Appendix F Attachment 1

Technical Memorandum
Results of the Air Pathway Analysis Using the USEPA Downhole Flux Chamber
and Surface Flux Chamber Technology

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August 2004

TECHNICAL MEMORANDUM

Results of the Air Pathway Analysis Using the USEPA
Downhole Flux Chamber and Surface Flux Chamber Technology
Ascon Landfill Site
Huntington Beach, California

Phase I- Downhole Flux Chamber Site Assessment
Phase II- Bucket Augering/Control Agent Testing
Phase IV- Lagoon Trenching/Control Agent Testing
Phase VIII- Pit F Downhole Flux Chamber Site Assessment/Control Agent Testing

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EXECUTIVE SUMMARY

Field measurements were conducted at the Ascon Landfill Site (Ascon or Site) located in Huntington Beach, California, as part of Pilot Study No. 3—Waste Characterization, Emissions, and Excavation Testing Program conducted during spring and summer of 2004. The testing is part of a site Air Pathway Analysis (APA) conducted by Project Navigator, Ltd. (PNL) and in association with GeoSyntec Consultants (GeoSyntec) by Dr. CE Schmidt and Hoby Rash for project-specific volatile organic compounds (VOCs), odor, and reduced sulfur compounds (project compounds) related to compounds found in the subsurface on site. The project consisted of measuring the subsurface flux of project compounds at multiple depths and at selected locations on site accessed either by hollow-stem drill rig (augering), bucket augering, and trenching. The emphasis of this testing effort was to determine the nature and extent of vapor phase emissions of subsurface compounds that may be involved in site restoration activities. In addition to subsurface flux chamber testing, several of the phases included in this effort tested the control efficiency of various agents to inhibit emissions.

Phase I Downhole Flux Chamber Site Assessment

Subsurface flux was measured using the USEPA Downhole Flux Chamber (flux chamber) at a total of 15 locations at one or more depths between the shallow soil (5' below land surface- BLS) to just above groundwater (approximately 27' BLS). The standard approach was to measure the subsurface flux downhole in the boring at six-foot intervals in and around the waste material layers in selected site locations. Some exploratory borings had only one or a few interval tests. In total, 46 downhole subsurface flux measurements were performed at 17 locations as follows:

PNL-1, 9', 15', 21', 26'
PNL-2, 9'. 15', 21'
PNL-3, 15', 21', 27'
PNL-5, 9'
PNL-5A, 11'
PNL-6, 9', 15'
PNL-7, 9', 15', 21'
PNL-8, 6', 12', 18', 24'
PNL-9, 9', 15', 21'
PNL-10, 9', 15'
PNL-10A, 13', 14.5'
PNL-11, 6', 9', 12'
PNL-12, 3', 9', 15', 21'
PNL-13, 6', 12', 18', 24'
PNL-14, 9', 15', 21', 27'
PNL-15, 6', 12', 16'

The purpose of this component of Phase I was to assess the subsurface flux of project compounds at depth. Real time data were collected using a flame ionization detector (FID) and photoionization

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detector (PID) to learn something about the characteristics of the waste at depth per location. The waste producing each downhole flux measurement was assigned a characteristic emission profile--soil gas, source like, or source—depending on the persistence of its emissions . A waste with a "soil gas" character generates an emission profile that is rather transient and does not persist. It may not need the same level of emission control as a source character material. A waste with "source" emissions has a persistent profile and would be more likely requiring emissions control as compared to other materials will lesser emissions potential. These data are quantitatively reported in the text and summarized here. The downhole profiles are provided in Attachment D.

Boring and Depth	*FID Response Profile*	*PID Response Profile*
PNL-1, 9'	Soil Like	Source
PNL-1, 15'	Source	Source
PNL-1, 21'	Source	Source
PNL-1, 26'	Soil Gas	Source
PNL-2, 9'	Soil Gas	Soil Gas
PNL-2, 15'	Soil Gas	Soil Gas
PNL-2, 21'	Soil Gas	Soil Gas
PNL-3, 15'	Soil Gas	Source
PNL-3, 21'	Source	N/A
PNL-3, 27'	Source	Source
PNL-5, 9'	Soil Gas	Soil Gas
PNL-5A, 11'	Soil Gas	Source
PNL-6, 9'	Source	Source
PNL-6, 15'	Soil Gas	Source
PNL-7, 9'	Soil Gas	Soil Gas
PNL-7, 15'	Soil Gas	Soil Gas
PNL-7, 21'	Source	Source
PNL-8, 6'	Source Like	Source
PNL-8, 12'	Source	Source
PNL-8, 18'	Soil Gas	Source
PNL-8, 24'	Source	Source
PNL-9, 9'	Soil Gas	Soil Gas
PNL-9, 15'	Source Like	Source
PNL-9, 21'	Soil Gas	Source
PNL-10, 9'	Soil Gas	Source
PNL-10, 15'	Soil Gas	Soil Gas
PNL-10a, 13'	Source Like	Source
PNL-10a, 14.5	Soil Gas	Soil Gas
PNL-11, 6'	Soil Gas	Soil Gas
PNL-11, 9'	Source	Source
PNL-12, 3'	Soil Gas	Source
PNL-12, 9'	Soil Gas	Source Like

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Boring and Depth	*FID Response Profile*	*PID Response Profile*
PNL-12, 15’	Soil Gas	Source Like
PNL-12, 21’	Soil Gas	Source Like
PNL-13, 6’	Soil Gas	Source Like
PNL-13, 12’	Source	Source
PNL-13, 18’	Soil Gas	Source
PNL-13, 24’	Soil Gas	Soil Gas
PNL-14, 9’	Soil Gas	Soil Gas
PNL-14, 15’	Soil Gas	Soil Gas
PNL-14, 21’	Source	Source
PNL-14, 27’	Soil Gas	Source
PNL-15, 6’	Soil Gas	Source Like
PNL-15, 12’	Soil Gas	Source

All interval testing included measuring flux using a field portable flame ionization detector (FID) and a photoionization detector (PID; TVA-1000 analyzer). Note that the FID response includes all volatile hydrocarbon compounds (to some level of response) and the PID includes compounds with ionization potential below the lamp voltage. In this application, the PID may represent the aromatic fraction of hydrocarbon emissions. A summary of these emission profiles arranged to represent the soil column is shown in Attachment D for all borings. This qualitative analysis, combined with other site data, presents a three dimensional representation of subsurface sources which include stained or contaminated soils and contaminated groundwater.

In addition, typically one sample was collected using evacuated canisters for off site analysis by USEPA Method TO-15 for volatile organic compound (VOC) detection and quantitation and USEPA Method TO-3 for total petroleum hydrocarbons. Sample collection was also conducted at these selected locations in tedlar bags for offsite analysis by ASTM E-679-91 for olfactory odor. These sample data (flux) can be used, along with an excavation/waste-handling scenario, to estimate potential impact to off-site receptors. The flux data can serve as input to a dispersion model for estimating offsite ambient concentrations. The hydrocarbon speciation flux data have been summarized for selected compounds along with odor flux data in Table 19. These data can be used to describe the various solid waste streams on site as part of the feasibility study supporting the site restoration effort.

Phase II Bucket Emission/Emission Agent Control Testing

Bucket auger bulk sample collection was used to acquire a sufficient amount of subsurface waste material for emission rate testing using the USEPA surface emission isolation flux chamber (flux chamber). The data from the Phase I downhole flux chamber testing effort were used to specifically identify subsurface waste material for testing. The highest emitting material was selected for testing. In total, seven areas were selected and waste materials were removed. One material obtained from PNL-8 area was selected as the highest emitter, and this material was used to test the control efficiency of seven control agents, including: Rusmar® foam, Petroclean®, Microblaze®, Biosolve®,

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Alabaster CS1®, Alabaster CS1® with Microbes, and water. Real time data (FID/PID) are reported and used to determine control efficiency by testing with the flux chamber. The waste material was placed in a drum, delivered to a staging area for flux testing, taken from the drum, placed in a wheelbarrow and testing without agent and then with agent. Some testing included canister and bag sample collection for off site analysis.

Hydrocarbon speciation flux data and odor flux data have been summarized for selected or key compounds for the emission control agent testing effort. Uncontrolled flux data as well as controlled flux data and calculated percent control efficiency are reported for benzene, toluene, ethylbenzene, xylenes (BTEX), styrene, and odor in Table 20. A summary of the real time testing data, odor data, and VOC speciation data from select compounds is provided below with greater detail provided in Table 7, Table 18, and Table 20, respectively. Note that when materials provided in drums are heterogeneous, the control efficiency data may not be valid. Further, some of the control agents tested produced FID and PID response, and this may affect control efficiency data using the broadband analyzer data.

Test Material	Rusmar % Control	Other Agent % Control	Rusmar % Control	Other Agent % Control	Rusmar Range of % Control	Other Agent Range of % Control
	PID/FID	FID/PID	Odor	Odor	VOC	VOC
PNL-BA01	90/96	53/55	85	--	92-0	--
PNL-BA03	82/89	--	35	--	82-0	--
PNL-BA06	65/91	--	78	--	96-48	--
PNL-BA07	50/35	--	45	--	48-24	--
PNL-BA08	34/76	37/49	80	0-to-53	92-11	100-0
PNL-BA11	57/66	--	61	--	100-27	--
PNL-BA13	95/99	--	93	--	99-89	--

Lagoon Trenching/Emission Control Agent Testing

Two test trenches were dug in each of five lagoons identified in the work plan for Phase IV site investigation. Materials from these lagoons were collected and tested in an identical fashion to the Phase II bucket augering and emission control agent testing, with the exception that materials were field screened with a Jerome hydrogen sulfide analyzer and samples were collected in tedlar bags for off site analysis for sulfur compounds of interest. Note that the project compound list for Phase IV included VOCs, odor, and reduced sulfur compounds. Also, the analysis focused on the two most promising control agents, including Rusmar foam and Alabaster CS1.

Hydrocarbon speciation flux data and odor flux data have been summarized for selected compounds for the emission control agent testing effort. Uncontrolled flux data as well as controlled flux data and calculated percent control efficiency are reported for benzene, toluene, ethylbenzene, xylenes (BTEX), styrene, hydrogen sulfide, carbonyl sulfide, carbon disulfide, and odor in Table 21. A

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summary of the real time testing data, odor data, and VOC speciation data from select compounds is provided below with greater detail provided in Table 9, Table 18, and Table 21, respectively. Note that when materials provided in drums are heterogeneous, the control efficiency data may not be valid. Further, some of the control agents tested produced FID and PID response, and this may affect control efficiency data using the broadband analyzer data.

Test Material	Rusmar % Control	Alabaster % Control	Rusmar % Control	Alabaster % Control	Rusmar Range of % Control	Alabaster Range of % Control
	PID/FID/H2S	PID/FID/H2S	Odor	Odor	VOC	VOC
PNL-L1A	96 / 98 / 89	26 / 0 / 3	89	23	100-77	46-23
PNL-L1B	93 / 98 / 88	2 / 5 / 0	99	95	100-39	100-0
PNL-L2A	96 / 99 / 92	58 / 58 / 42	99	93	100-65	89-19
PNL-L2B	96 / 99 / 90	10 / 8 / 5	85	64	100-44	70-0
PNL-L3A	81 / 62 / 90	0 / 0 / 8	61	29	100-14	100-0
PNL-L3B	95 / 100 / 78	59 / 0 / 0	92	29	100-72	100-9
PNL-L4A	58 / 61 / 100	0 / 0 / 29	67	64	73-0	100-8
PNL-L4B	96 / 99 / 100	0 / 0 / 0	94	--	100-77	0
PNL-L5A	0 / 100 / 0	0 / 0 / 100	74	8.2	100-49	100-1.8
PNL-L5B	56 / 26 / 88	0 / 0 / 67	80	14	86-0	33-0

Phase VIII Pit F Investigation/ Downhole Flux Chamber Testing

Subsurface flux was measured using the USEPA Downhole Flux Chamber (flux chamber) at a total of 7 locations at one or more depths between the shallow soil (4.5’ below land surface-BLS) to above groundwater (approximately 18’ BLS). The standard approach was to measure the subsurface flux downhole in the boring at six-foot intervals in and around the waste material layers in selected site locations. Some exploratory borings had only one or a few interval tests. In total, 16 downhole subsurface flux measurements were performed at 7 locations as follows:

PNL-F1, 8’, 13’
PNL-F3, 14’, 17’
PNL-F4, 13.5’, 15’, 16.5’, 18’
PNL-F5, 13.5’, 15’
PNL-F6, 10.5’
PNL-F7, 10.5’, 13.5’, 15’
PNL-F19, 4.5’, 10’

Downhole flux chamber testing was not conducted in five borings around Pit F. One boring did not encounter waste material (PNL-F11) and water was encountered in four borings prior to the opportunity to conduct testing (PNL-F17, 9’ BLS; PNL-F18, 15’ BLS; PNL-F21, 9’ BLS; and the slant boring under Pit F, PNL-F12).

The purpose of this component of the site investigation was to assess the subsurface flux of project compounds around Pit F and to determine the extent of subsurface migration of ‘styrene waste’ materials from Pit F to the surrounding area. Real time data were collected using a flame ionization detector and photoionization detector to learn something about the characteristics of the waste at depth per location. Each downhole flux measurement was assigned a characteristic emission profile--soil gas, source like, or source—depending on its emissions profile. A soil gas character generates an emission profile that is rather transient and does not persist. It may not need the same level of emission control as a source character material. Source emissions are characterized as persistent and would be more likely requiring emissions control as compared to other materials will lesser emissions potential. These data are quantitatively reported in the text and summarized here. The downhole profiles are provided in Attachment D.

Boring and Depth	*FID Response*	*PID Response*
PNL-F1, 8’	Source	Source
PNL-F1, 13’	Source	Source
PNL-F3, 14’	Source	Source
PNL-F3, 17’	Source-Like	Source-Like
PNL-F4, 13.5’	Source	Source
PNL-F4, 15’	Source	Source
PNL-F4, 16.5’	Source	Source
PNL-F4, 18’	Source-Like	Source-Like
PNL-F5, 13.5’	Soil Gas	Soil Gas
PNL-F5, 15’	Source	Source
PNL-F6, 10.5’	Soil Gas	Soil Gas
PNL-F7, 10.5’	Source-Like	Source-Like
PNL-F7, 13.5’	Source	Source
PNL-F7, 15’	Source	Source
PNL-19, 9’	Source	Source
PNL-6, 15’	Soil Gas	Source
PNL-7, 9’	Soil Gas	Soil Gas
PNL-7, 15’	Soil Gas	Soil Gas
PNL-7, 21’	Source	Source
PNL-18, 15’	Source	Source
PNL-19, 4.5’	Source	Source
PNL-19, 10’	Source	Source

All interval testing included measuring flux using a field portable flame ionization detector (FID) and a photoionization detector (PID; TVA-1000 analyzer). Note that the FID response includes all volatile hydrocarbon compounds (to some level of response) and the PID includes compounds with

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ionization potential below the lamp voltage. In this application, the PID may represent the aromatic fraction of hydrocarbon emissions. A summary of these emission profiles arranged to represent the soil column is shown in Attachment D for all borings. This qualitative analysis, combined with other site data, presents a three dimensional representation of subsurface sources which include stained or contaminated soils and contaminated groundwater.

In addition, typically one sample was collected using evacuated canisters for off site analysis by USEPA Method TO-15 for volatile organic compound (VOC) detection and quantitation and USEPA Method TO-3 for total petroleum hydrocarbons. Sample collection was also conducted at these selected locations in tedlar bag for offsite analysis by ASTM E-679-91 for olfactory odor and for reduced sulfur species. These sample data (flux) can be used, along with an excavation/waste-handling scenario, to estimate potential impact to offsite receptors. The flux data can serve as input to a dispersion model for estimating offsite ambient concentrations. The hydrocarbon speciation flux data have been summarized for selected compounds along with odor flux data. These data can be used to describe the various solid waste streams on site as part of the feasibility study supporting the site restoration effort.

Phase VIII Pit F Investigation/ Emission Control Agent Testing

Two bulk samples of Pit F waste material were obtained by solid waste collection technique as part of Phase VIII. Material from Pit F and impacted cuttings from near Pit F were collected and tested in a similar fashion to the Phase IV emission control agent testing. As in Phase IV testing, control agent testing focused on the two most promising control agents, Rusmar foam and Alabaster CS1.

Hydrocarbon speciation flux data and odor flux data have been summarized for selected or key compounds for the emission control agent testing effort. Uncontrolled flux data as well as controlled flux data and calculated percent control efficiency are reported for benzene, toluene, ethylbenzene, xylenes (BTEX), styrene, hydrogen sulfide, carbonyl sulfide, carbon disulfide, and odor in Table 22. A summary of the real time testing data, odor data, and VOC speciation data is provided below with greater detail provided in Table 12, Table 18, and Table 22, respectively. Note that when materials provided in drums are heterogeneous, the control efficiency data may not be valid. Furthermore, some of the tested control agents produced FID and PID response, and this may affect control efficiency data using the broadband analyzer data.

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Test Material	Rusmar % Control	Alabaster % Control	Rusmar % Control	Alabaster % Control	Rusmar Range of % Control	Alabaster Range of % Control
	PID / FID / H2S	PID / FID	Odor	Odor	VOC	VOC
STY1 (cuttings)	89 / 26 / 100	77 / 0	51	27	97-0	96-0
STY2 Pit F material	90 / 91 / 90	33 / 0	68	0	97-0	100-0

The control agent testing data from Phases II, IV, and VIII will factor into the selection of a control agent as a component of the air emissions control plan for remediation. The control efficiency data will be used as input to the modeling effort representing potential impact to the downwind air quality from a given area remediation using the uncontrolled air emissions flux data, the engineering scenario, and the selected emission control agent efficiency data.

During all Phases of fieldwork, quality control testing was conducted. This included on site, real-time instrument calibration, system blank sample collection and analysis, and replicate sample collection and analysis. The quality control data indicate that the downhole flux method was properly executed and the field and laboratory data met the QC requirements for testing (see Section III).

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I. INTRODUCTION

This technical memorandum describes the field testing that was conducted at the Ascon Landfill Site (Site) in Huntington Beach, California, in order to assess subsurface emissions potential and vapor control agent efficiencies. Field testing was conducted by Dr. CE Schmidt and Hoby Rash, along with representatives of Project Navigator, Ltd, (PNL) and GeoSyntec Consultants (GeoSyntec) as part of Pilot Study No. 3—Waste Characterization, Emissions, and Excavation Testing Program conducted during spring and summer of 2004. Test locations are shown in Figure 1 and are identified in ATTACHMENT A on the downhole flux sampling data sheets.

The objectives of this study were to provide site characterization data representative of disturbed waste air emissions to help improve the understanding of potential waste emissions and to assist in developing an air emissions control strategy for the site restoration. The downhole flux (DHF) chamber technology has provided air emissions potential data that are used to identify the source of compounds, and thus assist in the understanding of the source and migration of compounds found on site. Sampling location descriptions and sample collection information are provided in Table 1 for Phase I efforts (downhole flux), in Table 2 for Phase II efforts (bucket augering and emission control agent testing), Table 3 for Phase IV efforts (lagoon trenching and emission control agent testing), and in Table 4 for Phase VIII efforts (downhole flux and emission control agent testing). Flux chamber data for detected study compounds (VOCs and reduced sulfur species, where collected) are reported as chamber concentration (parts per million volume for real-time data) and area source flux values (micrograms per square meter per minute, $ug/m^2,min^{-1}$ for speciation data). Odor data are reported in odor concentration (D/T) and odor flux $(D/T)/m^2,min^{-1}$.

This memorandum includes a discussion of the testing methodology, quality control procedures, results, discussion of the results, and summary statements relevant to the analysis.

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II. TEST METHODOLOGY

Downhole Flux Chamber Technology

Background

The downhole flux chamber is used to measure the subsurface emission rates from the vadose zone at specific depths. The primary reference for this section is the document entitled "User's Guide for the Measurement of Gaseous Emissions from Subsurface Wastes Using a Downhole Flux Chamber," EPA, Office of Research and Development, Cincinnati, Ohio EPA Contract No. 68-CO-0003, Work Assignment No. 0-13, May, 1991 ("User's Guide (1)," 1).

The development of the current EPA-recommended downhole flux chamber started with the need to assess the emissions of air toxics from uncontrolled hazardous wastes without having to excavate and test the exposed waste using the EPA-recommended surface emission isolation flux chamber. Literature on direct measurement technologies was used to develop flux chambers of different size, shape, and construction materials. After several site assessments where this technology was used at uncontrolled superfund sites, EPA became interested in using the approach to characterize fugitive emissions from controlled treatment, storage, and disposal facilities (TSDFs). This interest led to the preparation of the User's Guide (1), which provides the specifications and operation of the downhole chamber.

The downhole chamber is lowered down into the hollow-stem of the drill tool to the advance of the auger flights. Sweep air is initiated and the soil gas concentration in the chamber is monitored over a time period from 12 to 20 residence times (or more). At approximately 1.0 liter per minute (lpm), a residence time is 0.63 minutes. Gas concentrations are monitored and recorded as a function of time by the real-time instruments. Grab samples of flux are collected from selected depths and analyzed in order to determine the composition of total hydrocarbons. The soil gas data as a function of time are reported and used to assist in understanding the location and potential emissions of the subsurface contamination.

Protocol

Downhole flux chamber sampling is a direct measurement of emission rates of air contaminants as a function of depth in subsurface waste. The downhole flux chamber is designed specifically to collect flux data from disturbed waste at depths not easily accessed by a small backhoe or other conventional techniques. The method is briefly described below.

The enclosure device referred to as the downhole flux chamber was used to sample gaseous emissions from defined surface areas in the hollow-stem auger. Clean, dry sweep air was added to the chamber at a fixed, controlled rate. The concentration of the species of interest was measured at the exit of the chamber. The emission rate was calculated as:

$$ER_i = (C_i \times Q \times CF) \div A$$

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where:

ER_i	= Emission rate of species i (ug/m^2,min^{-1})
C_i	= Measured concentration of species i (ug/l)
Q	= Air flow rate (l/min)
CF	= Correction Factor (recovery of compounds- if applicable)
A	= Exposed Surface Area (m^2)

The response time of the flux chamber is characterized by the residence time. The chamber residence time (t) is a function of chamber volume (V, 0.64 liter) and air flow rate (Q, typically 0.64 to 1.3 lpm). The quotient of volume and flow rate (V/Q = t) is the theoretical residence time. Five to 20 residence times are normally needed to establish steady-state conditions in the chamber at which time representative sampling can occur. This requires about 3 to 20 minutes per sampling point.

The chamber is an acrylic cylinder designed to fit internal to a conventional hollow-stem auger. The chamber has a 0.0032 m^2 exposed surface area and a volume of approximately 0.00064 m^3. One ¼-inch port was used to withdraw sample gas.

Dry, hydrocarbon-free sweep air (zero grade air) was provided from compressed gas cylinders. The sweep air passed through a calibrated rotometer with a needle-valve flow control. Inlet and outlet lines were made of Teflon and all fittings in contact with the gas were Teflon or stainless steel. The outlet line included a sampling manifold for monitoring and/or collection of the gaseous species of interest. This manifold consisted of a port for gas-canister sampling.

The flux chamber was wiped clean and dried before each use and then lowered into the auger at new auger advances. The sweep air is added at a flow rate of 1.0 lpm and the time was noted when the chamber was placed on the test surface. The outlet gas concentration was monitored using PID/FID analyzers until steady-state conditions were reached (typically four to 20 residence times); gas concentrations were recorded approximately every residence time. Once steady state was reached (>8 residence times), gas samples were collected as appropriate.

Data were recorded on a custom data form. The step-by-step protocol for downhole flux chamber testing is provided below.

1) Locate equipment at the sampling location;
2) Document location of measurement, date, time, and operator;
3) Initiate sampling by starting sweep air at 1.0 lpm, checking the flow rate, and lowering the chamber to the testing location;
4) Advance the hollow-stem auger to depth, remove the drive stem, and lower the downhole chamber down the auger to the advance depth. Caution- do not "spin" the auger flight more than is necessary to remove cuttings. This will prevent unnecessary disturbance of the materials available for testing at the advanced depth;

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5) Document any other data such as waste characteristics, etc., for possible correlations with site investigation data;
6) Monitor the gas concentrations and record data every residence time;
7) Collect gas samples (if appropriate) at steady state as indicated by time readings. Do not exceed a sample collection rate of 0.5 lpm. This will prevent entraining auger stem gas into the chamber;
8) Discontinue sample collection, remove the chamber from the auger, seal sample containers, back-flush the sample collection line, and discontinue the flux test;
9) Fill out appropriate chain-of-custody forms, master sample log entries for sample collected, and store samples in appropriate fashion; and
10) Prepare or relocate equipment and test at the next depth and/or location by repeating steps 1) through 9).

Surface Flux Chamber Technology

Background

This device is used to measure the subsurface emission rates from any emitting surface. The primary reference for this section is the document entitled "User's Guide for the Measurement of Gaseous Emissions from Subsurface Wastes Using a Surface Flux Chamber," EPA, Office of Research and Development, Cincinnati, Ohio EPA Contract No. 68-CO-0003, 1986 ("User's Guide (2)," 2).

