503) BATTELLE/CROW'S LANDING - G-9860-9101
Sample ID: (V-9111503-005) CROW-25-BT

Purgeable Organics, EPA 8240

Units: ug/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL
Styrene	ND	25	ND	5
Xylenes, Total	ND	25	ND	5

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9111604-002
Date Sampled: 22-APR-1991
Date Sample Rec'd: 26-APR-1991
Sample Type: SOLID

Project: (V-9111503) BATTELLE/CROW'S LANDING - G-9860-9101

Purgeable Organics, EPA 8240 Surrogate Summary

Date	Parameter (Method)	Percent Recovery	Acceptable Range
3-MAY-1991	1,2 DICHLOROETHANE-D4 (EPA 8240)	86	70-135
3-MAY-1991	TOLUENE-D8 (EPA 8240)	86	69-138
3-MAY-1991	BROMOFLUOROBENZENE (EPA 8240)	78	60-137

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9111604-003
Date Sampled: 24-APR-1991
Date Sample Rec'd: 26-APR-1991
Sample Type: SOLID
Date Prepared: 3-MAY-1991
Prep Method: EPA 5030 By: JC
Date Analyzed: 3-MAY-1991 By: JC

Project: (V-9111503) BATTELLE/CROW'S LANDING - G-9860-9101
Sample ID: (V-9111503-009) CROW-29-BT

Purgeable Organics, EPA 8240

Units: ug/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL	FN
Chloromethane	ND	10	ND	10	
Bromomethane	ND	10	ND	10	
Vinyl Chloride	ND	10	ND	10	
Chloroethane	ND	10	ND	10	
Methylene Chloride	8.5	5.0	5.4	5	#
Acetone	27	10	ND	10	
Carbon Disulfide	37	5	ND	5	
Trichlorofluoromethane	ND	5	ND	5	
1,1-Dichloroethene	ND	5	ND	5	
1,1-Dichloroethane	ND	5	ND	5	
Total 1,2-Dichloroethene	ND	5	ND	5	
Chloroform	ND	5	ND	5	
1,2-Dichloroethane	ND	5	ND	5	
2-Butanone	ND	10	ND	10	
1,1,1-Trichloroethane	ND	5	ND	5	
Carbon Tetrachloride	ND	5	ND	5	
Vinyl Acetate	ND	10	ND	10	
Bromodichloromethane	ND	5	ND	5	
1,2-Dichloropropane	ND	5	ND	5	
cis-1,3-Dichloropropene	ND	5	ND	5	
Trichloroethene	ND	5	ND	5	
Dibromochloromethane	ND	5	ND	5	
1,1,2-Trichloroethane	ND	5	ND	5	
Benzene	ND	5	ND	5	
trans-1,3-Dichloropropene	ND	5	ND	5	
2-Chloroethylvinyl ether	ND	10	ND	10	
Bromoform	ND	5	ND	5	
4-Methyl-2-pentanone	ND	10	ND	10	
2-Hexanone	ND	10	ND	10	
Tetrachloroethene	ND	5	ND	5	
1,1,2,2-Tetrachloroethane	ND	5	ND	5	
Toluene	ND	5	ND	5	
Chlorobenzene	ND	5	ND	5	
Ethylbenzene	ND	5	ND	5	

Analyte associated with sample processing and analysis in the lab environment. An acceptable method blank must contain less than five times the reporting limit of this analyte for this method.

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9111604-003
Date Sampled: 24-APR-1991
Date Sample Rec'd: 26-APR-1991
Sample Type: SOLID
Date Prepared: 3-MAY-1991
Prep Method: EPA 5030 By: JC
Date Analyzed: 3-MAY-1991 By: JC

Project: (V-9111503) BATTELLE/CROW'S LANDING - G-9860-9101
Sample ID: (V-9111503-009) CROW-29-BT

Purgeable Organics, EPA 8240

Units: ug/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL
Styrene	ND	5	ND	5
Xylenes, Total	ND	5	ND	5

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9111604-003
Date Sampled: 24-APR-1991
Date Sample Rec'd: 26-APR-1991
Sample Type: SOLID

Project: (V-9111503) BATTELLE/CROW'S LANDING - G-9860-9101

Purgeable Organics, EPA 8240 Surrogate Summary

Date	Parameter (Method)	Percent Recovery	Acceptable Range
3-MAY-1991	1,2 DICHLOROETHANE-D4 (EPA 8240)	92	70-135
3-MAY-1991	TOLUENE-D8 (EPA 8240)	91	69-138
3-MAY-1991	BROMOFLUOROBENZENE (EPA 8240)	81	60-137

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9111604-001/005
Date Sampled: 22-APR-1991
24-APR-1991
Date Sample Rec'd: 26-APR-1991
Sample Type: SOLID

Project: (V-9111503) BATTELLE/CROW'S LANDING - G-9860-9101

Matrix Spike/Matrix Spike Duplicate Report

Sample Number	Parameter (Method)	Units	Observed Concentration Sample	MS	MSD	Amt. Spiked	% Recovery MS	MSD	Avg.	% RPD
9111604-005	PHOSPHORUS, AS PHOSPHORUS (EPA 365.2)	mg/kg	12.1	30.5	32.3	20.0	92	101	96	9
9111420-002	1,1-DICHLOROETHENE (EPA 8240)	ug/kg	ND	53.0	55.2	50.0	106	110	108	4
9110606-001	1,1-DICHLOROETHENE (EPA 8240)	ug/kg	ND	40.6	48.	50.0	81	96	88	16
9111420-002	TRICHLOROETHENE (EPA 8240)	ug/kg	ND	38.7	41.6	50.0	77	83	80	7
9110606-001	TRICHLOROETHENE (EPA 8240)	ug/kg	ND	36.3	39.8	50.0	72	79	75	9
9111420-002	BENZENE (EPA 8240)	ug/kg	ND	55.7	65.7	50.0	111	131	121	16
9110606-001	BENZENE (EPA 8240)	ug/kg	ND	49.4	60.1	50.0	98	120	109	19
9111420-002	TOLUENE (EPA 8240)	ug/kg	ND	54.0	58.7	50.0	108	117	112	8
9110606-001	TOLUENE (EPA 8240)	ug/kg	ND	49.6	60.1	50.0	99	120	109	19
11420-002	CHLOROBENZENE (EPA 8240)	ug/kg	ND	49.5	52.0	50.0	99	104	101	4
10606-001	CHLOROBENZENE (EPA 8240)	ug/kg	ND	42.3	54.8	50.0	84	109	96	25

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Matrix Spike/Matrix Spike Duplicate Report Cross-Reference

QC Batch	Date	Parameter (Method)	Sample Nos.
9110606-001	25-APR-1991	1,1-DICHLOROETHENE (EPA 8240)	G-9111604-001
	25-APR-1991	TRICHLOROETHENE (EPA 8240)	G-9111604-001
	25-APR-1991	BENZENE (EPA 8240)	G-9111604-001
	25-APR-1991	TOLUENE (EPA 8240)	G-9111604-001
	25-APR-1991	CHLOROBENZENE (EPA 8240)	G-9111604-001
9111420-002	30-APR-1991	1,1-DICHLOROETHENE (EPA 8240)	G-9111604-002
			G-9111604-003
	30-APR-1991	TRICHLOROETHENE (EPA 8240)	G-9111604-002
			G-9111604-003
	30-APR-1991	BENZENE (EPA 8240)	G-9111604-002
			G-9111604-003
	30-APR-1991	TOLUENE (EPA 8240)	G-9111604-002
			G-9111604-003
	30-APR-1991	CHLOROBENZENE (EPA 8240)	G-9111604-002
			G-9111604-003
9111604-005	7-MAY-1991	PHOSPHORUS, AS PHOSPHORUS (EPA 365.2)	G-9111604-004
			G-9111604-005

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9111604-001/005
Date Sampled: 22-APR-1991
24-APR-1991
Date Sample Rec'd: 26-APR-1991
Sample Type: SOLID

Project: (V-9111503) BATTELLE/CROW'S LANDING - G-9860-9101

Laboratory Control Sample Report

QC Batch	Parameter (Method)	Amt. Spiked	Units	Avg. Spike Recov.	Acceptable Range	Rel. Pct. Diff.	Acceptable Range
L91130001	PHOSPHORUS, AS PHOSPHORUS (EPA 365.2)	2.00	mg/kg	86	80-120	9.	20
L91119001	1,1-DICHLOROETHENE (EPA 8240)	50.0	ug/kg	82	49-133	1.	15
L91119001	TRICHLOROETHENE (EPA 8240)	50.0	ug/kg	81	76-128	2.	15
L91119001	BENZENE (EPA 8240)	50.0	ug/kg	93	79-118	2.	14
L91119001	TOLUENE (EPA 8240)	50.0	ug/kg	92	75-118	3.	14
L91119001	CHLOROBENZENE (EPA 8240)	50.0	ug/kg	94	74-129	1.	14

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Laboratory Control Sample Report Cross-Reference

QC Batch	Date	Parameter (Method)	Sample Nos.
L91119001	26-APR-1991	1,1-DICHLOROETHENE (EPA 8240)	G-9111604-001
			G-9111604-002
			G-9111604-003
		TRICHLOROETHENE (EPA 8240)	G-9111604-001
			G-9111604-002
			G-9111604-003
		BENZENE (EPA 8240)	G-9111604-001
			G-9111604-002
			G-9111604-003
		TOLUENE (EPA 8240)	G-9111604-001
			G-9111604-002
			G-9111604-003
		CHLOROBENZENE (EPA 8240)	G-9111604-001
			G-9111604-002
			G-9111604-003
L91130001	7-MAY-1991	PHOSPHORUS, AS PHOSPHORUS (EPA 365.2)	G-9111604-004
			G-9111604-005

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Enseco - CRL
7440 Lincoln Way • Garden Grove, CA 92641
(714) 898-6370 • (213) 598-0458 • (800) LAB-1-CRL
FAX: (714) 891-5917

May 14, 1991

ENSECO CRL VENTURA
2810 BUNSEN AVE., UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9112007-001/001
Date Sampled: 26-APR-1991
Date Sample Rec'd: 30-APR-1991
Project: (V-9111703) BATTELLE/CROW'S LANDING #G-9860-9101

Enclosed with this letter is the report on the chemical and physical analyses on the sample from ANALYSIS NO: G-9112007-001/001 shown above.

The sample was received by CRL in a chilled state, intact and with the chain-of-custody record attached.

Note that ND means not detected at the reporting limit expressed. The reporting limit is raised to reflect the dilution factor of the sample.

Solid sample is reported on "as received" basis.

