February 27, 2009

Ms. Kris Flint
U.S. Environmental Protection Agency, Region 10
ECL 113
1200 Sixth Avenue, Suite 900
Seattle, WA 98101

Subject: Tacoma Landfill – Third Five-Year Closure Extension Request

Dear Kris,

In accordance with Section 3.4.2.1 of the Consent Decree Scope of Work, enclosed are three copies (plus two CDs) of the Tacoma Landfill Third Five-Year Closure Extension Request for your review and approval. If approved, this would extend the Central Area closure extension to December 31, 2014. The current 2nd Five-Year Extension expires on December 31, 2009.

The City of Tacoma has discussed this closure extension request with you, the Washington State Department of Ecology, and the Tacoma-Pierce County Health Department. The City believes the enclosed document provides the information needed and meets the requirements for the extension request approval.

If you have any questions or require additional information, please contact me at 253-593-7711.

Sincerely,

Calvin D. Taylor, L.H.G.
Tacoma Landfill Project Coordinator
Science and Engineering Division

CDT:sh (Cover Ltr CE III 27Feb09)

Enclosure

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File: Tacoma Landfill

Tacoma Landfill
Third Five-Year Closure Extension Request
Amendment #1

June 8, 2009

Prepared By
City of Tacoma Public Works Department
Environmental Services Division

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ACRONYMS AND ABBREVIATIONS

CERCLA	Comprehensive Environment Response, Compensation, and Liability Act
EOP	Edge of Plume
EPA	Environmental Protection Agency
EWV	Early Warning Value
FEMA	Federal Emergency Management Agency
GETS	Groundwater Extraction and Treatment System
GPS	Groundwater Performance Standard
HELP	Hydrologic Evaluation of Landfill Performance
HHW	Household Hazardous Waste
MCL	Maximum Contaminant Level
MSW	Municipal Solid Waste
NPL	National Priorities List
POC	Point of Compliance
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Tacoma Landfill Record of Decision
SWM	Solid Waste Management
TPCHD	Tacoma-Pierce County Health Department
UASI	Urban Area Security Initiative
VOC	Volatile Organic Compound

1.0 INTRODUCTION

This section describes the regulatory history of the Tacoma Landfill and summarizes the purpose of this closure extension request.

1.1 PURPOSE

The Tacoma Landfill is currently operating under the second five-year closure extension. This extension expires on December 31, 2009. This document[1] serves as the application for the third five-year closure extension allowed under Section 3.4.2.1 of the Consent Decree.

Requested approval will allow the City of Tacoma (City) to keep the Tacoma Landfill Central Area open, which will preserve the remaining solid waste disposal capacity for emergency disposal needs. This will provide the environment, rate payers, and the community a substantial benefit by insuring that a solid waste disposal option is available in the event of a natural disaster, terrorist attack, or other event which precludes hauling garbage to the 304th Street Landfill in Graham (LRI).

1.2 SITE REGULATORY HISTORY

The Tacoma Landfill (landfill) site encompasses 240 acres, approximately 35 acres of which comprise the Central Area. The City of Tacoma, Solid Waste Management (SWM) has operated the site since 1960. The site was placed on the National Priorities List (NPL) of hazardous waste sites as part of the Commencement Bay/South Tacoma Channel Superfund Site in 1983. The site remedial investigation/feasibility study (RI/FS) was completed in 1987. The Tacoma Landfill Record of Decision (ROD) was signed on March 31, 1988. The City, under a Consent Decree negotiated with the Environmental Protection Agency (EPA) and Washington State Department of Ecology (Ecology), has implemented the remedial actions specified in the ROD.

The ROD states that the City will implement a closure plan for the landfill under WAC 173-304, and that the closure schedule is considered part of the remedial action at this site. The closure schedule requires landfill closure by December 31, 1999. The closure schedule includes a provision for three five-year extensions. Two extensions have been granted to date. The most recent extension was granted on February 24, 2005, which extended the landfill closure date to December 31, 2009. The third five-year closure extension, if granted, would extend the landfill closure date until December 31, 2014.

The Central Area, the only remaining operational landfill cell, was constructed in two phases during 1987 and 1990. The Tacoma-Pierce County Health Department (TPCHD) issued the landfill a Solid Waste Permit with a variance, in accordance with WAC 173-304, upon Central Area liner installation completion. The landfill currently operates in accordance with WAC 173-351 under a full permit issued by TPCHD. The Central Area was designed and constructed to provide permanent source control for the cell so that operation would be protective of human

[1] This document is Amendment #1 to the Tacoma Landfill Third Five-Year Closure Extension Request document submitted on February 27, 2009. The primary purpose of this amendment is to update the figures, tables, and text to incorporate 2008 monitoring data.

health and the environment. This protection has been demonstrated by over twenty years of operation in accordance with TPCHD Solid Waste Permit and Consent Decree requirements. The Central Area has not received waste since 2003 in order to preserve the remaining volume for emergency use. The Central Area TPCHD Solid Waste Permit is in effect through December 31, 2014.

In addition to the ROD, Consent Decree, and TPCHD Solid Waste Permit described above, the landfill operates under the following federal, state, and local regulations and requirements:

- Federal – 40 CFR Part 258, RCRA Subtitle D, and CERCLA Section 105;
- State – RCW 70.95, WAC 173-304 & 351, and the Ecology Solid Waste Management Plan; and
- County and City – Tacoma-Pierce County Solid Waste Management Plan.

2.0 CLOSURE EXTENSION REQUIREMENTS

This section describes the requirements that the City must demonstrate in order to receive a five-year closure extension. These requirements are defined in the Consent Decree and identified by EPA in their February 2005 approval letter granting the second five-year closure extension. Sections 3.0 and 4.0 will demonstrate that the Tacoma Landfill and Solid Waste Management have met these requirements for closure extension.

2.1 CONSENT DECREE REQUIREMENTS

Consent Decree Scope of Work Section 3.4.2.1 identifies the requirements for closure extension. The section requires that the Settling Defendant (City) must demonstrate to the satisfaction of the Government Plaintiffs (EPA and Ecology) that all of the following conditions are being met in order for an extension to be granted:

1. That the continued operation of the landfill shall not result in a release or substantial threat of release of hazardous substances, pollutants or contaminants to the environment;

2. That the performance standards for the extraction-treatment system have been achieved;

3. That since the effective date of the Consent Decree, the Settling Defendant has instituted and is operating an aggressive solid waste recycling and hazardous materials collection project; and

4. That other feasible solid waste management alternatives to disposal at the landfill do not exist.

2.2 REQUIREMENTS INCLUDED IN SECOND FIVE-YEAR EXTENSION APPROVAL

The second five-year extension granted by EPA and Ecology on February 25, 2005, was granted subject to the following terms and conditions. The approval letter required the City to document in its next five-year approval application how it fulfilled these terms and conditions.

1. The City has permission to use the Central Area for waste disposal in emergencies only. For purposes of this condition, “emergency” shall be defined as an atypical situation that is not caused by any act or omission on the part of the City or its agents, but rather is caused by unforeseen circumstances that prohibit, in the short-term, disposal off-site. Examples of an “emergency” in this context are a natural disaster, a system failure, or a labor dispute. In the event that the City encounters an “emergency”, as defined herein, the City shall give EPA and Ecology notice that it has disposed waste in the Central Area. Such notice shall (1) describe the emergency necessitating such disposal and the approximate amount of waste disposed of in the Central Area, and (2) be sent to EPA and Ecology no later than seven days after the event occurs. In the event that the City seeks to dispose waste in the Central Area for a “non-emergency” purpose (e.g., construction project at the site that would have the result of temporarily preventing off-site transport of waste), the City shall apply to EPA and Ecology for permission prior to such disposal. It shall be solely within EPA and Ecology’s discretion to grant or deny such permission.

2. No later than May 1, 2005, the City shall submit, for EPA and Ecology approval, an estimate of anticipated leachate that should be generated and collected by the Central Area's leachate collection system. The City shall monitor daily volumes (reported in gallons) collected from the Central Area's leachate collection system, leak detection system, and toe-drain collection system. The flow meters shall be installed and functional no later than October 1, 2005. By the 15th of each month thereafter, the City shall submit monthly reports to EPA, Ecology and TPCHD describing the previous month's monitoring. In the event that the leachate flows from the Central Area differ significantly from what the agencies have determined is reasonable, the agencies may impose further requirements in order to reduce leachate generation at the Central Area. In the event that reliable leachate collection flow monitoring data cannot be obtained, the agencies may impose further conditions to mitigate leachate generation in the Central Area, including the use of temporary tarps, installation of an incremental permanent cover system, and/or final closure of the Central Area.

3. The City shall install and maintain temporary plastic tarps over all areas within the Central Area that achieve final filling elevation.

4. The City shall comply with the terms and conditions of the Solid Waste Permit issued by the TPCHD.

3.0 FULFILLMENT OF CONSENT DECREE REQUIREMENTS

This section describes how the Tacoma Landfill and Solid Waste Management have fulfilled the requirements listed in Section 2.1.

3.1 FIRST REQUIREMENT – PROTECTION OF THE ENVIRONMENT

Requirement: "That the continued operation of the landfill shall not result in a release or substantial threat of release of hazardous substances, pollutants or contaminants to the environment."

Section 3.1.1 describes the requirements in the Consent Decree for protection of human health and the environment; Section 3.1.2 provides an overview of the landfill remediation systems that have been installed at the Tacoma Landfill; and Section 3.1.3 describes the environmental systems that are specific to the Central Area.

3.1.1 Consent Decree Requirements

The ROD outlined that the following remedial actions be implemented to protect human health and the environment:

- Reduce the production of leachate by placing restraints on further site operations and by capping the landfill;
- Eliminate off-site gas migration through a gas extraction system;
- Prevent further migration of the contaminated plume via the groundwater extraction-treatment system;
- Further protect human health and the environment via monitoring of groundwater, surface water, gas probes, and air emissions;
- Provide an alternate water supply (Tacoma municipal water) to any residences deprived of their domestic water supply due to demonstrated contamination from the landfill or due to the action of the extraction-treatment system;
- Establish a closure plan for the landfill consistent with Washington State Minimum Functional Standards for Landfill Closure (WAC 173-304); and
- Establish institutional controls to assure that the remedial action will continue to protect human health and the environment.

3.1.2 Overview of Tacoma Landfill Remediation Systems

The landfill cap, landfill gas extraction system and flare station, and groundwater extraction-treatment system were all installed at the landfill to fulfill the Consent Decree requirements. The systems, which are described in more detail below, were approved by EPA and Ecology.

Extensive monitoring programs, which were approved by the responsible regulatory agencies, are operated to ensure these systems are functioning properly. Monitoring programs currently in place at the landfill include monitoring of the gas probes, groundwater wells, flare emissions,

and the leachate and condensate collection program. Reports are sent periodically to the agencies for review as required by the monitoring programs. These reports all indicate that the systems are functioning as designed and are fulfilling the first Consent Decree requirement.

3.1.2.a Tacoma Landfill Cap

The Tacoma Landfill cap system consists of the Public Receiving Facility Asphalt Cap, the Stage One Geomembrane Cap, and the Stage Two Geomembrane Cap. The Stage Three Geomembrane Cap will cover the Central Area. The Stage Three Cap is discussed in Section 3.1.3.c.

3.1.2.b Tacoma Landfill Gas Management

The Tacoma Landfill gas management system consists of approximately 330 landfill gas extraction wells, 140 monitoring probe stations, and two gas flares. The following actions were undertaken in the last five years to help maintain the system and ensure protection of human health and the environment:

- **Central Area** – Six new gas extraction wells were added in the Central Area due to declining production in some of the existing Central Area wells. Declining production likely occurred due to broken well pipes caused by refuse settlement.

- **Near Home Depot along Northern Landfill Property Line** – Four new gas probes and one gas extraction well were installed in 2006 to ensure that landfill gas was not migrating from the landfill and entering the adjacent Home Depot property. Data gathered from these wells and probes supports the conclusion that gas is being captured on the landfill property and that it is not migrating from the landfill to the Home Depot property. EPA and Ecology concur with this conclusion. Please refer to the technical memorandum prepared by CH2M Hill in Appendix A.

- **Flare Emissions** – Flare emissions testing was completed in 2007 and results met air quality standards. Please refer to the technical memorandum prepared by Parametrix in Appendix B.

- **Flares** – The City is currently in the design phase for a new flare due to declining production of landfill gas. The new flare station is expected to be constructed in 2009.

3.1.2.c Tacoma Landfill Groundwater Extraction-Treatment System

The Tacoma Landfill groundwater extraction-treatment system consists of 22 point of compliance extraction wells, 13 edge of plume extraction wells, 10 performance monitoring wells, 25 monitoring wells, and a groundwater air-stripping treatment system. This system will be discussed further in Section 3.2.

3.1.3 Central Area Environmental Systems

The Central Area, the only operational landfill cell, is lined and has successfully demonstrated compliance with WAC 173-351 and the Resource Conservation and Recovery Act (RCRA) Subtitle “D” permit requirements. This section will describe the safeguards and environmental systems specific to the Central Area that guard against a contaminant release to the environment.

3.1.3.a Central Area Liner

The purpose of the Central Area liner system is to prevent leachate from coming into contact with groundwater since it could further contaminate the groundwater beneath the landfill.

Construction

The Central Area liner was constructed in two phases. Phase 1 construction consisted of a geomembrane double liner and a leak detection system at the bottom of the Central Area and a single 40-mil geomembrane liner on the side walls. This first phase was approximately 18 acres in area and became operational in 1987. Phase 2 construction expanded the Phase 1 liner system to cover approximately 31 acres. The Phase 2 liner consisted of a single 60-mil geomembrane liner on the side walls of the Central Area.

Both liner phases were constructed to meet the Washington State Minimum Functional Standards for Solid Waste Handling (WAC 173-304). Additionally, the Central Area has successfully demonstrated compliance with WAC 173-351 requirements for existing landfills.

Liner Performance

Liner leakage calculations were performed on the liner system to demonstrate Central Area liner integrity (Appendix C). Results show that the estimated liner leakage rate is 59 gallons/acre/day and that the average size of a hole per acre in the Central Area is 0.014 cm^2. The estimated leakage rate is more than five times better than the classification of a Great Liner by EPA Standards (EPA, 1991).

Liner Classifications (Source: EPA, 1991)

	Great	**Good**	**Poor**
#Hole/Acre @ size in cm^2	1 @ 0.1	1 @ 1.0	30 @ 0.1
Rate of Flow gal/acre/day	330	3,300	10,000

This calculation was also submitted with the first five-year extension request, Tacoma Landfill Beyond 2000 Request (1998), and the results were almost identical (leakage rate = 48 gallons/acre/day and area of hole = 0.014 cm^2). This suggests that the integrity of the Central Area liner is holding up over time.

3.1.3.b Central Area Leachate Collection System

Leachate Monitoring

Leachate generation from the Central Area has been monitored using flow meters between 1996 and 1997, visually from 1998 to 2005, and then again using flow meters from 2005 to present. This section will describe the results of leachate monitoring conducted since 2005.

The meters were out of service between September 2006 and May 2007, due to a road construction project and repairs to meters. Central Area leachate meters will be regularly serviced beginning in 2009 as described in Appendix D.

- **Leachate Extraction** – Leachate is extracted from selected Central Area gas extraction wells for odor control. In addition, surface gas is monitored to ensure odor control. Leachate extraction and surface gas monitoring are managed as described in Appendix E.

- **Leachate Collection** – Figures 3-1, 3-2, and 3-3 show the leachate collection pipe flows versus rainfall for 2006, 2007, and 2008 respectively. As can be seen from the figures, the data shows a correlation between increased leachate flow with rainfall events. Initial data from the meters (January and February 2006) showed negative flows due to surcharging of the manholes. The data loggers were reprogrammed to not record these negative flows. Figure 3-3 shows leachate collection flows increasing over time during March and April 2008. Visual inspections of the meter suggested that the meter was clogged, so the meter was replaced on May 18, 2008.

  Between May 1, 2007 and April 30, 2008 (1 year elapsed period), the total flow was 11,994,360 gallons with an average flow of 22.8 gpm[2].

- **Leachate Detection and Surface Runoff** – Leachate detection and surface runoff meters are not logged with a data logger. Instead, field crews record the running flow total off of the meter during inspection events; these running flow totals are then subtracted from the previous month's data to determine the monthly flow total. If no flow is running through the meter during the inspection event, the meter displays "echo loss" which means that no flow data could be recorded.

  Monthly total flows for the leachate detection pipe are shown in Table 3-1. Between May 1, 2007 and April 30, 2008 (1 year elapsed period), the total flow from the leachate detection pipe and the surface runoff pipe was approximately 554,000 gallons and 8,255,000 gallons respectively.

- **Toe Drain** – Following discussions with the regulatory agencies, flows from the toe drain were not monitored with a meter since it was determined not to be feasible to install a third meter in the leachate collection manhole.

Leachate Generation – Modeling

In 2005, CH2M Hill developed a Hydrologic Evaluation of Landfill Performance (HELP) model of the Central Area to estimate anticipated leachate generation. The memorandum describing the results is presented in Appendix F.

The HELP model estimates the amount of runoff that may occur from the liner system based on simulated conditions. The HELP model was designed by EPA to evaluate design alternatives and was not designed to estimate leachate generation from an existing landfill. Therefore, model output should not be expected to accurately predict leachate generation from the landfill.