The development of the current EPA-recommended surface flux chamber started with the need to assess the emissions of air toxics from uncontrolled hazardous wastes from a variety of surfaces. Literature on direct measurement technologies was used to develop flux chambers of different size, shape, and construction materials. After several site assessments where this technology was used at uncontrolled superfund sites, EPA became interested in using the approach to characterize fugitive emissions from controlled treatment, storage, and disposal facilities (TSDFs). This interest led to the preparation of the User's Guide (2), which provides the specifications and operation of the surface flux chamber.

The surface chamber is a mixed tank reactor with a volume of 30 liters. Sweep air is initiated and the soil gas flux concentration in the chamber is monitored over a time period from 6 residence times (or more). At approximately 5.0 liter per minute, a residence time is 6 minutes. Gas concentrations are monitored using a PID and FID and recorded as a function of time. Grab samples are collected and flux is reported per waste type and condition (uncontrolled or controlled by using a vapor suppressant).

Protocol

The enclosure device referred to as the surface flux chamber was used to sample gaseous emissions from the defined surface area. Clean, dry sweep air was added to the chamber at a fixed, controlled rate. The concentration of the species of interest was measured at the exit of the chamber. The emission rate was calculated as:

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$$ER_i = (C_i \times Q) \div A$$

where:

ER_i = Emission rate of species i (ug/m^2,min)
C_i = Measured concentration of species i (ug/l)
Q = Air flow rate (l/min)
A = Exposed Surface Area (m^2)

The response time of the flux chamber is characterized by the residence time. The chamber residence time (t) is a function of chamber volume (V, 30 liter) and air flow rate (Q, typically 5.0 lpm). The quotient of volume and flow rate (V/Q = t) is the theoretical residence time. Six residence times are normally needed to establish steady-state conditions in the chamber at which time representative sampling can occur. This requires about 30 minutes per sampling point.

The chamber is an environmental chamber designed to operate in the dynamic operation mode. The chamber is constructed with a stainless steel bottom ring (7 inches tall and 16 inches in diameter) that is attached to an acrylic dome top. The chamber has a 0.13 m^2 exposed surface area and a volume of approximately 0.030 m^3. Sweep air is added into the chamber by an air distribution ring consisting of a ¼-inch Teflon tube fit concentric to the chamber with four small ports that act as air jets. Mixing in the chamber is caused by eddy currents formed on air addition through the jets and is facilitated by the cylindrical shape of the chamber. One ¼-inch port was used to withdraw sample gas.

Dry, hydrocarbon-free sweep air (zero grade air) was provided from compressed gas cylinders. The sweep air passed through a calibrated rotometer with a needle-valve flow control. Inlet and outlet lines were made of Teflon and all fittings in contact with the gas were Teflon or stainless steel. The outlet line included a sampling manifold for monitoring and/or collection of the gaseous species of interest. This manifold consisted of a port for gas-canister sampling.

The flux chamber was wiped clean and dried before each use. The sweep air is added at a flow rate of 5.0 lpm and the time was noted when the chamber was placed on the test surface. The outlet gas concentration was monitored using PID/FID analyzers until steady-state conditions were reached (typically four to five residence times); gas concentrations were recorded approximately every residence time. Once steady state was reached (>5 residence times), gas samples were collected as appropriate.

Data were recorded on a custom data form. The step-by-step protocol for surface flux chamber testing is provided below.

1) Locate equipment at the sampling location;
2) Document location of measurement, date, time, and operator;

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3) Initiate sampling by starting sweep air at 5.0 lpm, checking the flow rate, and placing the chamber on the testing location;
4) Document any other data such as waste characteristics, etc., for possible correlations with site investigation data;
5) Monitor the gas concentrations and record data every residence time;
6) Collect gas samples (if appropriate) at steady state as indicated by time readings. Do not exceed a sample collection rate of 2.0 lpm. This will prevent entraining air into the chamber;
7) Discontinue sample collection, remove the chamber from the test material, seal sample containers, back-flush the sample collection line, and discontinue the flux test;
8) Fill out appropriate chain-of-custody forms, master sample log entries for sample collected, and store samples in appropriate fashion; and
9) Prepare or relocate equipment and test at the next depth and/or location by repeating steps 1) through 8).

Grab Sample Collection Using Evacuated Canisters

Grab samples using canisters were collected from the exhaust line of the downhole flux chamber and surface flux chamber at steady-state conditions for speciation by gas chromatography. The sampling rate was maintained at less than 0.5 lpm. Canisters were collected by interfacing the canister using the ¼-inch Swagelok fittings, cracking the valve, and collecting a 1.0 or 3.2 liter sample over a time period, depending on the canister volume, to fill that canister at the target flow rate or less.

Prior to sample collection, each canister was cleaned and evacuated in the laboratory, and the absolute pressure was measured and recorded prior to use.

The canister sample collection protocol from the downhole and surface flux chamber is provided below:

1. The canister pressure (vacuum) is checked prior to sampling and recorded. The initial pressure should be between -30 and -27 inches of mercury. However, the canister will be considered acceptable (useable) if the value is <-24 inches of mercury;

2. Attach sampling line from the to flux chamber to the canister using a clean, 1/4 inch Teflon or stainless steel tube with ¼-inch Swagelok fittings;

3. Record start time on data sheet and open canister inlet valve slowly. A slight hissing sound can be heard during sampling by placing an ear against the canister;

4. The canister grab samples will be collected over a 2 to 12 minute period (depending on the size of the canister). Sample time is controlled by slowly opening the inlet valve so that the hissing sound is barely audible or the vacuum gauge begins to drop. A stopwatch or watch with a second hand should be used;

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5. After sample collection is completed, the canister inlet valves are closed and the sample line is disconnected from the canister;

6. The absolute canister pressure is again measured and recorded on the data sheet and the canister chain-of-custody form;

7. Prior to transporting to the laboratory, all canister valves are tightened and stem nuts sealed with Swagelok plugs;

8. Complete appropriate chain-of-custody forms, master sample log entries, and canister tags for samples collected, and ship canisters;

Grab Sample Collection Using Tedlar Bags

Grab samples using tedlar bags were collected from the exhaust line of the downhole flux and surface flux chambers at steady-state conditions for olfactory analysis and reduced sulfur species at select locations. Sampling rate was maintained at less than 0.5 lpm for downhole and 2.0 lpm for surface flux chambers. Bag samples were collected by interfacing the bag in a decompression lung device using ¼-inch tubing, drawing a vacuum on the lung with the aid of a foot pump, and collecting a 4 liter sample in a 5 liter tedlar bag.

Each bag was prepared for sampling by cleaning and packaging the bag in the laboratory. Bag samples were collected for both odor and reduced sulfur species analysis.

Real-Time Instrument Monitoring

A field instrument was used to measure sample concentrations in the flux chamber. A portable gas analyzer equipped with photoionization detection (PID) and flame ionization detection (FID) provided reliable data at the 1-to-100 ppbv level for total ionizable hydrocarbon compounds and approximately1-to-25,000 ppmv level for total hydrocarbon compounds. A sample dilution device was also used to increase the sensitivity by a factor of 10 when needed. The TVA-1000 was interfaced to the sample collection line of the chamber at the start of the measurement, and both detectors were operated simultaneously. In some instances, separate PID and FID instruments were used instead of the TVA-1000. In these cases, the sample line was shared between the two instruments. Both types of analyzers were calibrated prior to and after use, and both sets of data are considered equivalent. In addition to the TVA-1000, the latter field testing efforts included screening for reduced sulfur compounds using the Arizona Instruments Jerome 631X hydrogen sulfide analyzer. Background levels for the instruments were also recorded.

III. QUALITY CONTROL

Control procedures that were used to assure that data of sufficient quality resulted from the flux chamber study are listed and described below. The application and frequency of these procedures were developed to meet the program data quality objectives as described in the project work plan.

Field Documentation -- A field notebook containing data forms, including sample chain-of-custody (COC) forms, was maintained for the testing program. Attachment A contains the Emission Measurement Data Sheets.

Chain-of-Custody -- COC forms were not used for field data collection. Field data were recorded on the Flux Chamber Data Forms provided in Attachment A.

Note- Replicate field samples for downhole flux sampling typically do not meet precision goals. Downhole flux profiles change with time (typically decrease) and sample collection requirements necessitate sequential sampling, making the replicate or second sample typically lower in concentration.

TO-15; GC/MS (VOC)
Method Spike Recovery Analysis –Data not provided.

Laboratory Duplicate Analysis— Three samples were analyzed by the laboratory in duplicate. The QC criterion for laboratory duplicate analysis is ±30 relative percent difference (RPD). The laboratory duplicate analysis data are given below:

TO-15 Laboratory Duplicate Analyses				
Sample ID	**No. Pairs**	**Range RPD**	**Average RPD**	**No. Pairs Out**
PNL-L2B-SFU	10	0-to-8	1.2	0 of 10
PNL-F19-4-T	5	0-to-4.9	2.9	0 of 5
PNLBA8-17-SFC7	7	0-to-2.8	0.4	0 of 7

These data indicate acceptable method performance.

Laboratory Method Blank – Seventeen laboratory method blank analyses were performed. All 17 showed no compounds detected indicating acceptable method performance.

Field System Blank – Eight field sample blanks were collected for downhole and surface flux sampling. Downhole chamber blanks were collected by sampling clean air through the sample line. The surface flux chamber system blank was collected by sampling the chamber on a sheet of clean Teflon with clean air. The blank data are summarized below:

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TO-15 Field System Blanks		
Sample ID	**Compounds**	**Concentration (ug/m3)**
PNL-15-100DHF	None	Non-Detect
PNL-12-100DHF	None	Non-Detect
PNL-9-21-BDHF	2-Butanone	4.9
PNL-100-100-SF	2 Butanone	5.2
	Toluene	2.4
PNL-L1A-SF300	Vinyl Acetate	1.2
	2-Butanone	0.72
PNL-L5-100-SFU	Tetrachloroethene	2.9
SF-BLK	None	Non-Detect
PNL-F75-1-T	None	Non-Detect

These data show a limited number and level of study compounds detected and data correction is not recommended or required. These data indicate acceptable and typical sample collection and analytical method performance.

Replicate Sample – Six samples were collected and analyzed in replicate for downhole and surface flux sampling activities. The samples are not true replicate samples but sequential samples during an emissions test which changes in level over time. The QC criterion for field replicate samples is ±50 RPD. Field replicate data are provided below.

TO-15 Replicate Samples				
Sample ID	**No. Pairs**	**Range RPD**	**Average RPD**	**No. Pairs Out**
PNL-6-15RDHF	6	71-to-121	92	6 of 6
PNL-L1B-SFUR	8	0-to-17	5	0 of 8
PNL-F1-13-TR	3	68-to-92	81	3 of 3
SF-STY2-U-TR	7	21-to-24	22	0 of 7
PNL-12-15RDHF	6	39-to-89	64	5 of 6
PNL-BA3-X-SFU1	5	0-to-24	6	0 of 5

These data are typical of downhole flux replicate sample precision and are considered acceptable. These data indicate acceptable method performance and do not suggest data qualification.

TO-3; GC/FID (Petroleum Hydrocarbons)
Method Spike Recovery Analysis – Data not provided.

Laboratory Duplicate Analysis-- Eight samples were analyzed by the laboratory in duplicate. The QC criterion for laboratory duplicate analysis is ±30 relative percent difference (RPD). The laboratory duplicate analysis data are given below:

TO-3 Laboratory Duplicate Analyses				
Sample ID	**No. Pairs**	**Range RPD**	**Average RPD**	**No. Pairs Out**
PNL-7-21-DHF	6	0-to-7.4	3.3	0 of 6
PNL-L1A-SFU	2	0-to-3.6	1.8	0 of 2
PNL-F5-13.5-T	2	0-to-8.7	4.4	0 of 2
PNL-F19-10-T	2	0-to-7.8	3.9	0 of 2
PNL-11-12-DHF	2	5.0-to-6.5	5.7	0 of 2
SF-STY1-U-T	2	8.0-to-9.2	8.6	0 of 2
PNL-BA06-X-SFU	2	0-to-8.6	4.3	0 of 2
PNL-BA08-17-SF-C3	5	0-to-7.4	1.8	0 of 5

These data indicate acceptable method performance.

Laboratory Method Blank – A total of 14 method blank samples were analyzed, and no compounds were detected above method detection limits in any of the method blank samples. These data indicate acceptable method performance.

Field System Blank – A total of eight field system blank samples were collected and analyzed and are listed below. No compounds were detected in any field system blank sample, except for methane at 0.9 ppmv in one sample. These data indicate acceptable method performance.

TO-3 Field System Blanks		
Sample ID	**Compounds**	**Concentration (ppmv)**
PNL-15-100DHF	None	Non-Detect
PNL-12-100DHF	None	Non-Detect
PNL-9-21-BDHF	Methane	0.90
PNL-100-100-SF	None	Non-Detect
PNL-L1A-SF300	None	Non-Detect
PNL-L5-100-SFU	None	Non-Detect
SF-BLK	None	Non-Detect
PNL-F75-1-T	None	Non-Detect

Replicate Sample -- Six samples were collected and analyzed in replicate for downhole or surface flux sampling activities. The samples are not true replicate samples but sequential samples during an emissions test which changes in level over time. The QC criterion for field replicate samples is

+50 RPD. Field replicate data are provided below.

TO-3 Replicate Samples				
Sample ID	**No. Pairs**	**Range RPD**	**Average RPD**	**No. Pairs Out**
PNL-6-15RDHF	5	46-to-75	54	2 of 5
PNL-L1B-SFUR	2	10-to-24	17	0 of 2
PNL-F1-13-TR	2	71-to-92	81	2 of 2
SF-STY2-U-TR	2	0-to-9.5	4.8	0 of 2
PNL-12-15RDHF	2	63-to-137	100	2 of 2
PNL-BA3-X-SFU1	5	0-to-6.6	1.9	0 of 5

These data are typical of downhole flux replicate sample precision and are considered acceptable. These data indicate acceptable method performance and do not suggest data qualification.

ASTM E-679-91 (Odor)

Field System Blank – A total of seven field blanks were collected for odor assessment. An odor blank is a media blank where clean air is added to a clean tedlar bag. Field system blank values report the D/T (dilutions to threshold) value for blank samples in the range of less than 5 to 11 for the seven blank samples and are listed below. The average odor blank level was 8.4. This indicates acceptable method performance.

Odor Field System Blanks		
Phase	**Sample ID**	**Concentration (D/T)**
I	PNL-15-100DHF	8
I	PNL-12-100DHF	9
I	PNL-7-BDHF	7
II	PNL-BA3-100-SFC	<5
IV	PNL-L200-SFU	9
VIII	SF-BLK-O	11
VIII	PNL-F75-1-O	10

Replicate Sample – A total of five replicate odor samples were collected and analyzed and are listed below. The RPD range was 8.5 to 17, with an average RPD of 11. The QC criterion for odor replicate analysis is +50 RPD. These data indicate acceptable method performance.

Odor Replicate Samples	
Sample ID	**RPD**
PNL-7-21-RDHF	8.6
PNL-9-15-RDHF	8.6
PNL-L2A-SFURO	17
PNL-F1-13-OR	12
SF-STY1-U-OR	8.5

ASTM D 5504-01 (Reduced Sulfur Analysis)

Method Spike Recovery Analysis – Data not provided.

Laboratory Method Blank – A total of 13 method blank samples were analyzed for reduced sulfur species. No compounds were detected in any method blank samples above method detection limits. These data indicate acceptable method performance.

Field System Blank – Three field sample blanks were collected for downhole and surface flux sampling. Downhole chamber blanks were collected by sampling clean air through the sample line. The surface flux chamber system blank was collected by sampling the chamber on a sheet of clean Teflon with clean air. The blank data are summarized below:

Reduced Sulfur Field System Blanks		
Sample ID	**Compounds**	**Concentration (ug/m3)**
PNL-L200-SFUS	None	Non-Detect
SF-BLK-S	Hydrogen sulfide	3.7
	Carbon disulfide	18
PNL-F75-1-S	Carbonyl sulfide	14
	Carbon disulfide	21

These data show a limited number and level of study compounds detected and data correction is not recommended or required, however, these levels of reduced sulfur compounds are provided in the data tables and should be considered when evaluating the occurrence of these compounds, especially carbonyl sulfide and carbon disulfide in the field data set. These data indicate acceptable and typical sample collection and analytical method performance.

Laboratory Duplicate Analysis— One sample was analyzed by the laboratory in duplicate. The QC criterion for laboratory duplicate analysis is ±30 relative percent difference (RPD). The laboratory duplicate analysis data are given below:

Reduced Sulfur Laboratory Duplicate Analysis				
Sample ID	**No. Pairs**	**Range RPD**	**Average RPD**	**No. Pairs Out**
PNL-L4A-SFC2S	3	0-to-18	7.6	0 of 3

These data indicate acceptable method performance.

Replicate Sample -- Three samples were collected and analyzed in replicate for downhole and surface flux sampling activities. The samples are not true replicate samples but sequential samples during an emissions test which changes in level over time. The QC criterion for field replicate samples is ±50 RPD. Field replicate data are provided below.

Reduced Sulfur Replicate Samples				
Sample ID	**No. Pairs**	**Range RPD**	**Average RPD**	**No. Pairs Out**
PNL-L2B-SFC1-SR	3	10-to-21	16	0 of 3
SF-STY1-U-SR	5	0-to-48	24	0 of 5
PNL-F1-13-SR	8	8.8-to-37	18	0 of 8

These data are typical of downhole flux replicate sample precision and are considered acceptable. These data indicate acceptable method performance and do not suggest data qualification.

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IV. RESULTS AND DISCUSSIONS

A summary of sample collection information for Phase I, II, IV, and VIII is provided in Tables 1 through 4, respectively. All real time field data were recorded on data sheets and are available in Attachment A (see flux data field sheets).

Data reporting in the form of tabulated flux data (or concentration/odor units) is generally organized by Phase of testing activity. The exception to this is the odor data, since only one data point per test is generated (all odor data were summarized in one table). Data from downhole flux chamber testing includes real time concentration data (FID and PID instrument data) that are summarized as peak and steady state data in tables, and are plotted to show the air emissions characteristics of the depth-specific waste involved in the borehole test. These plots are provided in Attachment D and are organized by test Phase. The downhole flux emission profile plots are shown in several ways; in detail, stacked per boring representing their spatial arrangement (e.g., top to bottom), and are shown collectively per phase of activity for comparison purposes. Further, emission profile plots are shown with both fixed and variable concentration or magnitude axis (y axis) so that with a variable concentration axis, the fine character of the emission profile can be observed. Plotting on a fixed concentration axis looses that character but is very useful for comparing the absolute magnitude of emission character between intervals within a borehole and between boreholes across the site. These data will be useful in describing emission characteristics from the wide range of materials found on site in support of the remedial design.

The results of the Phase I (downhole flux) real-time data collection and description of test location emission profile information are summarized in the Executive Summary for each borehole. These data are further summarized for Phase I in Table 5. Phase I VOC downhole flux data are reported in Table 6, which includes both TO-3 and TO-15 hydrocarbon speciation data.

The results of the Phase II (bucket auger/emission control agent testing) real-time data collection and description of emission agent control testing are presented in Table 7. Phase II VOC flux data are reported in Table 8, which includes both TO-3 and TO-15 hydrocarbon speciation data.

The results of the Phase IV (lagoon trenching/emission control agent testing) real-time data collection and description of emission agent control testing are presented in Table 9. Phase IV VOC flux data are reported in Table 10, which includes both TO-3 and TO-15 hydrocarbon speciation data. Phase IV reduced sulfur compound flux data are reported in Table 11.

The results of the Phase VIII, Pit F emission control agent testing real-time data collection and description of emission agent control testing are presented in Table 12. Phase VIII VOC flux data for emission control agent testing are reported in Table 13, which includes both TO-3 and TO-15 hydrocarbon speciation data. Phase VIII reduced sulfur compound flux data are reported in Table 14.

And finally, the results of the Phase VIII, Pit F downhole flux testing real-time data collection are

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summarized in the Executive Summary and are presented in Table 15. Phase VIII VOC flux data for Pit F downhole flux testing are reported in Table 16, which includes both TO-3 and TO-15 hydrocarbon speciation data. Phase VIII reduced sulfur compound flux data are reported in Table 17.

All odor data, for both downhole investigations and for emission control agent testing, are provided in Table 18.

In addition to the full data reporting, data use tables have been prepared for selected study compounds, including (where applicable): benzene, toluene, ethylbenzene, xylenes (BTEX), styrene, hydrogen sulfide, carbonyl sulfide, carbon disulfide, and odor. Selected speciation data for all downhole flux chamber testing are reported in Table 19. Likewise, emission control agent testing data for selected study compounds and percent control efficiency data are reported in Tables 20, 21, and 22 for Phase II (bucket auger waste data), Phase IV (lagoon trenching waste data), and Phase VIII (Pit F), respectively.

Note that reduced sulfur data were not collected for Phase I and Phase II, but were collected for Phase IV and Phase VIII.

Odor data are reported in odor concentration units (D/T- dilution-to-threshold levels) as well as in odor flux units ((D/T)/m2,min-1). Emission control agent test data are also reported in percent control efficiency where appropriate. Hydrocarbon speciation data are provided in concentration units (ppmv as reported by the laboratory for TO-3 and ug/m3 for TO-15) and in flux units (ug/m2,min-1). Reduced sulfur compound data are reported in concentration units (ug/m3) and flux units (ug/m2,min-1).

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V. SUMMARY

Testing was conducted for the purpose of obtaining data of sufficient quality to assess the air emissions potential from waste materials on site during site remedial activities. The following is a summary of activities and results associated with this objective and the four phases of field investigation:

Phase I

Subsurface downhole flux measurements were made at multiple locations and at multiple depths on site as part of the Phase I site assessment.

- Subsurface downhole flux measurements of study compounds were measured at multiple locations on site using the USEPA recommended downhole flux chamber technology. This technology quantitatively measures vapor fluxes from waste at specific depths below the land surface due to the presence of subsurface volatile compounds.

- Field quality control data indicated acceptable sampling method performance. Field precision data were poor but typical of low-level sample analyses.

- The results of the evaluation of the Phase I real-time downhole flux data emission profiles indicate that that a majority of the materials tested have a persistent emission character. These materials act like a source of emissions and should be considered in the air emissions control program as requiring emissions suppression via control product. These qualitative data are summarized below.

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Boring and Depth	*FID Response*	*PID Response*
PNL-1, 9’	Soil Like	Source
PNL-1, 15’	Source	Source
PNL-1, 21’	Source	Source
PNL-1, 26’	Soil Gas	Source
PNL-2, 9’	Soil Gas	Soil Gas
PNL-2, 15’	Soil Gas	Soil Gas
PNL-2, 21’	Soil Gas	Soil Gas
PNL-3, 15’	Soil Gas	Source
PNL-3, 21’	Source	N/A
PNL-3, 27’	Source	Source
PNL-5, 9’	Soil Gas	Soil Gas
PNL-5A, 11’	Soil Gas	Source
PNL-6, 9’	Source	Source
PNL-6, 15’	Soil Gas	Source
PNL-7, 9’	Soil Gas	Soil Gas
PNL-7, 15’	Soil Gas	Soil Gas
PNL-7, 21’	Source	Source
PNL-8, 6’	Source Like	Source
PNL-8, 12’	Source	Source
PNL-8, 18’	Soil Gas	Source
PNL-8, 24’	Source	Source
PNL-9, 9’	Soil Gas	Soil Gas
PNL-9, 15’	Source Like	Source
PNL-9, 21’	Soil Gas	Source
PNL-10, 9’	Soil Gas	Source
PNL-10, 15’	Soil Gas	Soil Gas
PNL-10a, 13’	Source Like	Source
PNL-10a, 14.5	Soil Gas	Soil Gas
PNL-11, 6’	Soil Gas	Soil Gas
PNL-11, 9’	Source	Source
PNL-12, 3’	Soil Gas	Source
PNL-12, 9’	Soil Gas	Source Like
PNL-12, 15’	Soil Gas	Source Like
PNL-12, 21’	Soil Gas	Source Like
PNL-13, 6’	Soil Gas	Source Like
PNL-13, 12’	Source	Source
PNL-13, 18’	Soil Gas	Source
PNL-13, 24’	Soil Gas	Soil Gas
PNL-14, 9’	Soil Gas	Soil Gas
PNL-14, 15’	Soil Gas	Soil Gas
PNL-14, 21’	Source	Source
PNL-14, 27’	Soil Gas	Source
PNL-15, 6’	Soil Gas	Source Like
PNL-15, 12’	Soil Gas	Source

Phase II

- Bucket auger bulk sample collection was used to acquire a sufficient amount of subsurface waste material for emission rate testing using a surface emission isolation flux chamber (flux chamber). Seven control agents were tested on waste from seven test areas, including: Rusmar foam, Petroclean, Microblaze, Biosolve, Alabaster CS1, Alabaster CS1 with Microbes, and water.