Reviewed

Approved

The Report Cover Letter is an integral part of this report.
This report pertains only to the samples investigated and does not necessarily apply to other apparently identical or similar materials. This report is submitted for the exclusive use of the client to whom it is addressed. Any reproduction of this report or use of this Laboratory's name for advertising or publicity purposes without authorization is prohibited

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9112007-001
Date Sampled: 26-APR-1991
Date Sample Rec'd: 30-APR-1991
Sample Type: SOLID
Date Prepared: 7-MAY-1991
Prep Method: EPA 5030 By: JC
Date Analyzed: 7-MAY-1991 By: JC

Project: (V-9111703) BATTELLE/CROW'S LANDING #G-9860-9101
Sample ID: (V-9111703-002) CROW-8-BB

Purgeable Organics, EPA 8240

Units: ug/kg

Parameter	Sample Result	Sample RL	Blank Result	Blank RL
Chloromethane	ND	10	ND	10
Bromomethane	ND	10	ND	10
Vinyl Chloride	ND	10	ND	10
Chloroethane	ND	10	ND	10
Methylene Chloride	7.6	5	ND	5
Acetone	97	10	ND	10
Carbon Disulfide	ND	5	ND	5
Trichlorofluoromethane	ND	5	ND	5
1,1-Dichloroethene	ND	5	ND	5
1,1-Dichloroethane	ND	5	ND	5
Total 1,2-Dichloroethene	ND	5	ND	5
Chloroform	ND	5	ND	5
1,2-Dichloroethane	ND	5	ND	5
2-Butanone	ND	10	ND	10
1,1,1-Trichloroethane	15	5	ND	5
Carbon Tetrachloride	ND	5	ND	5
Vinyl Acetate	ND	10	ND	10
Bromodichloromethane	ND	5	ND	5
1,2-Dichloropropane	ND	5	ND	5
cis-1,3-Dichloropropene	ND	5	ND	5
Trichloroethene	18	5	ND	5
Dibromochloromethane	ND	5	ND	5
1,1,2-Trichloroethane	ND	5	ND	5
Benzene	ND	5	ND	5
trans-1,3-Dichloropropene	ND	5	ND	5
2-Chloroethylvinyl ether	ND	10	ND	10
Bromoform	ND	5	ND	5
4-Methyl-2-pentanone	ND	10	ND	10
2-Hexanone	ND	10	ND	10
Tetrachloroethene	ND	5	ND	5
1,1,2,2-Tetrachloroethane	ND	5	ND	5
Toluene	ND	5	ND	5
Chlorobenzene	ND	5	ND	5
Ethylbenzene	ND	5	ND	5
Styrene	ND	5	ND	5
Xylenes, Total	11	5	ND	5

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9112007-001
Date Sampled: 26-APR-1991
Date Sample Rec'd: 30-APR-1991
Sample Type: SOLID

Project: (V-9111703) BATTELLE/CROW'S LANDING #G-9860-9101

Purgeable Organics, EPA 8240 Surrogate Summary

Date	Parameter (Method)	Percent Recovery	Acceptable Range
7-MAY-1991	1,2 DICHLOROETHANE-D4 (EPA 8240)	104	70-135
7-MAY-1991	TOLUENE-D8 (EPA 8240)	100	69-138
7-MAY-1991	BROMOFLUOROBENZENE (EPA 8240)	90	60-137

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9112007-001
Date Sampled: 26-APR-1991
Date Sample Rec'd: 30-APR-1991
Sample Type: SOLID

Project: (V-9111703) BATTELLE/CROW'S LANDING #G-9860-9101

Matrix Spike/Matrix Spike Duplicate Report

Sample Number	Parameter (Method)	Units	Observed Concentration Sample	MS	MSD	Amt. Spiked	% Recovery MS	MSD	Avg.	% RPD
9111604-001	1,1-DICHLOROETHENE (EPA 8240)	ug/kg	ND	51.7	48.3	50.0	103	96	99	6
9111604-001	TRICHLOROETHENE (EPA 8240)	ug/kg	ND	52.7	50.7	50.0	105	101	103	3
9111604-001	BENZENE (EPA 8240)	ug/kg	ND	56.2	56.4	50.0	112	112	112	0
9111604-001	TOLUENE (EPA 8240)	ug/kg	ND	60.9	65.7	50.0	121	131	126	7
9111604-001	CHLOROBENZENE (EPA 8240)	ug/kg	ND	58.4	60.9	50.0	116	121	118	4

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A Corning Company

Matrix Spike/Matrix Spike Duplicate Report Cross-Reference

QC Batch	Date	Parameter (Method)	Sample Nos.
9111604-001	3-MAY-1991	1,1-DICHLOROETHENE (EPA 8240)	G-9112007-001
	3-MAY-1991	TRICHLOROETHENE (EPA 8240)	G-9112007-001
	3-MAY-1991	BENZENE (EPA 8240)	G-9112007-001
	3-MAY-1991	TOLUENE (EPA 8240)	G-9112007-001
	3-MAY-1991	CHLOROBENZENE (EPA 8240)	G-9112007-001

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Laboratory Report

ENSECO CRL VENTURA
2810 BUNSEN AVENUE, UNIT A
VENTURA, CA 93003
ATTN: MR. LEO RAAB

Analysis No.: G-9112007-001
Date Sampled: 26-APR-1991
Date Sample Rec'd: 30-APR-1991
Sample Type: SOLID

Project: (V-9111703) BATTELLE/CROW'S LANDING #G-9860-9101

Laboratory Control Sample Report

QC Batch	Parameter (Method)	Amt. Spiked	Units	Avg. Spike Recov.	Acceptable Range	Rel. Pct. Diff.	Acceptable Range
L91126020	1,1-DICHLOROETHENE (EPA 8240)	50.0	ug/kg	88	49-133	8.	15
L91126020	TRICHLOROETHENE (EPA 8240)	50.0	ug/kg	100	76-128	11.	15
L91126020	BENZENE (EPA 8240)	50.0	ug/kg	95	79-118	10.	14
L91126020	TOLUENE (EPA 8240)	50.0	ug/kg	105	75-118	10.	14
L91126020	CHLOROBENZENE (EPA 8240)	50.0	ug/kg	100	74-129	10.	14

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A Corning Company

Laboratory Control Sample Report Cross-Reference

QC Batch	Date	Parameter (Method)	Sample Nos.
L91126020	1-MAY-1991	1,1-DICHLOROETHENE (EPA 8240)	G-9112007-001
		TRICHLOROETHENE (EPA 8240)	G-9112007-001
		BENZENE (EPA 8240)	G-9112007-001
		TOLUENE (EPA 8240)	G-9112007-001
		CHLOROBENZENE (EPA 8240)	G-9112007-001

APPENDIX F

STACK EMISSIONS DATA FOR STACK EMISSIONS SAMPLING

(MODIFIED METHOD 5)

NATIONAL EXPRESS LABORATORIES

NAT

Mid-Pacific Environmental Laboratory, Inc.
625B Clyde Avenue
Mountain View, CA 94043
(415) 964-0844
FAX (415) 961-7113

April 16, 1991
MPELI ID: 9104001
Client PO: G 98609101

Battelle
Columbus Laboratories
505 King Avenue
Columbus, OH 43201

Attention: Mr. Say Kee Ong

Subject: Analysis of 4 MM5 Sample Trains, Received 4/1/91.

Modified Method 5 sample trains were prepared and analyzed for semivolatile organic compounds according to the Modified Method 5 protocol (EPA Method 0010) and EPA Method 8270 (SW-846, 3rd. Ed.,1986). Results are presented in Table 1. The method can be summarized as follows:

> Before extraction, surrogate compounds are added to each part to monitor extraction recoveries. The filter and XAD resin are soxhlet extracted. The probe and nozzle wash, and impinger and impinger condensate are extracted separately by shake out at pH >11 and at pH <2. All extractions are prepared using methylene chloride. All extracts are then combined and concentrated to 1 mL. Just prior to injection into a Gas Chromatograph/Mass Spectrometer (GC/MS) internal standards are added. The GC/MS is equipped with a fused silica capillary column and is setup for the analysis of semivolatile priority pollutants.

Qualitative identification of the priority pollutants is performed initially using the relative retention times and the relative abundance of three unique ions. The entire mass spectrum is checked before any final identifications are recorded. Quantitative analysis is performed by the internal standard method using a single characteristic ion and response factors obtained from a daily calibration standard. In the tables, an entry such as "<5" means that the compound was not found at a level above the laboratory's reporting limit. The reporting limit, which is based on EPA reporting levels, has been corrected for any sample dilution.

Prior to analysis, every sample is spiked with surrogate compounds as part of Mid-Pacific's Quality Control Program. These compounds simulate the behavior of compounds of interest and confirm that acceptable recoveries are being achieved on every sample. The results of surrogate recoveries are reported with the sample results.

If you should have any technical questions, please contact the undersigned at (415) 964-0844.

Approved by: Daniel L. Middleton
Daniel L. Middleton
Client Services Manager

These results were obtained by following standard laboratory procedures; the liability of Mid-Pacific Environmental Laboratory, Inc. shall not exceed the amount paid for this report. In no event shall Mid-Pacific be liable for special or consequential damages.

Table 1. Modified Method 5 Train Results

Battelle Sample ID

8270 Compounds	CL-01	CL-02	CL-BL	CL-03	Method Blank
	ug/train	ug/train	ug/train	ug/train	ug/train
Phenol	<10	<10	<10	<10	<10
Bis(2-chloroethyl)ether	<10	<10	<10	<10	<10
2-Chlorophenol	<10	<10	<10	<10	<10
1,3-Dichlorobenzene	<10	<10	<10	<10	<10
1,4-Dichlorobenzene	<10	<10	<10	<10	<10
Benzyl alcohol	<20	<20	<20	<20	<20
1,2-Dichlorobenzene	<10	<10	<10	<10	<10
2-Methylphenol	<10	<10	<10	<10	<10
Bis(2-chloroisopropyl)ether	<10	<10	<10	<10	<10
4-Methylphenol	<10	<10	<10	<10	<10
N-Nitroso-di-n-propylamine	<10	<10	<10	<10	<10
Hexachloroethane	<10	<10	<10	<10	<10
Nitrobenzene	<10	<10	<10	<10	<10
Isophorone	<10	<10	<10	<10	<10
2-Nitrophenol	<10	<10	<10	<10	<10
2,4-Dimethylphenol	<10	<10	<10	<10	<10
Benzoic acid	<50	<50	<50	<50	<50
Bis(2-chloroethoxy)methane	<10	<10	<10	<10	<10
2,4-Dichlorophenol	<10	<10	<10	<10	<10
1,2,4-Trichlorobenzene	<10	<10	<10	<10	<10
Naphthalene	24	<10	<10	<10	<10
4-Chloroaniline	<20	<20	<20	<20	<20
Hexachlorobutadiene	<10	<10	<10	<10	<10
4-Chloro-3-methylphenol	<10	<10	<10	<10	<10
2-Methylnaphthalene	<10	<10	<10	<10	<10
Hexachlorocyclopentadiene	<10	<10	<10	<10	<10
2,4,6-Trichlorophenol	<10	<10	<10	<10	<10
2,4,5-Trichlorophenol	<10	<10	<10	<10	<10
2-Chloronaphthalene	<10	<10	<10	<10	<10
2-Nitroaniline	<50	<50	<50	<50	<50
2-Chloronaphthalene	<50	<50	<50	<50	<50
Dimethyl phthalate	<10	<10	<10	<10	<10
Acenaphthylene	<10	<10	<10	<10	<10
3-Nitroaniline	<50	<50	<50	<50	<50
Acenaphthene	<10	<10	<10	<10	<10
2,4-Dinitrophenol	<50	<50	<50	<50	<50
4-Nitrophenol	<50	<50	<50	<50	<50
Dibenzofuran	<10	<10	<10	<10	<10
2,4-Dinitrotoluene	<10	<10	<10	<10	<10
2,6-Dinitrotoluene	<10	<10	<10	<10	<10

Table 1. Modified Method 5 Train Results (Cont.)