[2] As shown on Figure 3-3, there were two periods during 2008 where the data logger was not functioning or where data was not collected. Therefore, the May 1, 2007 to April 30, 2008 period was used as the most representative 1 year period.

Model results show that the peak monthly leachate generation rates should be 3,784,000 gallons/month with a peak average leachate generation rate of 2,517,000 gallons/month. The yearly average leachate generation rate predicted by the model is 14,624,000 gallons. Table 3-2 provides additional information about predicted monthly peak and average leachate generation rates. Flows measured from the leachate collection and leachate detection pipes over a one year period (May 1, 2007 and April 30, 2008) totaled approximately 12,525,360 gallons, which compares reasonably well with the HELP model prediction of 14,624,000 gallons.

Water Balance

The water balance for the Central Area between May 1, 2007 and April 30, 2008, was provided in a memorandum to the agencies on December 15, 2008 (Appendix G). This water balance calculation generally shows that no significant water loss in the Central Area is occurring.

3.1.3.c Central Area Partial Final Closure

To help reduce the volume of water that passes through the Central Area, the City is proposing to close a minimum of 8 acres of the Central Area by December 31, 2012. This final closure will be in accordance with the Consent Decree requirements for Stage 3 closure or an approved alternate design.

The actual acreage (8 acres minimum) for partial closure will be determined during the design phase. The City may decide that it is appropriate based on a cost benefit analysis to add additional garbage to the Central Area in order to increase the closure acreage.

3.1.4 Satisfaction of First Requirement

The City of Tacoma Solid Waste Management operates and monitors the landfill remediation systems and the Central Area environmental protection systems. These systems continue to be reviewed by the regulatory agencies responsible for extension request approval. Analytical data from the Central Area environmental protection systems indicate the landfill, including the Central Area, poses no substantial threat of release and shows that no new release has occurred. These systems are maintained, monitored, and working to protect human health and the environment.

3.2 SECOND REQUIREMENT – EXTRACTION-TREATMENT SYSTEM PERFORMANCE

Requirement: "That the performance standards for the extraction-treatment system have been achieved."

This section describes the Consent Decree requirements for the extraction-treatment system, the performance of the groundwater-extraction treatment system, and the status of the groundwater plume remediation.

3.2.1 Consent Decree Requirements

The performance standards for the extraction-treatment system identified in the Consent Decree Scope of Work Section 3.3 include the following:

- "The goal of the groundwater extraction system is to prevent any further degradation of existing water quality beyond the existing boundaries of the plume."

- "The extraction system shall continue to operate until the water quality at and beyond the point of compliance (defined by WAC 173-304-100(58)), consistently meets drinking water standards, or previously established and approved health-based criteria, as listed in Table 3 (Consent Decree Scope of Work)."

The groundwater performance standards for the Tacoma Landfill based on the Consent Decree Scope of Work Table 3 requirements are listed in Table 3-3.

3.2.2 Groundwater Extraction and Treatment System (GETS)

In March 1992, the City constructed the groundwater extraction and treatment system (GETS). The system consisted of 19 point of compliance (POC) wells, 9 edge of plume (EOP) wells, and associated pipelines to transport the groundwater from the extraction wells to the treatment facility. In addition, performance wells were installed to monitor the extraction system's effectiveness in capturing the groundwater plume. POC and EOP extraction well testing was completed by Spring 1993 and the City formally certified the GETS completion in January 1994. The GETS was formally approved by EPA in March 1995. Figure 3-4 shows the well installations at and surrounding the landfill.

3.2.2.a POC Enhancements since 1995

Groundwater analytical data collected at monitoring well TL-1 indicated third quarter vinyl chloride increases from 1991 to 1996. For this reason, three additional POC extraction wells (W-20, W-21, and W-22) were installed along the northern edge of the POC system to enhance POC capture. The wells became operational in February 1997. Vinyl chloride has not been detected in TL-1 groundwater samples since these wells became operational.

3.2.2.b EOP Enhancements since 1995

Initial groundwater monitoring data indicated that additional extraction wells along the edge of plume may be appropriate. The City conducted a study, which included pumping tests and bromide tracer tests, to better understand capture along the edge of plume. These tests and the groundwater analytical data at PW-1, PW-2, and PW-3/4 indicated additional extraction wells would help facilitate off-site cleanup. For this reason, four new groundwater extraction wells (W-40, W-41, W-42, and W-43) were installed during the summer of 1996. Analytical data following well installation indicated enhanced capture along the edge of plume.

3.2.2.c GETS Effluent Discharge

During 1998, extracted groundwater combined effluent contaminant concentrations (EOP and POC effluent combined together) decreased to below the performance standards identified in the Consent Decree for discharge to the sanitary sewer. This indicated that the landfill cap installed during 1991 and 1992 had prevented additional leachate generation. The City requested and received approval to shutdown the groundwater treatment system (air-stripper) during 1998. The treatment system remains on standby in the event that groundwater contaminant concentrations again exceed performance standards.

In 2002, the extracted groundwater combined iron and manganese concentrations met discharge requirements identified in the Consent Decree for discharge to surface water. EPA and Ecology approved the City's request to discharge the effluent to nearby Leach Creek. By 2003, all extracted groundwater combined effluent flows were discharged to Leach Creek via the City's storm sewer.

3.2.2.d Well Rehabilitation

In 2001, the extraction well rehabilitation method was changed to a carbon dioxide freezing method. This change resulted in significant production improvements in most of the rehabilitated wells. The City currently rehabilitates wells three to four times per year in groups of five to six wells.

3.2.3 Groundwater Plume Status

Groundwater monitoring data collected during the past five years indicate that the GETS and cap system are continuing to effectively restore groundwater quality to meet the cleanup requirements identified in the Consent Decree. Remaining exceedances of the groundwater performance criteria are consistent with the design expectations for the GETS system.

Since only a few remaining wells have contaminants that are detected above groundwater performance standards, the City requested in 2007 to shut down all of the extraction wells with the exception of W-1 and W-15. This request is currently being evaluated by EPA and Ecology.

This section describes in more detail the groundwater plumes, groundwater analytical data, decrease in contaminants along the plume, and plume capture zone evaluation.

3.2.3.a Groundwater Plume Description

As discussed in the Tacoma Landfill Beyond 2000 Request (1998) and the Tacoma Landfill Second Five-Year Closure Extension Request (2004), groundwater contamination was determined to exist in two locations: north area vinyl chloride plume, and south area 1,2-dichloroethane plume. The north area and south area are demarcated by a yellow line on Figure 3-5.

Contamination has not been detected since 2004[3] in monitoring wells TL-25A, TL-25B, P-05, P-06, and P-07, with the exception of one detection each in TL-25B and P-07 for chloroethane and one detection each in TL-25A, TL-25B, and P-06 for methlyene chloride[4]. Contamination was not detected in extraction wells W-34 and W-35 when these wells were last sampled in 1996. The analytical results from these wells document the area of uncontaminated groundwater between the north and south plumes.

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[3] Arsenic has been detected in monitoring wells TL-25A, TL-25B, P-05, P-06, and P-07 and extraction wells W-34 and W-35, but the concentrations have all been less than or equal to 10 µg/L with the exception of one detection of 11.8 ug/L in November 2008 in well TL-25B. The concentrations in these wells are believed to be within the natural background levels for the region. The Early Warning Value for arsenic is 10 µg/L.

[4] Methylene chloride is a common lab contaminant. It is likely that these single detections are due to lab contamination.

Northern Plume

The northern groundwater plume area has two distinct sub-areas:

- **North Sub-Area** – Extraction wells W-20 and W-21, and monitoring wells TL-4 and TL-5a; and

- **South Sub-Area** – Extraction wells W-15, W-36, W-37, W-38, and W-43, and monitoring wells TL-7a and P-08.

Please note that TL-17R is an off-site upgradient monitoring well contaminated by the plume generated from the former New Frontier Lanes bowling alley.

Southern Plume

The southern plume is defined by:

- **Extraction Wells** – W-01, W-05, W-30, W-31, W-32, W-33, W-40, and W-41; and

- **Monitoring Wells** – P-02, P-3/4, TL-9B, TL-11A, TL-19C, TL-20C, TL-26A, and TL-27B.

Please note that monitoring well 89.5 is not in the landfill groundwater plume. This well was contaminated by a source in the Nalley Valley.

3.2.3.b Contaminant Analytical Data Summary

Table 3-4 shows analytes that exceeded either the Groundwater Performance Standards (GPS) or the Early Warning Values (EWV) in the past five-year period (January 1, 2004 to December 31, 2008). The number of times the analyte exceeded either the GPS or EWV is also shown on the table. It should be noted that several POC wells were added to the sampling program during the past several years in order to support the City's request to shut down the majority of the groundwater extraction wells. This is why several wells included on Table 3-4 have not been discussed during previous five-year extension requests.

The following exceedances of the groundwater performance standards were observed in the past five years (January 1, 2004 to December 31, 2008):

- **1,2-Dichlorethane** – GPS exceedances were observed in wells P-3/4 and TL-26A. P-3/4 had only one exceedance of the GPS and this occurred in 2nd quarter 2005. 1,2-dichloroethene continues to exceed the GPS in TL-26A.

- **Methylene Chloride** – GPS exceedances were observed in wells TL-01B, TL-21A, TL-25A, TL-25B, and W-10. TL-01B exceeded the GPS twice in late 2007 to early 2008; these exceedances were likely due to contamination that occurred during well re-installation related to road construction in late-summer 2007. All other wells had only one exceedance of the GPS and these exceedances all occurred during 3rd quarter 2005. This indicates potential lab contamination.

- **Tetrachloroethene** – GPS exceedances continue to be observed in well TL-11A.

- **Trichloroethene** – GPS exceedances were observed in wells TL-11A, TL-12, and W-01. Wells TL-12 and W-01 each had one exceedance, and neither well has exceeded the GPS since 3rd quarter 2004. Trichloroethene continues to exceed the GPS in TL-11A.

- **Vinyl Chloride** – GPS exceedances were observed in wells P-08, TL-04, TL-05A, TL-05C, TL-07A, W-15, W-16, and W-36. Wells P-08, TL-04, TL-05A, TL-05C, and W-16 had just one exceedance of the GPS. Wells TL-07A, W-15, and W-36 continue to exceed the GPS.

- **Arsenic** – GPS exceedances were observed in wells EW-09, TL-04, TL-19A, W-02, W-03, W-05, W-07, W-16, W-17, W-18, W-19, W-20, W-21, and W-22. All wells had only one exceedance of the GPS with the exception of W-02, W-03, W-05, W-07, and W-19 which exceeded the GPS up to four times during the five year period.

3.2.3.c Groundwater Plume Contaminant Decrease – 1999 to 2009

This section describes how the concentration of analytes in the groundwater plume has changed over time.

All Analytes, Except Vinyl Chloride and 1,2-Dichloroethane

Data from early 1999 to early 2009 were graphed (Figures 3-6 to 3-9) to observe the trends in analyte concentrations over time. Graphs were created for all analytes that had more than two exceedances of the average value of the GPS and the EWV[5] in any one well. Graphs were not created for 1,1,1-trichloroethane, total 1,2-dichloroethane, benzene, chloroethane, ethylbenzene, methylene chloride, toluene, or total xylenes because none of these analytes met the graphing criteria described above.

As can be seen in Figures 3-6 to 3-9, contaminant concentrations are generally decreasing for the majority of analytes in most of the wells. Total arsenic concentrations, however, appear to be decreasing much less rapidly than other analytes or, in some cases, remaining at a particular concentration (Figure 3-9) which is likely due, in part, to the natural background level in groundwater in the region.

1,2-Dichloroethane

Figure 3-10 shows the concentration of 1,2-dichloroethane over time for all wells that had more than two exceedances of the average value (3 µg/L) of the GPS (5 µg/L) and the EWV (1 µg/L) in any one well. All of the wells graphed, with the exception of TL-04, are in the southern plume area. As can be seen from Figure 3-10, the concentration of 1,2-dichloroethane is generally decreasing over time.

[5] For example, for 1,1-dichloroethane, the average value of the GPS (20 ug/L) and the EWV (4 ug/L) is 12 ug/L. Wells that had greater than two exceedances of 12 µg/L from early 1999 to early 2009 were included on the graph for 1,1-dichloroethane.

Vinyl Chloride

Vinyl chloride was selected as the best analyte to represent the groundwater data in more detail since it is based on the strictest performance criteria and it is known to persist over time. Concentration data versus time[6] for the northern and southern plumes are graphed on Figures 3-11 and 3-12.

Concentration data are also presented symbolically using colored dots for selected wells, rather than contours, to show the discontinuous residual groundwater plume distribution. Figure 3-13 shows the northern and southern plume distribution. The colored dots represent the average concentration for samples collected during the 4th quarter of their respective year. Several of the wells on the east side of the landfill were not sampled between 1999 and 2001, which is why no dot is shown on the respective figure. Two wells had slight increases in concentration between 2007 and 2008; these increases are believed to be part of the natural variation in concentration values and are not indicative of a statistically significant increasing trend.

As can be seen from Figures 3-11 and 3-13, concentrations of vinyl chloride have continued to decrease in the north area with concentrations above 0.5 µg/L only occurring in eight wells during the 4th quarter of 2008. In the south area (Figures 3-12 and 3-13), three wells had concentrations of vinyl chloride above 0.5 µg/L in the 4th quarter of 2008. Figure 3-13 highlights the decreasing concentrations of vinyl chloride over time.

Vinyl chloride concentrations have decreased in the north and south areas by an order of magnitude from greater than 20 µg/L in the early 1990s to just over 3 µg/L[7] in fourth quarter 2008. As shown in the concentration versus time graphs and the concentration map of the landfill, vinyl chloride concentrations have generally continued to decrease over the past five years. The groundwater analytical results indicate the GETS and cap system are successfully preventing additional contamination and are working to shrink the size of the groundwater plume in a timely manner.

3.2.3.d Capture Zone Evaluation

This section describes the horizontal and vertical capture zone analysis conducted as a part of this closure extension request and as part of previous closure extension requests.

Horizontal Capture

The groundwater plume capture zone was analyzed as part of the Tacoma Landfill Third Five-Year Closure Extension Request to verify that capture was being maintained.

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[6] Since the EWV for vinyl chloride is based on the method detection limit (0.5 µg/L) rather than the 20% of the Maximum Contaminant Level (MCL) (0.4 µg/L), the average value (1.2 µg/L) was computed from the GPS and the MCL, not the EWV.

[7] Highest concentration detected of vinyl chloride during 4th quarter 2008 was 3.2 µg/L in extraction well W-15.

The capture zone overlap between wells (W-1 to W-20) is evident from the influence of pumping rate changes on the adjacent POC wells. For example, a pumping rate increase in W-1 causes a rapid decrease in the available drawdown in W-2. This leads to on-off well cycling in W-2 since the pumping rate can no longer be sustained with the reduced available drawdown.

In addition to the field observations discussed above, the horizontal capture zone and stagnation point and width were obtained using equations based on Javendal and Tsang (1986). These equations required the input of several parameters including the pumping rate for each well, aquifer transmissivity, and regional hydraulic gradient. The equations used were for a single pumping well. The calculated capture zones do not reflect the influence of other wells. Quarterly 2008 POC extraction well production rates and aquifer hydrogeologic parameters were used to determine well capture zones.

Equation input parameters are described below:

- **Saturated Aquifer Thickness** – Since the POC wells do not fully penetrate the aquifer, the Weight and Sonderegger (2001) equation for estimating saturated aquifer thickness in a partially penetrating well was used to estimate the saturated aquifer thickness for each well.

- **Hydraulic Conductivity** – The hydraulic conductivity for each well was based on the saturated aquifer sediment (e.g., sand, gravel) thickness in each well. The sediment hydraulic conductivity values reported in the Remedial Investigation Report (1987) were used.

- **Aquifer Transmissivity** – Transmissivity was calculated using the saturated aquifer thickness and the hydraulic conductivity.

- **Extraction Well Pumping Rates** – Extraction well pumping rates, recorded daily by the City, were used in this analysis.

- **Hydraulic Gradient** – An average 0.002 hydraulic gradient was determined using observations from multiple years.

The equations, pumping rates, and hydrogeologic parameters were entered into Microsoft Excel to calculate five coordinates for each well. These points represent the downstream distance to a stagnation point at the center point of the capture zone, the distance between dividing streamlines at the well line, and the distance between dividing streamlines far upstream from the wells. A capture zone curve for each well for each quarter of 2008 was generated and plotted on Figures 3-14A through 3-14D. The capture zone curve axes are perpendicular to the equipotential lines so the capture zone curves were overlain onto the fourth quarter 2008 groundwater flow contour map.

Groundwater was also analyzed for solid waste parameters to determine whether groundwater is impacted by leachate. Conductivity is a solid waste parameter which is analyzed quarterly in point of compliance, monitoring, and edge of plume wells. Long-term groundwater conductivity values were graphed for the northern and southern plume areas downgradient from the Central Area and southern landfill area.

The northern (Figure 3-15) and southern (Figure 3-16) areas show trends towards background conductivity values for extraction and monitoring wells. This indicates on-going effective source control and plume capture.

In addition to the capture zone analysis described above, an offsite evaluation conducted in 2005 to demonstrate plume capture and determine degree and extent of the residual offsite groundwater plume helps support the argument that capture is being maintained. The study was conducted using a Waterloo Profiler™ to profile vertical and horizontal groundwater volatile organic compounds and physical-chemical properties distribution. The investigation was documented in the End of Plume Residual Plume Characterization Report Tacoma Landfill – North Area & South Area (Landau Associates, 2006) (Appendix H).