- The results of the real time test data and odor data for Phase II testing are summarized below:

Test Material	Rusmar % Control	Other Agent % Control	Rusmar % Control	Other Agent % Control	Rusmar Range of % Control	Other Agent Range of % Control
	PID/FID	FID/PID	Odor	Odor	VOC	VOC
PNL-BA01	90 / 96	53/55	85	--	92-0	--
PNL-BA03	82 / 89	--	35	--	82-0	--
PNL-BA06	65 / 91	--	78	--	96-48	--
PNL-BA07	50 / 35	--	45	--	48-24	--
PNL-BA08	34 / 76	37/49	80	0-to-53	92-11	100-0
PNL-BA11	57 / 66	--	61	--	100-27	--
PNL-BA13	95 / 99	--	93	--	99-89	--

Phase IV

- Phase IV testing included two test trenches in each of five lagoons, and the test material was used to evaluate the two most promising control agents--Rusmar foam and Alabaster CS1.

- A summary of the real time testing data and odor data from Phase IV lagoon testing is provided below.

Test Material	Rusmar % Control	Alabaster % Control	Rusmar % Control	Alabaster % Control	Rusmar Range of % Control	Alabaster Range of % Control
	PID/FID/H2S	PID/FID/H2S	Odor	Odor	VOC	VOC
PNL-L1A	96 / 98 / 89	26 / 0 / 3	89	23	100-77	46-23
PNL-L1B	93 / 98 / 88	2 / 5 / 0	99	95	100-39	100-0
PNL-L2A	96 / 99 / 92	58 / 58 / 42	99	93	100-65	89-19
PNL-L2B	96 / 99 / 90	10 / 8 / 5	85	64	100-44	70-0
PNL-L3A	81 / 62 / 90	0 / 0 / 8	61	29	100-14	100-0
PNL-L3B	95 / 100 / 78	59 / 0 / 0	92	29	100-72	100-9
PNL-L4A	58 / 61 / 100	0 / 0 / 29	67	64	73-0	100-8
PNL-L4B	96 / 99 / 100	0 / 0 / 0	94	--	100-77	0
PNL-L5A	0 / 100 / 0	0 / 0 / 100	74	8.2	100-49	100-1.8
PNL-L5B	56 / 26 / 88	0 / 0 / 67	80	14	86-0	33-0

Phase VIII

- The results of the evaluation of the Phase VIII real-time downhole flux data emission profiles indicate that that a majority of the material tested has a persistent emission character, meaning it acts like a source of emissions and should be considered in the air emissions control program as requiring emissions suppression via a control product. These qualitative data are summarized below.

Boring and Depth	*FID Response*	*PID Response*
PNL-F1, 8’	Source	Source
PNL-F1, 13’	Source	Source
PNL-F3, 14’	Source	Source
PNL-F3, 17’	Source-Like	Source-Like
PNL-F4, 13.5’	Source	Source
PNL-F4, 15’	Source	Source
PNL-F4, 16.5’	Source	Source
PNL-F4, 18’	Source-Like	Source-Like
PNL-F5, 13.5’	Soil Gas	Soil Gas
PNL-F5, 15’	Source	Source
PNL-F6, 10.5’	Soil Gas	Soil Gas
PNL-F7, 10.5’	Source-Like	Source-Like
PNL-F7, 13.5’	Source	Source
PNL-F7, 15’	Source	Source
PNL-19, 9’	Source	Source
PNL-6, 15’	Soil Gas	Source

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PNL-7, 9’	Soil Gas	Soil Gas
PNL-7, 15’	Soil Gas	Soil Gas
PNL-7, 21’	Source	Source
PNL-18, 15’	Source	Source
PNL-19, 4.5’	Source	Source
PNL-19, 10’	Source	Source

- Phase VIII testing included emissions control agent testing on waste material from Pit F (STY2) and soils with impacts from Pit F materials (STY1) to evaluate the two most promising control agents, including Rusmar foam and Alabaster CS1.

- A summary of the real time testing data and odor data from Phase VIII Pit F testing is provided below.

Test Material	Rusmar % Control	Alabaster % Control	Rusmar % Control	Alabaster % Control	Rusmar Range of % Control	Alabaster Range of % Control
	PID / FID / H2S	PID / FID	Odor	Odor	VOC	VOC
STY1 (cuttings)	89 / 26 / 100	77 / 0	51	27	97-0	96-0
STY2 Pit F material	90 / 91 / 90	33 / 0	68	0	97-0	100-0

General Summary

- The control agent testing data from Phase II, Phase IV, and Phase VIII (Pit F study) will factor into the selection of control agents as a component of the air emissions control plan for remediation. The control efficiency data can be used as input to the modeling effort representing potential impact to the downwind air quality from a given area under remediation using the uncontrolled air emissions flux data, the engineering scenario, and the selected emission control agent efficiency data. The emission control data set is limited due to variability of waste collected, and some control data are higher than uncontrolled data. Speciation data can be more useful than the real time data, especially for risk based decision-making policies.

- The downhole flux emission characteristic profile data as well as the compound speciation data can be used to describe the emission control character of the various waste types found on site. These data can be used to predict the potential impact to offsite receptors during remedial activities and can be used in concert with the emission control agent test data to determine the type and level of control

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necessary to ensure that a given remedial activity results in acceptable offsite air quality.

REFERENCES

1) US EPA, *"User's Guide for the Measurement of Gaseous Emissions from Subsurface Wastes Using a Downhole Flux Chamber,"* EPA, Office of Research and Development, Cincinnati, Ohio EPA Contract No. 68-CO-0003, Work Assignment No. 0-13, May, 1991.

2) US EPA, *"User's Guide for the Measurement of Gaseous Emissions from Surfaces Using a Surface Emission Isolation Flux Chamber,"* EPA, Office of Research and Development, Cincinnati, Ohio EPA Contract No. 68-CO-0003, Work Assignment No. 0-13, 1986.

3) US EPA, *"Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air."* EPA-600/4-84-041, April 1984.

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Table 1. Summary of Phase I Downhole Flux Chamber Data Collection.

DATE	TIME	BORE ID	DEPTH	VOC ID	CAN ID	ODOR ID	COMMENT
5/3/2004	809	PNL-1	9'	N/A	N/A	N/A	
"	837	"	15'	PNL-1-15-DHF	6768	Odor Bag	
"	908	"	21'	N/A	N/A	N/A	
"	930	"	26'	N/A	N/A	N/A	
"	850	PNL-2	9'	N/A	N/A	N/A	
3/15/2004	917	"	15'	PNL-2-15-DHF	6758	Odor Bag	
"	945	"	21'	N/A	N/A	N/A	
3/16/2004	1436	PNL-3	15'	N/A	N/A	N/A	
"	N/A	"	21'	PNL-3-21-DHF	6776	Odor Bag	
"	1553	"	27'	N/A	N/A	N/A	
5/4/2004	N/A	PNL-4	N/A	N/A	N/A	N/A	Water precludes DHF
3/16/2004	815	PNL-5	9'	N/A	N/A	N/A	Last interval; water
"	948	PNL-5a	11'	PNL-5a-11-DHF	6777	Odor Bag	Move 6' east of 5
5/5/2004	753	PNL-6	9'	N/A	N/A	N/A	
"	815	"	15'	PNL-6-15-DHF	6765	Odor Bag	
5/3/2004	1350	PNL-7	9'	N/A	N/A	N/A	
"	1409	"	15'	N/A	N/A	N/A	
"	1441	"	21'	PNL-7-21-DHF	6763	Odor Bag	PNL-7-21R-DHF, Can and Bag
"	1530	N/A	N/A	N/A	N/A	PNL-7-B-DHF	Odor bag blank
5/5/2004	1248	PNL-8	6'	PNL-8-6-DHF	6776	N/A	
"	N/A	"	12'	N/A	N/A	N/A	
"	1342	"	18'	PNL-8-18-DHF	6777	Odor Bag	
"	1408	"	24'	N/A	N/A	N/A	
"	954	PNL-9	9'	N/A	N/A	N/A	
"	1014	"	15'	PNL-9-15-DHF	6767	Odor Bag/R	PNL-9-15R Odor bag repl
"	1039	"	21'	N/A	N/A	N/A	
"	1120	N/A	N/A	PNL-9-21-BDHF	6764	N/A	Canister line blank
5/4/2004	1445	PNL-10	9'	N/A	N/A	N/A	
"	1500	"	15'	N/A	N/A	N/A	Water precludes further DHF
"	1415	PNL-10a	13'	PNL-10a-DHF	6770	Odor Bag	50' North of PNL-10
"	1630	"	14.5'	N/A	N/A	N/A	
"	1130	PNL-11	6'	N/A	N/A	N/A	
"	1147	"	9'	N/A	N/A	N/A	
"	1210	"	12'	PNL-11-12-DHF	6771	Odor Bag	
3/16/2004	1140	PNL-12	3'	N/A	N/A	N/A	
"	N/A	N/A	N/A	PNL-12-100-DHF	6775	PNL-12-100-DHF	Can and odor bag blank
"	1200	PNL-12	9'	N/A	N/A	N/A	
"	1221	"	15'	PNL-12-15-DHF/R	6774	N/A	Can repl #06773
"	1246	"	21'	PNL-12-21-DHF	N/A	Odor Bag	
3/15/2004	1125	PNL-13	6'	N/A	N/A	N/A	
"	1144	"	12'	PNL-13-12-DHF	6760	Odor Bag	
"	N/A	"	18'	N/A	N/A	N/A	
"	1245	"	24'	N/A	N/A	N/A	
5/3/2004	1113	PNL-14	9'	N/A	N/A	N/A	
"	1130	"	15'	N/A	N/A	N/A	
"	1150	"	21'	PNL-14-21-DHF	6766	Odor Bag	
"	1219	"	27'	N/A	N/A	N/A	
3/15/2004	1447	PNL-15	6'	N/A	N/A	N/A	
"	1516	"	12'	PNL-15-12-DHF	6757	Odor Bag	
"	1534	N/A	N/A	PNL-15-100-DHF	6759	Odor Bag Blank	
"	1537	"	16'	N/A	N/A	N/A	

Table 2. Summary of Phase II Bucket Auger/Surface Flux Chamber Emission Agent Control Test Information.

DATE	TIME	AUGER ID	VOC ID	CAN ID	ODOR BAG	COMMENTS
5/10/2004	956	N/A	PNL-100-100-SF	6762	N/A	System Blank- Teflon
"	1600	PNL-BA01	PNL-BA1-17SFU	377	PNL-BA1-17SFU	Uncontrolled waste; Bore 1
5/11/2004	1118	PNL-BA-8	PNL-BA8-17-SFU	6772	PNL-BA8-17SFU	Uncontrolled waste; Bore 8
"	1204	PNL-BA-8	PNL-BA8-17-SFC1	552	PNLBA8-17-SFC1	Control- Petroclean
"	1315	PNL-BA-8	PNL-BA8-17-SFC2	547	PNLBA8-17-SFC2	Control- Microblaze
"	1414	PNL-BA-8	PNL-BA8-17-SFC3	170	PNLBA8-17-SFC3	Control- Biosolve
"	1514	PNL-BA-8	PNL-BA8-17-SFC4	544	PNLBA8-17-SFC4	Control- Alabaster CS1 Microbes
"	1604	PNL-BA-8	PNL-BA8-17-SFC5	451	PNLBA8-17-SFC5	Control- Alabaster CS1
5/12/2004	937	PNL-BA-8	PNL-BA8-17-SFC6	1157	PNLBA8-17-SFC6	Control- Water
"	1037	PNL-BA-8	N/A	N/A	N/A	Uncontrolled waste; Bore 8
"	1115	PNL-BA-8	N/A	N/A	N/A	Control- Water
"	1229	PNL-BA-8	N/A	N/A	N/A	Control- Alabaster CS1
"	1603	PNL-BA-1	N/A	N/A	N/A	Uncontrolled waste; Bore 1
"	1646	PNL-BA-1	N/A	N/A	N/A	Control- Alabaster CS1 Microbes
5/13/2004	837	N/A	N/A	N/A	N/A	Offgassing- Petrosolve
"	1136	PNL-BA-8	PNLBA8-17-SFC7	44	PNLBA8-17-SFC7	Control- Rusmar
"	1238	PNL-BA-1	N/A	N/A	N/A	Uncontrol waste; Bore 1
"	1337	PNL-BA-1	PNLBA1-17-SFC1	536	PNLBA1-17-SFC1	Control- Rusmar
"	1428	PNL-BA-3	PNLBA3-X-SFU	1372	PNLBA3-X-SFU	Uncontrolled waste; Bore 3
"	1523	PNL-BA-3	PNLBA3-X-SFC	315	PNLBA3-X-SFU	Control- Rusmar
5/14/2004	736	PNL-BA-11	PNLBA11-X-SFU	539	PNLBA11-X-SFU	Uncontrolled waste; Bore 11
"	834	PNL-BA-11	PNLBA11-X-SFC	485	PNLBA11-X-SFC	Control- Rusmar
"	937	PNL-BA-13	PNLBA13-X-SFU	1163	PNLBA13-X-SFU	Uncontrolled waste; Bore 13
"	1035	PNL-BA-13	PNLBA13-X-SFC	202	PNLBA13-X-SFU	Control- Rusmar
"	1143	PNL-BA-6	PNLBA06-X-SFU	235	PNLBA-06-X-SFU	Uncontrolled waste; Bore 6
"	1231	PNL-BA-06	PNLBA06-X-SFC	34	PNLBA-06-X-SFC	Controlled- Rusmar
"	1328	PNL-BA-07	PNLBA07-X-SFU	430	PNLBA-07-X-SFU	Uncontrolled waste; Bore 7
"	1419	PNL-BA-07	PNLBA07-X-SFC	310	PNLBA-07-X-SFC	Controlled- Rusmar

Table 3. Summary of Lagoon Trenching and Surface Flux Agent Emissions Testing Information.

DATE	TIME	LAGOON ID	VOC ID	CAN ID	ODOR BAG	SULFUR BAG	COMMENTS
5/26/2004	1245	Lagoon 1B	PNL-L1B-SFU/R	2003	Odor Bag	Sulfur Bag	Uncontr; Repl Can; 1242
"	1249	Lagoon 1B	N/A	N/A	N/A	N/A	Uncontrolled- Lagoon #1B
"	1340	Lagoon 1B	PNL-L1B-SFC2	1819	Odor Bag	Sulfur Bag	Control- Rusmar
"	1342	Lagoon 1B	PNL-L1B-SFC1	1601	Odor Bag	Sulfur Bag	Control- Alabaster CS1
5/27/2004	712	Lagoon 1A	PNL-L1A-SFU	1445	Odor Bag	Sulfur Bag	Uncontrolled- Lagoon #1A
	715	Lagoon 1A	N/A	N/A	N/A	N/A	Uncontrolled- Lagoon #1A
"	800	Lagoon 1A	PNL-L1A-SFC2	1903	Odor Bag	Sulfur Bag	Control- Rusmar
"	805	Lagoon 1A	PNL-L1A-SFC1	1380	Odor Bag	Sulfur Bag	Control- Alabaster CS1
"	850	QC	PNL-L1A-SF300	1449	N/A	N/A	Canister Blank
5/26/2004	1032	Lagoon 2B	N/A	N/A	N/A	N/A	Uncontrolled- Lagoon #2B
"	1036	Lagoon 2B	PNL-L2B-SFU	1373	Odor Bag	Sulfur Bag	Uncontrolled- Lagoon #2B
"	1112	Lagoon 2B	PNL-L2B-SFC1	531	Odor Bag	Sulfur Bag	Control- Alabaster CS1
"	1142	Lagoon 2B	PNL-L2B-SFC2	1168	Odor Bag	Sulfur Bag	Control- Rusmar
"	1449	Lagoon 2A	N/A	N/A	N/A	N/A	Uncontrolled- Lagoon #2A
"	1454	Lagoon 2A	PNL-L2A-SFU	1288	Odor Bag	Sulfur Bag	Uncontrolled- Lagoon #2A
"	1539	Lagoon 2A	PNL-L2A-SFC2	1291	Odor Bag	Sulfur Bag	Control- Rusmar
"	1544	Lagoon 2A	PNL-L2A-SFC1	1159	Odor Bag	Sulfur Bag	Control- Alabaster CS1
5/25/2004	1024	Lagoon 3B	N/A	N/A	N/A	N/A	Uncontrolled- Lagoon #3B
"	1028	Lagoon 3B	PNL-L3B-SFU	1180	Odor Bag	Sulfur Bag	Uncontrolled- Lagoon #3B
"	1106	Lagoon 3B	PNL-L3B-SFC2	323	Odor Bag	Sulfur Bag	Control- Rusmar
"	1119	Lagoon 3B	PNL-L3B-CS1	64	Odor Bag	Sulfur Bag	Control- Alabaster CS1
"	1412	Lagoon 3A	PNL-L3A-SFU	157	Odor Bag	Sulfur Bag	Uncontrolled- Lagoon #3A
"	1415	Lagoon 3A	N/A	N/A	N/A	N/A	Uncontrolled- Lagoon #3A
"	1415	QC	N/A	N/A	PNL-L200-SFUS	PNL-L200-SFU	Blank Odor and Sulfur Bag
"	1452	Lagoon 3A	PNL-L3A-SFC1	1233	Odor Bag	Sulfur Bag	Control- Alabaster CS1
"	1511	Lagoon 3A	PNL-L3A-SFC2	1547	Odor Bag	Sulfur Bag	Control- Rusmar
5/24/2004	812	QC	PNL-L5-100	219	Odor Bag	Sulfur Bag	System Blank- Teflon
"	1238	Lagoon 4B	N/A	N/A	N/A	N/A	Uncontrolled- Lagoon #4B
"	1245	Lagoon 4B	PNL-L4B-SFU	1533	Odor Bag	Sulfur Bag	Uncontrolled- Lagoon #4B
"	1321	Lagoon 4B	PNL-L4B-SFC2	497	Odor Bag	Sulfur Bag	Control- Rusmar
"	1334	Lagoon 4B	PNL-L4B-SFC1	382	Odor Bag	Sulfur Bag	Control- Alabaster CS1 Microbe
"	1442	Lagoon 4A	PNL-L4A-SFU	193	Odor Bag	Sulfur Bag	Uncontrolled- Lagoon #4A
"	1443	Lagoon 4A	N/A	N/A	N/A	N/A	Uncontrolled- Lagoon #4A
"	1534	Lagoon 4A	PNL-L4A-SFC2	N/A	Odor Bag	Sulfur Bag	Control- Rusmar
"	1535	Lagoon 4A	PNL-L4A-SFC1	450	Odor Bag	Sulfur Bag	Control- Albaster CS1
5/25/2004	826	Lagoon 5B	PNL-L5B-SFU	286	Odor Bag	Sulfur Bag	Uncontrolled- Lagoon #5B
"	827	Lagoon 5B	N/A	N/A	N/A	N/A	Uncontrolled- Lagoon #5B
"	918	Lagoon 5B	PNL-L5B-SFC2	260	Odor Bag	Sulfur Bag	Contol- Rusmar
"	923	Lagoon 5B	PNL-L5B-SFC1	591	Odor Bag	Sulfur Bag	Control- Albaster CS1
5/24/2004	1026	Lagoon 5A	PNL-L5A-SFU	296	Odor Bag	Sulfur Bag	Uncontrolled- Lagoon #5A
"	1026	Lagoon 5A	N/A	N/A	Odor Bag	Sulfur Bag	Uncontrolled- Lagoon #5A
"	1140	Lagoon 5A	PNL-L5A-SFC2	126	Odor Bag	Sulfur Bag	Uncontrolled- Lagoon #5A
"	1112	Lagoon 5A	PNL-L5A-SFC1	401	Odor Bag	Sulfur Bag	Contol- Alabaster CS1
"	1206	Lagoon 5A	N/A	N/A	N/A	N/A	Uncontrolled- Lagoon #5A

Table 4. Summary of Phase VIII, Pit F Investigation Field Information for Downhole Flux and Surface Flux Testing.

DATE	TIME	BORE ID	DEPTH	SAMPLE ID	CAN ID	SAMPLE ID	SAMPLE ID	COMMENT
Surface Flux (SF)				TO-15/TO-03		ODOR	SULFIDES	
6/28/2004	1337	N/A	N/A	SF-BLK	00300/SC00391	SF-BLK-O	SF-BLK-S	System blank on teflon
7/1/2004	904	N/A	N/A	SF-STY1-U-T	00339/SC00125	SF-STY1-U-O	SF-STY1-U-S	Uncontrolled, styrene contamination
7/1/2004	945	N/A	N/A	N/A	N/A	SF-STY1-U-OR	SF-STY1-U-SR	Replicate odor and sulfur samples
7/1/2004	915	N/A	N/A	SF-STY2-U-T	01529/SC00473	SF-STY2-U-O	SF-STY2-U-S	Uncontrolled, semi-liquid Pit F liner
7/1/2004	915	N/A	N/A	SF-STY2-U-TR	01490/SC00433	N/A	N/A	Replicate canister sample
7/1/2004	1034	N/A	N/A	SF-STY1-C1-T	00522/SC00022	SF-STY1-C1-O	SF-STY1C1-S	Control test (1)- Alibastor without microbes
7/1/2004	1042	N/A	N/A	SF-STY2-C1-T	01518/SC00575	SF-STY2-C1-O	SF-STY2-C1-S	Control test (2)- Alibastor without microbes
7/1/2004	1235	N/A	N/A	SF-STY1-C2-T	01105/SC00158	SF-STY1-C2-O	SF-STY1-C2-S	Control test (2)- Rusmar foam
7/1/2004	1238	N/A	N/A	SF-STY2-C2-T	00528/SC00537	SF-STY2-C2-O	SF-STY2-C2-O	Control test (1)- Rusmar foam
DownHole Flux (DHF)								
6/28/2004	1101	PNL-F4	13.5'	N/A	N/A	N/A	N/A	No grab samples; real time data only
6/28/2004	1138	PNL-F4	18'	N/A	N/A	N/A	N/A	No grab samples; no evidence of styrene
6/28/2004	1120	PNL-F4	16.5	N/A	N/A	N/A	N/A	
6/28/2004	1138	PNL-F4	18'	??	??	??	??	Grab sampling data not provided
6/28/2004	N/A	PNL-F5	13.5'	PNL-F5-13.5-T	06757/ISC00001	PNL-F5-13.50O	PNL-F5-13.5-S	
6/28/2004	N/A	PNL-F5	15'	N/A	N/A	N/A	N/A	No grab samples; real time data only
6/28/2004	1334	PNL-F6	10.6'	N/A	N/A	N/A	N/A	No grab samples; real time data only
6/28/2004	1351	PNL-F4	15'	PNL-F4-15-T	067661/1SC0009	PNL-F4-15-O	PNL-F4-15-S	
6/28/2004	1452	PNL-F7	10.5'	N/A	N/A	N/A	N/A	No grab samples; real time data only
6/28/2004	N/A	PNL-F7	13.5'	N/A	N/A	N/A	N/A	No grab samples; real time data only
6/28/2004	1518	PNL-F7	15'	N/A	N/A	N/A	N/A	No grab samples; chamber covered with water
6/29/2004	831	PNL-F3	14'	N/A	N/A	N/A	N/A	No grab samples; real time data only
6/29/2004	849	PNL-F3	17'	N/A	N/A	N/A	N/A	No grab samples; real time data only
6/29/2004	N/A	PNL-F11	9'	N/A	N/A	N/A	N/A	No sampling; clean fill to 9'
6/29/2004	N/A	PNL-F18	15'	N/A	N/A	N/A	N/A	Styrene odor; water at 15', no sampling
6/29/2004	N/A	PNL-F17	9'	N/A	N/A	N/A	N/A	Water at 9', no sampling
6/29/2004	N/A	PNL-F21	9'	N/A	N/A	N/A	N/A	Water at 9', no sampling; styrene strings on auger
6/29/2004	819	PNL-F19	4.5'	PNL-F19-4-T	06777/1SC00020	PNL-F19-4-O	PNL-F19-4-S	
6/29/2004	858	PNL-F19	10'	PNL-F19-10-T	06774/1SC00017	PNL-F19-10-O	PNL-F19-10-S	
6/29/2004	1040	PNL-F1	8'	N/A	N/A	N/A	N/A	No grab samples; real time data only
6/29/2004	1103	PNL-F1	13'	PNL-F1-13-T	06767/1SC0010	PNL-F1-12-O	PNL-F1-13S	
6/29/2004	1103	PNL-F1	13'	PNL-F1-13-TR	06770/1SC00013	PNL-F1-12-OR	PNL-F1-13SR	Replicate canister, odor bag and sulfur bag
6/30/2004	N/A	Slant Drill	19'	N/A	N/A	N/A	N/A	Slant drilling attempt; water prevented sampling
6/30/2004	N/A	N/A	N/A	PNL-F75-1-T	06769/1SC00012	PNL-F75-1-O	PNL-F75-1-S	Sample line system blank, canister, odor, sulfur

Table 5. Summary of Phase I Downhole Flux Real Time Data (PID/FID).