Battelle Sample ID

8270 Compounds	CL-01	CL-02	CL-BL	CL-03	Method Blank
	ug/train	ug/train	ug/train	ug/train	ug/train
Diethyl phthalate	41	41	<10	<10	<10
4-Chlorophenyl phenylether	<10	<10	<10	<10	<10
Fluorene	<10	<10	<10	<10	<10
4-Nitroaniline	<50	<50	<50	<50	<50
4,6-Dinitro-2-methylphenol	<50	<50	<50	<50	<50
N-Nitrosodiphenylamine	<10	<10	<10	<10	<10
4-Bromophenyl phenylether	<10	<10	<10	<10	<10
Hexachlorobenzene	<10	<10	<10	<10	<10
Pentachlorophenol	<50	<50	<50	<50	<50
Phenanthrene	68	<10	<10	68	<10
Anthracene	<10	<10	<10	<10	<10
Di-n-Butyl phthalate	<10	<10	<10	<10	<10
Fluoranthene	<10	<10	<10	16	<10
Pyrene	<10	<10	<10	<10	<10
Butyl benzyl phthalate	<10	<10	<10	<10	<10
3,3'-Dichlorobenzidine	<20	<20	<20	<20	<20
Benzo(a)anthracene	<10	<10	<10	<10	<10
Bis(2-ethylhexyl)phthalate	<10	<10	<10	<10	<10
Chrysene	<10	<10	<10	<10	<10
Di-n-octyl phthalate	<10	<10	120	<10	<10
Benzo(b)fluoranthene	<10	<10	<10	<10	<10
Benzo(k)fluoranthene	<10	<10	<10	<10	<10
Benzo(a)pyrene	<10	<10	<10	<10	<10
Indeno(1,2,3-cd)pyrene	<10	<10	<10	<10	<10
Dibenzo(a,h)anthracene	<10	<10	<10	<10	<10
Benzo(g,h,i)perylene	<10	<10	<10	<10	<10
Date Analyzed	4/10/91	4/10/91	4/10/91	4/10/91	4/10/91
Date Extracted	4/2/91	4/2/91	4/2/91	4/2/91	4/2/91

Surrogates	Percent Recovery (%)				
2-Fluorophenol	60	43	43	53	51
Phenol-d5	59	46	54	60	59
Nitrobenzene-d5	71	45	53	64	56
2-Fluorobiphenyl	84	63	54	59	50
2,4,6-Tribromophenol	40	34	46	41	46
p-Terphenyl-d14	41	74	53	60	48

Table 1. Modified Method 5 Train Results

Battelle Sample ID

8270 Compounds	Spike % Recov	Dup Spike % Recov
Phenol	52	45
Bis(2-chloroethyl)ether	NS	NS
2-Chlorophenol	54	47
1,3-Dichlorobenzene	NS	NS
1,4-Dichlorobenzene	59	48
Benzyl alcohol	NS	NS
1,2-Dichlorobenzene	NS	NS
2-Methylphenol	NS	NS
Bis(2-chloroisopropyl)ether	NS	NS
4-Methylphenol	NS	NS
N-Nitroso-di-n-propylamine	52	47
Hexachloroethane	NS	NS
Nitrobenzene	NS	NS
Isophorone	NS	NS
2-Nitrophenol	NS	NS
2,4-Dimethylphenol	NS	NS
Benzoic acid	NS	NS
Bis(2-chloroethoxy)methane	NS	NS
2,4-Dichlorophenol	NS	NS
1,2,4-Trichlorobenzene	62	52
Naphthalene	NS	NS
4-Chloroaniline	NS	NS
Hexachlorobutadiene	NS	NS
4-Chloro-3-methylphenol	65	61
2-Methylnaphthalene	NS	NS
Hexachlorocyclopentadiene	NS	NS
2,4,6-Trichlorophenol	NS	NS
2,4,5-Trichlorophenol	NS	NS
2-Chloronaphthalene	NS	NS
2-Nitroaniline	NS	NS
2-Chloronaphthalene	NS	NS
Dimethyl phthalate	NS	NS
Acenaphthylene	NS	NS
3-Nitroaniline	NS	NS
Acenaphthene	59	55
2,4-Dinitrophenol	NS	NS
4-Nitrophenol	82	79
Dibenzofuran	NS	NS
2,4-Dinitrotoluene	74	76
2,6-Dinitrotoluene	NS	NS

NS - Not spiked

Table 1. Modified Method 5 Train Results (Cont.)

Battelle Sample ID

8270 Compounds	Spike % Recov	Dup Spike % Recov
Diethyl phthalate	NS	NS
4-Chlorophenyl phenylether	NS	NS
Fluorene	NS	NS
4-Nitroaniline	NS	NS
4,6-Dinitro-2-methylphenol	NS	NS
N-Nitrosodiphenylamine	NS	NS
4-Bromophenyl phenylether	NS	NS
Hexachlorobenzene	NS	NS
Pentachlorophenol	84	84
Phenanthrene	NS	NS
Anthracene	NS	NS
Di-n-Butyl phthalate	NS	NS
Fluoranthene	NS	NS
Pyrene	57	58
Butyl benzyl phthalate	NS	NS
3,3'-Dichlorobenzidine	NS	NS
Benzo(a)anthracene	NS	NS
Bis(2-ethylhexyl)phthalate	NS	NS
Chrysene	NS	NS
Di-n-octyl phthalate	NS	NS
Benzo(b)fluoranthene	NS	NS
Benzo(k)fluoranthene	NS	NS
Benzo(a)pyrene	NS	NS
Indeno(1,2,3-cd)pyrene	NS	NS
Dibenzo(a,h)anthracene	NS	NS
Benzo(g,h,i)perylene	NS	NS
Date Analyzed	4/10/91	4/10/91
Date Extracted	4/2/91	4/2/91

Surrogates	Percent Recovery (%)	
2-Fluorophenol	57	48
Phenol-d5	64	55
Nitrobenzene-d5	63	54
2-Fluorobiphenyl	65	56
2,4,6-Tribromophenol	101	102
p-Terphenyl-d14	74	73

NS - Not spiked

APPENDIX G

STACK EMISSIONS DATA FOR STACK EMISSIONS SAMPLING

(VOLATILE ORGANIC SAMPLING TRAIN (VOST))

Mid-Pacific Environmental Laboratory, Inc.
625B Clyde Avenue
Mountain View, CA 94043
(415) 964-0844
FAX (415) 961-7113

April 17, 1991
MPELI ID: 9104002
Client PO: G 98609101

Battelle
Columbus Laboratories
505 King Avenue
Columbus, OH 43201

Attention: Mr. Say Kee Ong

Subject: Analysis of 12 Pairs of Vost Tubes, Received 4/1/91.

VOST traps were analyzed for purgeable organic compounds according to the standard VOST protocol (Method 5040 Test Methods for Evaluating Solid Waste EPA SW846 3rd. Ed., 1986). Results are presented in Table 1. The method can be summarized as follows:

> Traps are spiked with an internal standard and then desorbed for ten minutes at 180°C. The desorbed compounds are swept through a purging vessel containing 5 mL of water to retain any HCl and then onto an analytical trap for focusing. The analytical trap is heated and back flushed with helium to desorb the purgeables onto a chromatographic column. The gas chromatograph is temperature programmed to separate the purgeables which are then detected with a mass spectrometer.

Identification and quantitation of other volatile compounds in the VOST trap are presented in Table 2.

Qualitative identification of the priority pollutants is performed initially using the relative retention times and the relative abundance of three unique ions. The entire mass spectrum is checked before any final identifications are recorded. Quantitative analysis is performed by the internal standard method using a single characteristic ion and response factors obtained from a daily calibration standard. In the tables, an entry such as "<5" means that the compound was not found at a level above the laboratory's reporting limit. The reporting limit, which is based on EPA reporting levels, has been corrected for any sample dilution.

Prior to analysis, every sample is spiked with surrogate compounds as part of Mid-Pacific's Quality Control Program. These compounds simulate the behavior of compounds of interest and confirm that acceptable recoveries are being achieved on every sample. The results of surrogate recoveries are reported with the sample results.

If you should have any technical questions, please contact the undersigned at (415) 964-0844.

Approved by: Daniel L. Middleton
Daniel L. Middleton
Client Services Manager

These results were obtained by following standard laboratory procedures; the liability of Mid-Pacific Environmental Laboratory, Inc. shall not exceed the amount paid for this report. In no event shall Mid-Pacific be liable for special or consequential damages.

Table 1. VOST Results

Battelle Sample ID

5040 Compounds	CL-01 T,TC ng/pair	CL-01 BT,BTC ng/pair	CL-02 T,TC ng/pair	CL-03 T,TC ng/pair	CL-11 T,TC ng/pair
Chloromethane	12	<10	<10	21	580
Bromomethane	<10	<10	<10	<10	<10
Vinyl Chloride	<10	<10	<10	<10	12
Chloroethane	<10	<10	<10	<10	<10
Methylene chloride	<10	<10	<10	<10	*4600
Acetone	81	25	41	31	*45000
Carbon disulfide	35	11	60	39	82
1,1-Dichloroethene	<20	<20	<20	<20	<20
1,1-Dichloroethane	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<15	<15	<15	<15	<15
Chloroform	<10	<10	<10	<10	<10
1,2-Dichloroethane	<10	<10	<10	<10	<10
2-Butanone	21	<20	<20	<20	<20
Carbon tetrachloride	<15	<15	<15	<15	<15
1,1,1-Trichloroethane	<15	<15	<15	<15	<15
Bromodichloromethane	<10	<10	<10	<10	<10
1,1,2,2-Tetrachloroethane	<10	<10	<10	<10	<10
1,2-Dichloropropane	<15	<15	<15	<15	<15
cis-1,3-Dichloropropene	<10	<10	<10	<10	<10
Dibromochloromethane	<15	<15	<15	<15	<15
1,1,2-Trichloroethane	<15	<15	<15	<15	<15
Benzene	11	<10	<10	<10	<10
trans-1,3-Dichloropropene	<15	<15	<15	<15	<15
Bromoform	<10	<10	<10	<10	<10
4-Methyl-2-Pentanone	<20	<20	<20	<20	<20
Tetrachloroethene	<15	<15	<15	<15	<15
Toluene	55	<10	<10	<10	25
Chlorobenzene	<10	<10	<10	<10	<10
Ethylbenzene	33	<15	<15	<15	<15
Styrene	<15	<15	<15	<15	<15
Total xylenes	280	<15	<15	<15	<15
Trichlorofluoromethane	61	<20	28	<20	<20
1,3-Dichlorobenzene	<10	<10	<10	<10	<10
1,4-Dichlorobenzene	<10	<10	<10	<10	<10
1,2-Dichlorobenzene	<10	<10	<10	<10	<10
Acrylonitrile**	<20	<20	<20	<20	<20
Dibromomethane**	<20	<20	<20	<20	<20
Iodomethane**	<20	<20	<20	<20	<20
1,2,3-Trichloropropane**	<20	<20	<20	<20	<20

* - Estimated quantitation amounts are above 1000 ng range.
Client used acetone and methylene chloride in sampling.

** - Estimated reporting limit, compound not present in calibration standard

Table 1. VOST Results

Battelle Sample ID

Surrogates	CL-01 T,TC	CL-01 BT,BTC	CL-02 T,TC	CL-03 T,TC	CL-11 T,TC
	Percent Recoveries (%)				
1,2-Dichloroethane-d4	82	84	85	83	73
Toluene-d8	87	92	91	89	93
p-Bromofluorobenzene	103	97	98	95	85
Date Sampled	3/27/91	3/27/91	3/27/91	3/27/91	3/28/91
Date Analyzed	4/10/91	4/10/91	4/10/91	4/10/91	4/11/91

Table 1. VOST Results (Continued)

Battelle Sample ID

5040 Compounds	CL-12 T,TC ng/pair	CL-13 T,TC ng/pair	CL-21 T,TC ng/pair	CL-22 T,TC ng/pair	CL-23 T,TC ng/pair
Chloromethane	710	980	490	720	NA
Bromomethane	<10	<10	<10	<10	NA
Vinyl Chloride	<10	<10	<10	<10	NA
Chloroethane	<10	<10	<10	<10	NA
Methylene chloride	*15000	*45000	<10	*8100	NA
Acetone	*1600	630	870	350	NA
Carbon disulfide	16	<10	50	<10	NA
1,1-Dichloroethene	<20	<20	<20	<20	<20
1,1-Dichloroethane	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<15	<15	<15	<15	<15
Chloroform	<10	<10	<10	<10	<10
1,2-Dichloroethane	<10	<10	<10	<10	<10
2-Butanone	<20	<20	<20	<20	<20
Carbon tetrachloride	<15	<15	<15	<15	<15
1,1,1-Trichloroethane	<15	<15	<15	<15	<15
Bromodichloromethane	<10	<10	<10	<10	<10
1,1,2,2-Tetrachloroethane	<10	<10	<10	<10	<10
1,2-Dichloropropane	<15	<15	<15	<15	<15
cis-1,3-Dichloropropene	<10	<10	<10	<10	<10
Dibromochloromethane	<15	<15	<15	<15	<15
1,1,2-Trichloroethane	<15	<15	<15	<15	<15
Benzene	<10	<10	<10	<10	<10
trans-1,3-Dichloropropene	<15	<15	<15	<15	<15
Bromoform	<10	<10	<10	<10	<10
4-Methyl-2-Pentanone	<20	<20	<20	<20	<20
Tetrachloroethene	<15	<15	<15	<15	<15
Toluene	<10	<10	<10	<10	<10
Chlorobenzene	<10	<10	<10	<10	<10
Ethylbenzene	<15	<15	<15	<15	<15
Styrene	<15	<15	<15	<15	<15
Total xylenes	<15	<15	<15	<15	<15
Trichlorofluoromethane	<20	<20	24	<20	NA
1,3-Dichlorobenzene	<10	<10	<10	<10	<10
1,4-Dichlorobenzene	<10	<10	<10	<10	<10
1,2-Dichlorobenzene	<10	<10	<10	<10	<10
Acrylonitrile**	<20	<20	<20	<20	NA
Dibromomethane**	<20	<20	<20	<20	<20
Iodomethane**	<20	<20	<20	<20	<20
1,2,3-Trichloropropane**	<20	<20	<20	<20	<20