Northern Plume Capture

Vertical profile boreholes were advanced along an east-west transect from near the western landfill boundary downgradient from the Central Area to Leach Creek (Figure 3-17). The only point of compliance extraction well in the vicinity of the Central Area that had groundwater performance standard exceedances was extraction well W-15 which had slight vinyl chloride exceedances. A residual plume area was defined in the vicinity of Leach Creek (Figure 3-17).

The volatile organic compound (VOC) (Figure 3-17) and groundwater physical-chemical properties data also indicated plume capture. The significantly lower specific conductance values in the groundwater between the landfill boundary and the residual plume area near Leach Creek (Figure 3-18) indicate plume capture has resulted in specific conductance values returning to background levels over time.

Southern Plume Capture

Vertical profile boreholes were advanced along an east-west transect starting near the western landfill boundary then extending to a short distance downgradient from monitoring well TL-26A (Figure 3-18). There were no groundwater performance standard exceedances in the POC extraction wells (Figure 3-19) upgradient from TL-26A.

A residual plume area was defined in the vicinity of monitoring well TL-26A. Based on the vertical profile VOC and physical-chemical parameters residual contamination that exceeded groundwater the performance standard for 1,2-dichlorothane were limited to a zone at about 120 to 130 feet below ground surface (bgs) in the vicinity of TL-26A.

Elevated groundwater specific conductance values were not as significantly different in the residual plume area (Figures 3-20 to 3-23), with the exception of SA01 (Figure 3-20) which has significantly higher specific conductance values that correlate with the 120 to 130 bgs zone that contains the groundwater performance standard exceedances.

The groundwater analytical results indicated the extraction wells are maintaining plume capture at the point of compliance (Quarterly Reports, 2007). The residual plume in the vicinity of TL-26A may have resulted from sediment heterogeneity, such

as, greater percent fines (silt and clay) and higher organic content that resulted in greater contaminant adsorption and slower desorption over time. The 1,2-dichloroethane concentration continues to decrease over time.

Vertical Capture

This section describes the analysis conducted to verify that vertical capture of the groundwater plume is being maintained. The A completions of the monitoring wells are in the hydraulically connected Colvos Sand. The B and C completion monitoring wells (e.g., TL-09B) were installed in the upper and lower Older Gravel (Q_{OG}) respectively. By monitoring the B and C completions, it can be shown that vertical plume capture has been maintained.

Figures 3-24 through 3-39 show the B and C completion monitoring well contaminant concentrations over time since early 1999. Graphs were only created for monitoring wells that had more than two occurrences of the concentration value being greater than the method detection limit (0.5 µg/L for all analytes). These graphs help demonstrate whether or not effective vertical capture has been maintained. Observations are discussed in more detail below.

B Completion Monitoring Wells

Groundwater performance criteria were not exceeded for any compound in the B completion monitoring wells during the past five-year monitoring period (January 1, 2004 to December 31, 2008) with the exception of two methylene chloride exceedances in well TL-01B (Figure 3-28) and one exceedance in TL-25B in 2005. The exceedances that occurred in late 2007 and early 2008 in TL-01B are likely due to contamination that occurred during well re-installation in late-summer 2007; concentrations are expected to decrease over time.

The following exceedances of the EWV were observed in the past five years (January 31, 2003 to December 31, 2007):

- **1,1-Dichloroethane** – Well TL-09B exceeded the EWV during 2nd quarter 2005. The concentration continues to decrease over time in this well (Figure 3-24).[8]

- **1,2-Dichloroethane** – Wells TL-09B and TL-26B had several exceedances of the EWV over the past five years. Concentrations in both wells appear to be decreasing over time (Figure 3-25).

- **Methylene Chloride** – Well TL-01B has had three exceedances of the EWV over the past five years (Figure 3-28). The exceedances are likely due to contamination that occurred during well re-installation in late-summer 2007.

[8] Well TL-17BR had one exceedance of the EWV in 2004. This well, however, is an off-site upgradient monitoring well contaminated by the plume generated from the former New Frontier Lanes bowling alley.

TL-25B had one exceedance of the EWV in 2005; this appears to be an outlier likely caused by lab contamination.

- **Trichloroethene** – Well TL-11B continues to exceed the EWV over the past five years. Current and long-term trends indicate continued concentration decrease (Figure 3-29).

- **Vinyl Chloride** – Wells TL-01B, TL-09B, TL-26B, and TL27B had exceedances of the EWV during the past five years. None of these wells have exceeded since 4th quarter 2006 with the exception of TL-01B (Figure 3-30). TL-01B had three exceedances of the EWV in 2008 which is likely due to well resintallation that occurred in 2007.

- **Arsenic, total** – Wells TL-11B and TL-25B had exceedances of the EWV during the past five years. Well TL-25B had only one exceedance and the concentration in TL-11B continues to slowly decrease over time (Figure 3-31).

C Completion Monitoring Wells

Groundwater performance criteria were not exceeded for any compound in the C completion monitoring wells during the past five-year monitoring period with the exception of one exceedance in TL-05C for vinyl chloride in 2004.

The following exceedances of the EWV were observed in the past five years (January 31, 2004 to December 31, 2008):

- **1,1-Dichloroethane** – Wells TL-19C and TL-20C had exceedances of the EWV during the past five years. The concentration in both wells continues to decrease over time (Figure 3-33).

- **1,2-Dichloroethane** – Well TL-20C exceeded the EWV during the past five years. Concentrations during the past five years are generally decreasing over time (Figure 3-34).

- **Benzene** – Well TL-01C and TL-02C both had one exceedance of the EWV for samples collected on the same day in 2005. Benzene was not detected in either well during all subsequent sampling events.

- **Methylene Chloride** – Well TL-20C had one exceedance of the EWV over the past five years (Figure 3-37). Note: Sample was collected in duplicate, which is why two points are shown on the Figure. Since the concentration quickly returned to less than the detection limit (0.5 µg/L), this exceedance is not a cause for concern.

- **Vinyl Chloride** – Wells TL-05C and TL-20C exceeded the EWV over the past five years. Concentrations continue to decrease over time for all three wells (Figure 3-38).

- **Arsenic, total** – Wells TL-05C and TL-10C exceeded the EWV over the past five years (Figure 3-39).

3.2.4 Satisfaction of Second Requirement

The groundwater analytical data generally indicate that contaminant concentrations are decreasing over time. For vinyl chloride, an order of magnitude decrease in concentrations has occurred since the first five-year closure extension request. Due to the low contaminant concentrations in the majority of the wells, the City submitted a request to shutdown the majority of wells since the performance standards for cleanup identified in the Consent Decree have been achieved.

The low contaminant concentrations detected in downgradient wells indicate leakage past the groundwater extraction-treatment system is minimal and is within the design parameters for the GETS. These leakages have not significantly slowed plume shrinkage. The results indicate that the Consent Decree requirements described in Section 3.2.1 are being fulfilled.

3.3 THIRD REQUIREMENT – RECYCLING AND HAZARDOUS MATERIALS COLLECTION PROGRAM

Requirement: "That since the effective date of the Consent Decree, the Settling Defendant has instituted and is operating an aggressive solid waste recycling and hazardous materials collection project."

This section will discuss the programs that the City implemented to ensure compliance with the third Consent Decree requirement. This section will also provide a brief narrative on the rationale the City has used to reach the conclusion that the third Consent Decree requirement has been satisfied.

Since the third Consent Decree requirement does not provide numerical goals that have to be met or specific programmatic requirements, determination of compliance with this goal is subjective. The language of the requirements suggests that a focus on collection programs and the implementation and operation of the programs and not the attainment of numerical goals is more important.

3.3.1 Tacoma Waste Diversion Programs and Facilities

Since 1988, the City has been implementing innovative and aggressive programs to collect and process recyclable material to divert these materials from the landfill. Table 3-5 summarizes the City's recycling programs, including the year of implementation and the materials being collected or banned from disposal. Further descriptions of the services and facilities provided at the Tacoma Landfill are included below.

3.3.1.a Collection Programs

Residential Curbside Recycling

The City collects recyclable materials from its residential customers at the curb. Participation in the curbside recycling program is voluntary. Tacoma's residential curbside recycling program collects recyclable materials from households ranging from single family to fourplexes, and is based on a commingled collection system for all materials with the exception of glass and household batteries which are placed in a separate container. In 2007, over 48,000 customers were signed on to the City's curbside program, which equals about 92% of Tacoma's 52,000 single-family customers. Residents recycled 18,330 tons of material in 2007 through the curbside

collection program, which is nearly five times the amount recycled in the first extension request prepared in 1995.

For each participating customer, the City provides every other week pickup of plastic containers and film, polycoated paperboard, mixed papers, cardboard, aluminum, steel (tin) and aerosol cans, glass containers, magazines and catalogs, newspaper, phone books and household batteries. Participants commingle everything but the glass and batteries into one large container. Recyclable materials collected at the curb are taken to a private business where they are manually sorted into individual components and marketed.

Multi-Family Curbside Recycling

Curbside collection of recyclable materials is also provided for multi-family residential complexes in Tacoma. Duplexes, triplexes, and fourplexes in the City have received residential curbside recycling service since the inception of the program in 1990. They were transitioned to the commingled program when it went City-wide in 1997.

In 2002-2003, the City piloted a commingled recycling program for larger complexes. The pilot program showed that commingled recycling would work for larger complexes if the management and maintenance staff were willing to follow up with tenants who don't cooperate. The program will require a large investment in equipment and labor to make recycling available to all Tacoma apartment residences. Tonnages collected from multi-family buildings are included in one of two areas, commingled recycling or commercial recycling. In recent years, the multi-family program has been combined into the commercial recycling program, as the containers and trucks service both types of businesses simultaneously.

Commercial Customer Curbside Recycling

The City collects recyclable materials from commercial customers at the curb. Small businesses and schools participate in the same commingled program as the residential customers. Businesses that generate large quantities of glass and containers, such as restaurants and taverns, are served by a source separated five-bin system[9]. Businesses that generate large amounts of cardboard are served by our cardboard recycling program. This service is provided to customers on a voluntary basis.

In 2006, between 3,000 and 4,000 tons of material were collected in the City's commercial curbside programs. This is a slight increase over previous years. These results do not include businesses that receive recycling services provided by several private recycling companies in the Tacoma area. In 2009, SWM is implementing a major expansion of the commercial recycling program. The purpose of this expansion is to increase the number of customers and tons of diverted materials. It is hoped this will double the number of commercial recycling customers and increase the tons by 50%.

[9] The 5-bin system includes three containers to collect glass (clear, brown, green), one container for newspaper, and one container for tin cans.

Curbside Collection of Yard Waste

The City provides curbside yard waste service collection for residential customers. City yard waste collection trucks collect yard waste from participating customers at the curb every other week. Participation is voluntary. Pickups are made on the same day as curbside recycling collection, which also coincides with normal garbage collection.

In 2007, the City collected 23,780 tons of yard waste through the curbside collection program. This is nearly triple the amount recycled in 1995. The yard waste brought in by Tacoma curbside collection vehicles or self-haul customers is consolidated into transfer trailers and trucked to an area composting company where it is ground, composted with other organic waste, and then marketed as a soil amendment.

Produce Waste Recycling

The City began collecting produce waste from commercial customers in 1991. Produce waste was selected because the yard waste-composting program was already in operation and produce waste was identified as a compostable portion of the waste stream that can be diverted from the landfill. This program is currently offered to grocery stores, florists and certain restaurants that agree to separate plant waste from animal/seafood waste. Collection of produce waste is made twice per week in the cold months and three times per week in the warm months using semi-automated collection equipment. In 1995, 398 tons of commercial produce waste was recycled as a result of this program, while 486 tons of produce waste were recycled in 1996. In 2007, 400 tons of pre-consumer produce waste was recycled from 32 businesses.

In 2009, the City is planning a pilot program to collect and recycle commercial food waste, including both pre and post-consumer food waste. This pilot will increase the amount of available material that can be recycled, and also increase the number of customers that can participate in the program.

Waste Oil Recycling Program

The City collects and recycles used motor oil at convenient locations throughout the city. Waste oil has been collected at the landfill since 1988. SWM is now promoting used oil recycling at collection tanks established at four Schuck's Auto Supply stores and two NAPA Auto Parts stores within the City. Residents are urged to bring waste oil from automobiles, motorcycles, boats and lawn mowers to the tanks, as long as the oil is not mixed with other substances. (Used oil from Tacoma maintenance operations is also collected at various City of Tacoma Fleet Maintenance shops, Tacoma Belt Line, the Police garage, and Public Utilities maintenance shops.) The oil from this collection program is reprocessed for use as a fuel.

In 1994, the City recycled over 100,000 gallons of waste oil as a result of this program. Since 1994, SWM has collected an average of 88,582 gallons per year with a decreasing trend over the years. In 2007, the waste oil collected decreased to 75,126 gallons. The decrease in waste oil collected is likely due to the increased number of private collection sites available and a decrease in do-it-yourself oil changers. Used motor oil was targeted for collection because of its potential to contaminate groundwater and the Puget Sound ecosystem and because of the high volume of this waste.

3.3.1.b Tacoma Landfill Waste Diversion Facilities

Recycling Center

The Recycling Center, located at the Tacoma Landfill, collects aluminum cans, steel (tin) cans, aerosol cans, scrap metal, tin foil, glass containers, #1 PET plastic, #2 HDPE natural and colored, glossy magazines/catalogs, newspaper, cardboard, phone books and mixed waste paper. In 2001, at the same time the City expanded the curbside recycling program, the City added #3 - #7 plastics, polycoated paperboard, and plastic film to the items collected at the Recycling Center. In 2003, the City partnered with the local Goodwill Industries to collect used household goods and clothing and used building materials. The building materials go to a company called ReHarvest which trains disadvantaged workers in deconstruction and warehouse/retail skills. In 2004, the City added packing peanuts and clothes hangers to the list of materials collected at the Center.

Since one of the more effective waste recycling options at this time is local charities, an agreement was formed with the local Goodwill Industries chapter to provide a drop off station at the Recycling Center. This helps increase the awareness of this recycling option for users of the Tacoma Landfill. This agreement with Goodwill Industries was the second agreement of this type in the state, and it has been a successful partnership for both parties. For Goodwill Industries, the site offers many advantages over most of its other drop off sites, such as a covered working area, after-hours security, and restroom facilities at no charge to the organization.

The Recycling Center is open to the general public and commercial businesses seven days a week from 8 AM - 6 PM. In 2006, 2,135 tons of material was diverted at the Recycling Center. In 1995, 1,723 tons of material was collected for recycling. Tonnages decreased in 1996 to 1,627 tons, possibly due to the implementation of the curbside recycling pilot program.

Household Hazardous Waste

The centerpiece of the City's efforts to reduce hazardous wastes from entering the landfill is the permanent Household Hazardous Waste (HHW) Collection Facility. This facility collects all types of HHW from City residents and disposes or recycles the wastes through properly permitted treatment, storage and disposal facilities. This service is available to all Tacoma and Pierce County residents and is very successful at diverting HHW. This ongoing opportunity to properly dispose of HHW was first implemented at a temporary facility on Tacoma's landfill property in 1990, and was then moved to the permanent facility located near the Recycling Center.

In 2002, the City added the collection and recycling of fluorescent light bulbs to the collection capability at the HHW Facility. This service is offered to both residents and small generators, making this one of the more comprehensive diversion programs around.

In the latter part of 2003, a new program to collect cell phones was initiated as a pilot. Cell phones and their batteries have toxic components such as cadmium, nickel, and mercury. This program helps remove these waste phones from the disposal stream and get them to recycling facilities.

Tacoma's HHW diversion programs have been very successful. In 2006, over 8,300 City and County customers used the HHW collection services and approximately 100 tons of HHW was diverted during that time.

3.3.1.c On-Site Diversion and Source Control Efforts

Recyclable Materials – On-Site Diversion

Several recyclable materials are identified at the landfill scale house by landfill workers. These materials are separated for recycling at the landfill receiving area. Self-haul customers are directed to specific bays to unload the following recyclable materials: computer CPUs, scrap metal, white goods (appliances), tires, and yard waste. Nurseries and landscaping businesses are the primary customers self-hauling yard waste to the landfill. All yard waste self-haul customers are directed to dump their loads into transfer trailers bound for local composting companies. In 1996, 989 tons of scrap metal and appliances and 4,750 tons of yard waste were collected for recycling at the landfill receiving area. In 2007, scrap metal collection was over 1,750 tons, while approximately 6,500 tons of yard waste was diverted at the landfill.

Hazardous Materials – Source Control

Commercial hazardous waste diversion uses a combination of City source control efforts and existing vendors that handle regulated hazardous waste. The City's source control efforts utilize business assistance visits to audit businesses in the Tacoma service area and inspection of solid waste loads delivered to the landfill (Load Checking). Approximately 500 Tacoma businesses are visited each year, but the goal is to reach 1,000 businesses in 2009. Assistance visits usually comprise of an audit of hazardous waste handling practices, generation rates, storage methods and disposal records. At some businesses, checks of waste containers before collection is performed as an additional source control effort.

Load checks are performed at the landfill on waste that has been transported to the landfill. Waste loads are selected both randomly and by segregating specific loads from targeted businesses. Loads are inspected for regulated wastes and free liquids. City personnel are also instructed to inspect or observe waste loads at the scale house and at the various tipping facilities at the landfill.