BORING NUMBER	DEPTH BELOW SURF. ft	FID PEAK ppm	FID AT RES'D NUMBER	FID METHOD STEADY STATE[1] ppm	FID PERCENT of PEAK	PID PEAK ppm	PID AT RES'D NUMBER	PID METHOD STEADY STATE[1] ppm	PID PERCENT of PEAK	SAMPLES: CANISTER SAMPLE #	SAMPLES: CAN. #	SAMPLES: ODOR BAG SAMPLE #	COMMENTS
PNL - 1	9	20,000	2	7,300	37	110	1	68	**62**				
	15	34,000	4	29,000	**85**	119	1	81	**68**	PNL-1-15-DHF	6768	PNL-1-15-DHF	
	21	160,000	2	160,000	**100**	70	1	45	**64**				
	26	51,000	1	70	0	70	2	70	**100**				
PNL - 2	9	3,000	1	26	1	4	1	0	0				
	15	>10,000	1	1,200	12	5	1	2	40	PNL-2-15-DHF	6758	PNL-2-15-DHF	
	21	>10,000	1	40	0	7	1	0	0				
PNL - 3	15	>240,000	1	62,400	26	6	9	6	**100**				
	21	>670,000	1	>670,000	**100**	134	24	UNKNOWN		PNL-3-21-DHF	6776	PNL-3-21-DHF	Instrument flameout prevented some data capture
	27	> SCALE	1	720,000		206	15	161	**78**				
PNL - 4	--	--	--	--	--	--	--	--					No sample due to high groundwater level (7')
PNL - 4A	--	--	--	--	--	--	--	--					No sample due to high groundwater level (7')
PNL - 5	9	11,100	1	390	4	4	1	1	33				Location within the waste zone, but water prevented deeper sampling
PNL - 5A	11	5,100	1	105	2	4	1	2	**50**	PNL-5A-11-DHF	6777	PNL-5A-11-DHF	Water prevented deeper sampling
PNL - 6	9	119,000	2	88,000	**74**	25	7	25	**100**				Above the waste zone
	15	133,000	1	27,000	20	178	1	90	**51**	PNL-6-16-DHF PNL-6-16-RDHF	6765 6769	PNL-6-16-DHF	Top of the waste zone, but flux chamber in water-- results questionable
PNL - 7	9	8,900	1	165	2	28	1	6	21				Above the waste
	15	>118,000	1	1,600	1	190	1	11	6				Waste layer encountered at about 12'
	21	>195,000	2	140,000	**72**	170	5	150	**88**	PNL-7-21-DHF	6763	PNL-7-21-DHF PNL-7-21-RDHF *PNL-7-B-DHF*	 Blank sample
PNL - 8	6	785	2	369	47	7	2	4	**57**				Above the waste
	12	>370,000	1	370,000	**100**	120	17	90	**75**				Within the waste
	18	330,000	1	6,600	2	120	5	110	**92**	PNL-8-18-DHF	6777	PNL-8-18-DHF	
	24	63,100	5	57,700	**91**	140	5	140	**100**				
PNL - 9	9	908	1	35	4	30	1	5	17				Above the waste
	15	28,000	1	12,000	43	18	1	13	**72**	PNL-9-15-DHF	6767	PNL-9-15-DHF PNL-9-15-RDHF	At or within the waste
	21	11,000	1	1,307	12	48	1	36	**75**	*PNL-9-21-BDHF*			Probably below the waste. *Blank sample*
PNL - 10	9	93	1	4	4	1	1	1	**50**				Suspected styrene site
	15	180	2	2	1	1	2	0	0				Flux chamber in water-- results questionable; Suspected styrene site
PNL - 10A	13	5,100	17	2,100	41	2	17	1	**50**	PNL-10A-13-DHF	6770	PNL-10A-13-DHF	Suspected styrene site
	14.5	17,000	1	90	1	4	1	1	25				
PNL - 11	6	24	1	6	25	30	1	2	7				Suspected styrene site
	9	6,465	2	4,900	**76**	29	2	27	**93**				
	12	2,500	1	--		48	1	--		PNL-11-12-DHF	6771	PNL-11-12-DHF	Flux chamber completely immersed in water slurry-- results questionable
PNL - 12	3	6,200	1	1,500	24	12	1	6	**53**	*PNL-12-100-DHF*	6775	*PNL-12-100-DHF*	Blank samples
	9	9,500	1	71	1	6	1	2	33				
	15	146,500	1	224	0	20	2	5	25	PNL-12-15-DHF PNL-12-15-RDHF	6774 6773		No odor bag due to low TVA readings
	21	240,000	1	480	0	17	11	6	35			PNL-12-21-DHF	Flux chamber in water-- results questionable
PNL - 13	6	100,000	1	570	1	38	1	14	37				
	12	4,800	1	3,000	**63**	98	6	81	**83**	PNL-13-12-DHF	6760	PNL-13-12-DHF	
	18	>10,000	1	1,713	17	256	3	203	**79**				
	24	25,000	2	200	1	61	2	14	23				
PNL - 14	9	595	3	63	11	60	3	12	20				At or above waste level
	15	5,000	1	27	1	60	1	5	8				
	21	20,000	1	15,000	**75**	21	3	16	**76**	PNL-14-21-DHF	6766	PNL-14-21-DHF	
	27	>16,000	1	1,430	9	18	1	10	**56**				Below the waste level
PNL - 15	6	14,000	1	71	1	13	1	4	31				
	12	20,000	1	2,000	10	13	1	8	**62**	PNL-15-12-DHF *PNL-15-100-DHF*	6757 6759	PNL-15-12-DHF	 Blank sample
	16	>24,000	--	--		--	--	--					Sample void-- air line not connected, and water in chamber

[1] Steady State for this Mixed Tank Reactor is at 8 Residence Times

Green	Possible Source based on FID data
Blue	Possible Source based on PID data
Red	Possible Source based on both FID and PID data

Table5-P1DHF-RT

Table 6. Summary of Phase I Downhole Flux Hydrocarbon Emission Data (ug/m2,min-1).

COMPOUNDS	Method	Blank	Blank	QC	PNL-1-	PNL-1-	PNL-2-	PNL-2-	PNL-3-	PNL-3-	PNL-5A-	PNL-5A-	PNL-6-	PNL-6-	PNL-6-	PNL-6-	PNL-7-	PNL-7-	PNL-7-	PNL-7-	PNL-8-	PNL-8-
	Blank	15-100DHF	12-100DHF	Blank MDL	15-DHF	15-DHF	15-DHF	15-DHF	21-DHF	21-DHF	11-DHF	11-DHF	15-DHF	15-DHF	15-RDHF	15-RDHF	21-DHF	21-DHF	21-DHF-D	21-DHF-D	6-DHF	6-DHF
	(ppmv)	(ppmv)	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1
Methane	<0.5	<0.8	<0.8	<160	21,000	**4,206,720**	600	**120,192**	240,000	**48,076,800**	380	**76,122**	56,000	**11,217,920**	35,000	**7,011,200**	170,000	**34,054,400**	180,000	**36,057,600**	370	**74,118**
C2 as Ethane	<0.5	<0.8	<0.8	<300	30	**11,268**	ND		41	**15,400**	ND		3.3	**1,239**	ND		7.6	**2,855**	7.7	**2,892**	ND	
C3 as Propane	<0.5	<0.8	<0.8	<440	93	**51,232**	ND		390	**214,843**	ND		ND		ND		8.9	**4,903**	9.4	**5,178**	ND	
C4 as n-Butane	<0.5	<0.8	<0.8	<580	160	**116,186**	ND		800	**580,928**	ND		13	**9,440**	7.1	**5,156**	100	**72,616**	100	**72,616**	ND	
C5 as n-Pentane	<0.5	<0.8	<0.8	<720	140	**126,202**	ND		530	**477,763**	ND		13	**11,719**	8.1	**7,302**	140	**126,202**	140	**126,202**	ND	
C6 as n-Hexane	<0.5	<0.8	<0.8	<860	110	**118,439**	ND		280	**301,482**	ND		7.4	**7,968**	4.6	**4,953**	100	**107,672**	97	**104,442**	ND	
C6+ as n-Hexane	1.0	<1.6	<1.6	<1,720	1,700	**1,830,424**	2.0	**2,153**	1,400	**1,507,408**	2.1	**2,261**	81	**87,214**	37	**39,839**	1,300	**1,399,736**	1,400	**1,507,408**	6.0	**6,460**
	(ug/m3)	(ug/m3)	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1
Chloroform	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
Vinyl Chloride	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
1,3-Butadiene	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		140	**43.8**	ND		ND		N/A		8.1	**2.54**
Bromomethane	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
Chloroethane	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
Acetone	<5.0	<2.0	<2.1	<0.66	ND		45	**14.1**	ND		ND		ND		ND		ND		N/A		ND	
Trichlorofluoromethane	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
Acrylonitrile	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
1,1-Dichloroethene	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
Methylene Chloride	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		78	**24.4**	28	**8.8**	ND		N/A		36	**11.3**
Trichlorotrifluoroethane	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
Carbon Disulfide	<0.50	<2.0	<2.1	<0.66	ND		4.8		ND		2.1	**0.657**	36	**11.3**	13	**4.07**	ND		N/A		6.1	**1.91**
t-1,2-Dichloroethene	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
1,1-Dichloroethane	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
Methyl tert butyl ether	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
Vinyl Acetate	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
2-Butanone	<0.50	<2.0	<2.1	<0.66	ND		10		ND		8.2	**2.57**	69	**21.6**	33	**10.3**	ND		N/A		51	**16.0**
c-1,2-Dichloroethene	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
Chloroform	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
1,2-Dichloroethane	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
1,1,1-Trichloroethane	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
Benzene	<0.50	<2.0	<2.1	<0.66	21,000	**6,573**	ND		12,000	**3,756**	3.1	**0.97**	26	**8.1**	6.4	**2.00**	3,700	**1,158**	N/A		22	**6.89**
Carbon Tetrachloride	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
1,2-Dichloropropane	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
Bromodichloromethane	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
Trichloroethene	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
c-1,3-Dichloropropene	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
4-Methyl-2-Pentanone	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
t-1,3-Dichloropropene	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
1,1,2-Trichloroethane	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
Toluene	<0.50	<2.0	<2.1	<0.66	33,000	**10,329**	ND		4,800	**1,502**	3.0	**0.94**	18	**5.63**	ND		430	**135**	N/A		13	**4.07**
2-Hexanone	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
Dibromochloromethane	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
1,2-Dichloroethane	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
Tetrachloroethene	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
Chlorobenzene	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		92	**28.8**	37	**11.6**	ND		N/A		ND	
Ethylbenzene	<0.50	<2.0	<2.1	<0.66	11,000	**3,443**	ND		5,600	**1,753**	2.5	**0.783**	34	**10.6**	13	**4.07**	2,400	**751**	N/A		100	**31.3**
m/p-Xylene	<1.0	<2.0	<2.1	<0.66	25,000	**7,825**	ND		16,000	**5,008**	4.3	**1.35**	ND		ND		2,900	**112**	N/A		190	**59.5**
Bromoform	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
Styrene	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
o-Xylene	<0.50	<2.0	<2.1	<0.66	12,000	**3,756**	ND		6,100	**1,909**	2.8	**0.88**	ND		ND		1,300	**407**	N/A		32	**10.0**
1,1,2,2-Tetrachloroethane	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
1,3-Dichlorobenzene	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
1,4-Dichlorobenzene	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	
1,2-Dichlorobenzene	<0.50	<2.0	<2.1	<0.66	ND		ND		ND		ND		ND		ND		ND		N/A		ND	

Note- Flux data shown in **Bold**
DH Flux (ug/m2,min-1) = (ug/m3)(0.001 m3/min)/(0.0032 m2) or (ug/m3)(0.313)
Conversion from ppmv to ug/m3; example; propane- (44 mol wt/25 ideal gas law constant)(ppmv)(1000 ug/1mg)

Table 6. Summary of Phase I Downhole Flux Hydrocarbon Emission Data (ug/m2,min-1).

COMPOUNDS	**PNL-8-18-DHF**	**PNL-8-18-DHF**	**PNL-9-15-DHF**	**PNL-9-15-DHF**	**PNL-9-21-BDHF**	**PNL-9-21-BDHF**	**PNL-10A-13-DHF**	**PNL-10A-13-DHF**	**PNL-11-12-DHF**	**PNL-11-12-DHF**	**PNL-11-12-DHF-D**	**PNL-11-12-DHF-D**	**PNL-12-15-DHF**	**PNL-12-15-DHF**	**PNL-12-15-RDHF**	**PNL-12-15-RDHF**	**PNL-13-12-DHF**	**PNL-13-12-DHF**	**PNL-14-21-DHF**	**PNL-14-21-DHF**	**PNL-15-12-DHF**	**PNL-15-12-DHF**
	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1
Methane	47,000	**9,415,040**	6,600	**1,322,112**	0.9	**180**	1,700	**340,544**	5.8	**1,162**	6.1	**1,222**	750	**150,240**	140	**28,045**	1,200	**240,384**	170,000	**34,054,400**	1,600	**320,512**
C2 as Ethane	10	**3,756**	ND		ND		ND		ND		ND		ND		ND		ND		11	**4,132**	ND	
C3 as Propane	29	**15,976**	ND		ND		ND		ND		ND		ND		ND		ND		54	**29,748**	ND	
C4 as n-Butane	50	**36,308**	ND		ND		ND		ND		ND		ND		ND		3.3	**2,396**	240	**174,278**	0.84	**610**
C5 as n-Pentane	47	**42,368**	9.3	**8,383**	ND		ND		ND		ND		ND		ND		4.8	**4,327**	240	**216,346**	1.1	**992**
C6 as n-Hexane	33	**35,532**	6.2	**6,676**	ND		ND		ND		ND		ND		ND		5.4	**5,814**	170	**183,042**	ND	
C6+ as n-Hexane	300	**323,016**	50	**53,836**	ND		5.1	**5,491**	7.5	**8,075**	8.0	**8,614**	23	**24,765**	12	**12,921**	100	**107,672**	1,800	**1,938,096**	11	**11,844**
	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1
Chloroform	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
Vinyl Chloride	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
1,3-Butadiene	ND		ND		ND		4.4	**1.38**	ND		N/A		ND		ND		ND		ND		13	**4.1**
Bromomethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
Chloroethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
Acetone	ND		ND		ND		91	**28.5**	1,600	**501**	N/A		ND		ND		ND		ND		ND	
Trichlorofluoromethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
Acrylonitrile	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
1,1-Dichloroethene	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
Methylene Chloride	180	**56.3**	38	**11.9**	ND		ND		ND		N/A		ND		ND		ND		ND		ND	
Trichlorotrifluoroethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
Carbon Disulfide	ND		ND		ND		13	**4.07**	ND		N/A		ND		ND		ND		ND		6.0	**1.9**
t-1,2-Dichloroethene	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
1,1-Dichloroethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
Methyl tert butyl ether	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
Vinyl Acetate	ND		ND		ND		ND		25	**7.8**	N/A		ND		ND		ND		ND		ND	
2-Butanone	110	**34.4**	64	**20.0**	4.9	**1.53**	21	**6.57**	12	**3.76**	N/A		9.2	**2.88**	6.2	**1.94**	ND		ND		14	**4.4**
c-1,2-Dichloroethene	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
Chloroform	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
1,2-Dichloroethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
1,1,1-Trichloroethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
Benzene	9,000	**2817**	210	**65.7**	ND		24	**7.51**	220	**68.9**	N/A		57	**17.8**	22	**6.89**	580	**182**	8,900	**2786**	130	**41**
Carbon Tetrachloride	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
1,2-Dichloropropane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
Bromodichloromethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
Trichloroethene	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
c-1,3-Dichloropropene	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
4-Methyl-2-Pentanone	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
t-1,3-Dichloropropene	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
1,1,2-Trichloroethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
Toluene	5,300	**1659**	51	**16.0**	ND		20	**6.26**	160	**50.1**	N/A		15	**4.70**	7.2	**2.25**	1,300	**407**	710	**222**	86	**27**
2-Hexanone	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
Dibromochloromethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
1,2-Dichloroethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
Tetrachloroethene	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
Chlorobenzene	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
Ethylbenzene	2,600	**814**	360	**113**	ND		63	**19.7**	4,900	**1,534**	N/A		230	**72.0**	120	**37.56**	940	**294**	8,200	**2567**	140	**44**
m/p-Xylene	4,300	**1346**	750	**235**	ND		52	**16.3**	ND		N/A		98	**30.7**	51	**15.96**	2,200	**689**	10,000	**3130**	160	**50**
Bromoform	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
Styrene	280	**88**	ND		ND		5.2	**1.63**	1,100	**344**	N/A		ND		ND		ND		ND		ND	
o-Xylene	2,100	**657**	120	**37.6**	ND		27	**8.5**	11	**3.44**	N/A		30	**9.4**	16	**5.01**	1,400	**438**	2,000	**626**	100	**31**
1,1,2,2-Tetrachloroethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
1,3-Dichlorobenzene	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
1,4-Dichlorobenzene	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	
1,2-Dichlorobenzene	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND	

Table 7. Summary of Phase II Bucket Auger Waste Emission Control Tests with Real Time Data.

Boring Number	Agent	PID ppm	% Control	FID ppm	% Control	Sample Name	Note
PNL-BA01	PNL-BA01, 05-10-04	**30**		**123**		PNLBA1-17-SFU	
	PNL-BA01, 05-12-04						
	Uncontrolled Recheck	**15**	N/A	**60**	N/A	Instruments Only	
	Alabaster CS1 w/o microbes	7	*53*	27	*55*	Instruments Only	Application rate approx. 0.0141 gal / sq ft
	PNL-BA01, 05-13-04						
	Uncontrolled Recheck	**39**	N/A	**140**	N/A	Instruments Only	
	Rusmar Foam	4	*90*	5	*96*	Instruments Only	Approx 2" of foam applied
PNL-BA03	PNL-BA03, 05-13-04						
	Uncontrolled	**33**	N/A	**183**	N/A	PNLBA3-X-SFU	Replicate sample PNLBA3-X-SFU1
	Rusmar Foam	6	*82*	21	*89*	PNLBA3-X-SFC	Foam approx. 2" thick
PNL-BA06	PNL-BA06, 05-14-04						
	Uncontrolled	**26**	N/A	**67**	N/A	PNLBA6-X-SFU	
	Rusmar Foam	9	*65*	6	*91*	PNLBA6-X-SFC	Foam approx. 1-1/2" thick
PNL-BA07	PNL-BA07, 05-14-04						
	Uncontrolled	**20**	N/A	**65**	N/A	PNLBA7-X-SFU	
	Rusmar Foam	10	*50*	42	*35*	PNLBA7-X-SFC	Approx 2" of foam applied
PNL-BA08	PNL-BA08, 05-11-04						
	Uncontrolled	**63**	N/A	**357**	N/A	PNLBA8-17-SFU	
	Petroclean	65	*-3*	362	*-1*	PNLBA8-17-SFC1	Application rate approx. 0.0135 gal / sq ft
	Microblaze	52	*17*	318	*11*	PNLBA8-17-SFC2	Application rate approx. 0.0135 gal / sq ft
	Biosolve	69	*-10*	368	*-3*	PNLBA8-17-SFC3	Application rate approx. 0.0135 gal / sq ft
	Alabaster CS1 w/ microbes	67	*-6*	342	*4*	PNLBA8-17-SFC4	Application rate approx. 0.0141 gal / sq ft
	Alabaster CS1 w/o microbes	40	*37*	183	*49*	PNLBA8-17-SFC5	Application rate approx. 0.0141 gal / sq ft
	PNL-BA08, 05-12-04						
	Uncontrolled Recheck	**61**	N/A	**261**	N/A	Instruments Only	
	Water spray	21	*66*	78	*70*	PNLBA8-17-SFC6	Application rate approx. 0.0135 gal / sq ft
	Alabaster CS1 w/o microbes	49	*20*	179	*31*	Instruments Only	Application rate approx. 0.0141 gal / sq ft
	Recheck Water spray	40	*34*	129	*51*	Instruments Only	Application rate approx. 0.0135 gal / sq ft
	PNL-BA08, 05-13-04						
	Rusmar Foam	40	*34*	62	*76*	PNLBA8-17-SFC7	Minimal amount of waste mat'l available for this test
PNL-BA11	PNL-BA11, 05-14-04						
	Uncontrolled	**75**	N/A	**177**	N/A	PNLBA11X-SFU	Very high odor from this waste material
	Rusmar Foam	32	*57*	61	*66*	PNLBA11-X-SFC	Foam did not appear to mix properly this test.
PNL-BA13	PNL-BA13, 05-14-04						
	Uncontrolled	**157**	N/A	**1060**	N/A	PNLBA13-X-SFU	
	Rusmar Foam	8	*95*	9	*99*	PNLBA13-X-SFC	Foam approx. 3" thick
QC	Clean Flux Chamber, 5-13-04	**0.8**		**1.7**		Instruments Only	Background Sample, Flux Chamber on Clean Vessel
	Petroclean Product	7	*-775*	14	*-724*	Instruments Only	Petroclean product added to clean vessel

Sample number placeholder "X" was used when no information was available to indicate bucket auger sample depth.

Table 8. Summary of Phase 2 Bucket Auger Waste Emission Control Agent Testing VOC Data.

COMPOUNDS	Method Blank Lab	Blank PNL-100-100-SF Field	QC Blank MDL Reference	PNLBA1 17-SFU Uncontr	PNLBA1 17-SFU Uncontr	PNLBA1 17-SFC1 Rusmar	PNLBA1 17-SFC1 Rusmar	PNLBA3 X-SFU Uncontr	PNLBA3 X-SFU Uncontr	PNLBA3 X-SFU1 Repl	PNLBA3 X-SFU1 Repl	PNLBA3 X-SFC Rusmar	PNLBA3 X-SFC Rusmar	PNLBA06 X-SFU Uncontr	PNLBA06 X-SFU Uncontr	PNLBA06 X-SFU-D Lab Dupl	PNLBA06 X-SFU-D Lab Dupl	PNLBA06 X-SFC Rusmar	PNLBA06 X-SFC Rusmar	PNLBA07 X-SFU Uncontr	PNLBA07 X-SFU Uncontr
	(ppmv)	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1
Methane	<0.83	<0.83	<20	16	**394**	1.3	**32**	32	**788**	31	**764**	20	**493**	23	**567**	23	**567**	0.98	**24**	11	**271**
C2 as Ethane	<0.83	<0.83	<38	ND		ND		ND		ND		ND		ND		ND		ND		ND	
C3 as Propane	<0.83	<0.83	<56	ND		ND		ND		ND		ND		ND		ND		ND		ND	
C4 as n-Butane	<0.83	<0.83	<74	ND		ND		1.7	**152**	1.7	**152**	1.0	**89**	ND		ND		ND		ND	
C5 as n-Pentane	<0.83	<0.83	<92	ND		ND		2.3	**255**	2.3	**255**	0.94	**104**	ND		ND		ND		ND	
C6 as n-Hexane	<0.83	<0.83	<110	ND		ND		2.7	**358**	2.7	**358**	0.88	**117**	ND		ND		ND		ND	
C6+ as n-Hexane	<1.7	<1.7	<225	3.3	**437**	ND		63	**8,344**	59	**7,814**	11	**1,457**	11	**1,457**	12	**1,589**	ND		19	**2,516**
	(ug/m3)	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1
Chloroform	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
Vinyl Chloride	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
1,3-Butadiene	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
Bromomethane	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
Chloroethane	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
Acetone	<5.0	<2.1	<0.81	33	**1.3**	65	**2.5**	ND		ND		ND		64	**2.5**	N/A	N/A	25	**0.96**	130	**5.0**
Trichlorofluoromethane	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
Acrylonitrile	<0.50	<2.1	<0.081	ND		ND		ND		ND		28	**1.1**	ND		N/A	N/A	ND		ND	
1,1-Dichloroethene	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
Methylene Chloride	<0.50	<2.1	<0.081	8.2	**0.32**	ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
Trichlorotrifluoroethane	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
Carbon Disulfide	<0.50	<2.1	<0.081	19	**0.73**	28	**1.1**	ND		ND		86	**3.3**	12	**0.46**	N/A	N/A	42	**1.6**	36	**1.4**
t-1,2-Dichloroethene	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
1,1-Dichloroethane	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
Methyl tert butyl ether	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
Vinyl Acetate	<0.50	<2.1	<0.081	ND		ND		ND		200	**7.7**	ND		ND		N/A	N/A	ND		ND	
2-Butanone	<0.50	5.2	**0.20**	3.4	**0.13**	2.1	**0.081**	ND		ND		70	**2.7**	20	**0.77**	N/A	N/A	3.8	**0.15**	28	**1.1**
c-1,2-Dichloroethene	<0.50	<2.1	<0.081	1.2	**0.046**	ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
Chloroform	<0.50	<2.1	<0.081	1.6	**0.062**	3.7	**0.14**	ND		ND		ND		ND		N/A	N/A	0.99	**0.038**	ND	
1,2-Dichloroethane	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
1,1,1-Trichloroethane	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
Benzene	<0.50	<2.1	<0.081	110	**4.2**	72	**2.8**	560	**22**	440	**17**	500	**19**	180	**6.9**	N/A	N/A	93	**3.6**	27	**1.0**
Carbon Tetrachloride	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
1,2-Dichloropropane	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
Bromodichloromethane	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
Trichloroethene	<0.50	<2.1	<0.081	300	**12**	20	**0.77**	ND		ND		ND		ND		N/A	N/A	ND		ND	
c-1,3-Dichloropropene	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
4-Methyl-2-Pentanone	<0.50	<2.1	<0.081	ND		1.1	**0.042**	ND		ND		4.6	**0.18**	ND		N/A	N/A	ND		ND	
t-1,3-Dichloropropene	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
1,1,2-Trichloroethane	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
Toluene	<0.50	2.4	**0.092**	39	**1.5**	73	**2.8**	130	**5.0**	130	**5.0**	95	**3.7**	11	**0.42**	N/A	N/A	1.6	**0.062**	7.2	**0.28**
2-Hexanone	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	1.4	**0.054**	ND	
Dibromochloromethane	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
1,2-Dichloroethane	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
Tetrachloroethene	<0.50	<2.1	<0.081	670	**26**	540	**21**	ND		ND		ND		16	**0.62**	N/A	N/A	ND		ND	
Chlorobenzene	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	3.7	**0.14**	ND	
Ethylbenzene	<0.50	<2.1	<0.081	6.0	**0.23**	28	**1.1**	780	**30**	760	**29**	530	**20**	450	**17**	N/A	N/A	190	**7.3**	220	**8.5**
m/p-Xylene	<1.0	<2.1	<0.081	5	**0.19**	30	**1.2**	1900	**73**	1900	**73**	1000	**39**	220	**8.5**	N/A	N/A	92	**3.5**	130	**5.0**
Bromoform	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
Styrene	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		7.5	**0.29**	N/A	N/A	6.7	**0.26**	5.4	**0.21**
o-Xylene	<0.50	<2.1	<0.081	2	**0.058**	9.3	**0.36**	780	**30**	810	**31**	620	**24**	59	**2.3**	N/A	N/A	22	**0.85**	69	**2.7**
1,1,2,2-Tetrachloroethane	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
1,3-Dichlorobenzene	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		ND		N/A	N/A	ND		ND	
1,4-Dichlorobenzene	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		3.1	**0.12**	N/A	N/A	1.4	**0.054**	4.0	**0.15**
1,2-Dichlorobenzene	<0.50	<2.1	<0.081	ND		ND		ND		ND		ND		13	**0.50**	N/A	N/A	6.6	**0.25**	15	**0.58**

Note- Flux data shown in **Bold**
Surface Flux (ug/m2,min-1) = (ug/m3)(0.005 m3/min)/(0.13 m2) or (ug/m3)(0.0385)
Conversion from ppmv to ug/m3; example; propane- (44 mol wt/25 ideal gas law constant)(ppmv)(1000 ug/1mg)
SFU- Surface flux (test) on Uncontrolled waste
C- Control agent test
Emission Control Agents: Petroclean, Biosolve, Alabaster CS1, Alabaster CS1 with Microbes, Water, Rusmar

Table 8. Summary of Phase 2 Bucket Auger Waste Emission Control Agent Testing VOC Data.