* - Estimated quantitation amounts are above 1000ng range.
Client used acetone and methylene chloride in sampling.
NA - Not analyzed; instrument malfunction for compounds at these retention times.
** - Estimated reporting limit, compound not present in calibration standard

Table 1. VOST Results (Continued)

Battelle Sample ID

Surrogates	CL-12 T,TC	CL-13 T,TC	CL-21 T,TC	CL-22 T,TC	CL-23 T,TC
	Percent Recoveries (%)				
1,2-Dichloroethane-d4	103	127	95	97	116
Toluene-d8	90	90	86	88	93
p-Bromofluorobenzene	88	97	89	87	99
Date Sampled	3/28/91	3/28/91	3/29/91	3/29/91	3/29/91
Date Analyzed	4/12/91	4/12/91	4/11/91	4/12/91	4/12/91

Table 1. VOST Results (Continued)

Battelle Sample ID

5040 Compounds	CL-23 BT,BTC ng/pair	CROW-44 T,TC ng/pair	4-10-91 Method Blank ng/pair	4-11-91 Method Blank ng/pair	4-12-91 Method Blank ng/pair
Chloromethane	<10	NA	13	<10	<10
Bromomethane	<10	NA	<10	<10	<10
Vinyl Chloride	<10	NA	<10	<10	<10
Chloroethane	<10	NA	<10	<10	<10
Methylene chloride	250	NA	<10	<10	<10
Acetone	31	NA	27	<20	35
Carbon disulfide	<10	NA	<10	<10	<10
1,1-Dichloroethene	<20	NA	<20	<20	<20
1,1-Dichloroethane	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<15	<15	<15	<15	<15
Chloroform	<10	<10	<10	<10	<10
1,2-Dichloroethane	<10	<10	<10	<10	<10
2-Butanone	<20	<20	<20	<20	<20
Carbon tetrachloride	<15	NA	<15	<15	<15
1,1,1-Trichloroethane	<15	<15	<15	<15	<15
Bromodichloromethane	<10	<10	<10	<10	<10
1,1,2,2-Tetrachloroethane	<10	<10	<10	<10	<10
1,2-Dichloropropane	<15	<15	<15	<15	<15
cis-1,3-Dichloropropene	<10	<10	<10	<10	<10
Dibromochloromethane	<15	<15	<15	<15	<15
1,1,2-Trichloroethane	<15	<15	<15	<15	<15
Benzene	<10	NA	<10	<10	<10
trans-1,3-Dichloropropene	<15	<15	<15	<15	<15
Bromoform	<10	<10	<10	<10	<10
4-Methyl-2-Pentanone	<20	<20	<20	<20	<20
Tetrachloroethene	<15	<15	<15	<15	<15
Toluene	<10	<10	<10	<10	12
Chlorobenzene	<10	<10	<10	<10	<10
Ethylbenzene	<15	<15	<15	<15	<15
Styrene	<15	<15	<15	<15	<15
Total xylenes	<15	<15	<15	<15	<15
Trichlorofluoromethane	<20	NA	<20	<20	<20
1,3-Dichlorobenzene	<10	<10	<10	<10	<10
1,4-Dichlorobenzene	<10	<10	<10	<10	<10
1,2-Dichlorobenzene	<10	<10	<10	<10	<10
Acrylonitrile**	<20	<20	<20	<20	<20
Dibromomethane**	<20	<20	<20	<20	<20
Iodomethane**	<20	<20	<20	<20	<20
1,2,3-Trichloropropane**	<20	<20	<20	<20	<20

NA - Not analyzed; instrument malfunction for compounds at these retention times.
** - Estimated reporting limit, compound not present in calibration standard

Table 1. VOST Results (Continued)

	Battelle Sample ID				
	CL-23 BT,BTC	CROW-44 T,TC	4-10-91 Method Blank	4-11-91 Method Blank	4-12-91 Method Blank
Surrogates	Percent Recoveries (%)				
1,2-Dichloroethane-d4	101	NA	81	103	96
Toluene-d8	92	90	82	93	88
p-Bromofluorobenzene	90	73	92	91	82
Date Sampled	3/29/91	3/29/91	N/A	N/A	N/A
Date Analyzed	4/12/91	4/12/91	4/10/91	4/11/91	4/12/91

NA - Not analyzed
N/A - Not applicable

Table 2. Tentatively Identified Compounds

Battelle Sample ID

Volatile Compounds	CL-01 T,TC ng/pair	CL-01 BT,BTC ng/pair	CL-02 T,TC ng/pair	CL-03 T,TC ng/pair	CL-11 T,TC ng/pair
Dichlorodifluoromethane	240	ND	34	40	82
1,1,2-Trichloro-1,2-2-Trifluoroethane	160	ND	ND	ND	ND
C8 Hydrocarbon	25	ND	ND	ND	ND
C9 Hydrocarbon	28	ND	ND	ND	ND
Ethylmethyl benzene isomer	81	ND	ND	ND	ND
Trimethyl benzene isomer	43	ND	ND	ND	ND
Decane	52	ND	ND	ND	ND
Ethylmethyl benzene isomer	140	ND	ND	ND	ND
Tetrahydrofuran	ND	ND	30	ND	ND
Cyclohexane	ND	ND	ND	ND	1600
Benzaldehyde	ND	ND	ND	ND	31

ND - Not detected among the major peaks examined, detection limit unknown.

The above compounds (idents) are reported at the client's request. They were identified and quantitated by the following procedure:

After identification and quantitation of the target compounds, the 10 most intense peaks remaining in the chromatogram are selected for examination. The spectra for these peaks are compared by computer with a National Bureau of Standards library containing 42,000 entries. A chemist trained in mass spectral interpretation then examines the results. Since at the outset these peaks are unknown, no standards are usually analyzed to obtain retention time or response factor data. Quantitation is based on a comparison of the area of the reconstructed ion chromatogram from the unknown peak and the nearest internal standard. This follows the EPA CLP protocol.

Table 2. Tentatively Identified Compounds (Continued)

Battelle Sample ID

Volatile Compounds	CL-12 T,TC ng/pair	CL-13 T,TC ng/pair	CL-21 T,TC ng/pair	CL-22 T,TC ng/pair	CL-23 T,TC ng/pair
Dichlorodifluoromethane	110	ND	1700	46	ND
1,1,2-Trichloro-1,2-2 Trifluoroethane	ND	ND	ND	ND	ND
C8 Hydrocarbon	ND	ND	ND	ND	ND
C9 Hydrocarbon	ND	ND	ND	ND	ND
Ethylmethyl benzene isomer	ND	ND	ND	ND	ND
Trimethyl benzene isomer	ND	ND	ND	ND	ND
Decane	ND	ND	ND	ND	ND
Ethylmethyl benzene isomer	ND	ND	ND	ND	ND
Tetrahydrofuran	ND	ND	ND	ND	ND
Cyclohexane	ND	ND	ND	ND	ND
Benzaldehyde	ND	ND	24	ND	ND

ND - Not detected among the major peaks examined, detection limit unknown.

The above compounds (idents) are reported at the client's request. They were identified and quantitated by the following procedure:

After identification and quantitation of the target compounds, the 10 most intense peaks remaining in the chromatogram are selected for examination. The spectra for these peaks are compared by computer with a National Bureau of Standards library containing 42,000 entries. A chemist trained in mass spectral interpretation then examines the results. Since at the outset these peaks are unknown, no standards are usually analyzed to obtain retention time or response factor data. Quantitation is based on a comparison of the area of the reconstructed ion chromatogram from the unknown peak and the nearest internal standard. This follows the EPA CLP protocol.

Table 2. Tentatively Identified Compounds (Continued)

	Battelle Sample ID				
	CL-23 BT,BTC	CROW-44 T,TC	4-10-91 Method Blank	4-11-91 Method Blank	4-12-91 Method Blank
Volatile Compounds	ng/pair	ng/pair	ng/pair	ng/pair	ng/pair
Dichlorodifluoromethane	ND	ND	ND	ND	ND
1,1,2-Trichloro-1,2-2 Trifluoroethane	ND	ND	ND	ND	ND
C8 Hydrocarbon	ND	ND	ND	ND	ND
C9 Hydrocarbon	ND	ND	ND	ND	ND
Ethylmethyl benzene isomer	ND	ND	ND	ND	ND
Trimethyl benzene isomer	ND	ND	ND	ND	ND
Decane	ND	ND	ND	ND	ND
Ethylmethyl benzene isomer	ND	ND	ND	ND	ND
Tetrahydrofuran	ND	ND	ND	ND	ND
Cyclohexane	ND	ND	ND	ND	ND
Benzaldehyde	ND	ND	ND	ND	ND

ND - Not detected among the major peaks examined, detection limit unknown.

The above compounds (idents) are reported at the client's request. They were identified and quantitated by the following procedure:

After identification and quantitation of the target compounds, the 10 most intense peaks remaining in the chromatogram are selected for examination. The spectra for these peaks are compared by computer with a National Bureau of Standards library containing 42,000 entries. A chemist trained in mass spectral interpretation then examines the results. Since at the outset these peaks are unknown, no standards are usually analyzed to obtain retention time or response factor data. Quantitation is based on a comparison of the area of the reconstructed ion chromatogram from the unknown peak and the nearest internal standard. This follows the EPA CLP protocol.