Businesses that dispose of hazardous wastes improperly are directed to the vendors that provide hazardous waste services. Because there is an existing private infrastructure for handling small quantity and large quantity generator hazardous wastes in Pierce County, the City determined it was not necessary to compete with the existing hazardous waste disposal companies.

In the latter part of 2002, Tacoma implemented a campaign to aid in the diversion of hazardous materials from the solid waste stream. This campaign targeted mercury reduction within households and businesses in Tacoma. This included a thermometer exchange at local drug stores and the Tacoma Home and Garden Show, a mercury awareness program to educate residents on the hazards associated with mercury, a collection program to divert mercury containing waste from municipal solid waste (MSW), a thermostat exchange program, a technical assistance program to advise local businesses on how to properly handle and dispose of mercury, and a dental amalgam diversion program.

3.3.2 Tacoma Waste Reduction and Environmental Stewardship Programs

Tacoma also sponsors or participates in other programs that stress waste reduction, recycling, or environmental stewardship. A brief summary of those programs is provided here.

- **Grass Cycling and Green Gardening** – Since its inception, the City has participated in the region-wide grass cycling and green gardening program. This program provides low cost electric mulching mowers at a reduced price, with the City providing additional rebates as an incentive to purchase. The electric mulching mowers reduce the amount of solid waste and air pollution generated when compared to normal grass cutting with gasoline mowers. As part of the promotion, the City recycles gasoline mowers to remove the mowers from use.

- **2Good2Toss** – The City participated along with Ecology in a regional effort to sponsor 2Good2Toss, which is an online exchange that encourages the reuse of usable materials. This popular program has helped facilitate the transfer of usable materials region-wide.

- **Green Building Promotion** – The City has actively participated in the various green building programs. The City has sponsored a workshop on the topic for local government employees and contractors. The City has also worked with the Master Builders Association to foster a program for implementation through that group.

- **Waste Free Holidays** – Waste Free Holidays is a program developed by King County Solid Waste. SWM participated in cooperation with King County, the City of Seattle and Pierce County. In the Waste Free Holidays program, participating businesses and organizations offer discounts of 15 to 50 percent on music, plays, sporting events, museums, restaurant meals, massages and much more. The idea is to give experiences instead of gifts that require packaging or wrapping. The Waste Free Holidays program rewards the public for reducing waste, and supports local businesses.

- **EnviroHouse** – The City of Tacoma EnviroHouse is a hands-on showcase of green building and landscape ideas, materials and techniques to create a healthy home and planet. Featuring the latest advances in green building design and construction, the EnviroHouse champions the benefits of sustainable living and building practices to homeowners, builders, suppliers, landscapers, real estate agents and the general public, highlighting readily available products for new and existing homes and yards. Visitors are able to see and touch everything from recycled building materials and furniture, non-toxic building materials and ways to conserve water and energy both inside and out.

- **Climate Change** – Staff from the City's Public Works Department and SWM have taken leadership roles in the City's effort to address global warming. In 2006, the Tacoma City Council passed a resolution that requires City staff to evaluate emissions and identify measures that the City can take to reduce greenhouse gas emissions. Because of past work on the issue, SWM is responsible for performing the emissions inventories and evaluating potential response measures. SWM is also staffing a public process to set Carbon Dioxide emissions reduction goals and strategies to reduce greenhouse gas emissions in the City.

- **Electronics Product Stewardship** – The City has been an active participant in the electronics product stewardship issues and is now a participant in the Northwest Product Stewardship Council steering committee.

3.3.3 Community Education and Outreach

3.3.3.a Promotion of Recycling Services

The City uses many different avenues to promote its programs, with a heavy reliance on direct mail advertising. Some of the specific messages include:

- A yearly mailing of a recycling brochure to each single-family household in Tacoma.
- Quarterly newsletters called "EnviroTalk" with information on recycling and household hazardous waste disposal and overall solid waste issues.
- Information in utility bill inserts.
- Periodic education pieces on the local municipal television station, which is aired on local cable access stations.
- An education display at the Tacoma Landfill.
- Presentations to community groups, business groups, and other organizations, as well as presentations to all levels of students, from elementary school to college level classes.
- Landfill tours for different community and school groups.
- Miscellaneous brochures and pamphlets promoting waste reduction and recycling are produced and distributed.
- Staff is available during regular business hours to answer a phone line dedicated to recycling and waste reduction.
- The City participates in fairs, shows and other events where staff can communicate with significant amounts of people in a target audience.

3.3.3.b School EnviroChallanger Program

The EnviroChallenger Program was started in 2000 to teach Tacoma's children how they can help keep the Puget Sound environment healthy. The EnviroChallenger educators go to Tacoma's public and private schools and teach hands-on environmental science lessons to kindergarten through eighth grade students. Students learn how their actions can affect the environment, how to identify healthy habits, how to recognize the factors that harm the Puget Sound environment, and what actions they can take to maintain the health of our local waterways. This project helps prevent future stormwater problems, reduces toxic discharges into Puget Sound, increases recycling, and reduces the amount and toxicity of waste generated in Tacoma. The City's Public Works Department / Environmental Services sponsors the program.

The EnviroChallenger Program targets a culturally diverse student population. Enrollment in Tacoma Public Schools is 23% African American, 13% Hispanic, 12% Asian, 2% Native American, 1% Pacific Islander and 49% white.

The EnviroChallenger Program is expected to travel to two classrooms per day, teaching two lessons to second through eighth grade classes, within six topic areas. All of Tacoma's 36 elementary schools, 11 middle schools, and up to 12 private schools, as well as home school organizations, are targeted for EnviroChallenger visits.

A secondary audience is the general community, particularly parents, guardians, and grandparents of public and private school elementary children that will join their children in environmental learning. The program expands its reach by attending a variety of community events, primarily on weekends. In 2007, the EnviroChallenger educators attended 30 different events contacting approximately 3,500 community members.

Since its inception in 2000, the EnviroChallenger educators have booked or delivered programs to more than 50 schools in Tacoma, logging 4,621 in-class lessons, which represents 106,283 opportunities to get waste reduction and conservation messages to second through eighth grade students and their parents.

Due to the program's popularity, the City added a second education van in May 2003.

3.3.3.c Commercial Education Programs

Technical assistance regarding recycling and hazardous waste disposal is available to businesses. Upon request, a resource conservation specialist from SWM visits a business and helps determine which waste materials currently produced can be recycled, which of the recycling methods would be the most cost effective, and ways to prevent excess waste being generated. The expert can also help the business get set up for recycling. In addition, routine audits are performed to reduce the amounts of hazardous wastes disposed in the solid waste stream. During these audits performed by SWM staff, recycling information and assistance is also delivered to businesses that can benefit from this assistance.

In 2009, the goal for waste audits is 1,000 visits.

3.3.4 Waste Diversion and Reduction Program Awards

The City's waste diversion and reduction programs have been recognized by many groups as innovative and effective. Some of the awards and recognition the City has received for its programs are listed below.

- 2005 Award of Distinction, Tacoma Recycles at Work Program.
- 2004 Recycler of the Year, Washington State Recycling Association.
- 2000 Association of Washington Cities Livability Award for recycling operations and PR campaign.

- 1999 Association of Washington Cities Municipal Achievement Award for the "Talking Trash" campaign.

- 1999 Washington State Department of Ecology Solid Waste Reduction and Recycling Award for Best Large Government program.

- 1995 National Recycling Coalition *Outstanding Urban Program*, City of Tacoma Recycling Program.

- 1994 *James C Howland Award for Urban Enrichment, Honorable Mention*, City of Tacoma Community Waste Oil Recycling Program (sponsored by National League of Cities CH2MHill).

- 1994 Washington State Department of Ecology Solid Waste Reduction and Recycling Award, *Best Government Program in Western Washington*, City of Tacoma Solid Waste Utility.

- 1994 *Weyerhaeuser Company Foundation for Recycling*, Tacoma Public Schools/Solid Waste Utility Waste Watchers paper recycling program.

- 1993 *Washington Ecological Commission Environmental Excellence Award, Best Public Agency*, City of Tacoma Solid Waste Utility community waste oil recycling program.

- 1992 National Environmental Achievement Award (sponsored by City and State Magazine) *Best Mid-sized City Recycling Program in the Nation*, City of Tacoma Solid Waste Utility.

In addition, the program's public relations staff won numerous awards from agencies recognizing their quality public relations work.

3.3.5 Recycling Program – Anticipated Future Improvements

While the City's recycling programs have received state and national recognition, the programs continue to be evaluated in hopes of further refining the recycling efforts in the City. The City has evaluated potential improvements to the solid waste collection and recycling programs, which would increase the amount of recyclables diverted from the waste stream.

Many of the planned improvements for the City's recycling programs have been identified in previous sections. A summary of those improvements is provided here.

Commercial Recycling – In 2009, the City is implementing a major expansion of the commercial recycling program. The purpose of this expansion is to increase the number of customers and tons of diverted materials. It is hoped that the expanded program will double the number of commercial recycling customers and increase the tonnage by 50%.

Commercial Food Waste Recycling – In 2009, the City is planning a pilot program to collect and recycle commercial food waste, including both pre and post-consumer food waste. This pilot will increase the amount of available material that can be recycled, and also increase the amount of customers that can participate in the program.

3.3.6 Satisfaction of the Third Requirement

The City's aggressive efforts to implement, operate, and improve the diversion of hazardous materials and recyclable materials is well documented. The City has satisfied the third Consent Decree requirement based on the following:

- The City's recycling programs offer one of the widest ranges of materials that can be recycled.
- The City offers its citizens excellent access to its recycling services, both at the curb and at drop-off stations.
- The City's recycling programs have been recognized on both a national and state level, as proven by the numerous awards the programs have received. The Hazardous Waste Program was featured in a national publication that focuses on effective and innovative collection programs.
- The Hazardous Waste diversion program achieves a very high participation rate for HHW collection, and the historical efforts of the City in HHW and commercial hazardous wastes is providing dividends in reduced hazardous wastes found in waste loads at the landfill. The comprehensive nature of the small quantity generator program, which includes many different source control efforts, has been highly effective at reducing commercial hazardous waste disposal at the landfill.
- The willingness to pursue changes to improve an award winning Recycling Program indicates the City's commitment to capturing the highest possible percentage of recyclable materials, and the commitment to aggressive, effective programs.

3.4 FOURTH REQUIREMENT – ALTERNATIVE DISPOSAL OPTIONS

Requirement: "That other feasible solid waste management alternatives to disposal at the landfill do not exist."

This section describes how the alternative disposal requirement is fulfilled by continuing to identify the Central Area as an emergency disposal alternative.

The City contends that the Central Area should continue to be allowed as an emergency disposal site in the event of unforeseen conditions that would prohibit disposal by long haul because:

1. The Central Area has not contributed to contamination;
2. The City continues to fulfill the remedial actions identified in the Consent Decree; and
3. By serving as an emergency disposal site, the Central Area provides a substantial benefit to the environment, Tacoma residents, and the surrounding local community.

3.4.1 Central Area – Not Responsible for Contamination

The Central Area has not contributed to contamination of the groundwater surrounding the landfill. In fact, the Central Area is a lined cell that was operating when the Consent Decree was signed. The cell has been permitted as an existing landfill under WAC 173-351.

Section 3.1 and 3.2 provide the backup information necessary to show that the Central Area is not contributing to contamination. The primary evidence to support this argument includes:

- **Liner Performance** – The Central Area liner's estimated leakage rate is nearly 7 times better than the classification as a Great Liner by EPA Standards (EPA, 1991).

- **Leachate Data** – The leachate collection and detection data indicates that the system is performing well and is within the design expectations for this type of system. The City will continue to monitor leachate flows over time to help identify any changes in performance.

- **Groundwater Contamination Decreasing** – Groundwater contamination near the landfill is decreasing (Section 3.2.3) and the majority of wells have no detectable levels of contamination. Due to the low levels of contamination, the City submitted a request in 2007 to shut down the majority of the EOP and POC wells.

3.4.2 Continued Progress of Remedial Actions

The City is continuing to fulfill the remedial actions identified for the site to protect human health and the environment. Allowing the Central Area to remain open for emergency use will not impact or delay any of these remedial actions. The primary remedial actions are:

1. Operating the groundwater extraction-treatment system until sampling results indicate that the system can be shutoff.

2. Maintaining the gas extraction system to ensure landfill gas does not leave the site.

3. Monitoring and maintaining the existing landfill cap.

3.4.3 Substantial Need for Emergency Disposal Sites within the Community

The need for emergency debris disposal capacity in an urban environment such as Tacoma is well documented in federal guidance documents and through lessons learned recently by communities in other parts of the country responding to disaster events.

It is unlikely that maintaining the Central Area for emergency capacity was a consideration when the Consent Decree was signed. As a result of recent disasters, the need for disaster planning has become a priority for federal, state, and local governments. Maintaining the Central Area as a regional emergency disposal option is a critical component for disaster planning and will allow the region to respond in a timely manner to public health threats presented during and following a disaster.

The need for the Central Area to serve as an emergency disposal site is supported by the discussions in the following sections:

3.4.3.a Emergency Disposal Planning – Guidance Documents

The need for emergency debris disposal options has been identified by numerous federal agencies. The following guidance documents discuss the need for emergency disposal sites:

- Planning for Natural Disaster Debris, US Environmental Protection Agency, March 2008 (Appendix I).

This document was prepared for local communities to assist in the creation of disaster debris management plans. The document includes recommended components of disaster debris management plans, case studies documenting how several communities planned for and managed debris generated by a recent natural disaster, and other helpful guidance for federal, state, and local resources to consult with in planning for natural disasters.

The document states: "Having an inventory of existing waste management facilities, their capacities, and capabilities, and planning for additional temporary storage/staging and disposal options will help…Making sure that debris management is accomplished in an environmentally sound manner will protect the community during and immediately after the natural disaster occurs, as well as, into the future."

- Debris Management Guide, FEMA-325, US Federal Emergency Management Agency, July 2007 (Appendix J).

  This document was prepared by the Federal Emergency Management Agency (FEMA) to assist communities in developing debris management plans and ensuring that these plans are consistent with FEMA's eligibility criteria. The document also discusses the pros and cons of debris management sites, which are temporary sites used to store, reduce, segregate, and/or process debris before it is hauled to its final disposal sites. Debris management sites are frequently used when landfill space is limited or when the landfill is not in close proximity to the debris removal area.

- Urban Area Security Initiative – Disaster Debris Management Plan

  The Seattle Urban Area Security Initiative region, composed of King, Pierce, and Snohomish counties, is in the process of developing a disaster debris management plan. A draft of this plan is included in Appendix K. The draft plan identifies the Central Area of the Tacoma Landfill as an existing regional landfill with remaining capacity.

  The next step in the planning initiative is to work with counties and then with cities to develop individual debris management plans. This planning effort will also create inter-local agreements between cities and between counties in order to effectively work together during an emergency. This work, which will include planning for Pierce County and the City, is expected to be completed in 2009. The City anticipates that the Central Area of the Tacoma Landfill will be an integral part of the City's and region's debris management plans.

3.4.3.b Examples Demonstrating the Need for Emergency Disposal Sites

The following are recent examples of landfills that were used for emergency disposal following a disaster in the local community:

- **New Orleans, LA** – The Gentilly Landfill, which was a closed landfill and a Superfund site, was reopened in the wake of Hurricane Katrina to process disaster debris and serve as a disposal site.

- **Pensacola, FL** – The Saufley Landfill, a construction and demolition landfill, received disaster debris from hurricanes in 2005 and 2006.

- **New York, NY** – The Staten Island Landfill (a.k.a. Fresh Kills Landfill) was reopened following the September 11 terrorist attacks. An estimated 1.2 million tons of debris were disposed at the landfill over a nine month period.

- **Palm Beach County, FL** – The Palm Beach County Solid Waste Authority accepted hurricane debris at their landfill and waste to energy plant.

- **Oklahoma** – The Oklahoma Department of Environmental Quality identified numerous existing and permitted landfills that could potentially receive vegetative debris from a 2007 ice storm.

The following table, excerpted from CH2M Hill's Draft Disaster Management Plan under the Urban Area Security Initiative (UASI), summarizes the amount of debris generated from recent disasters.

Disaster	Volume	Type
Hurricane Andrew: Metro-Dade County (FL)	43 million CY	disaster debris
Northridge Earthquake (CA)	7 million CY	disaster debris
World Trade Center (NY)	2.8 million CY	disaster debris
Hurricane Katrina (AL)	2 million CY	disaster debris
Hurricane Katrina (MS)	42 million CY	disaster debris
Hurricane Katrina (LA)	50 million CY	disaster debris
December 2007 Floods: Lewis County (WA)	15,600 CY	vegetative debris
December 2007 Floods: Lewis County (WA)	77,000 CY	sediment
December 2007 Floods: Lewis County (WA)	30,600 CY	household flood related debris

The Central Area has approximately 290,000 CY of remaining capacity. This means the Central Area could provide final disposal for all the waste generated from a disaster more than twice as large as the December 2007 Lewis County floods (123,200 CY total disaster debris).

3.4.4 Regional Emergency Disposal Sites

There are only three available disposal sites within the Puget Sound region (Figure 3-40):

- Cedar Hills Landfill – 16645 228th Ave SE, Maple Valley, WA 98038

  The Cedar Hills Landfill is located 33 miles northeast of the Tacoma Landfill. The primary transportation corridor between the two landfills is Highway 16, Interstate 5, Highway 18, and Cedar Groves Road. Traveling along this route requires the crossing (on/under) of forty-seven (47) bridge structures. One of these structures crosses the Puyallup River, one the Duwamish River, and two the Cedar River.