COMPOUNDS	PNLBA07	PNLBA07	PNLBA8	PNLBA8	PNLBA8	PNLBA8	PNLBA8	PNLBA8	PNLBA8	PNLBA8	PNLBA8	PNLBA8	PNLBA8	PNLBA8	PNLBA8	PNLBA8	PNLBA8	PNLBA8	PNLBA8	PNLBA8	PNLBA8
	X-SFC	X-SFC	17-SFU	17-SFU	17-SFC1	17-SFC1	17-SFC2	17-SFC2	17-SFC3	17-SFC3	17-SFC3D	17-SFC3D	17-SFC4	17-SFC4	17-SFC5	17-SFC5	17-SFC6	17-SFC6	17-SFC7	17-SFC7	17-SFC7D
	Rusmar	Rusmar	Uncotr	Uncontr	Petrocln	Petrocln	Microblz	Microblz	Biosolve	Biosolve	Lab Dupl	Lab Dupl	Alab Micr	Alab Micr	Albaster	Alabaster	Water	Water	Rusmar	Rusmar	Lab Dup
	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)
Methane	12	**296**	84	**2,070**	56	**1,380**	48	**1,183**	58	**1,429**	57	**1,404**	49	**1,207**	29	**715**	15	**370**	17	**419**	N/A
C2 as Ethane	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		N/A
C3 as Propane	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		N/A
C4 as n-Butane	ND		0.99	**88**	0.79	**71**	0.64	**57**	0.75	**67**	0.75	**67**	0.82	**73**	ND		ND		ND		N/A
C5 as n-Pentane	ND		3.2	**355**	2.3	**255**	1.9	**211**	1.8	**200**	1.8	**200**	2.3	**255**	1.3	**144**	0.65	**72**	ND		N/A
C6 as n-Hexane	ND		4.2	**556**	3.5	**464**	2.8	**371**	2.7	**358**	2.7	**358**	3.4	**450**	1.7	**225**	0.89	**118**	0.64	**85**	N/A
C6+ as n-Hexane	10	**1,324**	140	**18,542**	150	**19,866**	120	**15,893**	130	**17,217**	140	**18,542**	130	**17,217**	68	**9,006**	26	**3,443**	12	**1,589**	N/A
	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)
Chloroform	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
Vinyl Chloride	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
1,3-Butadiene	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
Bromomethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
Chloroethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
Acetone	37	**1.4**	ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
Trichlorofluoromethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
Acrylonitrile	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
1,1-Dichloroethene	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
Methylene Chloride	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
Trichlorotrifluoroethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
Carbon Disulfide	55	**2.1**	ND		ND		ND		ND		N/A		ND		ND		ND		37	**1.4**	37
t-1,2-Dichloroethene	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
1,1-Dichloroethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
Methyl tert butyl ether	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
Vinyl Acetate	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
2-Butanone	6.1	**0.23**	10		ND		ND		ND		N/A		ND		ND		ND		ND		ND
c-1,2-Dichloroethene	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
Chloroform	4.9	**0.19**	ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
1,2-Dichloroethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
1,1,1-Trichloroethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
Benzene	18	**0.69**	1500	**58**	2,700	**104**	2200	**85**	2400	**92**	N/A		2000	**77**	1,500	**58**	660	**25**	1600	**62**	1,600
Carbon Tetrachloride	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
1,2-Dichloropropane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
Bromodichloromethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
Trichloroethene	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
c-1,3-Dichloropropene	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
4-Methyl-2-Pentanone	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
t-1,3-Dichloropropene	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
1,1,2-Trichloroethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
Toluene	4.6	**0.18**	1200	**46**	2,400	**92**	2000	**77**	2000	**77**	N/A		1400	**54**	1200	**46**	720	**28**	1400	**54**	1,400
2-Hexanone	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
Dibromochloromethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
1,2-Dichloroethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
Tetrachloroethene	19		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
Chlorobenzene	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
Ethylbenzene	120	**4.6**	1600	**62**	3,200	**123**	2600	**100**	2400	**92**	N/A		1800	**69**	1,600	**62**	840	**32**	1200	**46**	1,200
m/p-Xylene	99	**3.8**	2500	**96**	3,800	**146**	2400	**92**	2800	**108**	N/A		2700	**104**	2,100	**81**	1100	**42**	1300	**50**	1,300
Bromoform	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
Styrene	3.8	**0.15**	250	**10**	530		550		570	**22**	N/A		320	**12**	290		220	**8.5**	230	**8.9**	230
o-Xylene	40	**1.5**	1200	**46**	2,100	**81**	1300	**50**	1500	**58**	N/A		1300	**50**	1,200	**46**	630	**24**	700	**27**	720
1,1,2,2-Tetrachloroethane	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
1,3-Dichlorobenzene	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
1,4-Dichlorobenzene	ND		ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND
1,2-Dichlorobenzene	4.4	**0.17**	ND		ND		ND		ND		N/A		ND		ND		ND		ND		ND

Table 8. Summary of Phase 2 Bucket Auger Waste Emission Control Agent Testing VOC Data.

COMPOUNDS	PNLBA8	PNLBA11	PNLBA11	PNLBA11	PNLBA11	PNLBA13	PNLBA13	PNLBA13	PNLBA13
	17-SFC7D	X-SFU	X-SFU	X-SFC	X-SFC	X-SFU	X-SFU	X-SFC	X-SFC
	Lab Dup	Uncontr	Uncontr	Rusmar	Rusmar	Uncontr	Uncontr	Rusmar	Rusmar
	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1
Methane	N/A	2.1	**52**	1.0	**25**	15	**370**	0.63	**16**
C2 as Ethane	N/A	ND		ND		ND		ND	
C3 as Propane	N/A	ND		ND		ND		ND	
C4 as n-Butane	N/A	ND		ND		2.3	**205**	ND	
C5 as n-Pentane	N/A	ND		ND		6.4	**710**	ND	
C6 as n-Hexane	N/A	ND		ND		9.8	**1,298**	ND	
C6+ as n-Hexane	N/A	60	**7,946**	28	**3,708**	530	**70,193**	3.5	**464**
	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1
Chloroform		ND		ND		ND		ND	
Vinyl Chloride		ND		ND		ND		ND	
1,3-Butadiene		ND		ND		ND		ND	
Bromomethane		ND		ND		ND		ND	
Chloroethane		ND		ND		ND		ND	
Acetone		ND		ND		ND		48	**1.8**
Trichlorofluoromethane		ND		ND		ND		ND	
Acrylonitrile		ND		ND		ND		ND	
1,1-Dichloroethene		ND		ND		ND		ND	
Methylene Chloride		ND		ND		ND		ND	
Trichlorotrifluoroethane		ND		ND		ND		ND	
Carbon Disulfide	**1.4**	ND		ND		ND		69	**2.7**
t-1,2-Dichloroethene		ND		ND		ND		ND	
1,1-Dichloroethane		ND		ND		ND		ND	
Methyl tert butyl ether		ND		ND		ND		ND	
Vinyl Acetate		ND		ND		ND		11	**0.42**
2-Butanone		ND		ND		ND		11	**0.42**
c-1,2-Dichloroethene		ND		ND		ND		2.5	**0.10**
Chloroform		ND		ND		ND		28	**1.1**
1,2-Dichloroethane		ND		ND		ND		ND	
1,1,1-Trichloroethane		ND		ND		ND		ND	
Benzene	**62**	330	**13**	ND		1300	**50**	140	**5.4**
Carbon Tetrachloride		ND		ND		ND		ND	
1,2-Dichloropropane		ND		ND		ND		ND	
Bromodichloromethane		ND		ND		ND		ND	
Trichloroethene		ND		ND		ND		ND	
c-1,3-Dichloropropene		ND		ND		ND		ND	
4-Methyl-2-Pentanone		ND		ND		ND		2.1	**0.081**
t-1,3-Dichloropropene		ND		ND		ND		ND	
1,1,2-Trichloroethane		ND		ND		ND		ND	
Toluene	**54**	1400	**54**	760	**29**	3700	**142**	380	**15**
2-Hexanone		ND		ND		ND		3.2	**0.12**
Dibromochloromethane		ND		ND		ND		ND	
1,2-Dichloroethane		ND		ND		ND		ND	
Tetrachloroethene		ND		ND		ND		2.1	**0.081**
Chlorobenzene		ND		ND		ND		ND	
Ethylbenzene	**46**	19000	**732**	11000	**424**	3200	**123**	170	**6.5**
m/p-Xylene	**50**	ND		ND		7200	**277**	430	**17**
Bromoform		ND		ND		ND		ND	
Styrene	**8.9**	39000	**1502**	28000	**1078**	ND		15	**0.58**
o-Xylene	**28**	ND		ND		5100	**196**	320	**12**
1,1,2,2-Tetrachloroethane		ND		ND		ND		ND	
1,3-Dichlorobenzene		ND		ND		ND		ND	
1,4-Dichlorobenzene		ND		ND		ND		4.2	**0.16**
1,2-Dichlorobenzene		ND		ND		ND		9.2	**0.35**

Table 9. Summary of Phase IV Lagoon Waste Emission Agent Control Data with Real Time Instruments.

Lagoon Number	Trench	Flux Chamber	Sample Type	PID ppm	% Control	FID ppm	% Control	H_2S ppm	% Control	Sample Number	Note*
--	--	B	System Blank	**-0.20**	--	**-2.57**	--	0.000		PNL-L5-100-SFU	Canister 00219 / SC00203
1	A	B	Uncontrolled	**54**		**68**		**0.029**		Instruments Only	
1	A	B	Alabaster CS1 w/o microbes	40	26	89	-31	0.028	3	PNL-L1A-SFC1	Canister 01380/AC00176; Odor and Sulfur Bags taken
1	A	D	Uncontrolled	**78**		**110**		**0.027**		PNL-L1A-SFU	Canister 01445/AC00292; Odor and Sulfur Bags taken
1	A	D	Rusmar Foam	3.4	96	2.7	98	0.003	89	PNL-L1A-SFC2	Canister 01903/AC00554; Odor and Sulfur bags taken
1	B	B	Uncontrolled	**43**		**120**		**0.053**		Instruments Only	
1	B	B	Alabaster CS1 w/o microbes	42	2	114	5	0.056	-6	PNL-L1B-SFC1	Canister 01601/AC00386; Odor and Sulfur bags taken
1	B	D	Uncontrolled *Replicate Canister*	**43**		**130**		**0.050**		PNL-L1B-SFU *PNL-L1B-SFUR*	Canister 02003/AC00590; Odor and Sulfur bags taken *Canister 01242/AC00232*
1	B	D	Rusmar Foam	**3.2**	93	**3.2**	98	**0.006**	88	PNL-L1B-SFC2	Canister 01819/AC00482; Odor and Sulfur bags taken
2	A	D	Uncontrolled	**99**		**236**		**0.026**		Instruments Only	
2	A	D	Alabaster CS1 w/o microbes	42	58	98	58	0.015	42	PNL-L2A-SFC1	Canister 01159/AC00225; Odor and Sulfur bags taken
2	A	B	Uncontrolled *Replicate Odor Bag*	**210**		**626**		**0.051**		PNL-L2A-SFU	Canister 01288/AC00140; Sulfur bag taken *Odor bag PNL-L2A-SFU, Replicate: -SFURO*
2	A	B	Rusmar Foam	8	96	9	99	0.004	92	PNL-L2A-SFC2	Canister 00129/AC00037; Odor and Sulfur bags taken
2	B	D	Uncontrolled	**39**		**107**		**0.039**		Instruments Only	
2	B	D	Alabaster CS1 w/o microbes *Replicate Sulfur Bag*	35	10	98	8	0.037	5	PNL-L2B-SFC1	Canister 00531/AC00549; Odor bag taken *Sulfur bag PNL-L2B-SFC1S, Replicate: -SC1SR*
2	B	B	Uncontrolled	**40**		**111**		**0.041**		PNL-L2B-SFU	Canister 01373/SC00413; Odor and Sulfur bags taken
2	B	B	Rusmar Foam	1.7	96	1.0	99	0.004	90	PNL-L2B-SFC2	Canister 01168/AC00161; Odor and Sulfur bags taken
3	A	B	Uncontrolled	**11**		**63**		**0.026**		Instruments Only	
3	A	B	Alabaster CS1 w/o microbes	14	-27	71	-13	0.024	8	PNL-L3A-SFC1	Canister 01233/SC00561; Odor and Sulfur bags taken
3	A	D	Uncontrolled	**14**		**65**		**0.021**		PNL-L3A-SFU	Canister 00157/SC00104; Odor and Sulfur bags taken
3	A	D	Rusmar Foam	2.6	81	25	62	0.002	90	PNL-L3A-SFC2	Canister 01547/SC00491; Odor and Sulfur bags taken
3	B	B	Uncontrolled	**76**		**91**		**0.006**		PNL-L3B-SFU	Canister 01180/SC00333; Odor and Sulfur bags taken
3	B	B	Alabaster CS1 w/o microbes	31	59	94	-3	0.006	0	PNL-L3B-SFC1	Canister 00064/SC00132; Odor and Sulfur bags taken
3	B	D	Uncontrolled	**58**		**92**		**0.009**		Instruments Only	
3	B	D	Rusmar Foam	2.9	95	-0.4	100	0.002	78	PNL-L3B-SFC2	Canister 00323/SC00068; Odor and Sulfur bags taken
4	A	B	Uncontrolled	**9**		**39**		**0.007**		Instruments Only	
4	A	B	Alabaster CS1 w/o microbes	11	-22	48	-23	0.005	29	PNL-L4A-SFC1	Canister 00450/SC00534; Odor and Sulfur bags taken
4	A	D	Uncontrolled	**15**		**74**		**0.006**		PNL-L4A-SFU	Canister 00193/SC00045; Odor and Sulfur bags taken
4	A	D	Rusmar Foam	6.3	58	29	61	0.000	100	PNL-L4A-SFC2	Canister, and Odor and Sulfur bags taken
4	B	B	Uncontrolled	**47**		**221**		**0.005**		PNL-L4B-SFU	Canister 01533/SC00477; Odor and Sulfur bags taken
4	B	B	Alabaster CS1 w/o microbes	72	-53	381	-72	0.008	-60	PNL-L4B-SFC1	Canister 00382/SC00118; Odor and Sulfur bags taken
4	B	D	Uncontrolled	41		215		0.004		Instruments Only	
4	B	D	Rusmar Foam	1.8	96	1.7	99	0.000	100	PNL-L4B-SFC2	Canister 00497/SC00086; Odor and Sulfur bags taken
5	A	B	Uncontrolled	**7**		**51**		**0.001**		Instruments Only	
5	A	B	Alabaster CS1 w/o microbes	122	-1643	96	-88	0.000	100	PNL-L5A-SFC1	Canister 00401/SC00408; Odor and Sulfur bags taken
5	A	B	Retest Uncontrolled	40		34		0.000		Instruments Only	
5	A	D	Uncontrolled	**9**		**56**		**0.000**		PNL-L5A-SFU	Canister 00296/SC00140; Odor and Sulfur bags taken
5	A	D	Rusmar Foam	12	-33	-0.23	100	0.000	--	PNL-L5A-SFC2	Canister 00126/SC00180; Odor and Sulfur bags taken
5	B	B	Uncontrolled	**9**		**34**		**0.750**		Instruments Only	
5	B	B	Alabaster CS1 w/o microbes	27	-200	63	-85	0.250	67	PNL-L5B-SFC1	Canister 00591/SC00061; Odor and Sulfur bags taken
5	B	D	Uncontrolled	**18**		**58**		**0.640**		PNL-L5B-SFU	Canister 00286/SC00571; Odor and Sulfur bags taken
5	B	D	Rusmar Foam	8	56	43	26	0.080	88	PNL-L5B-SFC2	Canister 00260/SC00172; Odor and Sulfur bags taken
--	--	B	*Sulfur Bag Blank*		*Taken before 3A uncontrolled*					*PNL-L200-SFUS*	*Taken through sample line*
--	--	B	*Odor Bag Blank*		*Taken before 3A uncontrolled*					*PNL-L200-SFU*	*Taken through sample line*

* Odor bags have the same sample ID numbers as the canisters. Sulfur bags have the same number with an "S" suffix (e.g. -SFUS or -SFC1S).

Table 10. Summary of Phase IV Lagoon Waste Emission Control Agent Testing.

COMPOUNDS	Method	Blank	Blank	QC	PNL-L1A	PNL-L1A	PNL-L1A	PNL-L1A	PNL-L1A	PNL-L1A	PNL-L1A	PNL-L1A	PNL-L1B	PNL-L1B	PNL-L1B	PNL-L1B	PNL-L1B	PNL-L1B	PNL-L1B	PNL-L1B	PNL-L2A
	Blank	PNL-L1A	PNL-L5	Blank MDL	SFU	SFU	SFU-D	SFU-D	SFC1	SFC1	SFC2	SFC2	SFU	SFU	SFU-R	SFU-R	SFC1	SFC1	SFC2	SFC2	SFU
	Lab	SF-300	100-SFU	Reference	Uncontr	Uncontr	Lab Dupl	Lab Dupl	Alabastr	Alabastr	Rusmar	Rusmar	Uncontr	Uncontr	Repl	Repl	Alabastr	Alabastr	Rusmar	Rusmar	Uncontr
	(ppmv)	(ppmv)	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)
Methane	<0.83	<0.56	<0.60	<20	30	**739**	30	**739**	23	**567**	4.6	**113**	38	**936**	30	**739**	26	**641**	ND		52
C2 as Ethane	<0.83	<0.56	<0.60	<38	ND		ND		ND		ND		ND		ND		ND		ND		ND
C3 as Propane	<0.83	<0.56	<0.60	<56	ND		ND		ND		ND		ND		ND		ND		ND		ND
C4 as n-Butane	<0.83	<0.56	<0.60	<74	ND		ND		ND		ND		ND		ND		ND		ND		ND
C5 as n-Pentane	<0.83	<0.56	<0.60	<92	ND		ND		ND		ND		ND		ND		ND		ND		2.2
C6 as n-Hexane	<0.83	<0.56	<0.60	<110	ND		ND		ND		ND		ND		ND		ND		ND		5.8
C6+ as n-Hexane	<1.7	<1.1	<1.2	<225	27	**3,576**	28	**3,708**	15	**1,987**	ND		31	**4,106**	28	**3,708**	31	**4,106**	ND		210
	(ug/m3)	(ug/m3)	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)
Chloroform	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
Vinyl Chloride	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
1,3-Butadiene	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
Bromomethane	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
Chloroethane	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
Acetone	<5.0	<5.7	<6.1	<0.23	ND		N/A		80	**3.1**	17	**0.65**	190	**7.3**	170	**6.5**	270	**10**	25	**0.96**	ND
Trichlorofluoromethane	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
Acrylonitrile	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
1,1-Dichloroethene	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
Methylene Chloride	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
Trichlorotrifluoroethane	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
Carbon Disulfide	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		2.7	**0.10**	6.4	**0.25**	ND		9.6	**0.37**	1.5	**0.058**	ND
t-1,2-Dichloroethene	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		1.4	**0.054**	ND		ND		ND		ND		ND
1,1-Dichloroethane	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
Methyl tert butyl ether	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
Vinyl Acetate	<0.50	1.2	<0.61	**0.046**	ND		N/A		ND		ND		ND		ND		ND		1.5	**0.058**	ND
2-Butanone	<0.50	0.72	<0.61	**0.20**	13	**0.50**	N/A		17	**0.65**	2.1	**0.081**	46	**1.8**	48	**1.8**	57	**2.2**	2.3	**0.089**	73
c-1,2-Dichloroethene	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
Chloroform	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		2.7	**0.10**	ND		ND		ND		9.3	**0.36**	ND
1,2-Dichloroethane	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
1,1,1-Trichloroethane	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
Benzene	<0.50	<0.57	<0.61	<0.023	720	**28**	N/A		410	**16**	140	**5.4**	130	**5.0**	110	**4.2**	79	**3.0**	2.5	**0.096**	950
Carbon Tetrachloride	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
1,2-Dichloropropane	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
Bromodichloromethane	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		1.8	**0.069**	ND
Trichloroethene	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
c-1,3-Dichloropropene	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
4-Methyl-2-Pentanone	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
t-1,3-Dichloropropene	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
1,1,2-Trichloroethane	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
Toluene	<0.50	<0.57	<0.61	<0.023	30	**1.2**	N/A		20	**0.77**	7.4	**0.28**	60	**2.3**	59	**2.3**	47	**1.8**	2.4	**0.092**	3800
2-Hexanone	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		2.7	**0.10**	ND		ND		ND		1.2	**0.046**	ND
Dibromochloromethane	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		1.5	**0.058**	ND
1,2-Dichloroethane	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
Tetrachloroethene	<0.50	<0.57	2.9	**0.11**	ND		N/A		ND		ND		ND		ND		ND		ND		ND
Chlorobenzene	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
Ethylbenzene	<0.50	<0.57	<0.61	<0.023	1,000	**39**	N/A		710	**27**	220	**8.5**	470	**18**	450	**17**	360	**14**	8.7	**0.33**	1,800
m/p-Xylene	<1.0	<1.1	<1.2	<0.046	51	**2.0**	N/A		30	**1.2**	11	**0.42**	90	**3.5**	90	**3.5**	93	**3.6**	4.2	**0.16**	4,400
Bromoform	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
Styrene	<0.50	<0.57	<0.61	<0.023	9.7		N/A		ND		2.8	**0.11**	ND		ND		ND		ND		53
o-Xylene	<0.50	<0.57	<0.61	<0.023	37	**1.4**	N/A		20	**0.77**	6	**0.22**	47	**1.8**	46	**1.8**	43	**1.7**	1.3	**0.050**	2,700
1,1,2,2-Tetrachloroethane	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
1,3-Dichlorobenzene	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		ND		ND		ND		ND		ND		ND
1,4-Dichlorobenzene	<0.50	<0.57	<0.61	<0.023	ND		N/A		ND		0.91	**0.035**	ND		ND		ND		ND		ND
1,2-Dichlorobenzene	<0.50	<0.57	<0.61	<0.023	7.1	**0.27**	N/A		ND		1.2	**0.046**	8.5	**0.33**	8.5	**0.33**	7.8	**0.30**	ND		ND

Note- Flux data shown in **Bold**
Surface Flux (ug/m2,min-1) = (ug/m3)(0.005 m3/min)/(0.13 m2) or (ug/m3)(0.0385)
Conversion from ppmv to ug/m3; example; propane- (44 mol wt/25 ideal gas law constant)(ppmv)(1000 ug/1mg)
SFU- Surface flux (test) on Uncontrolled waste
C- Control agent test
Emission Control Agents: Alabaster CS1, Rusmar

Table 10. Summary of Phase IV Lagoon Waste Emission Control Agent Testing.