APPENDIX H

CALIBRATION RECORDS AND CHAIN OF CUSTODY FORMS

FOR STACK EMISSIONS SAMPLING

Battelle
Columbus Laboratories

9104-001 4001 ~~Room 109~~ R3/S6

CHAIN OF CUSTODY RECORD

Form No. 04

Proj. No. 7-9860 9101

Project Title: CROWS LANDING

SAMPLERS: (Signature) William C. Boynton / Harry Leonard

DATE	TIME	SEQ. NO.	CART. NO.	SAMPLE I.D.	8270 MMS SEMI VOL ANALYSIS	Container No.	Number of Containers	Remarks
7 March	1635			CL-01-PW	✓		1	-01A
27 March	1635			CL-01-F	✓		1	-01B
27 March	1635			CL-01-XAD-2	✓		1	-01C
				P.S				
28 March	1315			CL-02-PW	✓		1	-02A
28 March	1315			CL-02-F	✓		1	-02B
28 March	1315			CL-02-XAD-2	✓		1	-02C
8 March	0830			CL-BL-PW	✓		1	-03A
8 March	0830			CL-BL-F	✓		1	-03B
8 March	0830			CL-BL-XAD-2	✓		1	-03C
9 MARCH	1045			CL-03-PW	✓		1	-04A
9 MARCH	1045			CL-03-F	✓		1	-04B
9 MARCH	1045			CL-03-XAD-2	✓		1	-04C

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
William C Boynton	3/29/91 1145A				

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)

Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks
		[illegible] ATT. ERIN MEADE	4-1-91 12:40	Mid PACIFIC ENVIR. LAB 625 B CLYDE AVENUE MOUNTAIN VIEW CA 94043

Page 1 of 1

Battelle 9104-002

Columbus Laboratories

Form No. 05

CHAIN OF CUSTODY RECORD

Proj. No. 1-9860 9101

Project Title: CROWS LANDING

SAMPLERS: (Signature) Curtis Bridges

SAMPLE TYPE (✓): EPA 8240 TOTAL PLUS 10 TIC

DATE	TIME	SEQ. NO.	CART. NO.	SAMPLE I.D.	EPA 8240 TOTAL PLUS 10 TIC	Container No.	Number of Containers	Remarks
27MAR	1415			CL-01-T	✓			-01A
27MAR	1415			CL-01-TC	✓			-01B
27MAR	1300			CL-01-BT	✓			-02A
27MAR	1300			CL-01-BTC	✓			-02B
27MAR	1510			CL-02-T	✓			-03A
27MAR	1510			CL-02-TC	✓			-03B
27MAR	1610			CL-03-T	✓			-04A
27MAR	1610			CL-03-TC	✓			-04B
28MAR	1055			CL-11-T	✓			-05A
28MAR	1055			CL-11-TC	✓			-05B
28MAR	1150			CL-12-T	✓			-06A
28MAR	1150			CL-12-TC	✓			-06B
28MAR	1240			CL-13-T	✓			-07A
28MAR	1240			CL-13-TC	✓			-07B

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Curtis Bridges	29 Mar 1200				

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)

Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks
		[illegible]	4/1/91 12:40	ATT. DON MIDDLETON

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4002

9104-002

Battelle
Columbus Laboratories

Form No. 06

CHAIN OF CUSTODY RECORD

Proj. No. G9860 9101

Project Title: CROWS LANDING

SAMPLERS: (Signature) Curtis Bridges

SAMPLE TYPE (✓): 8240 EPA 8240 / 1251 MWA 624 / 0-12 / 8240 / 1,2-DCE

DATE	TIME	SEQ. NO.	CART. NO.	SAMPLE I.D.	8240 EPA 8240 / 1251 MWA 624	0-12	8240	1,2-DCE	Container No.	Number of Containers	Remarks
29 MAR	0825			CL-21-T	✓						-08A
29 MAR	0825			CL-21-TC	✓						-08B
29 MAR	0920			CL-22-T	✓						-09A
29 MAR	0920			CL-22-TC	✓						-09B
29 MAR	1010			CL-23-T	✓						-10A
29 MAR	1010			CL-23-TC	✓						-10B
29 MAR	1015			CL-23-BT	✓						-11A
29 MAR	1015			CL-23-BTC	✓						-11B
29 MAR	1100			CROW-44-T	✓						-12A
29 MAR	1100			CROW-44-TC	✓						-12B

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Curtis Bridges	29 Mar 1200				
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks	
		Robin Nb	4/1/91 12:40	ATT. DON MIDDLETON	

Page 2 of 2

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

NOTICE CORD. 5 MICR SAMPLER MODEL NO. 201 SN 31 21

Battelle
Columbus Laboratories

Date MARCH 15, 1991 Meter box number X 40513

Barometric pressure, P_b = 29.46 in. Hg Calibrated by W Baytos

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperatures: Wet test meter (t_w), °F	Temperatures: Dry gas meter Inlet (t_{d_i}), °F	Temperatures: Dry gas meter Outlet (t_{d_o}), °F	Temperatures: Dry gas meter Avg[a] (t_d), °F	Time (θ), min	Y_i	$\Delta H@_i$, in. H_2O
0.5	5								
1.0	830.643 / 825.000	413.744 / 408.000	71, 71 / 71 71	71, 74 / 77, 78	70 70 / 71 71	72.75	10.0	0.9832	1.788
1.5	841.030 / 830.700	424.521 / 414.000	71 71 / 71 71	74 81 / 82, 84	70 70 / 71, 72	73.50	15.0	0.9865	1.792
2.0	853.091 / 841.200	437.203 / 425.100	71 70 / 69, 71	78, 84 / 85, 96	72, 72 / 73, 73	77.87	15.0	0.9917	1.790
3.0	10								
4.0	10								
							Avg	0.987	1.79

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(t_w + 460)}$	$\Delta H@_i = \frac{0.0317\ \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\ \theta}{V_w}\right]^2$
0.5	0.0368		
1.0	0.0737	= 0.9832	= 1.788
1.5	0.110	= 0.9865	= 1.792
2.0	0.147	= 0.9917	= 1.790
3.0	0.221		
4.0	0.294	(note: used program on HP 67 for calculation)	

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d.

Checked by: [illegible]
Date: 3/14/91

SER # 1035779

C 10019 USER BAYTOS, W

3-14-91 STANDARDS 745226, 723800

TEMP 21°C BAROMETRIC PRESSURE 28.82 IN. Hg BACK PRESSURE 0.05 IN. H_2O

RUN NG	START RUN READING	TOTAL	STANDARD VOLUME	% ERROR	RATE OF RUN
04.953	200.000	4.953	5.0	0.94	275 CFH
4.952	210.000	4.952	5.0	0.96	275 CFH
4.991	230.000	4.991	5.0	0.18	137.5 CFH
4.991	240.000	4.991	5.0	0.18	137.5 CFH
5.001	260.000	5.001	5.0	0.02	27.5 CFH
5.000	270.000	5.000	5.0	0.00	27.5 CFH
4.997	300.000	4.997	5.0	0.06	45 CFH
4.997	310.000	4.997	5.0	0.06	45 CFH

Probe &
Pitot tube # 1-22

Pitot tube assembly level? ✓ yes ____ no

Pitot tube openings damaged? ____ yes (explain below) ✓ no

α_1 = 0 ° (<10°), α_2 = 1 ° (<10°), β_1 = 1 ° (<5°),
β_2 = 2 ° (<5°)

γ = 1 °, θ = 0 °, A = 1.015" cm (in.)

z = A sin γ = 1/64" cm (in.); <0.32 cm (<1/8 in.),
w = A sin θ = 1/64" cm (in.); <0.08 cm (<1/32 in.)

P_A .507 cm (in.) P_b 1.015 cm (in.)

D_t = .375" cm (in.)

Comments: ____

Calibration required? ____ yes ✓ no

RaL 3-20-91
H.L. L 3/20/91

Figure 1.7 Type S pitot tube inspection data form.

Probe 4

Pitot tube # 1-2

Pitot tube assembly level? ✓ yes ____ no

Pitot tube openings damaged? ____ yes (explain below) ✓ no

α_1 = 0 ° (<10°), α_2 = 1 ° (<10°), β_1 = 0 ° (<5°),

β_2 = 2 ° (<5°)

γ = 3 °, θ = 0 °, A = .780" cm (in.)

z = A sin γ = 1/32" cm (in.); <0.32 cm (<1/8 in.),

w = A sin θ = 1/64" cm (in.); <0.08 cm (<1/32 in.)

P_A 3.90 cm (in.) P_b .780" cm (in.)

D_t = .312" cm (in.)

Comments: ____

Calibration required? ____ yes ✓ no

Ref 3-20-91
[illegible] 3/20/91

Figure 1.7 Type S pitot tube inspection data form.

NOMOGRAPH DATA

PLANT NAVY AUX. LANDING FIELD

DATE 3/27/91

SAMPLING LOCATION CROWS LANDING, CALIF

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.79
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	100
PERCENT MOISTURE IN GAS STREAM BY VOLUME	B_{wo}	1.4
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	30.10
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.073$ x STACK GAUGE PRESSURE in in. H_2O)	P_s	30.15
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	90°F
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.12
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	0.14
C FACTOR	1.1	
CALCULATED NOZZLE DIAMETER, in.	0.34	
ACTUAL NOZZLE DIAMETER, in.	0.31	
REFERENCE Δp, in. H_2O	0.18	

EPA (Dur) 234
4/72

$\Delta H = 1.2$

Checked by: WB

D-9860-9102
NAVY ANY. LANDING FIELD
WB
4/19/91

I/O PROGRAM FOR HP-65 • EPA METHOD 5 PARTICULATE EMISSION CALCULATIONS

		Run No	CL-01		CL-02		CL-03	
		Date	3/27/91		3/28/91		3/29/91	
		Time	1335-1635		1015-1315		0745-1045	
		PROGRAM CARD - 1 process wt. rate	10,233 lb/hr		4,024 lb/hr		7,153 lb/hr	
1		Pm, Orif. Dif. in.W ΔH	1.40		1.65		1.03	
2		Pb, Bar. Pres, in Hg	29.74		30.10		30.00	
3		Tm, Gas meter Temp,F	79.4		72.		74.5	
4		Vm, Vol. gas meter'd CF	125.752		131.69		111.48	
5		Vw, Vol water coll' ml	27.7		34.5		19.5	
	A	Vmstd, Gas vol dscf	122.80		132.04		110.72	
	B	Vwgas, Water as vap, acf	1.31		1.64		0.92	
	C	% M, Gas moisture	1.06		1.22		0.83	
	D	Md, Mole frac. dry	0.99		0.99		0.99	
•		CO_2, per cent	0.001		0.001		0.001	
•		O_2, per cent	21.		21.		21.	
•		CO, per cent	0.001		0.001		0.001	
•		N_2, per cent	79		79		79.	
	E	Mwd, Mol. wt. gas dry	28.84		28.84		28.84	
		PROGRAM CARD - 2						
1		Ps, Stk pres, in.Hg	29.80		30.15		30.05	
2		Ts, Stk temp, °F	90.8		88.2		77.8	
3		$\sqrt{\Delta Ps \times Ts}$	8.64		8.78		7.28	
4		Tt, Run time, min.	180.0		180.		180.	
5		Dn, Noz. dia., in.	0.310		0.310		0.310	
6		Cp, Pitot coeff.	0.84		0.84		0.85	
7		Mwd	28.84		28.84		28.84	
8		Md	0.99		0.99		0.99	
9		Vmstd	122.80		132.04		110.72	
	A	MW, Mol.wt.gas wet	28.73		28.73		28.73	
	B	Vs, Velocity, ft/min	1,287.29		1,279.49		1,080.14	
	C	% I, Isokinetic	106		109		110	
		PROGRAM CARD - 3						
1		Ps	29.80		30.15		30.05	
2		Ts	90.8		88.2		77.8	
3		As, Stk area, sq. in.	28.274		28.274		28.274	
4		mf, Filter catch, mg	0.001		.001		.001	
5		Dn	0.310		0.310		0.310	
6		Vs	1,287.29		1,279.49		1,080.14	
8		Md	0.99		.99		.99	
9		Vmstd	122.80		132.04		110.72	
	A	Qa, Stk flo rate, acfm	252.76		251.22		212.08	
	B	Qs, Stk flo rate, dscfm	238.95		249.44		207.07	
	C	Can, Emis. grains/dscf						
	D	Caw, Emis. lbs/hr						
	E	Cat, Emis. grains/acf						
		PROGRAM CARD - 4						
1		CO_2, %						
2		O_2, %						
3		N_2, %						
4		Fuel rate, lb/hr						
5		Fuel heat val. Btu/lb						
6		Can						
7		Caw						
	A	grains/scf@12%CO_2						
	B	grams/M^3						
	C	% EA, Excess air						
	D	lb/1000 lb gas @ 50%EA						
	E	lb/10^6 Btu						