- 304th Street Landfill (LRI) – 30919 Meridian St E, Graham, WA 98338

  The 304th Street Landfill (LRI) is located 28 miles southeast of the Tacoma Landfill. The primary transportation corridor between the two landfills is Highway 16, Interstate 5, Highway 512, and Meridian Road. Traveling along this route requires the crossing (on/under) of 24 bridge structures.

- Tacoma Landfill – 3510 S Mullen St, Tacoma, WA 98409

  Tacoma Landfill is located in central Tacoma and serves the City. In an emergency, the landfill would also serve as a regional disposal site for the South Puget Sound. The majority of the Pierce County population lives in Tacoma and the adjacent communities. The Central Area is adjacent to Highway 16, near Interstate 5.

Disadvantages for Tacoma and the South Puget Sound in using the Other Regional Emergency Disposal Sites

The utilization of either Cedar Hills or LRI as an emergency disposal site for the City and the South Puget Sound region is problematic. Neither of the landfills is located within the core population area for the region and the primary transportation corridors to both facilities are susceptible to damage and closure as a result of a disaster.

Distance of Alternate Disposal Sites to Tacoma/Pierce County Core Population

In order to provide the greatest benefit during an emergency situation, an emergency disposal site should be located as close as possible to the disaster site and core population area. Neither of the alternate disposal sites (Cedar Hills or LRI) is in close proximity to the core population area for the south Puget Sound region. This will result in longer transit times to the disposal sites which will slow the recovery efforts during a disaster. In addition, there will likely be limited resources such as vehicles, fuel, and staff. These limited resources will negatively impact recovery efforts, especially when distances to disposal sites are lengthy, and could result in loss of additional life or property.

Potential Closure of Primary Transportation Corridor

As indicated above, the primary transportation corridors to the alternate disposal sites require the crossing of a significant number of bridge structures. These structures are susceptible to damage during earthquake and/or flooding events. Damage to one or more of these structures will very likely prevent access to the potential emergency disposal sites, and result in major traffic detours that could significantly impact the ability to utilize alternate routes.

3.4.5 Benefits to Tacoma and South Puget Sound in Retaining the Tacoma Landfill as a Regional Emergency Disposal Site

The Tacoma Landfill Central Area emergency disposal utilization provides many benefits to the citizens of Tacoma, the South Puget Sound region, and the environment.

Location

As indicated above, in order to provide the greatest benefit during an emergency situation, an emergency disposal site should be located as close as possible to the disaster site and core population area.

The Central Area of the landfill provides the following benefits:

1. The landfill is located in the most densely populated area of Pierce County based on the 2000 census (Figure 3-41).

2. By being located in the core population area, the landfill provides shorter transit times for disposal. This will allow emergency responders to reach affected locations faster, which is critical in minimizing losses of human life and property.

3. Limited resources (e.g., personnel, vehicles, fuel, and staff) may be available to conduct the cleanup due to the nature of the disaster. By minimizing the distance between the debris location and the disposal site, these resources can be best utilized and the site can be cleaned up faster.

Existing Infrastructure

The landfill has environmental controls and infrastructure in place to handle solid waste. The site also has the required infrastructure to manage landfill traffic, sorting of recyclables and other debris, and fencing to limit access to the disposal area.

These controls include the leachate and condensate collection system, stormwater runoff collection and treatment systems, groundwater monitoring infrastructure and monitoring programs, and gas collection infrastructure and monitoring programs.

Permitted Solid Waste Site

The landfill is permitted under WAC 173-351 as an existing landfill. In addition, the landfill's Solid Waste Permit currently allows the use of the Central Area during an emergency situation.

3.4.5.a Example Events Where the Central Area is Needed

Below are a few example situations that demonstrate the critical need for the Central Area of the landfill during an emergency situation:

- **Earthquake** – There are numerous faults in Tacoma and the Puget Sound area. These include the Tacoma Fault Zone, Seattle Fault Zone, Olympia Fault and the Hood Canal Fault. Tacoma is located on the Tacoma Fault Zone as shown on Figure 3-42. A significant earthquake along these faults will likely cause substantial damage to infrastructure and property in Tacoma and the surrounding Puget Sound area.

  In addition, another subduction zone earthquake similar to the February 2001 6.8 magnitude earthquake or greater will likely cause substantial damage.

  The table below lists some recent subduction zone earthquakes that impacted in the Tacoma/Pierce County area.

Date	Magnitude
July 22, 2001	4.3
June 10, 2001	5.0
February 28, 2001	6.8
July 2, 1999	5.8

April 29, 1965	6.5
April 13, 1949	7.1

- **Tsunami** – A tsunami could occur in the South Puget Sound region following an earthquake along either the Tacoma Fault, Seattle Fault, or the Rosedale-dominant Tacoma fault. As shown in Figure 3-43, any of these earthquakes could create several feet of inundation in the Port of Tacoma region (Appendix L) which would impact the north-south transportation route.

- **Flooding** – A significant portion of the Puyallup River valley lies within the potential flood hazard area identified by Pierce County (Figure 3-44). A significant flood would likely impact the north-south transportation route and could require significant evacuations along the Puyallup River valley. Note: FEMA is currently revising the 100-year and 500-year floodplain maps. These revisions are expected to significantly increase the areas that are within the floodplains.

- **Mount Rainier Volcanic Eruption** – A lahar generated by eruption of Mount Rainier would impact more than 150,000 people (USGS, Appendix M) in the South Puget Sound region and would cause significant damage to the area. Even a moderately sized event (Figure 3-45) would generate flows through the Puyallup River valley and the Tacoma tide flats prior to discharging into Commencement Bay.

- **Terrorist Attack** – A terrorist attack could result in infrastructure damage impacting the ability to transport and dispose of waste. This further emphasizes the need for a local emergency disposal site.

3.4.6 Satisfaction of the Fourth Requirement

The Central Area did not contribute to the contamination caused by the unlined cells of the landfill and it was designed with the appropriate environmental safeguards to protect the environment. The data presented in Sections 3.1 and 3.2 show that these safeguards are functioning as designed.

The benefits of using the Central Area for emergency disposal are:

- Location within the core population area;

- Permitted landfill cell; and

- Protective of human health and the environment.

The fourth requirement language included in the Consent Decree could not anticipate today's change in circumstances that have increased the importance of emergency disposal sites. Examples throughout the country over the past several years, however, have clearly demonstrated the need for emergency disposal sites that are in close proximity to the disaster.

For these reasons, the City believes that the Central Area should continue to serve as an emergency disposal site in the event that a natural or man-made disaster prohibits disposal by long haul.

4.0 FULFILLMENT OF 2ND CLOSURE EXTENSION APPROVAL REQUIREMENTS

This section discusses how the City has complied with the requirements included in the 2nd closure extension request approval dated February 25, 2005.

4.1 FIRST REQUIREMENT – EMERGENCY DISPOSAL

Requirement: "The City has permission to use the Central Area for waste disposal in emergencies only. For purposes of this condition, "emergency" shall be defined as an atypical situation that is not caused by any act or omission on the part of the City or its agents, but rather is caused by unforeseen circumstances that prohibit, in the short-term, disposal off-site. Examples of an "emergency" in this context are a natural disaster, a system failure, or a labor dispute. In the event that the City encounters an "emergency", as defined herein, the City shall give EPA and Ecology notice that it has disposed waste in the Central Area. Such notice shall (1) describe the emergency necessitating such disposal and the approximate amount of waste disposed of in the Central Area, and (2) be sent to EPA and Ecology no later than seven days after the event occurs. In the event that the City seeks to dispose waste in the Central Area for a "non-emergency" purpose (e.g., construction project at the site that would have the result of temporarily preventing off-site transport of waste), the City shall apply to EPA and Ecology for permission prior to such disposal. It shall be solely within EPA and Ecology's discretion to grant or deny such permission."

Since the last five year extension, no "emergency" events occurred that required the City to dispose of waste in the Central Area. The City did re-dispose waste excavated from the Central Area back into the Central Area during a landfill mining pilot study conducted in the summer of 2007. The City received pre-approval from EPA and Ecology to re-dispose of this waste in the Central Area as required under this emergency disposal requirement.

4.1.1 Satisfaction of the First Requirement

The City has complied with the requirements related to emergency disposal included in the 2nd closure extension request approval dated February 25, 2005. Therefore, the City has complied with this requirement.

4.2 SECOND REQUIREMENT – LEACHATE GENERATION MODELING AND MONITORING

Requirement: "No later than May 1, 2005, the City shall submit, for EPA and Ecology approval, an estimate of anticipated leachate that should be generated and collected by the Central Area's leachate collection system. The City shall monitor daily volumes (reported in gallons) collected from the Central Area's leachate collection system, leak detection system, and toe-drain collection system. The flow meters shall be installed and functional no later than October 1, 2005. By the 15th of each month thereafter, the City shall submit monthly reports to EPA, Ecology and TPCHD describing the previous month's monitoring. In the event that the leachate flows from the Central Area differ significantly from what the

agencies have determined is reasonable, the agencies may impose further requirements in order to reduce leachate generation at the Central Area. In the event that reliable leachate collection flow monitoring data cannot be obtained, the agencies may impose further conditions to mitigate leachate generation in the Central Area, including the use of temporary tarps, installation of an incremental permanent cover system, and/or final closure of the Central Area."

The requirements of this Section are discussed in detail in Section 3.1.3.b.

4.2.1 Satisfaction of the Second Requirement

The flow metering of the Central Area shows that the leachate collection system is performing as expected. The leachate detection pipe continues to have low flows that average approximately 1.0 gallons per minute and these flows correspond to the liner that exceeds the performance of EPA's Great Liner classification by more than 7 times. The HELP model performed by CH2M Hill also shows that the liner is working as expected. These analyses show that the City has complied with the requirements related to leachate generation modeling and monitoring.

4.3 THIRD REQUIREMENT – CENTRAL AREA TARPS

Requirement: "The City shall install and maintain temporary plastic tarps over all areas within the Central Area that achieve final filling elevation."

The City installed tarps in the south third of the Central Area that has achieved final elevation. These tarps will be maintained, as needed, to reduce the amount of runoff entering the underlying refuse.

4.3.1 Satisfaction of the Third Requirement

By installing tarps in the south third of the Central Area, the City believes it has complied with this requirement.

4.4 FOURTH REQUIREMENT – TPCHD SOLID WASTE PERMIT

Requirement: "The City shall comply with the terms and conditions of the Solid Waste Permit issued by the TPCHD."

The City has and continues to comply with the terms and conditions of the Solid Waste Permit issued by the TPCHD. As issues arise, the City and TPCHD have worked together to resolve the issues in a timely manner.

4.4.1 Satisfaction of the Fourth Requirement

The City has complied with the requirements related to complying with the terms and conditions of the Solid Waste Permit issued by TPCHD.

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TABLES

Table 3-1
Leachate Detection

Leachate Detection Flows	
Month	Total Flow (gallons)
May-07	29,829
June-07	31,989
July-07	31,961
August-07	25,198
September-07	28,125
October-07	36,959
November-07	54,232
December-07	57,508
January-08	76,999
February-08	73223
March-08	63,118
April-08	44,955
Total	554,096

Table 3-2
HELP Model Predicted Leachate Generation Rates
Source: CH2M Hill. See Appendix C.

Summary of Precipitation and associated Maximum and Average Help Modeling Results per Month

Month	Precipitation (gallons)	Maximum Leachate Generation Rate (gallons)	Average Leachate Generation Rate (gallons)	Monthly Summary Avg. Daily Head (inch)[a]
January	3,858,000	2,230,000	1,969,000	0.098
February	3,080,000	3,391,000	2,298,000	0.145
March	3,274,000	2,773,000	2,279,000	0.213
April	1,859,000	3,784,000	2,517,000	0.579
May	1,759,000	2,480,000	1,790,000	0.458
June	1,694,000	1,399,000	1,105,000	0.361
July	1,181,000	986,000	462,000	0.299
August	753,000	313,000	179,000	0.240
September	719,000	266,000	98,000	0.157
October	1,853,000	539,000	199,000	0.000
November	3,312,000	847,000	657,000	0.008
December	2,021,000	1,087,000	1,071,000	0.022
Yearly Total	**25,363,000**	**20,095,000**	**14,624,000**	NA

[a] Occurs over the uncovered floor area.

Head over liner assumes adequate leachate removal practices are being performed.

Table 3-3
Groundwater Performance Standards

Chemicals of Concern	Units	MCL[1]	HBC[2]	Groundwater Performance Standard	Early Warning Value
Volatile Organics					
1,1,1-Trichloroethane	µg/L	200		200	40
1,1-Dichloroethane	µg/L		20	20	4
1,2-Dichloroethane	µg/L	5		5	1
1,2-Dichloroethenes (Total)	µg/L			70	14
cis-isomer	µg/L	70		70	14
trans-isomer	µg/L	100		100	20
Benzene	µg/L	5		5	1
Chloroethane	µg/L		20	20	4
Ethylbenzene	µg/L	700	320	320	64
Methylene chloride	µg/L	5	5	5	1
Tetrachloroethene	µg/L	5		5	1
Toluene	µg/L	1,000	175	175	35
Trichloroethene	µg/L	5		5	1
Vinyl chloride	µg/L	2		2	0.5 [3]
Xylenes (Total)	µg/L	10,000	10	10	2
Metals					
Arsenic (Total)	µg/L	50		50	10

1 Code of Federal Regulations: 40 CFR 141 (7-1-95 ed.) Safe Drinking Water Act Maximum Contaminant Level (MCL)
2 Tacoma Landfill Consent Decree (5/17/91) Health Based Criteria (HBC)
3 Early Warning Value (EWV) established at the Method Detection Limit (MDL) of 0.5 µg/L

Table 3-4
GPS and EWV Exceedances by Analyte
2004 - 2008

Chemicals of Concern	Groundwater Performance Standard (GPS) µg/L	Early Warning Value (EWV) µg/L	5 - Year Review (2004 - 2008)	
			GPS Exceedances	EWV Exceedances
			Well (# Exceedances)	Well (# Exceedances)
Volatile Organics				
1,1,1-Trichloroethane	200	40	---	---
1,1-Dichloroethane	20	4	---	P-3/4(60), TL-09B(1), *TL-17AR(9), TL-17BR(1)*, TL-19C(1), TL-20C(13), TL-26A(20), W-05(1), W-31(13), W-41(1)
1,2-Dichloroethane	5	1	P-3/4(1), TL-26A(18)	P-3/4(60), TL-04(20), TL-09B(7), TL-12(3), *TL-17AR(1)*, TL-20C(20), TL-26A(20), TL-26B(9), W-05(19), W-06(12), W-31(13), W-32(19)
1,2-Dichloroethenes (Total)	70	14	---	TL-11A(1), TL-26A(15)
Benzene	5	1	---	P-01(1), P-02(1), P-3/4(1), TL-01A(1), TL-01C(1), TL-02C(1)
Chloroethane	20	4	---	---
Ethylbenzene	320	64	---	---
Methylene chloride	5	1	TL-01B(2), TL-21A(1), TL-25A(1), TL-25B(1), W-10(1)	EW-00(1), EW-09(2), P-01(1), P-02(1), P-3/4(1), TL-01B(3), TL-20C(1), TL-21A(1), TL-25A(1), TL-25B(1), W-10(1), W-33(1), W-43(1)
Tetrachloroethene	5	1	TL-11A(20)	TL-11A(20), TL-12(5), TL-26A(12), W-01(5), W-02(13), W-03(6), W-05(1), W-15(3)
Toluene	175	35	---	---
Trichloroethene	5	1	TL-11A(20), TL-12(1), W-01(1)	EW-09(5), TL-11A(20), TL-11B(10), TL-12(5), TL-26A(20), W-01(20), W-02(13), W-03(12), W-04(13), W-05(14), W-07(10), W-15(2), W-22(17)
Vinyl chloride	2	0.5 [1]	P-08(1), TL-04(1), TL-05A(1), TL-05C(1), TL-07A(13), W-15(15), W-16(1), W-36(12)	EW-12(2), P-08(20), P-3/4(44), TL-01B(3), TL-04(19), TL-05A(14), TL-05C(15), TL-07A(21), TL-09B(2), TL-10A(1), TL-20C(3), TL-26B(7), TL-27B(2), W-01(1), W-02(2), W-03(10), W-04(12), W-05(15), W-15(20), W-16(13), W-17(7), W-18(1), W-20(10), W-21(19), W-31(1), W-32(1), W-36(20), W-37(1), W-40(1), W-41(16), W-43(1)
Xylenes (Total)	10	2	---	EW-09(1), W-19(1)
Metals				
Arsenic (Total)	50	10	EW-09(1), TL-04(1), TL-19A(1), W-02(4), W-03(2), W-05(2), W-07(2), W-16(1), W-17(1), W-18(1), W-19(3), W-20(1), W-21(1), W-22(1)	EW-00(20), EW-09(2), EW-12(18), EW-13(20), EW-16(2), EW-19(19), EW-21(3), EW-24(1), EW-30R(16), P-08(11), P-09(1), TL-04(18), TL-05A(17), TL-05C(18), TL-07A(1), TL-10C(20), TL-11A(20), TL-11B(20), TL-19A(2), *TL-23A(4)*, TL-25B(1), W-01(20), W-02(13), W-03(12), W-04(13), W-05(19), W-06(12), W-07(12), W-08(13), W-10(16), W-11(1), W-12(3), W-14(8), W-15(19), W-16(13), W-17(11), W-18(12), W-19(13), W-20(14), W-21(20), W-22(5), W-36(2), W-38(1), W-43(12)

1 Early Warning Value (EWV) established at the Method Detection Limit (MDL) of 0.5 µg/L

Underlined wells are background groundwater quality wells that are located upgradient or cross-gradient of the landfill.