COMPOUNDS	PNL-L2A	PNL-L2A	PNL-L2A	PNL-L2A	PNL-L2A	PNL-L2B	PNL-L2B	PNL-L2B	PNL-L2B	PNL-L2B	PNL-L2B	PNL-L2B	PNL-L2B	PNL-L3A	PNL-L3A	PNL-L3A	PNL-L3A	PNL-L3A	PNL-L3A	PNL-L3B	PNL-L3B	PNL-L3B
	SFU	SFC1	SFC1	SF-C2	SF-C2	SFU	SFU	SFU-D	SFU-D	SFC1	SFC1	SFC2	SFC2	SFU	SFU	SFC1	SFC1	SFC2	SFC2	SFU	SFU	SFC1
	Uncontr	Alabastr	Alabastr	Rusmar	Rusmar	Uncontr	Uncontr	Lab Dupl	Lab Dupl	Alabastr	Alabastr	Rusmar	Rusmar	Uncontr	Uncontr	Alabastr	Alabastr	Rusmar	Rusmar	Uncontr	Uncontr	Alabastr
	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)
Methane	1,281	8.9	219	0.98	24	46	1,133	N/A		34	838	ND		34	838	42	1,035	29	715	34	838	31
C2 as Ethane		ND		ND		ND		N/A		ND		ND		ND		ND		ND		ND		ND
C3 as Propane		ND		ND		ND		N/A		ND		ND		ND		ND		ND		ND		ND
C4 as n-Butane		ND		ND		ND		N/A		ND		ND		ND		ND		ND		ND		ND
C5 as n-Pentane	244	ND		ND		ND		N/A		ND		ND		ND		ND		ND		ND		ND
C6 as n-Hexane	768	ND		ND		0.7	93	N/A		ND		ND		ND		ND		ND		ND		ND
C6+ as n-Hexane	27,812	49	6,490	1.7	225	34	4,503	N/A		33	4,371	ND		9.4	1,245	22	2,914	4.0	530	22	2,914	24
	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)
Chloroform		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Vinyl Chloride		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1,3-Butadiene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Bromomethane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Chloroethane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Acetone		95	3.7	33	1.3	140	5.4	140	5.4	120	4.6	22	0.85	120	4.6	210	8.1	17	0.65	ND		68
Trichlorofluoromethane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Acrylonitrile		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1,1-Dichloroethene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Methylene Chloride		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Trichlorotrifluoroethane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Carbon Disulfide		ND		2.5	0.10	12	0.46	13	0.50	ND		8.0	0.31	29	1.1	7.1	0.27	22	0.85	ND		18
t-1,2-Dichloroethene		ND		ND		ND		ND		ND		0.72	0.028	8.2	0.32	8.6	0.33	1.9	0.073	ND		ND
1,1-Dichloroethane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Methyl tert butyl ether		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Vinyl Acetate		ND		3.8	0.15	ND		ND		ND		4.4	0.17	ND		ND		ND		ND		ND
2-Butanone	2.8	22	0.85	2.8	0.11	27	1.0	27	1.0	30	1.2	2.2	0.08	29	1.1	52	2.0	2	0.077	ND		23
c-1,2-Dichloroethene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Chloroform		ND		2.4	0.092	ND		ND		ND		23	0.89	ND		ND		1.3	0.050	ND		ND
1,2-Dichloroethane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1,1,1-Trichloroethane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Benzene	37	150	5.8	45	1.7	410	16	420	16	290	11	52	2.0	200	7.7	200	7.7	38	1.5	140	5.4	170
Carbon Tetrachloride		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1,2-Dichloropropane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Bromodichloromethane		ND		ND		ND		ND		ND		4.0	0.15	ND		ND		ND		ND		ND
Trichloroethene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
c-1,3-Dichloropropene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
4-Methyl-2-Pentanone		ND		ND		7.1	0.27	7.1	0.27	ND		ND		5.5	0.21	12	0.46	ND		ND		ND
t-1,3-Dichloropropene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1,1,2-Trichloroethane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Toluene	146	610	23	180	6.9	240	9.2	240	9.2	70	2.7	33	1.3	29	1.1	26	1.0	6	0.23	200	7.7	200
2-Hexanone		ND		1.1	0.042	ND		ND		ND		1.4	0.054	ND		ND		ND		ND		ND
Dibromochloromethane		ND		ND		ND		ND		ND		2.7	0.10	ND		ND		ND		ND		ND
1,2-Dichloroethane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Tetrachloroethene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Chlorobenzene		ND		0.95	0.037	ND		ND		ND		0.74	0.028	ND		ND		ND		ND		ND
Ethylbenzene	69	350	13	64	2.5	530	20.4	520	20.0	520	20	67	2.6	260	10	260	10	46	1.8	650	25	660
m/p-Xylene	169	830	32	140	5.4	450	17	450	17	150	5.8	47	1.8	78	3.0	72	2.8	14	0.54	620	24	550
Bromoform		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Styrene	2.0	11	0.42	3.0	0.12	ND		ND		ND		ND		ND		39000	1502	ND		ND		8.6
o-Xylene	104	500	19	73	2.8	200	7.7	200	7.7	65	2.5	15	0.58	54	2.1	61	2.3	7.8	0.30	390	15	340
1,1,2,2-Tetrachloroethane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1,3-Dichlorobenzene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1,4-Dichlorobenzene		ND		0.76	0.029	ND		ND		ND		ND		ND		ND		ND		ND		ND
1,2-Dichlorobenzene		7.4	0.28	1.0	0.039	6.1	0.23	6.1	0.23	ND		ND		ND		3.2	0.12	ND		ND		ND

Table 10. Summary of Phase IV Lagoon Waste Emission Control Agent Testing.

COMPOUNDS	**PNL-L3B**	**PNL-L3B**	**PNL-L3B**	**PNL-L4A**	**PNL-L4A**	**PNL-L4A**	**PNL-L4A**	**PNL-L4A**	**PNL-L4A**	**PNL-L4B**	**PNL-L4B**	**PNL-L4B**	**PNL-L4B**	**PNL-L4B**	**PNL-L4B**	**PNL-L5A**	**PNL-L5A**	**PNL-L5A**	**PNL-L5A**	**PNL-L5A**	**PNL-L5A**	**PNL-L5B**
	SFC1	**SFC2**	**SFC2**	**SFU**	**SFU**	**SFC1**	**SFC1**	**SFC2**	**SFC2**	**SFU**	**SFU**	**SFC1**	**SFC1**	**SFC2**	**SFC2**	**SFU**	**SFU**	**SFC1**	**SFC1**	**SFC2**	**SFC2**	**SFU**
	Alabastr	**Rusmar**	**Rusmar**	**Uncontr**	**Uncontr**	**Alabastr**	**Alabastr**	**Rusmar**	**Rusmar**	**Uncontr**	**Uncontr**	**Alabastr**	**Alabastr**	**Rusmar**	**Rusmar**	**Uncontr**	**Uncontr**	**Alabastr**	**Alabastr**	**Rusmar**	**Rusmar**	**Uncontr**
	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)
Methane	**764**	ND		20	**493**	9.2	**227**	9.0	**222**	23	**567**	52	**1,281**	0.71	**17**	23	**567**	22	**542**	0.84	**21**	32
C2 as Ethane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C3 as Propane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C4 as n-Butane		ND		ND		ND		ND		ND		0.89	**79**	ND		ND		ND		ND		ND
C5 as n-Pentane		ND		ND		ND		ND		ND		1.6	**177**	ND		ND		ND		ND		ND
C6 as n-Hexane		ND		ND		ND		ND		1.2	**159**	3.3	**437**	ND		ND		ND		ND		ND
C6+ as n-Hexane	**3,179**	ND		19	**2,516**	17	**2,251**	4.6	**609**	68	**9,006**	130	**17,217**	ND		18	**2,384**	16	**2,119**	ND		12
	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)
Chloroform		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Vinyl Chloride		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1,3-Butadiene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Bromomethane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Chloroethane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Acetone		11	**0.42**	160	**6.2**	ND		ND		ND		ND		66	**2.5**	ND		ND		21	**0.81**	ND
Trichlorofluoromethane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Acrylonitrile		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1,1-Dichloroethene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Methylene Chloride		ND		ND		ND		ND		35	**1.3**	ND		0.71	**0.027**	ND		ND		ND		ND
Trichlorotrifluoroethane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Carbon Disulfide		9.6	**0.37**	ND		ND		11	**0.42**	ND		ND		85	**3.3**	ND		ND		5.2	**0.20**	27
t-1,2-Dichloroethene		1.2	**0.046**	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1,1-Dichloroethane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Methyl tert butyl ether		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Vinyl Acetate		ND		ND		ND		ND		ND		ND		28	**1.1**	ND		ND		ND		ND
2-Butanone		0.74	**0.028**	32	**1.2**	ND		ND		ND		ND		10	**0.39**	ND		21	**0.81**	1.6	**0.062**	9.2
c-1,2-Dichloroethene		1	**0.039**	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Chloroform		2.1	**0.081**	ND		ND		ND		ND		ND		3.3	**0.13**	ND		ND		4.6	**0.18**	ND
1,2-Dichloroethane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1,1,1-Trichloroethane		ND		ND		ND		ND		ND		ND		1.1	**0.042**	ND		ND		ND		ND
Benzene	**7**	38	**1.5**	130	**5.0**	43	**1.7**	43	**1.7**	320	**12**	660	**25**	73	**2.8**	ND		22	**0.85**	3.9	**0.15**	ND
Carbon Tetrachloride		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1,2-Dichloropropane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Bromodichloromethane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Trichloroethene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
c-1,3-Dichloropropene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
4-Methyl-2-Pentanone		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
t-1,3-Dichloropropene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1,1,2-Trichloroethane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Toluene	**8**	52	**2.0**	41	**1.6**	ND		16	**0.62**	180	**6.9**	360	**13.9**	29	**1.1**	ND		ND		3.5	**0.13**	12
2-Hexanone		0.74	**0.028**	ND		ND		ND		ND		ND		ND		ND		ND		0.97	**0.037**	ND
Dibromochloromethane		0.61	**0.023**	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1,2-Dichloroethane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Tetrachloroethene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Chlorobenzene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Ethylbenzene	**25**	100	**3.9**	400	**15**	220	**8.5**	150	**5.8**	870	**33**	1600	**62**	120	**4.6**	150	**5.8**	200	**7.7**	30	**1.2**	400
m/p-Xylene	**21**	88	**3.4**	320	**12**	180	**6.9**	110	**4.2**	1400	**54**	2700	**104**	180	**6.9**	310	**12**	400	**15**	49	**1.9**	ND
Bromoform		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Styrene		2.5	**0.10**	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
o-Xylene	**13**	45	**1.7**	150	**5.8**	85	**3.3**	49	**1.9**	300	**12**	650	**25**	38	**1.5**	160	**6.2**	210	**8.1**	20	**0.77**	11
1,1,2,2-Tetrachloroethane		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1,3-Dichlorobenzene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1,4-Dichlorobenzene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1,2-Dichlorobenzene		ND		ND		ND		ND		ND		ND		1.5	**0.058**	ND		ND		ND		ND

Table 10. Summary of Phase IV Lagoon Waste Emission Control Agent Testing.

COMPOUNDS	PNL-L5B	PNL-L5B	PNL-L5B	PNL-L5B	PNL-L5B
	SFU	SFC1	SFC1	SFC2	SFC2
	Uncontr	Alabastr	Alabastr	Rusmar	Rusmar
	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1
Methane	**788**	26	**641**	23	**567**
C2 as Ethane		ND		ND	
C3 as Propane		ND		ND	
C4 as n-Butane		ND		ND	
C5 as n-Pentane		ND		ND	
C6 as n-Hexane		ND		ND	
C6+ as n-Hexane	**1,589**	18	**2,384**	5.0	**662**
	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1
Chloroform		ND		ND	
Vinyl Chloride		ND		ND	
1,3-Butadiene		ND		ND	
Bromomethane		ND		ND	
Chloroethane		ND		ND	
Acetone		ND		52	**2.0**
Trichlorofluoromethane		ND		ND	
Acrylonitrile		ND		10	**0.39**
1,1-Dichloroethene		ND		ND	
Methylene Chloride		ND		ND	
Trichlorotrifluoroethane		ND		ND	
Carbon Disulfide	**1.0**	7.8	**0.30**	8.6	**0.33**
t-1,2-Dichloroethene		ND		ND	
1,1-Dichloroethane		ND		ND	
Methyl tert butyl ether		ND		ND	
Vinyl Acetate		ND		ND	
2-Butanone	**0.35**	7.6	**0.29**	5.5	**0.21**
c-1,2-Dichloroethene		ND		ND	
Chloroform		ND		ND	
1,2-Dichloroethane		ND		ND	
1,1,1-Trichloroethane		ND		ND	
Benzene		6.1	**0.23**	23	**0.89**
Carbon Tetrachloride		ND		ND	
1,2-Dichloropropane		ND		ND	
Bromodichloromethane		ND		ND	
Trichloroethene		ND		ND	
c-1,3-Dichloropropene		ND		ND	
4-Methyl-2-Pentanone		ND		ND	
t-1,3-Dichloropropene		ND		ND	
1,1,2-Trichloroethane		ND		ND	
Toluene	**0.46**	8.4	**0.32**	59	**2.3**
2-Hexanone		ND		ND	
Dibromochloromethane		ND		ND	
1,2-Dichloroethane		ND		ND	
Tetrachloroethene		ND		ND	
Chlorobenzene		ND		ND	
Ethylbenzene	**15**	440	**17**	230	**8.9**
m/p-Xylene		24	**0.92**	25	**0.96**
Bromoform		ND		ND	
Styrene		ND		200	
o-Xylene	**0.42**	7.3	**0.28**	7.7	**0.30**
1,1,2,2-Tetrachloroethane		ND		ND	
1,3-Dichlorobenzene		ND		ND	
1,4-Dichlorobenzene		ND		ND	
1,2-Dichlorobenzene		7.7	**0.30**	3.3	**0.13**

Table 11. Summary of Phase IV, Lagoon Waste Emission Control Agent Testing.

COMPOUNDS	**Method**		**Blank**		**QC**	**PNL-L1A**	**PNL-L1A**	**PNL-L1A**	**PNL-L1A**	**PNL-L1A**	**PNL-L1A**	**PNL-L1B**	**PNL-L1B**	**PNL-L1B**	**PNL-L1B**	**PNL-L1B**	**PNL-L1B**	**PNL-L2A**	**PNL-L2A**
	Blank		**PNL-L200**		**Blank MDL**	**SFU**	**SFU**	**SFC1**	**SFC1**	**SFC2**	**SFC2**	**SFU**	**SFU**	**SFC1**	**SFC1**	**SFC2**	**SFC2**	**SFU**	**SFU**
	Lab		**SFUS**		**Reference**	**Uncontr**	**Uncontr**	**Alabastr**	**Alabastr**	**Rusmar**	**Rusmar**	**Uncontr**	**Uncontr**	**Alabastr**	**Alabastr**	**Rusmar**	**Rusmar**	**Uncontr**	**Uncontr**
	(ug/m3)		(ug/m3)		ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1
Hydrogen Sulfide	<7.0	<	7	<	0.27	4.8	**0.18**	9.4	**0.36**	ND		51	**2.0**	40	**1.5**	4.8	**0.18**	29	**1.1**
Carbonyl Sulfide	<12	<	12	<	0.46	ND		ND	ND	ND		23	**0.89**	31	**1.2**	14	**0.54**	35	**1.3**
Methyl Mercaptan	<9.8	<	9.8	<	0.38	ND		ND	ND	ND		ND		ND		ND		ND	
Ethyl Mercaptan	<13	<	13	<	0.50	ND		ND	ND	ND		ND		ND		ND		ND	
Dimethyl Sulfide	<13	<	13	<	0.50	ND		ND	ND	ND		ND		ND		ND		ND	
Carbon Disulfide	<7.8	<	7.8	<	0.30	11	**0.42**	8.0	**0.31**	17	**0.65**	18	**0.69**	21	**0.81**	21	**0.81**	30	**1.2**
Isopropyl Mercaptan	<16	<	16	<	0.62	ND		ND	ND	ND		ND		ND		ND		ND	
tert-Butyl Mercaptan	<18	<	18	<	0.69	ND		ND	ND	ND		ND		ND		ND		ND	
n-Propyl Mercaptan	<16	<	16	<	0.62	ND		ND	ND	ND		ND		ND		ND		ND	
Ethyl Methyl Sulfide	<16	<	16	<	0.62	ND		ND	ND	ND		ND		ND		ND		ND	
Thiophene	<17	<	17	<	0.65	ND		ND	ND	ND		ND		ND		ND		17	**0.65**
Isobutyl Mercaptan	<18	<	18	<	0.69	ND		ND	ND	ND		ND		ND		ND		ND	
Diethyl Sulfide	<18	<	18	<	0.69	ND		ND	ND	ND		ND		ND		ND		ND	
n-Butyl Mercaptan	<18	<	18	<	0.69	ND		ND	ND	ND		ND		ND		ND		ND	
Dimethyl Disulfide	<9.6	<	9.6	<	0.37	ND		ND	ND	ND		ND		ND		ND		ND	
3-Methylthiophene	<20	<	20	<	0.77	ND		ND	ND	ND		ND		ND		ND		35	**1.3**
Tetrahydrothiophene	<18	<	18	<	0.69	ND		ND	ND	ND		ND		ND		ND		ND	
2,5-Dimethylthiophene	<23	<	23	<	0.89	ND		ND	ND	ND		ND		ND		ND		ND	
2-Ethylthiophene	<23	<	23	<	0.89	ND		ND	ND	ND		ND		ND		ND		ND	
Diethyl Disulfide	<12	<	12	<	0.46	ND		ND	ND	ND		ND		ND		ND		ND	

Note- Flux data shown in **Bold**
Surface Flux (ug/m2,min-1) = (ug/m3)(0.005 m3/min)/(0.13 m2) or (ug/m3)(0.0385)
SFU- Surface flux (test) on Uncontrolled waste
C- Control agent test
S- Sulfur Sample
Emission Control Agents: Alabaster CS1, Rusmar

Table 11. Summary of Phase IV, Lagoon Waste Emission Control Agent Testing.

COMPOUNDS	**PNL-L2A**	**PNL-L2A**	**PNL-L2A**	**PNL-L2A**	**PNL-L2B**	**PNL-L2B**	**PNL-L2B**	**PNL-L2B**	**PNL-L2B**	**PNL-L2B**	**PNL-L2B**	**PNL-L2B**	**PNL-L3A**	**PNL-L3A**	**PNL-L3A**	**PNL-L3A**	**PNL-L3A**
	SFC1	**SFC1**	**SF-C2**	**SF-C2**	**SFU**	**SFU**	**SFC1**	**SFC1**	**SFC1S-R**	**SFC1S-R**	**SFC2**	**SFC2**	**SFU**	**SFU**	**SFC1**	**SFC1**	**SFC2**
	Alabastr	**Alabastr**	**Rusmar**	**Rusmar**	**Uncontr**	**Uncontr**	**Alabastr**	**Alabastr**	**Repl**	**Repl**	**Rusmar**	**Rusmar**	**Uncontr**	**Uncontr**	**Alabastr**	**Alabastr**	**Rusmar**
	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)
Hydrogen Sulfide	23	**0.89**	ND		4.1	**0.16**	10	**0.39**	11	**0.42**	4.7	**0.18**	3.4	**0.13**	ND		ND
Carbonyl Sulfide	16	**0.62**	ND		ND		13	**0.50**	16	**0.62**	ND		ND		ND		ND
Methyl Mercaptan	ND		ND		ND		ND		ND		ND		ND		ND		ND
Ethyl Mercaptan	ND		ND		ND		ND		ND		ND		ND		ND		ND
Dimethyl Sulfide	ND		ND		ND		ND		ND		ND		ND		ND		ND
Carbon Disulfide	18	**0.69**	11	**0.42**	18	**0.69**	15	**0.58**	18	**0.69**	22	**0.85**	ND		8.6	**0.33**	8.9
Isopropyl Mercaptan	ND		ND		ND		ND		ND		ND		ND		ND		ND
tert-Butyl Mercaptan	ND		ND		ND		ND		ND		ND		ND		ND		ND
n-Propyl Mercaptan	ND		ND		ND		ND		ND		ND		ND		ND		ND
Ethyl Methyl Sulfide	ND		ND		ND		ND		ND		ND		ND		ND		ND
Thiophene	ND		ND		ND		ND		ND		ND		ND		ND		ND
Isobutyl Mercaptan	ND		ND		ND		ND		ND		ND		ND		ND		ND
Diethyl Sulfide	ND		ND		ND		ND		ND		ND		ND		ND		ND
n-Butyl Mercaptan	ND		ND		ND		ND		ND		ND		ND		ND		ND
Dimethyl Disulfide	ND		ND		ND		ND		ND		ND		ND		ND		ND
3-Methylthiophene	ND		ND		ND		ND		ND		ND		ND		ND		ND
Tetrahydrothiophene	ND		ND		ND		ND		ND		ND		ND		ND		ND
2,5-Dimethylthiophene	ND		ND		ND		ND		ND		ND		ND		ND		ND
2-Ethylthiophene	ND		ND		ND		ND		ND		ND		ND		ND		ND
Diethyl Disulfide	ND		ND		ND		ND		ND		ND		ND		ND		ND

Table 11. Summary of Phase IV, Lagoon Waste Emission Control Agent Testing.

COMPOUNDS	**PNL-L3A**	**PNL-L3B**	**PNL-L3B**	**PNL-L3B**	**PNL-L3B**	**PNL-L3B**	**PNL-L3B**	**PNL-L4A**	**PNL-L4A**	**PNL-L4A**	**PNL-L4A**	**PNL-L4A**	**PNL-L4A**	**PNL-L4A**	**PNL-L4A**	**PNL-L4B**	**PNL-L4B**
	SFC2	**L3B-SFU**	**L3B-SFU**	**SFC1**	**SFC1**	**SFC2**	**SFC2**	**SFU**	**SFU**	**SFC1**	**SFC1**	**SFC2**	**SFC2**	**SFC2S-D**	**SFC2S-D**	**SFU**	**SFU**
	Rusmar	**Uncontr**	**Uncontr**	**Alabastr**	**Alabastr**	**Rusmar**	**Rusmar**	**Uncontr**	**Uncontr**	**Alabastr**	**Alabastr**	**Rusmar**	**Rusmar**	**Lab Dupl**	**Lab Dupl**	**Uncontr**	**Uncontr**
	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1
Hydrogen Sulfide		6.3	**0.24**	ND		10	**0.39**	11	**0.42**	7.3	**0.28**	12	**0.46**	10	**0.39**	3.8	**0.15**
Carbonyl Sulfide		ND		ND		ND		18	**0.69**	ND		36	**1.4**	36	**1.4**	ND	
Methyl Mercaptan		ND		ND		ND		ND		ND		ND		ND		ND	
Ethyl Mercaptan		ND		ND		ND		ND		ND		ND		ND		ND	
Dimethyl Sulfide		ND		ND		ND		ND		ND		ND		ND		ND	
Carbon Disulfide	**0.34**	11	**0.42**	7.9	**0.30**	ND		16	**0.62**	13	**0.50**	21	**0.81**	22	**0.85**	13	**0.50**
Isopropyl Mercaptan		ND		ND		ND		ND		ND		ND		ND		ND	
tert-Butyl Mercaptan		ND		ND		ND		ND		ND		ND		ND		ND	
n-Propyl Mercaptan		ND		ND		ND		ND		ND		ND		ND		ND	
Ethyl Methyl Sulfide		ND		ND		ND		ND		ND		ND		ND		ND	
Thiophene		ND		ND		ND		ND		ND		ND		ND		ND	
Isobutyl Mercaptan		ND		ND		ND		ND		ND		ND		ND		ND	
Diethyl Sulfide		ND		ND		ND		ND		ND		ND		ND		ND	
n-Butyl Mercaptan		ND		ND		ND		ND		ND		ND		ND		ND	
Dimethyl Disulfide		ND		ND		ND		ND		ND		ND		ND		ND	
3-Methylthiophene		ND		ND		ND		ND		ND		ND		ND		ND	
Tetrahydrothiophene		ND		ND		ND		ND		ND		ND		ND		ND	
2,5-Dimethylthiophene		ND		ND		ND		ND		ND		ND		ND		ND	
2-Ethylthiophene		ND		ND		ND		ND		ND		ND		ND		ND	
Diethyl Disulfide		ND		ND		ND		ND		ND		ND		ND		ND	

Table 11. Summary of Phase IV, Lagoon Waste Emission Control Agent Testing.