WB .14-78

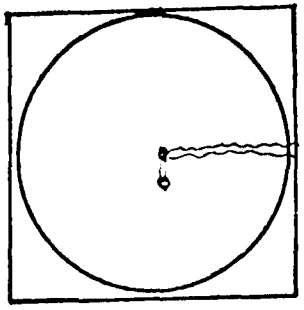
APPENDIX I

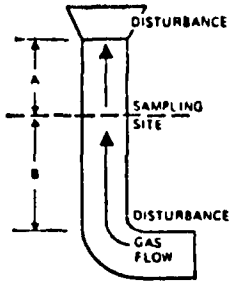
STACK EMISSION SAMPLING

FIELD DATA SHEET

PARTICULATE FIELD DATA

SCHEMATIC OF STACK





CROSS SECTION

PLANT AUXILIARY NAVY AIRFIELD CROWS LANDING, CALIF

DATE 3/27/91

LOCATION outlet of charcoal filter

OPERATOR Leonard, Gaytos

STACK NO. CL-01

RUN NO. CL-01

SAMPLE BOX NO. 3

METER BOX NO. X-40573

AMBIENT TEMPERATURE 69°F

BAROMETRIC PRESSURE 29.74" Hg

ASSUMED MOISTURE, % 1.6

PROBE LENGTH, in. 18" Pyrex

NOZZLE DIAMETER, in. 0.310

STACK DIAMETER, in. 6

PROBE HEATER SETTING ~250°F

HEATER BOX SETTING 250°F

METER $\Delta H_@$ 1.79

C FACTOR 1.1

PROCESS WEIGHT RATE 2,222 lbs/hr

WEIGHT OF PARTICULATE COLLECTED, mg		
SAMPLE	FILTER	PROBE WASH
FINAL WEIGHT		
TARE WEIGHT	0.4606	
WEIGHT GAIN		

Leak Check : TOTAL

Pre 0.02 CFM, 120 "Hg; Post 0.02 cfm, 8 "Hg

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	STATIC PRESSURE (in. H_2O)	STACK TEMPERATURE (T_s), °F	VELOCITY HEAD (ΔP_s) ($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	DESIRED	GAS SAMPLE VOLUME (V_m), ft³	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET ($T_{m_{IN}}$), °F	OUTLET ($T_{m_{OUT}}$), °F	Temp., F Filter	Last Imp.	XAD-2 OUTLET	FILTER FRIT	PUMP VACUUM in. Hg gauge	VELOCITY fps
middle	13:35/0		90°F	0.14	1.50	1.50	283.162							6.0	
	13:45/10		91°	0.12	1.25	1.25	295.0	70	69	256	68	460	240	6.1	
	13:55/20		91°	0.12	1.25	1.25	301.6	72	70	259	59	45	240	6.4	
	14:05/30		91°	0.12	1.25	1.25	308.3	74	70	259	81	46	245	6.5	
	14:15/40		91°	0.14	1.50	1.50	314.9	76	72	259	83	46	248	6.6	
	14:25/50		90°	0.14	1.50	1.50	321.9	77	73	265	82	46	246	6.8	
	14:35/60		94°	0.13	1.40	1.40	328.8	8678	8274	269	82	46	248	6.8	
	14:45/70		91°	0.13	1.40	1.40	335.8	79	75	267	59	46	245	6.8	
	14:55/80		91°	0.13	1.40	1.40	342.7	81	76	265	58	46	240	6.8	
	1505/90		91°	0.14	1.40	1.40	349.4	82	78	265	59	46	245	7.0	
	15:15/100		92°	0.14	1.50	1.50	356.8	82	79	262	60	46	248	7.0	
	15:25/110		91°	0.14	1.50	1.50	363.9	82	80	264	60	46	250	7.0	
	15:35/120		91°	0.14	1.50	1.50	371.0	85	84	264	60	46	246	7.0	
	15:45/130		91°	0.14	1.50	1.50	378.0	86	85	265	60	46	248	7.0	
	15:55/140		90°	0.14	1.50	1.50	385.3	85	85	267	62	45	250	7.0	
TOTAL															
AVERAGE															

VOLUME OF LIQUID WATER COLLECTED	IMPINGER VOLUME ml 1	2	3	4	SILICA GEL WEIGHT, g
FINAL	5	900	-0-	582.7	
INITIAL	-0-	100.0	-0-	550.0	550
LIQUID COLLECTED					
TOTAL VOLUME COLLECTED					

{500g Silica gel, 500g charcoal.

ORSAT MEASUREMENT	TIME	CO_2	O_2	CO	N_2
1					
2					
3					
4					

COMMENTS: File ID. 44303-29-16

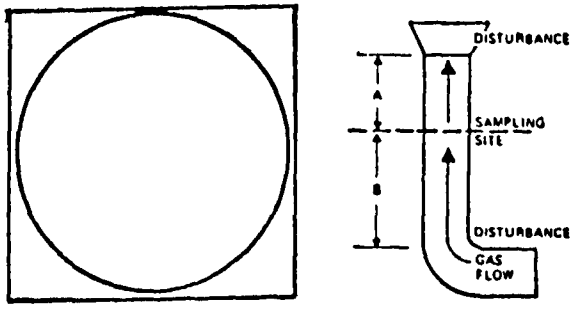
XAD-2 ID CL-01

process rate not steady

Checked by: MB

PARTICULATE FIELD DATA

SCHEMATIC OF STACK



CROSS SECTION

PLANT _____

DATE 3/28/91

LOCATION outlet of charcoal filter

OPERATOR Leonard, Baytos

STACK NO. _____

RUN NO. CL-02

SAMPLE BOX NO. 2

METER BOX NO. X-40513

AMBIENT TEMPERATURE 68°F

BAROMETRIC PRESSURE 30.10 "Hg

ASSUMED MOISTURE, % 1.4

PROBE LENGTH, in. 18" pyrex

NOZZLE DIAMETER, in. 0.310

STACK DIAMETER, in. 6

PROBE HEATER SETTING 275°F

HEATER BOX SETTING 250°F

METER ΔH@ 1.79

C FACTOR 1.1

PROCESS WEIGHT RATE 4,024 lbs/hr

WEIGHT OF PARTICULATE COLLECTED, mg		
SAMPLE	FILTER	PROBE WASH
FINAL WEIGHT		
TARE WEIGHT	0.4554	
WEIGHT GAIN		
Leak Check :	TOTAL	

Pre 0.014 CFM, 20 "Hg; Post .02 CFM, 13 "Hg

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	STATIC PRESSURE (in. H_2O)	STACK TEMPERATURE (T_s), °F	VELOCITY HEAD (ΔP_s)	($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	DESIRED	GAS SAMPLE VOLUME (V_m), ft^3	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET ($T_{m_{IN}}$), °F	OUTLET ($T_{m_{OUT}}$), °F	Temp., F Filter	Last Imp.	XAD-2 OUTLET	FILTER FRIT	PUMP VACUUM in. Hg gauge	VELOCITY fps
middle	10:15/0		87	0.14		1.50	1.50	415.221			250	45	42		9.0	
	10:25/10		87	0.14		1.50	1.50	421.7	69	68	274	45	42	250	9.5	
	10:35/20		88	0.14		1.50	1.50	428.6	71	69	273	47	42	260	9.5	
	10:45/30		88	0.14		1.50	1.50	435.6	72	69	272	48	43	270	9.5	
	10:55/40		87	0.14		1.50	1.50	442.6	71	68	270	48	42	270	9.5	
	11:05/50		87	0.15		1.55	1.55	449.6	71	69	272	50	43	270	10.0	
	11:15/60		88	0.16		1.65	1.65	456.7	70	68	274	51	43	270	10.2	
	11:25/70		88	0.16		1.65	1.65	464.1	72	69	273	51	43	270	10.5	
	11:35/80		89	0.15		1.55	1.55	471.4	72	69	274	52	43	270	10.2	
	11:45/90		89	0.16		1.65	1.65	478.7	73	70	274	53	42	270	10.2	
	11:55/100		89	0.17		1.75	1.75	486.1	73	72	273	54	42	270	11.0	
	12:05/110		89	0.16		1.65	1.65	493.7	74	71	273	54	42	270	11.0	
	12:15/120		89	0.17		1.75	1.75	501.1	74	71	274	55	43	270	11.0	
	12:25/130		89	0.17		1.75	1.75	508.7	75	72	272	55	43	270	11.0	
	12:35/140		89	0.17		1.75	1.75	516.4	75	73	273	56	43	270	11.2	
TOTAL																
AVERAGE																

dist. leak #1 10:03
#2 11:17
#3 11:57
#4 12:39
#5 not dumped #5 12:45

VOLUME OF LIQUID WATER COLLECTED	IMPINGER VOLUME ml 1	2	3	4	SILICA GEL WEIGHT, g
FINAL	10.0	95.0	2.0	577.5	
INITIAL	-0-	100.0	-0-	550.0	
LIQUID COLLECTED	10.0	-5.0	2.0	27.5	
TOTAL VOLUME COLLECTED					24.5

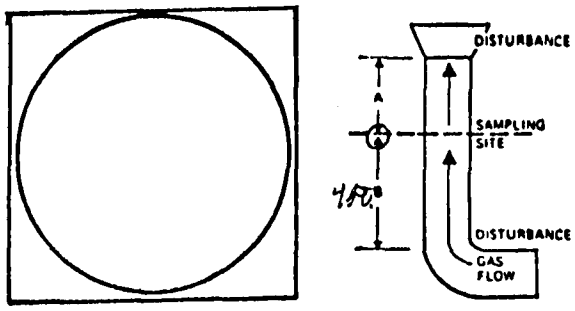
ORSAT MEASUREMENT	TIME	CO_2	O_2	CO	N_2
1					
2					
3					
4					

COMMENTS:

Checked by: _____

PARTICULATE FIELD DATA

SCHEMATIC OF STACK



CROSS SECTION

PLANT Crows Landing, Calif.
DATE 3/29/91
LOCATION outlet of charcoal filter
OPERATOR Leonard, Baytos
STACK NO.
RUN NO. C6-03
SAMPLE BOX NO. #2
METER BOX NO. X-40573

AMBIENT TEMPERATURE 60
BAROMETRIC PRESSURE 30.00" Hg
ASSUMED MOISTURE, % 1.4
PROBE LENGTH, in. 18" Pyrex
NOZZLE DIAMETER, in. ~~0.310~~ 0.310
STACK DIAMETER, in. 6"
PROBE HEATER SETTING 250
HEATER BOX SETTING 250

METER $\Delta H_@$ 1.79
C FACTOR 1.1
PROCESS WEIGHT RATE 7,153 lbs/hr

WEIGHT OF PARTICULATE COLLECTED, mg		
SAMPLE	FILTER	PROBE WASH
FINAL WEIGHT	29.10	
TARE WEIGHT	0.4510 g	
WEIGHT GAIN		
Leak Check :	TOTAL	

Pre 0.012 CFM, 22"Hg; Post 0.02 cfm, 9.5"Hg

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	STATIC PRESSURE (in. H_2O)	STACK TEMPERATURE (T_s), °F	VELOCITY HEAD (ΔP_s) ($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	DESIRED	GAS SAMPLE VOLUME (V_m), ft³	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET ($T_{m_{IN}}$), °F	OUTLET ($T_{m_{OUT}}$), °F	Temp., F Filter	Last Imp.	XAD-2 OUTLET	FILTER FRIT	PUMP VACUUM in. Hg gauge	VELOCITY fps
middle	7:45/0		72	.120	1.25	1.25	550.434							7.0	
	7:55/10		73	.120	1.25	1.25	557.1	63	60		44	42	220	7.5	
	8:05/20		74	.110	1.15	1.15	563.2	65	61		45	42	225	7.6	
	8:15/30		75	.100	1.10	1.10	569.4	69	65		47	42	230	7.8	
	8:25/40		75	.090	1.00	1.00	575.6	71	67		48	42	240	7.9	
	8:35/50		76	.090	1.00	1.00	581.3	73	69		49	43	250	8.0	
	8:45/60		75	.090	1.00	1.00	587.1	75	71		50	43	250	8.0	
	8:55/70		75	.090	1.00	1.00	592.9	76	73		51	43	250	7.9	
	9:05/80		76	.100	1.10	1.10	599.1	77	73		52	43	250	7.9	
	9:15/90		78	.100	1.10	1.10	605.4	80	77		54	44	250	7.9	
	9:25/100		78	.090	1.00	1.00	611.7	79	77		53	44	250	7.9	
	9:35/110		80	.100	1.10	1.10	617.9	79	77		55	43	250	7.9	
	9:45/120		82	.090	1.00	1.00	624.4	81	78		56	43	250	7.9	
	9:55/130		81	.090	1.00	1.00	630.5	80	78		57	43	250	7.9	
	10:05/140		81	0.100	1.10	1.00	636.9	80	78		58	43	260	7.9	
TOTAL															
AVERAGE															