Notes:

Figure 3-5
Tacoma Recycling

Program	Material Type	Year Implemented
New Material Collected at Landfill Recycling Center		
New Material Collected at Landfill Recycling Center	Cell Phones Ink Jet Cartridges	2004-2007
New Material Collected at HHW Facility or White Goods	Refrigerator compressors and CFLs Cooking Oil	2004-2007
New Material Collected at Landfill Recycling Center	Used Furniture	2004
New Material Collected at Landfill Recycling Center	Packing Peanuts	2003
New Material banned from disposal by Commercial Generators		2003
New Material Diverted at Landfill Recycling Center	Computer CPUs	2003
New Material added to Landfill Recycling Center	Used Household Goods and Clothing Used Building Materials	2002
Commingled Residential, Multi-family, School and Small Business Curbside Collection Implemented City-wide	Aluminum & Tin Cans Container Glass Magazines Newspaper/Phone Books Empty Aerosol Cans Household Batteries Mixed Waste Paper #1, #2 Plastic Bottles Corrugated Cardboard	1997
Commingled Residential Curbside Collection – Pilot Program	Aluminum & Tin Cans Container Glass Magazines Newspaper/Phone Books Empty Aerosol Cans Household Batteries Mixed Waste Paper #1, #2 Plastic Bottles Corrugated Cardboard	1996
Produce Waste Collection/Recycling	Produce Waste	1991

Figure 3-5
Tacoma Recycling

Program	Material Type	Year Implemented
Waste Watchers (Schools)	Cardboard File Stock Grade Paper	1991
Source Separated Residential Curbside Collection	Aluminum & Tin Cans Container Glass Magazines Newspaper/Phone Books Empty Aerosol Cans Household Batteries	1990
Curbside Yard Waste Collection	Non-Commercial Yard Waste	1990
Source Separated Multi-Family Curbside Collection	Same as residential Curbside Collection, except Batteries and Magazines are not part of this service	1990
School Recycling (TRASH) - Community Drop Off Program	Aluminum Newspaper	1988
Waste Oil Collection	Waste Oil from Do-it-yourselfers	1988
Landfill Recycling Center	Aluminum & Steel Cans Empty Aerosol Cans Ferrous scrap metal Container Glass #1 & # 2 Plastic Magazines & Catalogs Newspaper Telephone Books Mixed Waste Paper Waste Oil	1988
Landfill Receiving Area	Ferrous Scrap Metal Non Ferrous Scrap Metal Appliances Polyurethane Foam Tires Yard Waste (self haul)	1986

FIGURES

Figure 3-1
Tacoma Landfill - Central Area Leachate Collection Pipe Flow Monitoring 2006

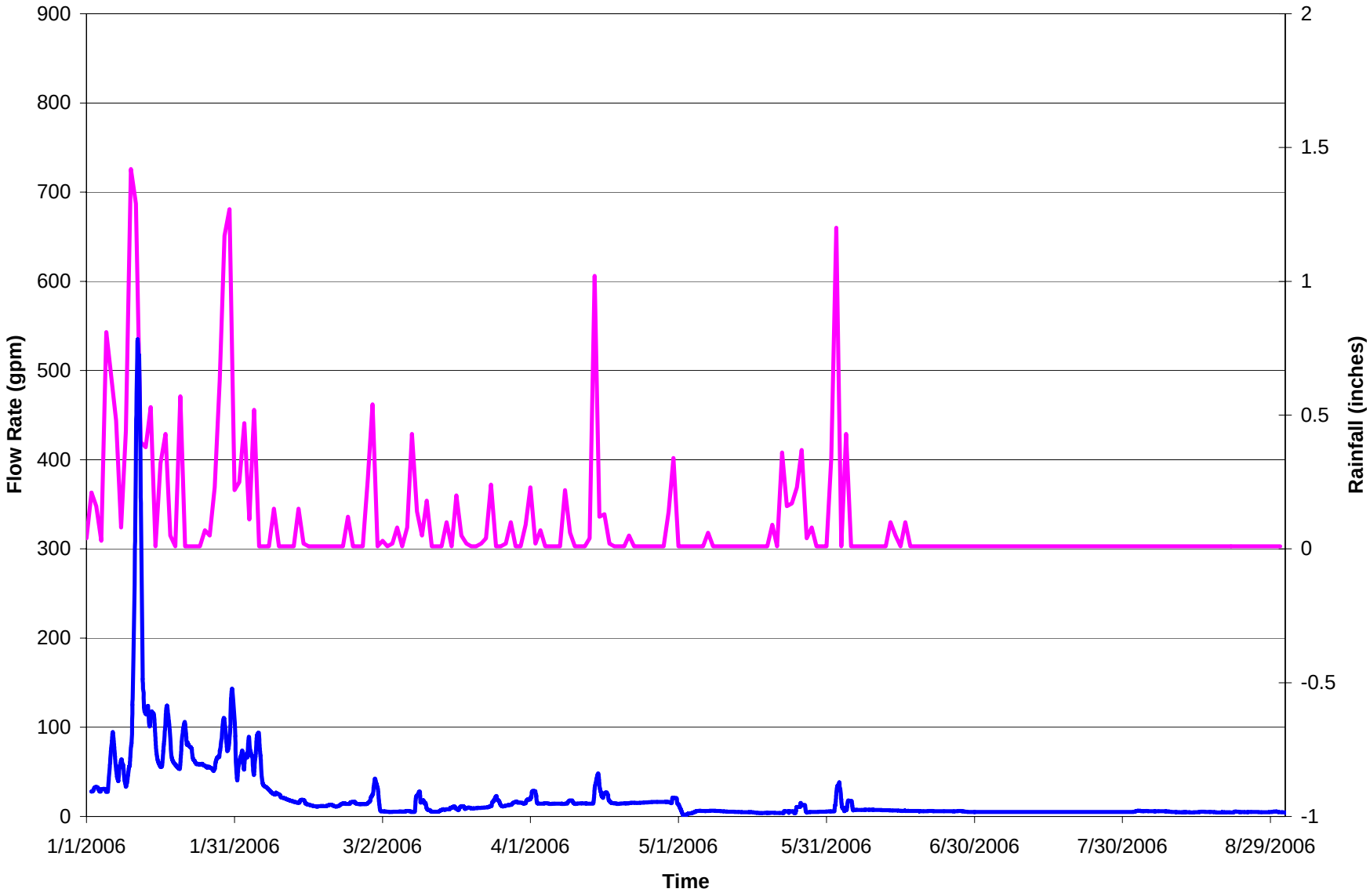


Figure 3-2
Tacoma Landfill - Central Area Leachate Collection Pipe Flow Monitoring 2007

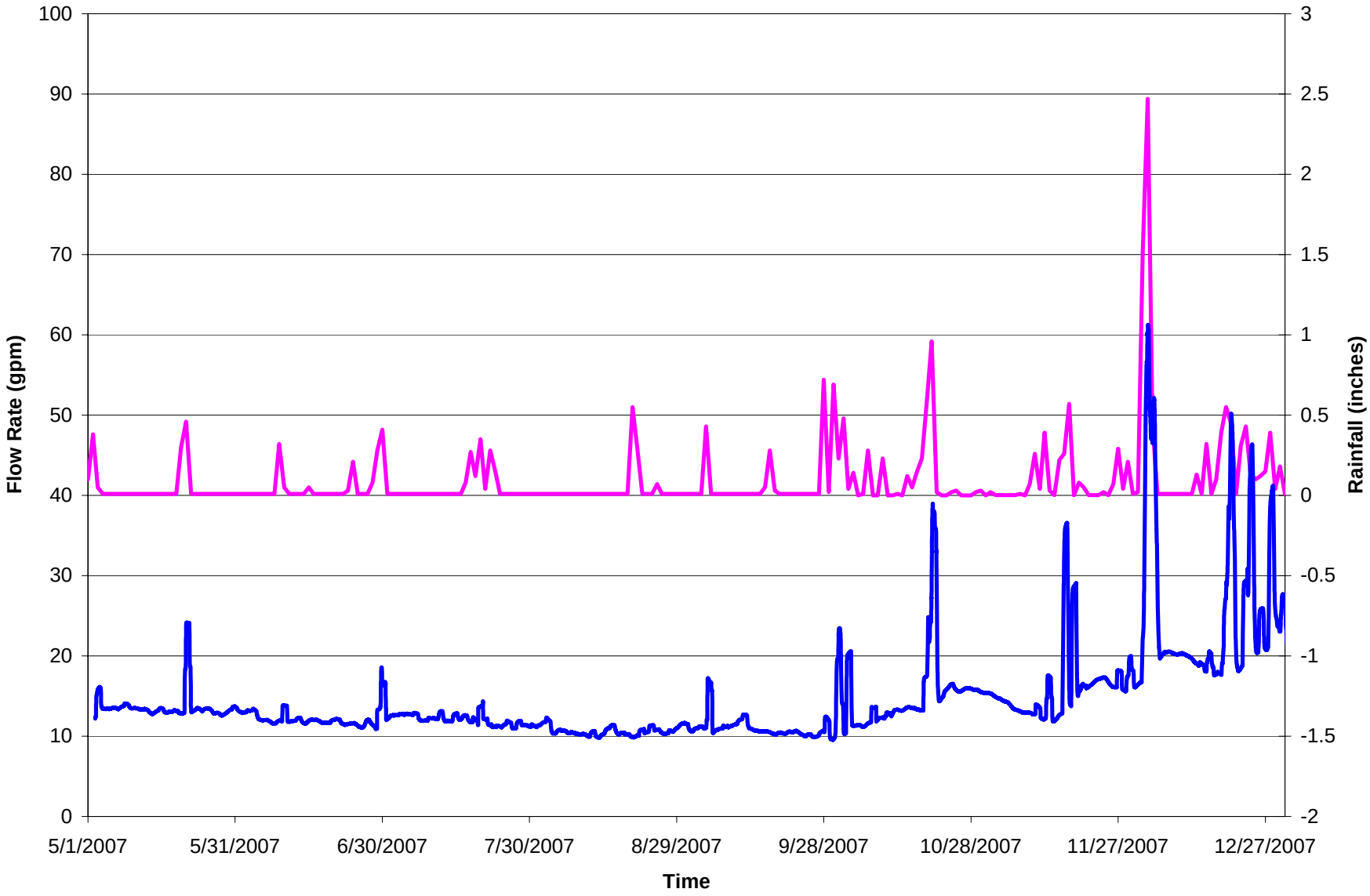
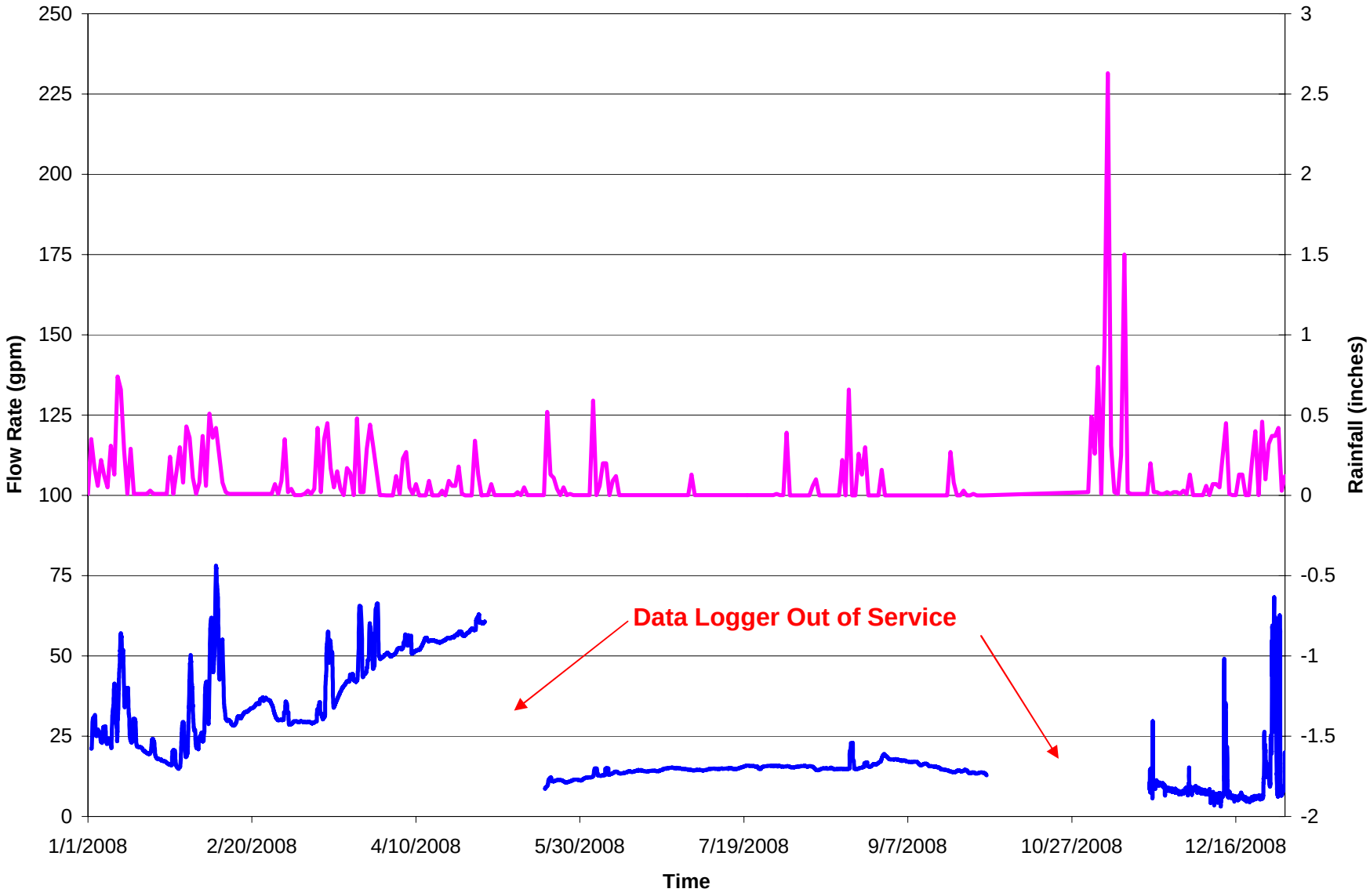


Figure 3-3
Tacoma Landfill - Central Area Leachate Collection Pipe Flow Monitoring 2008



LEGEND

- EW-14 — Existing Private Drinking Water Well
- W-34 — GETS Extraction Well
- P-3/4 — GETS Performance Monitoring Well
- TL-12 / TL-1a — Tacoma Landfill Monitoring Well
- FW-4 — City of Fircrest Well
- LC-01 — Leach Creek Sampling Location