COMPOUNDS	PNL-L4B	PNL-L4B	PNL-L4B	PNL-L4B	PNL-L5A	PNL-L5A	PNL-L5A	PNL-L5A	PNL-L5A	PNL-L5A	PNL-L5B	PNL-L5B	PNL-L5B	PNL-L5B	PNL-L5B	PNL-L5B
	SFC1	SFC1	SFC2	SFC2	SFU	SFU	SFC1	SFC1	SFC2	SFC2	SFU	SFU	SFC1	SFC1	SFC2	SFC2
	Alabastr	Alabastr	Rusmar	Rusmar	Uncontr	Uncontr	Alabastr	Alabastr	Rusmar	Rusmar	Uncontr	Uncontr	Alabastr	Alabastr	Rusmar	Rusmar
	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1
Hydrogen Sulfide	ND		3.9	**0.15**	12	**0.46**	6.6	**0.25**	5.4	**0.21**	350	**13**	300	**12**	47	**1.8**
Carbonyl Sulfide	19	**0.73**	15	**0.58**	ND		ND		ND		27	**1.0**	23	**0.89**	25	**1.0**
Methyl Mercaptan	ND		ND		ND		ND		ND		ND		ND		ND	
Ethyl Mercaptan	ND		ND		ND		ND		ND		ND		ND		ND	
Dimethyl Sulfide	ND		ND		ND		ND		ND		ND		ND		ND	
Carbon Disulfide	20	**0.77**	14	**0.54**	11	**0.42**	10	**0.39**	16	**0.62**	8.1	**0.31**	8.8	**0.34**	12	**0.46**
Isopropyl Mercaptan	ND		ND		ND		ND		ND		ND		ND		ND	
tert-Butyl Mercaptan	ND		ND		ND		ND		ND		ND		ND		ND	
n-Propyl Mercaptan	ND		ND		ND		ND		ND		ND		ND		ND	
Ethyl Methyl Sulfide	ND		ND		ND		ND		ND		ND		ND		ND	
Thiophene	ND		ND		ND		ND		ND		ND		ND		ND	
Isobutyl Mercaptan	ND		ND		ND		ND		ND		ND		ND		ND	
Diethyl Sulfide	ND		ND		ND		ND		ND		ND		ND		ND	
n-Butyl Mercaptan	ND		ND		ND		ND		ND		ND		ND		ND	
Dimethyl Disulfide	ND		ND		ND		ND		ND		ND		ND		ND	
3-Methylthiophene	ND		ND		ND		ND		ND		ND		ND		ND	
Tetrahydrothiophene	ND		ND		ND		ND		ND		ND		ND		ND	
2,5-Dimethylthiophene	ND		ND		ND		ND		ND		ND		ND		ND	
2-Ethylthiophene	ND		ND		ND		ND		ND		ND		ND		ND	
Diethyl Disulfide	ND		ND		ND		ND		ND		ND		ND		ND	

Table 12. Summary of Phase VIII Pit F Real Time Agent Control Data.

Area Number	Bore	Flux Chamber	Sample Type	PID ppm	% Control	FID ppm	% Control	H_2S ppm	% Control	Sample Number	Note*
--	**--**	Flux	System Blank	**N/A**	**--**	**N/A**	**--**	**N/A**		SF-BLK	Canister 00300/SCV00391; Odor and Sulfur Bags taken
Pit F	**PNL-F1**	D	Uncontrolled- Sample #1	**64**		**19**		**0.000**	N/A	SF-STY1-U-T	Canister 00339/SC00125; Odor and Sulfur Bags/Reps
Pit F	**Pond**	F	Uncontrolled- Sample #2	**36**		**51**		**0.20**	N/A	SF0STY2-U-T	Canister 01529/SC00473; Odor and Sulfur Bags taken
Pit F	**PNL-F1**	D	Alabaster CS1 w/o microbes	**15**	77%	**26**	-130%	N/A	N/A	SF-STYI-C1-T	Canister 00522/SC00022; Odor and Sulfur Bags taken
Pit F	**Pond**	F	Alabaster CS1 w/o microbes	**43**	33%	**90**	-370%	N/A	N/A	SF-STY2-C1-T	Canister 01518/SC00575; Odor and Sulfur Bags taken
Pit F	**PNL-F1**	D	Rusmar	**7.2**	89%	**14**	26%	**0.000**	100%	SF-STY1-C2-T	Canister 01105/SC00158; Odor and Sulfur Bags taken
Pit F	**Pond**	F	Rusmar	**3.7**	90%	**4.4**	91%	**0.020**	90%	SF-STY2-C2-T	Canister 00528/SC00537; Odor and Sulfur Bags taken

* Odor bags have the same sample ID numbers as the canisters. Sulfur bags have the same number with an "S" suffix

STY- Styrene

Table 13. Summary of Phase VIII, Pit F Waste Emission Control Agent Test
VOC Results.

COMPOUNDS	Method	Blank	Blank	QC	SF-STY1	SF-STY1	SF-STY1	SF-STY1	SF-STY1	SF-STY1	SF-STY1	SF-STY1	SF-STY2	SF-STY2	SF-STY2	SF-STY2	SF-STY2	SF-STY2	SF-STY2	SF-STY2
	Blank	SF-BLK	PNL-F75-1	Blank MDL	U-T	U-T	U-T-D	U-T-D	C1-T	C1-T	C2-T	C2-T	U-T	U-T	U-T-R	U-T-R	C1-T	C1-T	C2-T	C2-T
	Lab	Field	Field	Reference	Uncontr	Uncontr	Lab Dupl	Lab Dupl	Alabastr	Alabastr	Rusmar	Rusmar	Uncontr	Uncontr	Repl	Repl	Alabastr	Alabastr	Rusmar	Rusmar
	(ppmv)	(ppmv)	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1
Methane	<0.5	<0.59	<0.78	<19	**1.3**	**32**	**1.2**	**30**	0.91	**22**	0.75	**18**	1.0	**25**	1.1	**27**	ND		1.5	**37**
C2 as Ethane	<0.5	<0.59	<0.78	<36	ND		ND		ND		ND		ND		ND		ND		ND	
C3 as Propane	<0.5	<0.59	<0.78	<53	ND		ND		ND		ND		ND		ND		ND		ND	
C4 as n-Butane	<0.5	<0.59	<0.78	<70	ND		ND		ND		ND		ND		ND		ND		ND	
C5 as n-Pentane	<0.5	<0.59	<0.78	<86	ND		ND		ND		ND		ND		ND		ND		ND	
C6 as n-Hexane	<0.5	<0.59	<0.78	<103	ND		ND		ND		ND		ND		ND		ND		ND	
C6+ as n-Hexane	1.0	<1.2	<1.6	<212	**6.2**	**821**	**6.8**	**901**	14	**1,854**	4.9	**649**	20	**2,649**	20	**2,649**	5.1	**675**	ND	
	(ug/m3)	(ug/m3)	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1
Chloroform	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
Vinyl Chloride	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
1,3-Butadiene	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
Bromomethane	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
Chloroethane	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
Acetone	<5.0	<6.0	<19	<0.73	ND		NA		300	**12**	150	**5.8**	ND		ND		ND		96	**3.7**
Trichlorofluoromethane	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
Acrylonitrile	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
1,1-Dichloroethene	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
Methylene Chloride	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
Trichlorotrifluoroethane	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
Carbon Disulfide	<0.50	<0.60	<1.9	<0.073	ND		NA		11	**0.42**	ND		920	**35**	730	**28**	1400	**54**	160	**6.2**
t-1,2-Dichloroethene	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
1,1-Dichloroethane	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
Methyl tert butyl ether	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
Vinyl Acetate	<1.0	<1.2	<3.9	<0.15	ND		NA		ND		ND		ND		ND		ND		ND	
2-Butanone	<0.50	<0.60	<1.9	<0.073	ND		NA		14	**0.54**	ND		33	**1.3**	26	**1.0**	67	**2.6**	4.9	**0.19**
c-1,2-Dichloroethene	<0.50	<0.60	<1.9	<0.073	ND		NA		N/A		ND		ND		ND		ND		ND	
Chloroform	<0.50	<0.60	<1.9	<0.073	ND		NA		N/A		ND		ND		ND		ND		3.2	**0.12**
1,2-Dichloroethane	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
1,1,1-Trichloroethane	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
Benzene	<0.50	<0.60	<1.9	<0.073	1,200	**46**	NA		2000	**77**	1700	**65**	ND		ND		ND		2.1	**0.081**
Carbon Tetrachloride	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
1,2-Dichloropropane	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
Bromodichloromethane	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
Trichloroethene	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		170	**6.5**	ND	
c-1,3-Dichloropropene	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
4-Methyl-2-Pentanone	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		0.64	**0.025**
t-1,3-Dichloropropene	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
1,1,2-Trichloroethane	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
Toluene	<0.50	<0.60	<1.9	<0.073	580	**22**	NA		930	**36**	940	**36**	30	**1.2**	24	**0.92**	93	**3.6**	3.2	**0.12**
2-Hexanone	<0.50	<0.60	<1.9	<0.073			NA		ND		ND		ND		ND		ND		1.3	**0.050**
Dibromochloromethane	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
1,2-Dichloroethane	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
Tetrachloroethene	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		13000	**501**	1.3	**0.050**
Chlorobenzene	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		8.3	**0.32**
Ethylbenzene	<0.50	<0.60	<1.9	<0.073	5,200	**200**	NA		9500	**366**	7100	**273**	290	**11**	230	**8.9**	140	**5.4**	8.9	**0.34**
m/p-Xylene	<1.0	<1.2	<3.9	<0.15	ND		NA		22	**0.85**	36	**1.4**	48	**1.8**	39	**1.5**	ND		4.6	**0.18**
Bromoform	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
Styrene	<0.50	<0.60	<1.9	<0.073	89	**3.43**	NA		190	**7.3**	120	**4.62**	12000	**462**	9400	**362**	1400	**53.9**	610	**23**
o-Xylene	<0.50	<0.60	<1.9	<0.073	11	**0.42**	NA		21	**0.81**	23	**0.89**	32	**1.2**	26	**1.0**	ND		3	**0.12**
1,1,2,2-Tetrachloroethane	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		ND	
1,3-Dichlorobenzene	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		1.1	**0.042**
1,4-Dichlorobenzene	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		8	**0.31**
1,2-Dichlorobenzene	<0.50	<0.60	<1.9	<0.073	ND		NA		ND		ND		ND		ND		ND		0.96	**0.037**

Note- Flux data shown in **Bold**
Surface Flux (ug/m2,min-1) = (ug/m3)(0.005 m3/min)/(0.13 m2) or (ug/m3)(0.0385)
Conversion from ppmv to ug/m3; example; propane- (44 mol wt/25 ideal gas law constant)(ppmv)(1000 ug/1mg)
SFU- Surface flux (test) on Uncontrolled waste
C- Control agent test
Emission Control Agents: Alabaster CS1, Rusmar

Table 14. Summary of Phase VIII, Pit F Waste Emission Agent Control Flux Reduced Sulfur Data.

COMPOUNDS	Method		Blank		Blank		QC	SF-STY1	SF-STY1	SF-STY1	SF-STY1	SF-STY1	SF-STY1	SF-STY1	SF-STY1	SF-STY2	SF-STY2	SF-STY2	SF-STY2	SF-STY2	SF-STY2
	Blank		SF-BLK		PNL-F75-1		Blank MDL	U-S	U-S	U-S-R	U-S-R	C1-S	C1-S	C2-S	C2-S	U-S	U-S	C1-S	C1-S	C2-S	C2-S
	Lab						Reference	Uncontr	Uncontr	Repl	Repl	Alabastr	Alabastr	Rusmar	Rusmar	Uncontr	Uncontr	Alabastr	Alabastr	Rusmar	Rusmar
	(ug/m3)		(ug/m3)		(ug/m3)		ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1
Hydrogen Sulfide	<7.0		3.7	<	7.0	<	0.27	18	**0.69**	24	**0.92**	9.9	**0.38**	7.1	**0.27**	300	**12**	2300	**89**	22	**0.85**
Carbonyl Sulfide	<12	<	12		14		**0.54**	19	**0.73**	31	**1.2**	35	**1.3**	37	**1.4**	210	**8.1**	1500	**58**	96	**3.7**
Methyl Mercaptan	<9.8	<	9.8	<	9.8	<	0.38	ND		ND		ND		ND		7.9	**0.30**	30.00	**1.2**	ND	
Ethyl Mercaptan	<13	<	13	<	13	<	0.50	ND		ND		ND		ND		ND		19	**0.73**	ND	
Dimethyl Sulfide	<13	<	13	<	13		0.50	ND		ND		ND		ND		ND		ND		ND	
Carbon Disulfide	<7.8		18		21	<	**0.81**	19	**0.73**	25	**0.96**	42	**1.6**	48	**1.8**	1200	**46**	3900	**150**	430	**17**
Isopropyl Mercaptan	<16	<	16	<	16	<	0.62	ND		ND		ND		ND		ND		ND		ND	
tert-Butyl Mercaptan	<18	<	18	<	18	<	0.69	ND		ND		ND		ND		ND		ND		ND	
n-Propyl Mercaptan	<16	<	16	<	16	<	0.62	ND		ND		ND		ND		ND		ND		ND	
Ethyl Methyl Sulfide	<16	<	16	<	16	<	0.62	ND		ND		ND		ND		ND		ND		ND	
Thiophene	<17	<	17	<	17	<	0.65	ND		ND		ND		ND		ND		ND		ND	
Isobutyl Mercaptan	<18	<	18	<	18	<	0.69	ND		ND		ND		ND		ND		ND		ND	
Diethyl Sulfide	<18	<	18	<	18	<	0.69	12	**0.46**	12	**0.46**	18	**0.69**	18	**0.69**	ND		ND		ND	
n-Butyl Mercaptan	<18	<	18	<	18	<	0.69	ND		ND		ND		ND		ND		ND		ND	
Dimethyl Disulfide	<9.6	<	9.6	<	9.6	<	0.37	ND		ND		ND		ND		24	**0.92**	ND		ND	
3-Methylthiophene	<20	<	20	<	20	<	0.77	ND		ND		ND		ND		ND		ND		ND	
Tetrahydrothiophene	<18	<	18	<	18	<	0.69	21	**0.81**	18	**0.69**	28	**1.1**	15	**0.58**	ND		ND		ND	
2,5-Dimethylthiophene	<23	<	23	<	23	<	0.89	ND		ND		ND		ND		ND		ND		ND	
2-Ethylthiophene	<23	<	23	<	23	<	0.89	ND		ND		ND		ND		ND		ND		ND	
Diethyl Disulfide	<12	<	12	<	12	<	0.46	ND		ND		ND		ND		ND		ND		ND	

Note- Flux data shown in **Bold**
Surface Flux (ug/m2,min-1) = (ug/m3)(0.005 m3/min)/(0.13 m2) or (ug/m3)(0.0385)
SFU- Surface flux (test) on Uncontrolled waste
C- Control agent test
S- Sulfur Sample
Emission Control Agents: Alabaster CS1, Rusmar

Table 15. Summary of Phase VIII, Pit F Downhole Flux Real Time Data and Characteristics.

BORING NUMBER	DEPTH BELOW SURF. ft	FID PEAK ppm	FID AT RES'D NUMBER	FID METHOD STEADY STATE[1] ppm	FID PERCENT of PEAK	PID PEAK ppm	PID AT RES'D NUMBER	PID METHOD STEADY STATE[1] ppm	PID PERCENT of PEAK	SAMPLES: CANISTER SAMPLE #	SAMPLES: CANISTER CAN. #	SAMPLES: ODOR/SULFUR BAG SAMPLE #	COMMENTS
PNL - 1F	8'	235	2	151	**64**	124	2	92	**74**				
	13'	522	1	280	**54**	287	2	155	**65**	PNL-F1-13-T/-TR	6767/6770	PNL-F1-13-O/S	Also sulfur bag replicate (-SR)
PNL - 3F	14'	427	8	395	**110**	154	12	149	**103**				
	17'	2,081	6	810	39	337	6	149	44	PNL-2-15-DHF	6758	PNL-2-15-DHF	
PNL - F4	13.5'	490	7	478	**98**	8.4	13	7	**114**				
	15'	2,518	2	2,276	**90**	230	5	229	**200**	PNL-F4-15-T	6766	PNL-F4-15-O/S	
	16.5	1,510	2	1,460	**97**	215	16	213	**100**				Jerome H2S showed 0.022 ppmv at 5 residence times
	18'	1,776	1	855	**48**	228	7	141	**62**				
PNL - F5	13.5'	>3000	1	179	6	129	1	24	19	PNL-F5-13.5-T	6757	PNL-F5-13.5-O/S	
	15'	850	1	621	**73**	64	1	57	**89**				
PNL - F6	10.5'	154	1	45	29	7.3	1	4.0	**55**				
PNL -F7	10.5'	375	1	120	32	82	1	33	40				
	13.5'	189	4	182	**96**	67	4	65	**97**				
	15'	2,610	4	2,125	**81**	96	4	62	**63**				

[1] Steady State for this Mixed Tank Reactor is at 8 Residence Times

Green	Possible Source based on FID data
Blue	Possible Source based on PID data
Red	Possible Source based on both FID and PID data

Table 16. Summary of Phase VIII, Pit F Downhole Flux VOC Data.

COMPOUNDS	Method	Blank	Blank	QC	PNL-F1	PNL-F1	PNL-F1	PNL-F1	PNL-F4	PNL-F4	PNL-F5	PNL-F5	PNL-F5	PNL-F5	PNL-F19	PNL-F19	PNL-F19	PNL-F19	PNL-F19	PNL-F19	PNL-F19	PNL-F19
	Blank	SF-BLK	PNL-F75-1	Blank MDL	13-T	13-T	13-TR	13-TR	15-T	15-T	13.5-T	13.5-T	13.5-T-D	13.5-T-D	4-T	4-T	4-T-D	4-T-D	10-T	10-T	10-T-D	10-T-D
	(ppmv)	(ppmv)	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1	(ppmv)	ug/m2,min-1
Methane	<0.5	<0.59	<0.78	<156	21	**4,207**	7.8	**1,562**	1,200	**240,384**	59	**11,819**	59	**11,819**	4	**881**	N/A		150	**30,048**	150	**30,048**
C2 as Ethane	<0.5	<0.59	<0.78	<292	ND		ND		ND		ND		ND		ND		N/A		ND		ND	
C3 as Propane	<0.5	<0.59	<0.78	<430	ND		ND		ND		ND		ND		ND		N/A		ND		ND	
C4 as n-Butane	<0.5	<0.59	<0.78	<566	ND		ND		ND		ND		ND		ND		N/A		ND		ND	
C5 as n-Pentane	<0.5	<0.59	<0.78	<703	ND		ND		ND		ND		ND		ND		N/A		ND		ND	
C6 as n-Hexane	<0.5	<0.59	<0.78	<840	ND		ND		ND		ND		ND		ND		N/A		ND		ND	
C6+ as n-Hexane	1.0	<1.2	<1.6	<1,720	86	**92,598**	41	**44,146**	230	**247,646**	22	**23,688**	24	**25,841**	3.3	**3,553**	N/A		37	**39,839**	40	**43,069**
	(ug/m3)	(ug/m3)	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1	(ug/m3)	ug/m2,min-1
Chloroform	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
Vinyl Chloride	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
1,3-Butadiene	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		6.0	**1.9**	6.3	**2.0**	ND		N/A	
Bromomethane	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
Chloroethane	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
Acetone	<5.0	<6.0	<19	<5.9	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
Trichlorofluoromethane	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
Acrylonitrile	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
1,1-Dichloroethene	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
Methylene Chloride	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
Trichlorotrifluoroethane	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
Carbon Disulfide	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		7.3	**2.3**	7.0	**2.2**	ND		N/A	
t-1,2-Dichloroethene	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
1,1-Dichloroethane	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
Methyl tert butyl ether	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
Vinyl Acetate	<1.0	<1.2	<3.9	<1.2	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
2-Butanone	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		4.6	**1.4**	ND		ND		N/A	
c-1,2-Dichloroethene	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
Chloroform	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
1,2-Dichloroethane	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
1,1,1-Trichloroethane	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
Benzene	<0.50	<0.60	<1.9	<0.59	35,000	**10,955**	13,000	**4,069**	15,000	**4,695**	ND		N/A		ND		ND		ND		N/A	
Carbon Tetrachloride	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
1,2-Dichloropropane	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
Bromodichloromethane	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
Trichloroethene	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
c-1,3-Dichloropropene	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
4-Methyl-2-Pentanone	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
t-1,3-Dichloropropene	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
1,1,2-Trichloroethane	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
Toluene	<0.50	<0.60	<1.9	<0.59	9,900	**3,099**	4,000	**1,252**	11,000	**3,443**	ND		N/A		11	**3.4**	11	**3.4**	ND		N/A	
2-Hexanone	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
Dibromochloromethane	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
1,2-Dichloroethane	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
Tetrachloroethene	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
Chlorobenzene	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
Ethylbenzene	<0.50	<0.60	<1.9	<0.59	91,000	**28,483**	45,000	**14,085**	250,000	**78,250**	ND		N/A		800	**250**	790	**247**	3,300	**1,033**	N/A	
m/p-Xylene	<1.0	<1.2	<3.9	<1.2	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
Bromoform	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
Styrene	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		5.1	**1.6**	4.9	**1.5**	ND		N/A	
o-Xylene	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
1,1,2,2-Tetrachloroethane	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
1,3-Dichlorobenzene	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
1,4-Dichlorobenzene	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	
1,2-Dichlorobenzene	<0.50	<0.60	<1.9	<0.59	ND		ND		ND		ND		N/A		ND		ND		ND		N/A	

Note- Flux data shown in **Bold**

DH Flux (ug/m2,min-1) = (ug/m3)(0.001 m3/min)/(0.0032 m2) or (ug/m3)(0.313)

Conversion from ppmv to ug/m3; example; propane- (44 mol wt/25 ideal gas law constant)(ppmv)(1000 ug/1mg)

Table 17. Summary of Phase VIII, Pit F Downhole Flux Reduced Sulfur Compound Data.

COMPOUNDS	Method Blank Lab (ug/m3)		Blank SF-BLK (ug/m3)		Blank PNL-F75-1 (ug/m3)		QC Blank MDL Reference ug/m2,min-1	PNL-F1 13-S (ug/m3)	PNL-F1 13-S ug/m2,min-1	PNL-F1 13-S-R Repl (ug/m3)	PNL-F1 13-S-R Repl ug/m2,min-1	PNL-F4 15-S (ug/m3)	PNL-F4 15-S ug/m2,min-1	PNL-F5 13.5-S (ug/m3)	PNL-F5 13.5-S ug/m2,min-1	PNL-F19 4-S (ug/m3)	PNL-F19 4-S ug/m2,min-1	PNL-F19 10-S (ug/m3)	PNL-F19 10-S ug/m2,min-1
Hydrogen Sulfide	<7.0		3.7	<	7.0	<	2.2	9.6	**3.0**	14	**4.4**	21	**6.6**	10	**3.1**	2.9	**0.91**	5.0	**1.6**
Carbonyl Sulfide	<12	<	12		14		**4.4**	340	**106**	300	**94**	360	**113**	82	**25.7**	19	**5.9**	76	**24**
Methyl Mercaptan	<9.8	<	9.8	<	9.8	<	3.1	ND		ND		ND		ND		ND		ND	
Ethyl Mercaptan	<13	<	13	<	13	<	4.1	ND		ND		8.4	**2.6**	ND		ND		ND	
Dimethyl Sulfide	<13	<	13	<	13		4.1	24	**7.5**	21	**6.6**	17	**5.3**	ND		ND		ND	
Carbon Disulfide	<7.8		18		21	<	**6.6**	450	**141**	400	**125**	74	**23**	14	**4.4**	46	**14**	27	**8.5**
Isopropyl Mercaptan	<16	<	16	<	16	<	5.0	ND		ND		ND		ND		ND		ND	
tert-Butyl Mercaptan	<18	<	18	<	18	<	5.6	43	**13**	33	**10**	54	**17**	ND		ND		ND	
n-Propyl Mercaptan	<16	<	16	<	16	<	5.0	ND		ND		ND		ND		ND		ND	
Ethyl Methyl Sulfide	<16	<	16	<	16	<	5.0	ND		ND		13	**4.1**	ND		ND		ND	
Thiophene	<17	<	17	<	17	<	5.3	43	**13**	36	**11**	32	**10**	ND		ND		ND	
Isobutyl Mercaptan	<18	<	18	<	18	<	5.6	ND		ND		ND		ND		ND		ND	
Diethyl Sulfide	<18	<	18	<	18	<	5.6	750	**235**	650	**203**	100	**31**	ND		ND		ND	
n-Butyl Mercaptan	<18	<	18	<	18	<	5.6	ND		ND		ND		ND		ND		ND	
Dimethyl Disulfide	<9.6	<	9.6	<	9.6	<	3.0	ND		ND		ND		ND		ND		ND	
3-Methylthiophene	<20	<	20	<	20	<	6.3	ND		ND		ND		ND		ND		ND	
Tetrahydrothiophene	<18	<	18	<	18	<	5.6	273	**85**	250	**78**	48	**15**	ND		ND		ND	
2,5-Dimethylthiophene	<23	<	23	<	23	<	7.2	ND		ND		ND		ND		ND		ND	
2-Ethylthiophene	<23	<	23	<	23	<	7.2	ND		ND		ND		ND		ND		ND	
Diethyl Disulfide	<12	<	12	<	12	<	3.8	ND		ND		ND		ND		ND		ND	

Note- Flux data shown in **Bold**

Surface Flux (ug/m2,min-1) = (ug/m3)(0.005 m3/min)/(0.13 m2) or (ug/m3)(0.0385)

DH Flux (ug/m2,min-1) = (ug/m3)(0.001 m3/min)/(0.0032 m2) or (ug/m3)(0.313)

Table 18. Summary of Odor Flux Data for Phases I, II, IV and VIII Including Percent Odor Control Efficiency for Control Agents.