VOLUME OF LIQUID WATER COLLECTED	IMPINGER VOLUME ml 1	2	3	4	SILICA GEL WEIGHT, g
FINAL	5.0	94.0	3.0	567.5	
INITIAL	-0-	100.0	-0-	550.0	
LIQUID COLLECTED	5.0	-6.0	3.0	17.5	
TOTAL VOLUME COLLECTED					19.5

ORSAT MEASUREMENT	TIME	CO_2	O_2	CO	N_2
1					
2					
3					
4					

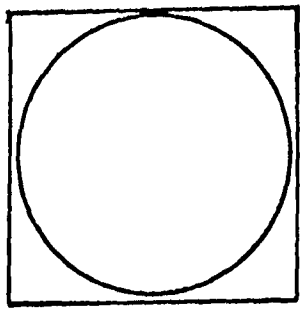
COMMENTS: #9 - 9:47
#10 - 10:05
#11 - 10:13
#12 - 10:25
#13 - 10:32

#1 - 8:05
#2 - 8:12
#3 - 8:21
#4 - 8:30
#5 - 8:37
#6 - 8:45
#7 - 9:31 case upper plugge
#8 - 9:40

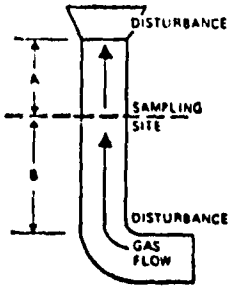
Checked by: _____

PARTICULATE FIELD DATA

SCHEMATIC OF STACK



CROSS SECTION



PLANT _____

DATE _____

LOCATION _____

OPERATOR _____

STACK NO. _____

RUN NO. _____

SAMPLE BOX NO. _____

METER BOX NO. _____

AMBIENT TEMPERATURE _____

BAROMETRIC PRESSURE _____

ASSUMED MOISTURE, % _____

PROBE LENGTH, in. _____

NOZZLE DIAMETER, in. _____

STACK DIAMETER, in. _____

PROBE HEATER SETTING _____

HEATER BOX SETTING _____

METER $\Delta H_@$ _____

C FACTOR _____

PROCESS WEIGHT RATE _____

WEIGHT OF PARTICULATE COLLECTED, mg		
SAMPLE	FILTER	PROBE WASH
FINAL WEIGHT		
TARE WEIGHT		
WEIGHT GAIN		

Leak Check : TOTAL

Pre ____ CFM, ____ "Hg; Post ____ Cfm, ____ "Hg

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	STATIC PRESSURE (in. H_2O)	STACK TEMPERATURE (T_s), °F	VELOCITY HEAD (ΔP_s)	($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	DESIRED	GAS SAMPLE VOLUME (V_m), ft^3	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET ($T_{m_{IN}}$), °F	OUTLET ($T_{m_{OUT}}$), °F	Temp., F Filter	Last Imp.	XAD-2 OUTLET	FILTER FRIT	PUMP VACUUM in. Hg gauge	VELOCITY fps
	10:15/150		82	.090		1.00	1.00	643.2	80	78		60	43	250	7.9	
	10:25/160		83	.110		1.15	1.15	649.5	81	79		62	43	250	8.0	
	10:35/170		85	.100		1.10	1.10	655.7	82	80		63	43	250	7.8	
	10:45/180	off						661.914								
TOTAL																
AVERAGE																

VOLUME OF LIQUID WATER COLLECTED	IMPINGER VOLUME ml 1	2	3	4	SILICA GEL WEIGHT, g
FINAL					
INITIAL					
LIQUID COLLECTED					
TOTAL VOLUME COLLECTED					

ORSAT MEASUREMENT	TIME	CO_2	O_2	CO	N_2
1					
2					
3					
4					

COMMENTS:

Checked by: _____

Plant (CROWS LANDING) NAVY AUX. LANDING FLD

Date 27 March 91

Location CROWS LANDING, CALIF.

Operator C. Bridges/N. Davis

Field Blank I.D.: Tenax CL-01BT (Pre) 1300 ng

Tenax/Charcoal CL-01BTC (Pre)

Run # CL-01

Stack No. VAPOR PAC. Unit #1

Probe No. 01 - 10 ft Teflon tubing -

VOST No. SYSTEM #2 280/01B

Rotometer No. C 10031 ✓

Dry Gas Meter No. C 10297 ✓ BAE x 39011

Pair No. (b)	Leak Check	Cartridge I.D. Tenax	Cartridge I.D. Tenax/Charcoal	Rotameter(a) Reading (l/min)	Time Initial	Time Final	Sampling Duration (min)	Probe(a) Temp. (°C)	Barometric Pressure (in of Hg)	Condenser Outlet(a) Temp. (°C) #1	Meter Temp. (outlet) IN OUT	Dry Gas Meter Initial	(a) Meter Final	Gas Sample Volume (liters)	Comments
721A 722A	ok. ws.	77 CL-01-T	78 CL-01-TC	85 = ~~20 cc/min~~	~~1390~~ 1335 ~~0.680~~	10 min		—	29.74	10	21 21	0.000 10 20 30			
				85	1345			—	"	13	21 20	—	5.0		
				85	1355	20		—	"	11	23 23	—	10.08		
				85	1405	30		—	"	11	25 25	—	15.23		
	post-leak check ok-ws				1415	40	40 min		"	12	25 · 25		20.43	20.43	end of 1st run.

(a) Reading should be tabulated at the beginning of a run and every ~~five~~ minutes thereafter.
(b) Pair refers to sample collection on one pair of Tenax and Tenax/Charcoal traps.

Plant NAVY ADX. LANDING FIELD

Date 27 MAR 91

Location CROW'S LANDING, CA.

Operator C. BRIDGES / [illegible]

Field Blank I.D.: Tenax ~~SAME AS PAGE #1~~

Tenax/Charcoal

RUN # 10

Stack No. 01

Probe No. 01 - 10 ft TEFLON TUBING

VOST No. SYSTEM #2 280/01B

Rotometer No. C 10031

Dry Gas Meter No. C 10297 BMI X-39011

ir .(b)	Leak Check	Cartridge I.D. Tenax	Cartridge I.D. Tenax/ Charcoal	Rotameter(a) Reading (l/min)	Time Initial	Time Final	Sampling Duration (min)	Probe(a) Temp. (°C)	Barometric Pressure (in of Hg)	Condenser Outlet(a) Temp. (°C)	Meter Temp. (outlet) IN OUT	Dry Gas Meter (a) Initial	Dry Gas Meter (a) Final	Gas Sample Volume (liters)	Comments
2B 1B TC	B OK VB ✓ 0.01 in Hg	CL-02-T	CL-02-TC	85 - 90	1430	10		—	29.74	13	25 - 25	0.000			back pres. 1" Hg.
				85	1440			—	"	12	25 - 25		4.95		
				85	1450	20		—		11	26 - 26		10.05		
				85	1500	30		—		12	26 - 26		15.15		
	Post leak check ok UB				1510	40	end.	—	"	12	27 - 27		20.34	liters -	end of 2d Set. UB

a) Reading should be tabulated at the beginning of a run and every ~~five~~ ten minutes thereafter.
b) "refers to sample collection on one pair of Tenax and Tenax/Charcoal traps.

Plant NAS AUX LANDING FIELD

Date 27 MAR 1991

Location CROW'S LANDING, CALIF

Operator C. BRIDGES / W. BAMTOS

Field Blank I.D.: Tenax SAME AS PAGE #1

Tenax/Charcoal

Run # CL-01

Stack No.

Probe No. 10 ft TEFLON TUBING (4)

VOST No. SYSTEM #2 280/01B

Rotometer No. C 10031

Dry Gas Meter No. C. 10297 BMI X-39011

Pair No.(b)	Leak Check	Cartridge I.D. Tenax	Cartridge I.D. Tenax/Charcoal	Rotameter(a) Reading (l/min)	Time Initial	Time Final	Sampling Duration (min)	Probe(a) Temp. (°C)	Barometric Pressure (in of Hg)	Condenser Outlet(a) Temp. (°C)	Meter Temp. (outlet) IN. OUT	Dry Gas Meter(a) Initial	Dry Gas Meter(a) Final	Gas Sample Volume (liters)	Comments
722A 721B π	0-10"Hg OK ✓	CL-03-T	CL-03-TC	85	1530		0	—	29.74	13	26 26.	0.000			
				85	1540		10	—	"	12	26-26	5.12			
				85	1550		20		"	12	25-25	10.20			
				85	1600		30		"	13	26-26	15.44			
	Post-leak check ok WB.			85	1610		40		"	13	26-26	20.68	20.68	Liter	end of Run WB

Tem

(a) Reading should be tabulated at the beginning of a run and every ~~five~~ minutes thereafter.
(b) refers to sample collection on one pair of Tenax and Tenax/Charcoal traps.

Site: NAVY AUX. LANDING FIELD. Run # CL-02 Site No. VAPOR-PAC unit #1

Date MARCH 28, 1991 Probe No.

Location CROW'S LANDING / CALIF VOST No. System #2

Operator C. BRIDGES, W. BAYTOS Rotometer No. C-10031

Field Blank I.D.: Tenax Dry Gas Meter No. C 10297 BMI V39011

Tenax/Charcoal

Pair No.(b)	Leak Check	Cartridge I.D. Tenax	Cartridge I.D. Tenax/Charcoal	Rotameter(a) Reading (l/min)	Time Initial	Time Final	Sampling Duration (min)	Probe(a) Temp. (°C)	Barometric Pressure (in of Hg)	Condenser Outlet(a) Temp. (°C)	Meter Temp. (outlet) IN / OUT	Dry Gas Meter Initial	(a) Meter Final	Gas Sample Volume (liters)	Comments
	ok WB	CL-11-T	CL-11-TC	85	PST 1015	START		—	30.10	9	17-17	0.000			
				85	1025	10			30.10 "Hg	9	19-19	5.00			
				85	1035	20			"	10	20-20	10.00			
				85	1045	30			"	9	21-21	15.00			
	final			85	1055	40 minutes			"	9	23-23	20.00	—	20.00	end of 1st set.
	leak check OK WB	STOP OK WB													

TEN

(a) Reading should be tabulated at the beginning of a run and every ~~five~~ minutes thereafter.
(b) refers to sample collection on one pair of Tenax and Tenax/Charcoal traps.

Plant NAS AUX LANDING FIELD — Run C 2.

Date MAR. 28, 1991

Location CROW'S LANDING, CALIF.

Operator C. BRIDGES / W. BANTOS

Field Blank I.D.: Tenax

Tenax/Charcoal

Stack No. VMTOR INC. Wind #1

Probe No.

VOST No. SYSTEM #2

Rotometer No.

Dry Gas Meter No. C-10297 - B4I x 39011

Pair No.(b)	Leak Check	Cartridge I.D. Tenax	Cartridge I.D. Tenax/Charcoal	Rotameter(a) Reading (l/min)	Time Initial	Time Final	Sampling Duration (min)	Probe(a) Temp. (°C)	Barometric Pressure (in of Hg)	Condenser Outlet(a) Temp. (°C)	Meter Temp. (outlet) IN / OUT	Dry Gas Meter(a) Initial	Dry Gas Meter(a) Final	Gas Sample Volume (liters)	Comments
	ok up	CL-12-T	CL-12T C	85	1110			none used	30.10" Hg	10	24 -24	0.000			
				85	1120					10	24-24	5.00			
				85	1130					10	25-25	10.00			
				85	1140					8	26-26	15.00			
final leak check 8" Hg 0.0 l/min				85	1150	40 minutes				9	27-27	20.06	20.06	20.06	end of Run - ok

TEN

(a) Reading should be tabulated at the beginning of a run and every ~~five~~ minutes thereafter.
(b) refers to sample collection on one pair of Tenax and Tenax/Charcoal traps.