GETS TREATMENT PLANT

20/2-13D1 Decomissioned

Leach Creek

SCALE IN FEET
0 300 600 1200

N

TACOMA LANDFILL
EXTRACTION WELL
LOCATIONS

FIGURE 3-4

J:\Landfill\GETS\landfill wells-WITH CAPTURE ZONES 3-1.dwg, 5/9/2008 9:49:39 AM

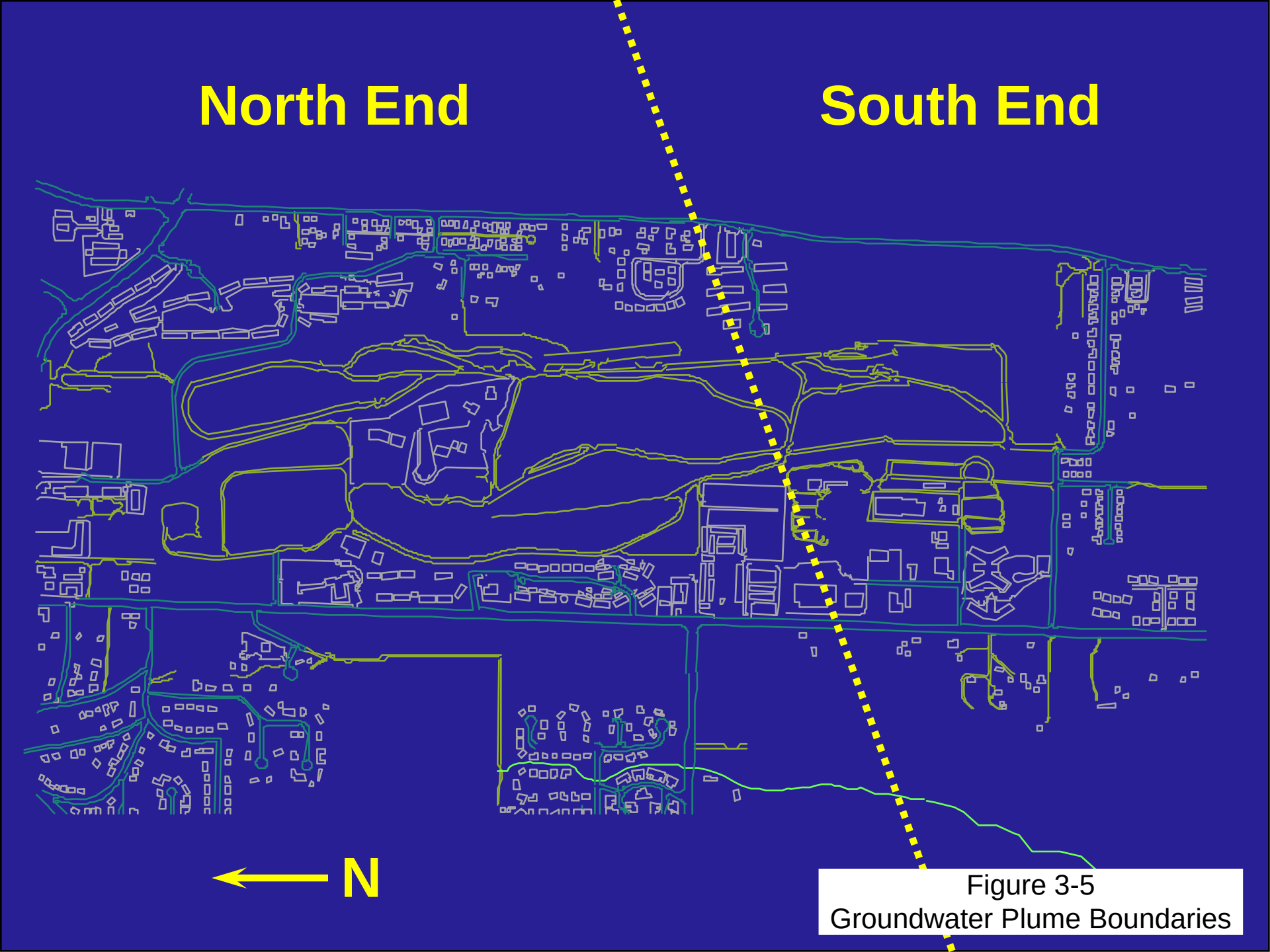


Figure 3-5
Groundwater Plume Boundaries

Figure 3-6
1,1-Dichloroethane

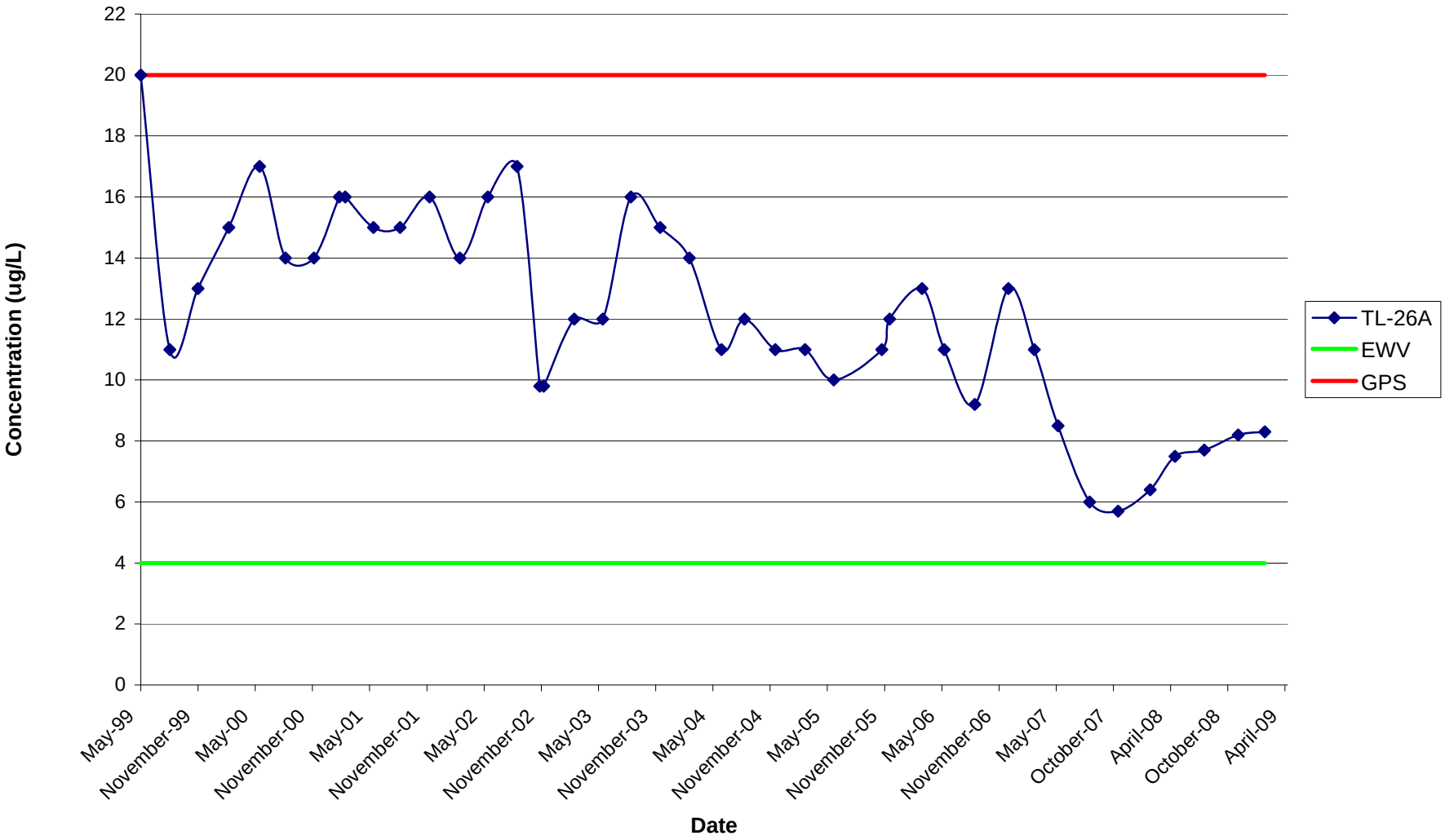


Figure 3-7
Tetrachloroethene

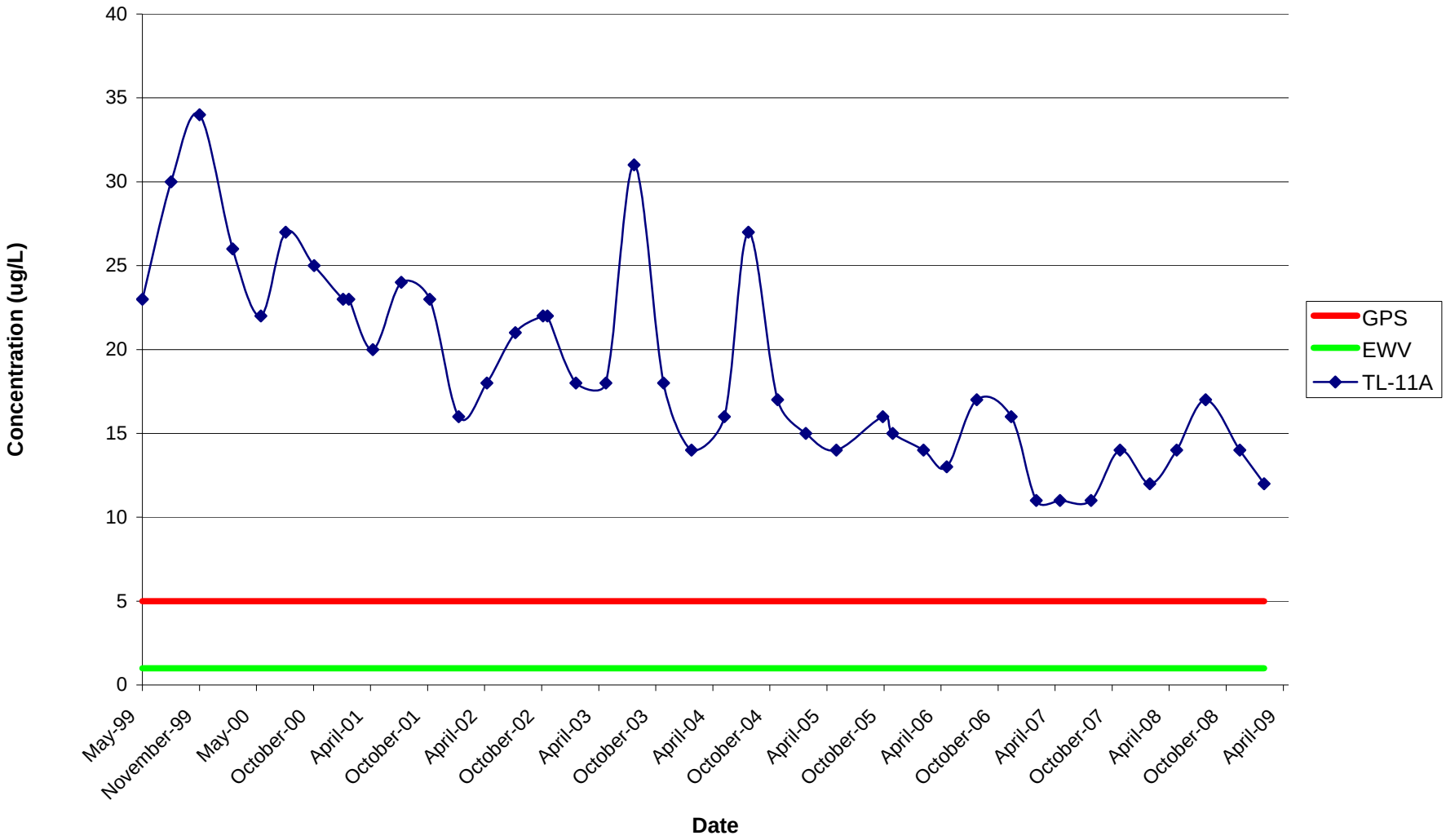


Figure 3-8
Trichloroethene

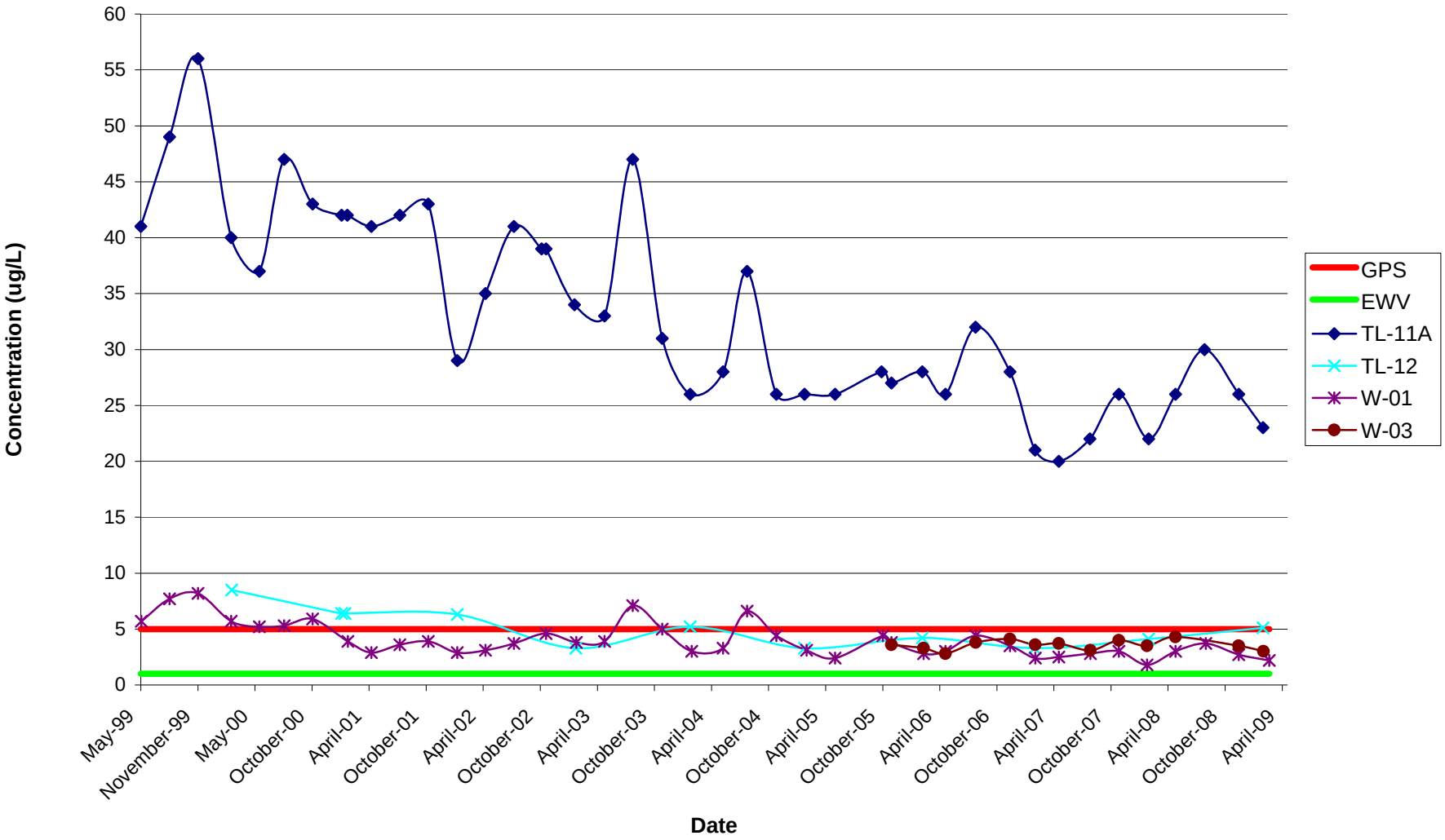


Figure 3-9
Arsenic, Total

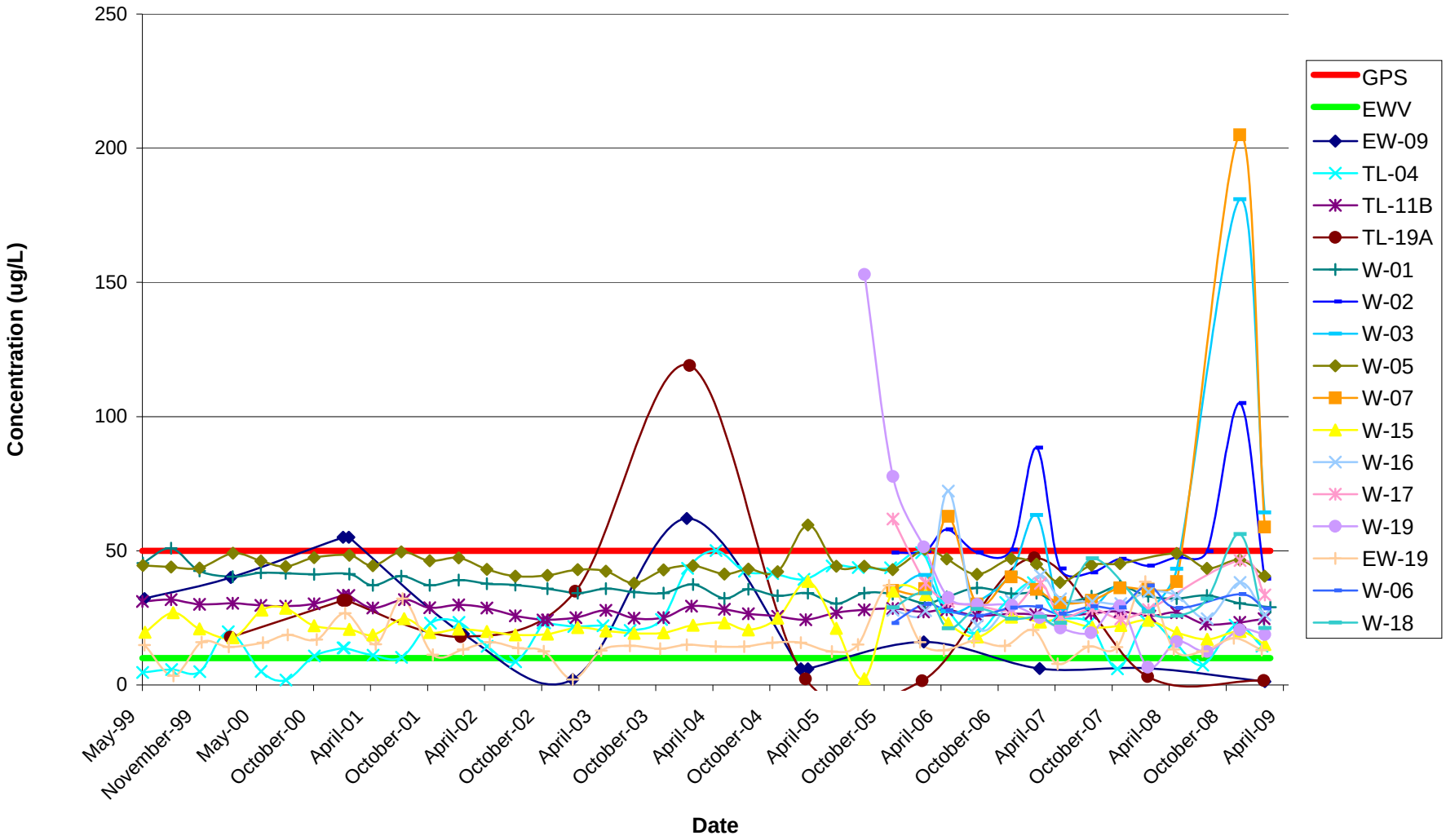


Figure 3-10
1,2-Dichloroethene

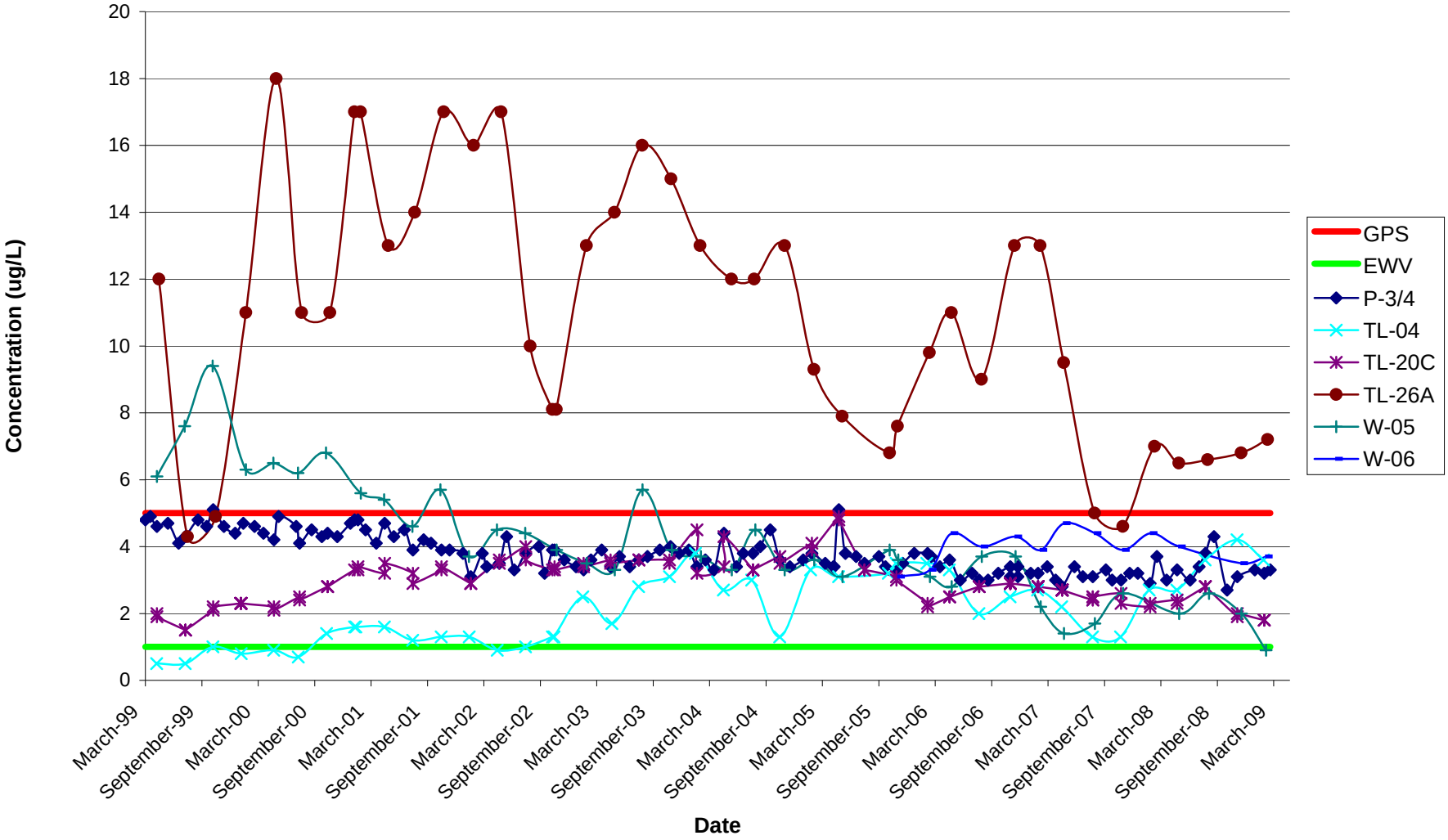


Figure 3-11
Vinyl Chloride - Northern Plume

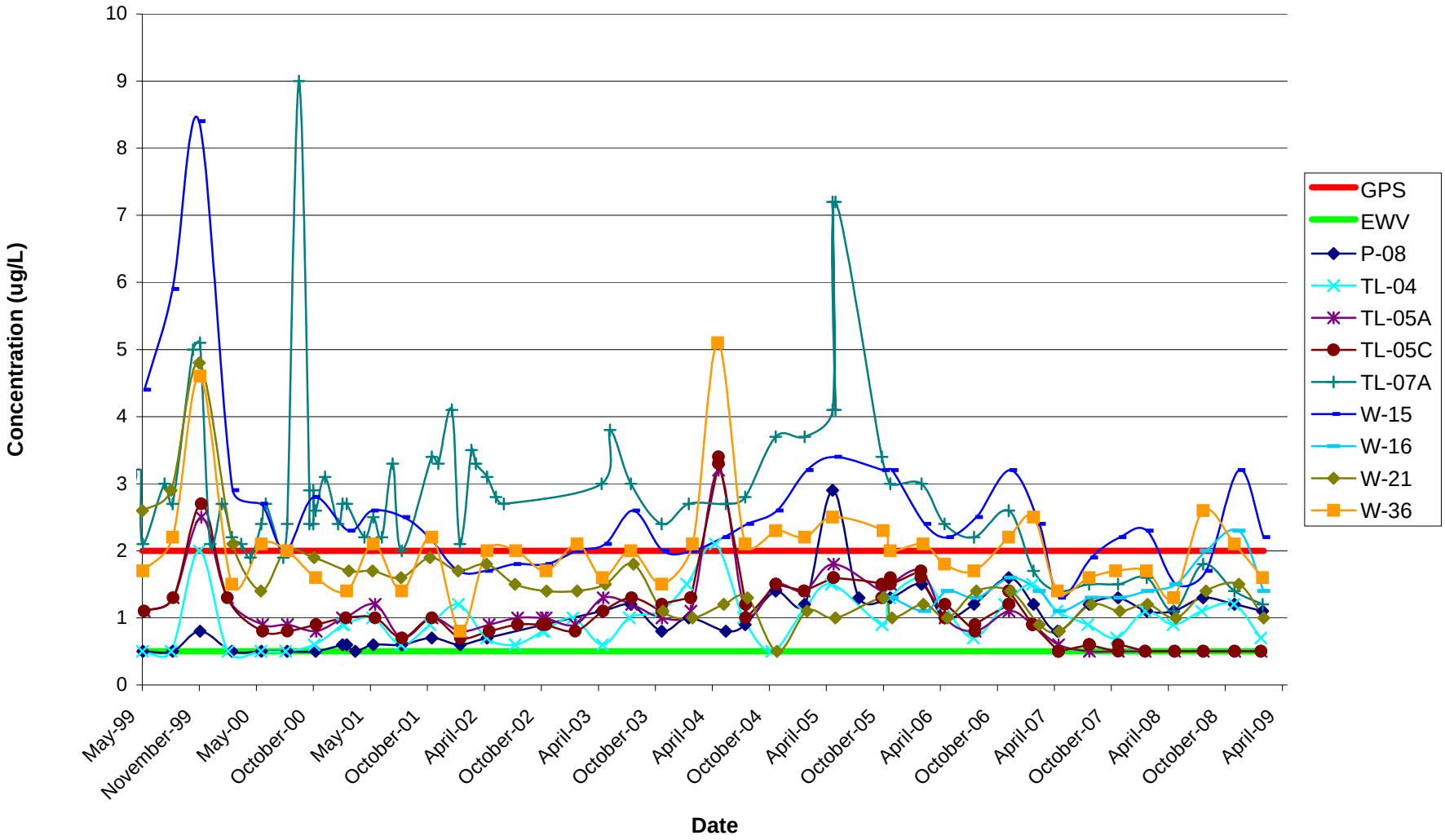


Figure 3-12 Vinyl Chloride
Southern Plume

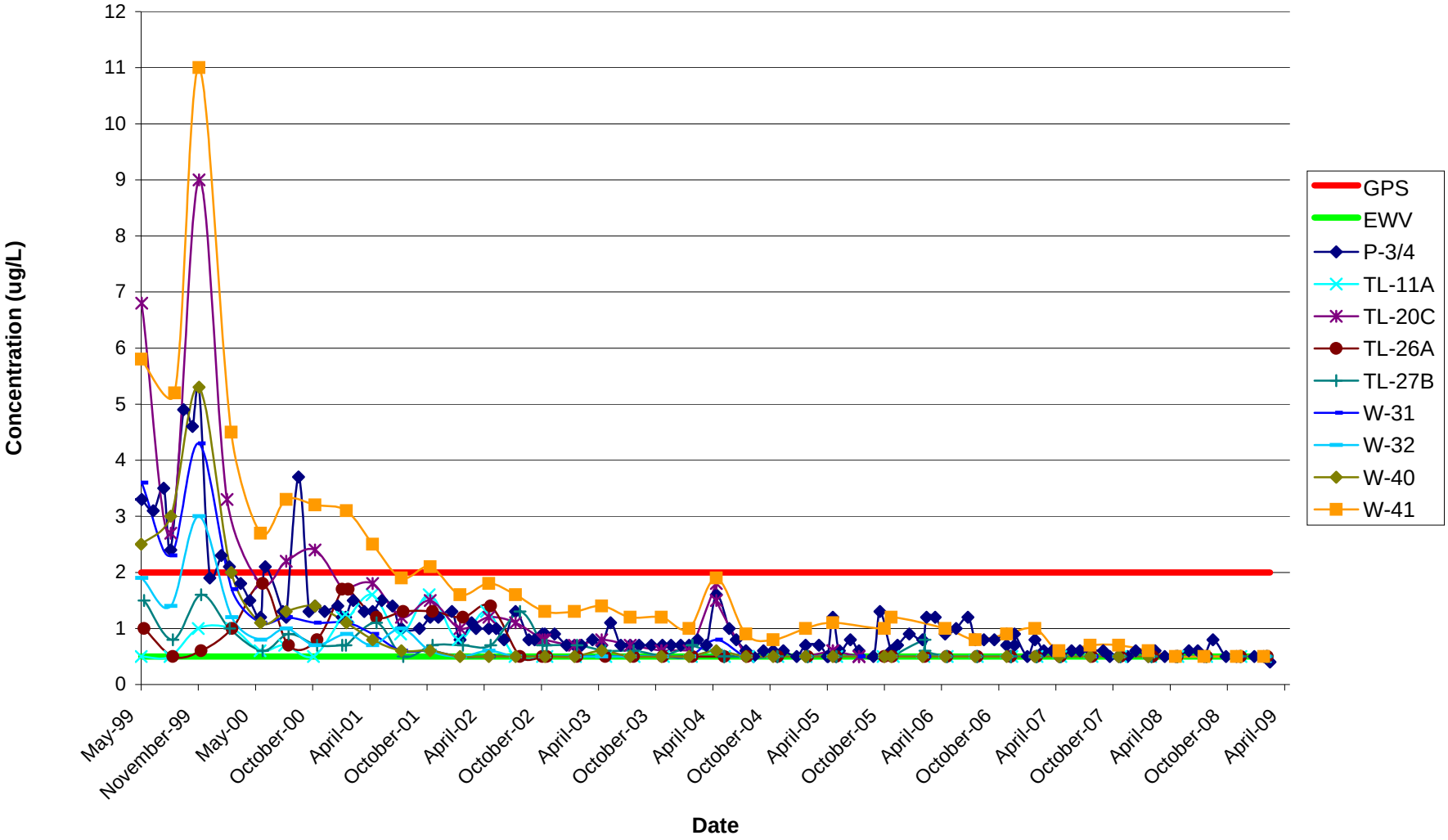
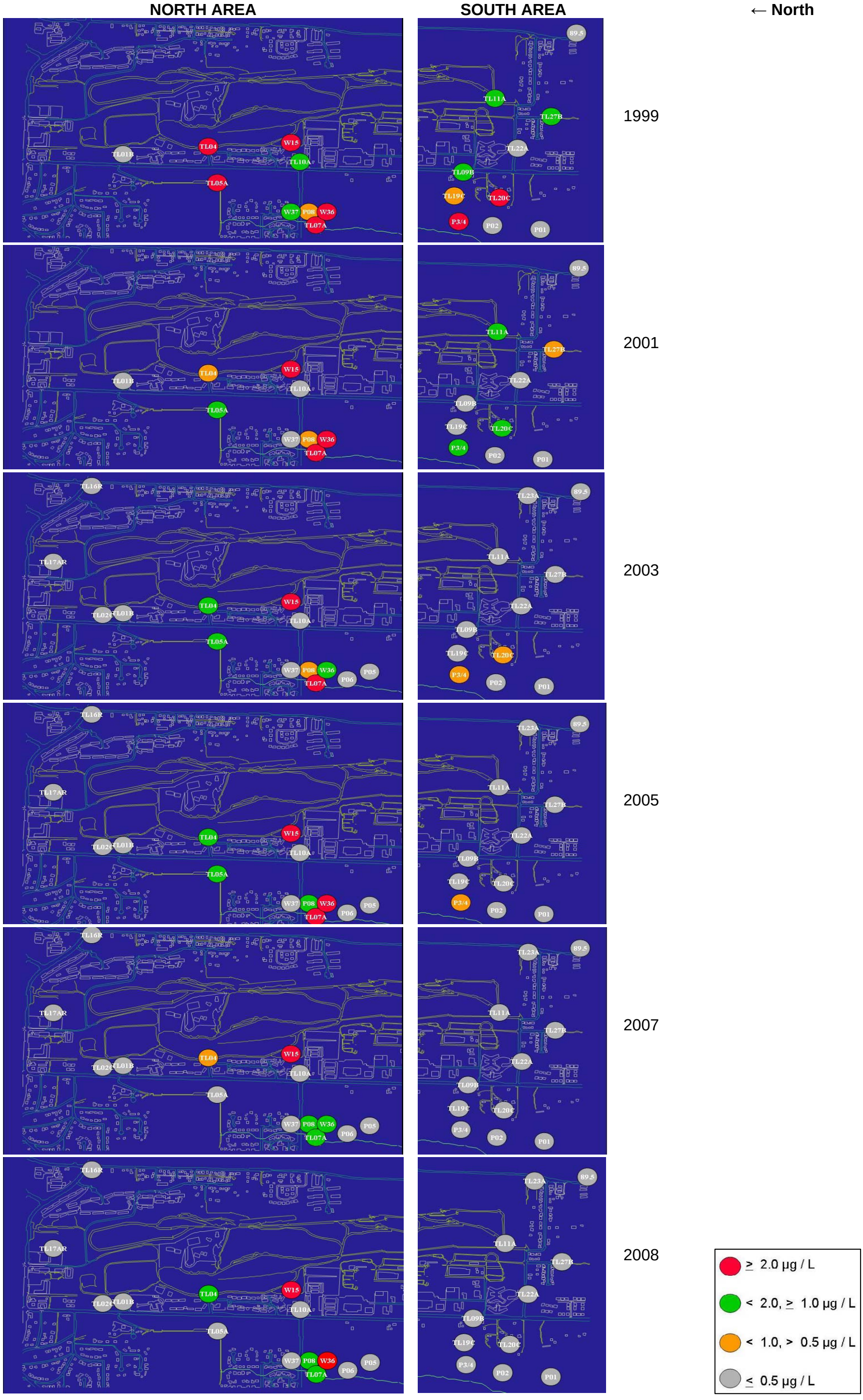


Figure 3-13
Vinyl Chloride Concentrations Over Time

NORTH AREA | **SOUTH AREA** | **← North**



LEGEND

- EW-14 — Existing Private Drinking Water Well
- W-34 — GETS Extraction Well
- P-3/4 — GETS Performance Monitoring Well
- TL-12 / TL-1a — Tacoma Landfill Monitoring Well
- FW-4 — City of Fircrest Well