SAMPLE ID	DATE	D/T	ODOR FLUX	CONTROL AGENT	PERCENT
			(D/T)/m2,min-1		CONTROL
Phase I DHF Borings					
PNL-1-15DHF	5/3/2004	2,958	926	N/A	N/A
PNL-2-15DHF	3/15/2004	11	3.4	N/A	N/A
PNL-3-21DHF	3/16/2004	8,313	2602	N/A	N/A
PNL-5a-11DHF	3/16/2004	41	13	N/A	N/A
PNL-6-15DHF	5/5/2004	275	86	N/A	N/A
PNL-7-B-DHF (Blank)	5/3/2004	7	2.2	N/A	N/A
PNL-7-21DHF	5/3/2004	4,539	1421	N/A	N/A
PNL-7-21RDHF	5/3/2004	4,949	1549	N/A	N/A
PNL-8-18DHF	5/5/2004	4,539	1421	N/A	N/A
PNL-9-15-DHF	5/5/2004	4,602	1440	N/A	N/A
PNL-9-15-RDHF	5/5/2004	5,018	1571	N/A	N/A
PNL-10A-13-DHF (ID as "B")	5/4/2004	1,274	399	N/A	N/A
PNL-11-12DHF	5/4/2004	385	121	N/A	N/A
PNL-12-100DHF (Blank)	3/15/2004	9	2.8	N/A	N/A
PNL-12-21DHF	3/15/2004	1,166	365	N/A	N/A
PNL-13-12DHF	3/15/2004	2,295	718	N/A	N/A
PNL-14-21DHF	5/3/2004	25,250	7903	N/A	N/A
PNL-15-100DHF (Blank)	3/15/2004	8	2.5	N/A	N/A
PNL-15-12DHF	3/15/2004	385	121	N/A	N/A
Bucket Auger/Emission Control					
PNL-BA1-17SFU	5/10/2004	163	6.3	N/A	N/A
PNL-BA1-17-SFC1	5/13/2004	25	1.0	Rusmar	85%
PNL-BA3-100-SFC (Blank)	5/13/2004	5	0.19	N/A	N/A
PNL-BA3-X-SFU	5/13/2004	193	7.4	N/A	N/A
PNL-BA3-X-SFC	5/13/2004	126	4.9	Rusmar (not identified)	35%
PNL-BA6-X-SFU	5/14/2004	106	4.1	N/A	N/A
PNL-BA6-X-SFC	5/14/2004	23	0.89	Rusmar	78%
PNL-BA7-X-SFU	5/14/2004	89	3.4	N/A	N/A
PNL-BA7-X-SFC	5/14/2004	49	1.9	Rusmar	45%
PNL-BA8-17-SFU	5/11/2004	979	38	N/A	N/A
PNL-BA8-17-SFC1	5/11/2004	1,265	49	Petroclean	VOID
PNL-BA8-17-SFC2	5/11/2004	1,166	45	Microblaze	VOID
PNL-BA8-17-SFC3	5/11/2004	1,265	49	Biosolvve	VOID
PNL-BA8-17-SFC4	5/11/2004	1,265	49	Alabaster CS1 Microbes	VOID
PNL-BA8-17-SFC5	5/11/2004	1,265	49	Alabaster CS1	VOID
PNL-BA8-17-SFC6	5/12/2004	458	18	Water	53%
PNL-BA8-17-SFC7	5/13/2004	193	7.4	Rusmar	80%
PNL-BA11-X-SFU	5/14/2004	126	4.9	N/A	N/A
PNL-BA11-X-SFC	5/14/2004	49	1.9	Rusmar	61%
PNL-BA13-X-SFU	5/14/2004	193	7.4	N/A	N/A
PNL-BA13-X-SFC	5/24/2004	13	0.50	Rusmar	93%
Lagoon/Emission Control					
PNL-L1A-SFU	5/26/2004	194	7.5	N/A	N/A
PNL-L1A-SFC1	5/26/2004	149	5.7	Alabaster CS1	23%
PNL-L1A-SFC2	5/26/2004	22	0.85	Rusmar	89%
PNL-L1B-SFU	5/26/2004	2,123	82	N/A	N/A
PNL-L1B-SFC1	5/26/2004	106	4.1	Alabaster CS1	95%
PNL-L1B-SFC2	5/26/2004	16	0.62	Rusmar	99%
PNL-L200-SFU Blank)	5/25/2004	9	0.35	N/A	N/A
PNL-L2A-SFU	5/26/2004	2,310	89	N/A	N/A
PNL-L2A-SFURO	5/26/2004	1,947	75	N/A	N/A
PNL-L2A-SFC1	5/26/2004	163	6.3	Alabaster CS1	93%
PNL-L2A-SFC2	5/26/2004	30	1.2	Rusmar	99%
PNL-L2B-SFU	5/26/2004	583	22	N/A	N/A
PNL-L2B-SFC1 (ID as L2A)	5/26/2004	210	8.1	Alabaster CS1	64%
PNL-L2B-SFC2	5/26/2004	32	1.2	Rusmar	85%
PNL-L3A-SFU	5/25/2004	163	6.3	N/A	N/A
PNL-L3A-SFC1	5/25/2004	115	4.4	Alabaster CS1	29%
PNL-L3A-SFC2	5/25/2004	63	2.4	Rusmar	61%
PNL-L3B-SFU	5/25/2004	193	7.4	N/A	N/A
PNL-L3B-SFC1	5/25/2004	137	5.3	Alabaster CS1	29%
PNL-L3B-SFC2	5/25/2004	16	0.62	Rusmar	92%
PNL-L4A-SFU	5/24/2004	250	9.6	N/A	N/A
PNL-L4A-SFC1	5/24/2000	89	3.4	Alabaster CS1	64%
PNL-L4A-SFC2	5/24/2004	82	3.2	Rusmar	67%
PNL-L4B-SFU	5/24/2004	211	8.1	N/A	N/A
PNL-L4B-SFC1	5/24/2004	Missing		Alabaster CS1 Microbes	None
PNL-L4B-SFC2	5/24/2004	13	0.50	Rusmar	94%
PNL-L5A-SFU	5/24/2004	97	3.7	N/A	N/A
PNL-L5A-SFC1	5/24/2004	89	3.4	Alabaster CS1	8.2%
PNL-L5A-SFC2	5/24/2004	25	1.0	Rusmar	74%
PNL-L5B-SFU	5/24/2004	451	17	N/A	N/A
PNL-L5B-SFC1	5/24/2004	386	15	Alabaster CS1	14%
PNL-L5B-SFC2	5/24/2004	89	3.4	Rusmar	80%
Phase VIII (Pit F) DHF Borings				N/A	N/A
PNL-F1-13-O	6/30/2004	1,894	593	N/A	N/A
PNL-F1-13-OR	6/30/2004	2,132	667	N/A	N/A
PNL-F4-15-O	6/28/2004	2,703	846	N/A	N/A
PNL-F5-13.5-O	6/28/2004	58	18	N/A	N/A
PNL-F19-4-O	6/30/2004	82	26	N/A	N/A
PNL-F19-10-O	6/30/2004	825	258	N/A	N/A
PNL-F75-1-O (Blank)	6/30/2004	10	3.1	N/A	N/A
Phase VIII (Pit F) Emission Control					
SF-BLK-O	6/28/2004	11	0.42	System Blank	N/A
SF-STY1-U-O	7/1/2004	45	1.73	Uncontrolled, sample #1	N/A
SF-STY1-U-OR	7/1/2004	49	1.89	Replicate sample	N/A
SF-STY2-U-O	7/1/2004	211	8.12	Uncontrolled, sample #2	N/A
SF-STY1-C1-O	7/1/2004	35	1.35	Alabaster w/o microbes #1	27%
SF-STY2-C1-O	7/1/2004	707	27.2	Alabaster w/o microbes #2	VOID
SF-STY1-C2-O	7/1/2004	23	0.89	Rusmar, sample #1	51%
SF-STY2-C2-O	7/1/2004	15	0.58	Rusmar, sample #2	68%

Note- percent control greater than 100% indicates odor added by the control agent or non-uniform waste
(e.g. additional sample from the source is different between the uncontrolled test and controlled test)
Downhole Flux (D/T)/m2,min-1 = (D/T)(0.001 m3/min)/(0.0032 m2) or (D/T)(0.313)
Surface Flux (D/T)/m2,min-1 = (D/T)(0.005 m3/min)/(0.13 m2) or (D/T)(0.0385)
VOID- Control test odor flux is greater than uncontrolled test (waste hetrogeneity).

Table 19. Summary of Downhole Flux Data for Selected Study Compounds and Odor Flux.

Boring	Depth	CH4	C6+	Benzene	Toluene	EthylBez	m,p-Xyl	o-Xylene	Styrene	H2S	COS	CS2	Odor
	(feet)	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	(D/T)/m2,min-1
PNL-1	15'	4,200,000	1,800,000	6,600	10,000	3,400	7,800	3,800	<0.66	NA	NA	NA	930
PNL-2	15'	120,000	2,200	<0.66	<0.66	<0.66	<0.66	<0.66	<0.66	NA	NA	NA	3.4
PNL-3	21'	48,000	1,500,000	3,800	1,500	1,800	5,000	1,900	<0.66	NA	NA	NA	2,600
PNL-5A	11'	76,000	2,300	0.97	0.94	0.78	1.4	0.88	<0.66	NA	NA	NA	13
PNL-6	15'	11,000,000	87,000	8.1	5.6	29	11	<0.66	<0.66	NA	NA	NA	86
PNL-7	21'	36,000,000	1,500,000	1,200	140	750	110	410	<0.66	NA	NA	NA	1,500
PNL-8	6'	74,000	6,500	6.9	4.1	31	60	10	<0.66	NA	NA	NA	Missing?
PNL-8	18'	9,400,000	320,000	2,800	1,700	810	1,300	660	88	NA	NA	NA	1,400
PNL-9	15'	1,300,000	54,000	66	16	110	240	38	<0.66	NA	NA	NA	1,600
PNL-10A	13'	340,000	5,500	8	6.3	20	16	8.5	1.6	NA	NA	NA	400
PNL-11	12'	1,200	8,100	69	4.1	31	60	10	344	NA	NA	NA	120
PNL-12	15' (21'?)	150,000	25,000	18	4.7	72	31	9.4	<0.66	NA	NA	NA	370
PNL-13	12'	240,000	110,000	180	410	290	690	440	<0.66	NA	NA	NA	720
PNL-14	21'	34,000,000	1,900,000	2,800	220	2,600	3,100	630	<0.66	NA	NA	NA	7,900
PNL-15	12'	320,000	12,000	41	27	44	50	31	<0.66	NA	NA	NA	120
(Pit F)													
PNL-F1	13'	4,200	93,000	11,000	4,100	28,000	<0.59	<0.59	<0.59	3.0	110	140	670
PNL-F4	15'	240,000	250,000	4,700	3,400	78,000	<0.59	<0.59	<0.59	6.6	110	23	850
PNL-F5	13.5'	12,000	24,000	<0.59	<0.59	<0.59	<0.59	<0.59	<0.59	3.1	26	4.4	18
PNL-F19	4'	880	3,600	1.4	3.4	250	<0.59	<0.59	1.6	0.91	5.9	14	26
PNL-F19	10'	30,000	43,000	<0.59	<0.59	<0.59	<0.59	<0.59	<0.59	1.6	24	8.5	260
Maximum		36,000,000	1,900,000	11,000	4,100	78,000	5,000	3,800	344	6.6	110	140	7,900
Location		PNL-7, 21'	PNL-14, 21'	PNL-F1, 13'	PNL-F1, 13'	PNL-F5, 15'	PNL3, 21'	PNL-1, 15'	PNL-11, 12'	PNL-F4, 15'	PNL-F1, 13'	PNL-F1, 13'	PNL-14, 21'

CH4-Methane
C6+ Carbon compounds with 6 or more carbon atoms expressed as hexane
Ethylbez- Ethylbenzene
m,p-Xyl- m,p-Xylene
H2S- Hydrogen sulfide
COS- Carbonyl sulfide
CS2- Carbon disulfide
Note- Summary of all downhole flux speciation data for selected compounds and odor.

Table 20. Summary of Bucket Auger Waste, Emission Agent Control Data for Selected Compounds and Odor (percent).

Waste	Test Sample	Test	CH4	C6+	Benzene	Toluene	EthylBez	m,p-Xyl	o-Xylene	Styrene	H2S	COS	CS2	Odor
			ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	(D/T)/m2,min-1
PNL-BA01	BA1-17-SFU	Uncontrolled	390	440	4.2	1.5	0.23	0.19	0.058	<0.081	NA	NA	NA	6.3
	BA1-17-SFC	Rusmar	32	<225	2.8	2.8	1.1	1.2	0.058	<0.081	NA	NA	NA	1.0
			92%	100%	33%	NA	NA	NA	0%	NA	NA	NA	NA	85%
PNL-BA03	BA3-X-SFU	Uncontrolled	790	8,300	22	5.0	30	73	31	<0.081	NA	NA	NA	7.4
	BA3-X-SFC	Rusmar	490	1,500	19	3.7	20	39	31	<0.081	NA	NA	NA	4.9
			38%	82%	14%	26%	33%	47%	0%	NA	NA	NA	NA	35%
PNL-BA06	BA6-X-SFU	Uncontrolled	570	1,600	6.9	0.42	17	8.5	12	0.58	NA	NA	NA	4.1
	BA6-X-SFC	Rusmar	24	<230	3.6	0.062	7.3	3.5	0.85	0.26	NA	NA	NA	0.89
			96%	100%	48%	85%	57%	59%	93%	55%	NA	NA	NA	78%
PNL-BA07	BA7-X-SFU	Uncontrolled	270	2,500	1.0	0.28	8.5	5.0	2.7	0.21	NA	NA	NA	3.4
	BA7-X-SFC	Rusmar	300	1,300	0.69	0.18	4.6	3.8	1.5	0.15	NA	NA	NA	1.9
			NA	48%	31%	36%	46%	24%	44%	29%	NA	NA	NA	44%
PNL-BA08	BA8-17-SFU	Uncontrolled	2,100	19,000	58	46	62	96	46	10	NA	NA	NA	38
	BA8-17-SFC1	Petroclean	1,400	20,000	1,000	92	120	150	81	<0.081	NA	NA	NA	49
			33%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	BA8-17-SFC2	Microblaze	1,200	16,000	85	77	100	92	50	<0.081	NA	NA	NA	45
			43%	16%	NA	NA	NA	5.0%	NA	100%	NA	NA	NA	NA
	BA8-17-SFC3	Biosolve	1,400	19,000	92	77	92	110	58	22	NA	NA	NA	49
			33%	0%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	BA8-17-SFC4	Alab/micro	1,200	17,000	77	54	69	100	50	12	NA	NA	NA	49
			43%	11%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	BA8-17-SFC5	Alabaster	720	9,000	58	46	62	81	46	<0.081	NA	NA	NA	49
			64%	53%	0%	0%	0%	16%	0%	100%	NA	NA	NA	NA
	BA8-17-SFC6	Water	370	3,400	25	28	32	42	24	8.5	NA	NA	NA	18
			82%	82%	57%	39%	48%	56%	48%	15%	NA	NA	NA	53%
	BA8-17-SFC7	Rusmar	420	1,600	62	54	46	50	28	8.9	NA	NA	NA	7.4
			80%	92%	NA	NA	26%	48%	36%	11%	NA	NA	NA	81%
PNL-BA11	BA-11-X-SFU	Uncontrolled	52	7,900	13	54	730	<0.081	<0.081	1,500	NA	NA	NA	4.9
	BA-11-X-SFC	Rusmar	25	3,700	<0.081	29	420	<0.081	<0.081	1,100	NA	NA	NA	1.9
			52%	53%	100%	46%	42%	NA	NA	27%	NA	NA	NA	62%
PNL-BA13	BA-13-X-SFU	Uncontrolled	370	70,000	50	140	120	280	200	<0.081	NA	NA	NA	7.4
	BA-13-X-SFC	Rusmar	16	460	5.4	15	6.5	17	12	0.58	NA	NA	NA	0.5
			96%	99%	89%	89%	95%	94%	94%	NA	NA	NA	NA	93%

CH4-Methane
C6+ Carbon compounds with 6 or more carbon atoms expressed as hexane
Ethylbez- Ethylbenzene
m,p-Xyl- m,p-Xylene
H2S- Hydrogen sulfide
COS- Carbonyl sulfide
CS2- Carbon disulfide
Note- Summary of all downhole flux speciation data for selected compounds and odor.
NA- Percent not applicable because the controled emissions was greater than the uncontrolled, or ND in both
ND values shown at method (sample batch) detection limit

Table 21. Summary of Lagoon Trenching Waste Emission Control Agent Data for Selected Compounds and Odor (percent).

Waste	Test Sample	Test	CH4	C6+	Benzene	Toluene	EthylBez	m,p-Xyl	o-Xylene	Styrene	H2S	COS	CS2	Odor
			ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	(D/T)/m2,min-1
PNL-L1A	L1A-SFU	Uncontrolled	740	3,700	28	1.2	39	2.0	1.4	<0.023	0.18	<0.46	0.42	7.5
	L1A-SFC1	Alabaster	570	2,000	16	0.77	27	1.2	0.77	<0.023	0.36	<0.46	0.31	5.7
			23%	46%	43%	36%	31%	40%	45%	NA	NA	NA	26%	23%
	L1A-SFC2	Rusmar	40	<225	5.4	0.28	8.5	0.42	0.22	0.11	<0.27	<0.46	0.65	0.85
			85%	100%	81%	77%	78%	79%	84%	NA	100%	NA	NA	85%
PNL-L1B	L1B-SFU	Uncontrolled	940	4,100	5.0	0.28	8.5	0.42	0.22	0.11	2.0	0.89	0.69	82
	L1B-SFC1	Alabaster	640	4,100	3.0	1.8	14	3.6	1.7	<0.023	1.5	1.2	0.81	4.1
			32%	0%	40%	NA	NA	NA	NA	100%	25%	NA	NA	95%
	L1B-SFC2	Rusmar	<20	<230	0.096	0.092	0.33	0.16	0.050	<0.023	0.98	0.54	0.81	0.62
			100%	100%	98%	67%	NA	62%	77%	100%	51%	39%	NA	99%
PNL-L2A	L2A-SFU	Uncontrolled	1,300	28,000	37	150	69	170	100	2	1.1	1.3	1.2	89
	L2A-SFC1	Alabaster	220	6,500	5.8	23	13	19	19	0.42	0.89	0.62	0.69	6.3
			83%	77%	84%	85%	81%	89%	81%	79%	19%	52%	74%	93%
	L2A-SFC2	Rusmar	24	230	1.7	6.9	2.5	5.4	2.8	0.12	<0.27	<0.46	0.42	1.2
			98%	99%	95%	95%	96%	97%	97%	67%	100%	100%	65%	99%
PNL-L2B	L2B-SFU	Uncontrolled	1,100	4,500	16	9.0	20	17	8.0	<0.023	0.16	<0.46	0.69	22
	L2B-SFC1	Alabaster	840	4,400	11	2.7	20	5.8	2.5	<0.023	0.42	0.62	0.69	8.1
			24%	2.20%	31%	70%	0%	66%	69%	NA	NA	NA	0%	64%
	L2B-SFC2	Rusmar	<20	<230	2.0	1.3	2.6	1.8	0.58	<0.023	<0.27	<0.46	0.42	1.2
			100%	100%	82%	52%	87%	69%	93%	NA	100%	NA	44%	85%
PNL-L3A	L3A-SFU	Uncontrolled	840	1,200	7.7	1.1	10	3.0	2.1	<0.023	0.13	<0.46	<0.30	6%
	L3A-SFC1	Alabaster	1,000	2,900	7.7	1.0	10	2.8	2.3	1,500	<0.27	<0.46	0.33	4.4
			NA	NA	0%	10%	0%	6.7%	NA	NA	100%	NA	NA	30%
	L3A-SFC2	Rusmar	760	530	1.5	0.23	1.8	0.54	0.30	<0.023	<0.27	<0.46	0.34	2.4
			14%	56%	81%	77%	82%	82%	86%	NA	100%	NA	NA	62%
PNL-L3B	L3B-SFU	Uncontrolled	838	2900	5.4	7.7	25	24	15	<0.023	0.24	<0.46	0.42	7.4
	L3B-SFC1	Alabaster	760	3,200	7.0	8.0	25	21	13	<0.023	<0.027	<0.46	0.3	5.3
			9%	NA	NA	NA	NA	13%	13%	NA	100%	NA	30%	28%
	L3B-SFC2	Rusmar	<20	<230	1.5	2.0	3.9	3.4	1.7	0.1	0.39	<0.46	<0.30	0.62
			100%	100%	72%	74%	84%	86%	89%	NA	NA	NA	100%	92%
PNL-L4A	L4A-SFU	Uncontrolled	490	2,500	5.0	1.6	15	12	5.8	<0.023	0.42	0.69	0.62	9.6
	L4A-SFC1	Alabaster	230	2,300	1.7	<0.023	8.5	6.9	3.3	<0.023	0.28	<0.46	0.50	3.4
			53%	8%	66%	100%	43%	43%	43%	NA	33%	100%	20%	64%
	L4A-SFC2	Rusmar	220	610	1.7	0.62	5.8	4.2	1.9	<0.023	0.46	1%	0.85	3.2
			4.30%	73%	0%	61%	32%	39%	42%	NA	NA	NA	NA	67%
PNL-L4B	L4B-SFU	Uncontrolled	570	9,000	12	6.9	33	54	12	<0.023	0.15	<0.46	0.50	8.1
	L4B-SFC1	Alabaster	1,300	17,000	25	14	62	100	25	<0.023	0.73	<0.46	0.77	NA
			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.50
	L4B-SFC2	Rusmar	17	<230	2.8	1.1	4.6	6.9	1.5	<0.023	0.15	0.56	0.54	94%
			97%	100%	77%	84%	86%	87%	88%	NA	0%	NA	NA	3.7
PNL-L5A	L5A-SFU	Uncontrolled	570	2,400	<0.023	1.1	4.6	6.9	1.5	<0.023	0.46	<0.46	0.42	3.7
	L5A-SFC1	Alabaster	540	2,200	0.81	<0.023	7.7	15	8.1	<0.023	0.25	<0.46	0.39	3.4
			1.8%	8.2%	NA	100%	NA	NA	NA	NA	46%	NA	7.10%	8.1%
	L5A-SFC2	Rusmar	21	<230	0.15	0.13	1.2	1.9	0.77	<0.023	0.21	<0.46	0.62	1.0
			96%	100%	NA	88%	74%	72%	49%	NA	54%	NA	NA	79%
PNL-L5B	L5B-SFU	Uncontrolled	790	1,600	<0.023	0.46	15	<0.023	0.42	<0.023	13	1.0	0.31	17
	L5B-SFC1	Alabaster	640	2,400	0.23	0.32	17	0.92	0.28	<0.023	12	0.89	0.34	15
			19%	NA	NA	30%	NA	NA	33%	NA	7.7%	11%	NA	12%
	L5B-SFC2	Rusmar	570	660	0.89	2.3	8.9	0.96	0.3	<0.023	1.8	1.0	0.46	3.1
			38%	59%	NA	NA	41%	NA	30%	NA	86%	0%	NA	82%

CH4-Methane; C6+ Carbon compounds with 6 or more carbon atoms expressed as hexane; Ethylbez- Ethylbenzene; m,p-Xyl- m,p-Xylene; H2S- Hydrogen sulfide; COS- Carbonyl sulfide; CS2- Carbon disulfide

Note- Summary of all downhole flux speciation data for selected compounds and odor.

NA- Percent not applicable because the controled emissions was greater than the uncontrolled, or ND in both

ND values shown at method (sample batch) detection limit

Table 22. Summary of Pit F Waste Emission Control Agent Testing for Selected Compounds and Odor (percent).

Waste	Test		CH4	C6+	Benzene	Toluene	EthylBez	m,p-Xyl	o-Xylene	Styrene	H2S	COS	CS2	Odor
			ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	ug/m2,min-1	(D/T)/m2,min-1
Pit F- STY1 (drill cuttings)	Uncontrolled		30	900	46	22	200	<0.073	0.42	3.4	9.2	1.2	0.96	1.9
	Alabaster		22	1900	72	36	370	0.85	0.81	7.3	0.38	1.3	1.6	1.4
			27%	NA	NA	NA	NA	NA	NA	NA	96%	NA	NA	26%
	Rusmar		18	650	65	36	270	1.4	0.89	4.6	0.27	1.4	1.8	0.89
			40%	28%	NA	NA	NA	NA	NA	NA	97%	NA	NA	53%
Pit F- STY2 (Pit F material)	Uncontrolled		27	2,600	<0.073	1.2	11	1.8	1.2	460	12	8.1	0.30	8.1
	Alabaster		<19	680	<0.073	3.6	5.4	<0.073	<0.073	54	89	58	150	27
			100%	74%	NA	NA	51%	100%	100%	88%	NA	NA	NA	NA
	Rusmar		37	<200	0.081	0.12	0.34	0.18	0.12	23	0.85	3.7	17	0.58
			NA	NA	NA	90%	97%	90%	90%	95%	93%	54%	NA	98%

CH4-Methane
C6+ Carbon compounds with 6 or more carbon atoms expressed as hexane
Ethylbez- Ethylbenzene
m,p-Xyl- m,p-Xylene
H2S- Hydrogen sulfide
COS- Carbonyl sulfide
CS2- Carbon disulfide
Note- Summary of all downhole flux speciation data for selected compounds and odor.
NA- Percent not applicable because the controled emissions was greater than the uncontrolled, or ND in both
ND values shown at method (sample batch) detection limit