Plant NAVY AUX LANDING FIELD

CL 2

Stack No. VARIOR

Date MAR. 28, 1991

Probe No. no probe

Location CHOW'S LANDING, CALIF

VOST No. SYSTEM #2

Operator C. BRIDGES / N. BAMTOG

Rotometer No. C-10031

Field Blank I.D.: Tenax

Dry Gas Meter No. C-10297 BMI-X 39011

Tenax/Charcoal

Pair No.(b)	Leak Check	Cartridge I.D. Tenax	Cartridge I.D. Tenax/Charcoal	Rotameter(a) Reading (l/min)	Time Initial	Time Final	Sampling Duration (min)	Probe(a) Temp. (°C)	Barometric Pressure (in of Hg)	Condenser Outlet(a) Temp. (°C)	Meter Temp. (outlet) IN / OUT	Dry Gas Meter (a) Initial	Dry Gas Meter (a) Final	Gas Sample Volume (liters)	Comments
	leak check ok up at 8" Hg	CL 13T	CL 13TC	85 flow spike	12:00			—	30.10	9	27-27	0.000			
				75 adjust	1210	10				9	27 27	4.45			developing a back pressure in.
				to 85	1220	20				9	27.27	8.95			The system — -3" Hg, normally runs at -1" Hg
				85	1230	30				9	29-29	13.18			
				85	1240	40	40 minutes	—		10	30-30	18.85	18.85	18.85	end of Run
	final leak check at 12" Hg ok .00 lpm														

(a) Reading should be tabulated at the beginning of a run and every ~~five~~ TEN minutes thereafter.
(b) "refers to sample collection on one pair of Tenax and Tenax/Charcoal traps.

Plant NAVY AUX LANDING FIELD

Date March 29 1991

Location CROWS LANDING, CALIF

Operator C. Burdgs, Bill Baxter

Field Blank I.D.: Tenax

Tenax/Charcoal

Run CL-2

Stack No. VAPOR VAC UNIT #

Probe No. none- use a 10' length of 1 flow tubing

VOST No. SYSTEM #2

Rotometer No. C-10031

Dry Gas Meter No. C-10297 BMI-X39011

air o.(b)	Leak Check	Cartridge I.D. Tenax	Cartridge I.D. Tenax/ Charcoal	Rotameter(a) Reading (l/min)	Time Initial	Time Final	Sampling Duration (min)	Probe(a) Temp. (°C)	Barometric Pressure (in of Hg)	Condenser Outlet(a) Temp. (°C)	Meter Temp. (outlet)	Dry Gas Meter (a) Initial	Dry Gas Meter (a) Final	Gas Sample Volume (liters)	Comments
	leak check ok	CL-21-T	CL-21-TC	85	0745			none-	30.0	12	14 14	0.00			back press 1" Hg-
				85	0755	10				12	17-17	4.80			
				85 adj to 90	0805	20				12	20-20	9.80			
				90 adj to 87	0815	30				12	22-22	14.85			
	final leak check ok			87	0825	40 minutes				13	22-22	20.21	20.21	20.21	end of run.

(a) Reading should be tabulated at the beginning of a run and every ~~five~~ ten minutes thereafter.
(b) refers to sample collection on one pair of Tenax and Tenax/Charcoal traps.

Plant NAVY AUX LANDING FIELD

Date FRI. MAR 29, 1991

Location CROW'S LANDING / CALIF.

Operator C. BRIDGES / W. BAYTOS

Field Blank I.D.: Tenax

Tenax/Charcoal

Run CL-03 (cont)

Stack No. VAPOR PNC H

Probe No. no probe

VOST No. SYSTEM #2

Rotometer No. C 10031

Dry Gas Meter No. C-10297 BMI X39011

air o.(b)	Leak Check	Cartridge I.D. Tenax	Cartridge I.D. Tenax/Charcoal	Rotameter(a) Reading (l/min)	Time Initial	Time Final	Sampling Duration (min)	Probe(a) Temp. (°C)	Barometric Pressure (in of Hg)	Condenser Outlet(a) Temp. (°C)	Meter Temp. (outlet) in / out	Dry Gas Meter (a) Initial	Dry Gas Meter (a) Final	Gas Sample Volume (liters)	Comments
	leak check at 0 OK	CL-22T	CL-22TC	85	0840	10		no probe well flow sample line -	30.0	11	26 26	0.00			leak press 2" Hg.
				85	0850	20				9	26-26	4.85			
				84	0900	30				8	26-26	9.83			
				85	0910	40.3				7	28-28	14.80			
	final leak check OK at 9 inc.			85	0920		40 min			8	28-28	20.0	20.0	20.0	-

(a) Reading should be tabulated at the beginning of a run and every ~~five~~ ten minutes thereafter.
(b) refers to sample collection on one pair of Tenax and Tenax/Charcoal traps.

Plant NAVY AUX LANDING FIELD

Date MARCH 29, 1991 (FRIDAY)

Location CROW'S LANDING, CALIF

Operator G. BRIDGES / W BAYTOS

Field Blank I.D.: Tenax CL-23-BT- POST-TEST

Tenax/Charcoal CL 23- BT/C - POST TEST.

TRIP BLANK T = ~~RCL-44-T~~ CROW-44-T

TRIP BLANK T/C = ~~RCL-44-~~TC CROW-44-TC

Run CL.03 (cont)

1015 HRS

1100 HRS

Stack No. OK-C

Probe No. no probe

VOST No. System #2

Rotometer No. C 10031

Dry Gas Meter No. C 10297 - BMI Y39011

Air (b)	Leak Check	Cartridge I.D. Tenax	Cartridge I.D. Tenax/Charcoal	Rotameter(a) Reading (l/min)	Time Initial	Time Final	Sampling Duration (min)	Probe(a) Temp. (°C)	Barometric Pressure (in of Hg)	Condenser Outlet(a) Temp. (°C)	Meter Temp. (outlet)	Dry Gas Meter (a) Initial	Dry Gas Meter (a) Final	Gas Sample Volume (liters)	Comments
	Leak check ok at 10 in Hg	CL-23T	CL-23-TC	85	0930			no probe	30.0" Hg	9	28-28	0.000			back pressure -1" Hg
				85	0940	10				9	28-28	4.9			
				85	0950	20				9	27-27	10.10			
				85	1000	30				10	27-27	15.13			
	final leak check ok at 10 in Hg			85	1010	39.7 min				10	27-27	20.00	20.00	20.00	end of run.

Post Test Field Blanks. set up into the VOST system, pulled no air through, then removed from system.

TEN

(a) Reading should be tabulated at the beginning of a run and every five minutes thereafter.
(b) Refers to sample collection on one pair of Tenax and Tenax/Charcoal traps.

NAVAL AUXILIARY LANDING FIELD
CROWS LANDING
GROUNDWATER CONCENTRATIONS CALCULATIONS

BY

BATTELLE MEMORIAL INSTITUTE

Report #4

Groundwater Concentrations Calculations

Problem Statement

To demonstrate that the use of treated soil from the LT^3® system as road bed material will not have any potential impact on the quality of the groundwater

Assumptions

1. The treated material is spread over the ground to a depth of 1 foot. Porosity and bulk density of treated material were assumed to be 0.3 and 1,500 kg/m^3, respectively.
2. Contaminants in the treated material are as follows (from final report (Torres et al., 1991)):

Contaminants	Soil Concentration (mg/kg)	Water Quality Goals ($\mu g/l$)+
Benzene	non-detect (assume 0.005)*	1
Toluene	0.037	40
Xylene	non-detect (assume 0.015)*	20
Ethylbenzene	non-detect (assume 0.005)*	30

+ taken from "A compilation of Water Quality Goals, 1989"
* detection limits

3. As a conservative estimate, contaminants from the treated material were leached out completely into the leachate and transported to the groundwater.

   Assume a 1′ x 1′ x 1′ cube of treated material (0.028 m^3) or 42.5 kg of soil and that the treated material was saturated with water. The volume of water in this cube is 84.9 liters. If all the contaminants were leached out then the aqueous concentration of these contaminants in the leachate are as follows:

Contaminants	Mass Eluded (mg)	Initial Concentration (μg/l)
Benzene	0.2125	25
Toluene	1.57	185
Xylene	0.6375	75
Ethylbenzene	0.2125	25

Two approaches were used to compute the final concentrations of the contaminants at the water table:

Approach 1

In the first approach, the methodology as outlined in the staff report of the California Regional Water Quality Control Board, Central Valley Region was used.

In this approach, an attenuation factor of 100 was assumed. This attenuation factor is applicable as the soil at the site is silty-clay and the depth of the water table is 15 to 20 feet. The final concentrations of selected contaminants as calculated are shown below.

Contaminants	Initial Conc. (μg/l)	Final Conc. (μg/l)	Water Quality Goals (μg/l)
Benzene	25	0.25	1
Toluene	188	1.88	40
Xylene	75	0.75	20
Ethylbenzene	25	0.25	30

Based on this approach, the concentrations in the leachate at the water table were less than the water quality goals, therefore, the use of the bed road material will not have any adverse impact on the groundwater.

Approach 2

In this approach, a 2-dimmensional advection-dispersion contaminant transport equation was used to compute the final concentration of the contaminants. Further assumptions for this approach are as follows:

a. The soil above the groundwater was assumed to be unfractured silty sand and that the soil was saturated with water. This is a worst case scenario that will maximize transport of the contaminants through the soil. Under normal circumstances the soil will be unsaturated, therefore transport to the groundwater will be slower. Also, estimated final concentrations will be conservative as the soil at the site is silty clay.
b. The hydraulic conductivity for silty sand soil was 1×10^{-6} m/s. For a pressure gradient of 1×10^{-2} (m/m), the darcy's velocity was 1×10^{-8} m/s. Assuming a water table of 15 feet (4.57 m) below ground level, the time required for the leachate to reach the water table was 4.57×10^{8} s.
c. As a conservative estimate, no adsorption was assumed.

The peak concentration of the contaminants at the water table is given by the following equation (Freeze and Cherry, 1979)

$$C_{max} = \frac{M}{(4 \pi t) \sqrt{D_x D_y}}$$

where C_{max} = peak concentration (mg/l)
D_x = longitudinal dispersion coefficient

1×10^{-7} m/s (from Freeze and Cherry, 1979)

D_y = transverse dispersion coefficient

0.5×10^{-7} m/s (from Freeze and Cherry, 1979)

M = mass per unit length (mg/m)

t = time at peak concentration (s)

Substituting the various values into the above equation, the final concentrations are as follows:

Contaminants	M (mg/m)	Final Conc. (μg/l)	Water Quality Goals (μg/l)
Benzene	0.2125	0.52	1
Toluene	1.57	3.86	40
Xylene	0.6375	1.57	20
Ethylbenzene	0.2125	0.52	30

With this approach, the final concentrations were below that of the water quality goal. Therefore, the use of the treated material as road bed material will not have any adverse impact on the groundwater.

References

California Regional Water Quality Control Board, Central Valley Region, June 1989, Staff Report on The Designated Level Methodology for Water Classification and Clean-up Level Determinations.

California Regional Water Quality Control Board, Central Valley Region, 1989, Staff Report on A Compilation of Water Quality Goals.

Freeze, R.A., and Cherry, J.A., 1979, Groundwater, Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

Torres, T., et al., 1991, Evaluation of the LT^3® System for the the Treatment of Hydrocarbon-contaminated Soil at NALF Crows Landing, A report submitted by Battelle to Naval Civil Engineering Laboratory, Port Hueneme, California