- LC-01 — Leach Creek Sampling Location
- Well Capture Zone–2007
- Groundwater Contour–2007 (Prepared by Pacific Groundwater Group)

GETS TREATMENT PLANT

20/2-13D1 Decomissioned

Leach Creek

0 300 600 1200
SCALE IN FEET

N

TACOMA LANDFILL
EXTRACTION WELLS
CAPTURE ZONES 1st Qrtr 2008

FIGURE 3–14A

P:\EnvServices\Projects\Landfill\capture zones\landfill wells-WITH CAPTURE ZONES 5-27-09.dwg, 5/29/2009 1:51:20 PM

LEGEND

- EW-14 — Existing Private Drinking Water Well
- W-34 — GETS Extraction Well
- P-3/4 — GETS Performance Monitoring Well
- TL-12 / TL-1a — Tacoma Landfill Monitoring Well
- FW-4 — City of Fircrest Well
- LC-01 — Leach Creek Sampling Location
- Well Capture Zone–2007
- Groundwater Contour–2007 (Prepared by Pacific Groundwater Group)

GETS TREATMENT PLANT

20/2-13D1 Decomissioned

Leach Creek

0 300 600 1200
SCALE IN FEET

N

TACOMA LANDFILL
EXTRACTION WELLS
CAPTURE ZONES 2th Qrtr 2008

FIGURE 3–14B

P:\EnvServices\Projects\Landfill\capture zones\landfill wells-WITH CAPTURE ZONES 5-27-09.dwg, 5/29/2009 1:47:55 PM

LEGEND

- EW-14 — Existing Private Drinking Water Well
- W-34 — GETS Extraction Well
- P-3/4 — GETS Performance Monitoring Well
- TL-12 / TL-1a — Tacoma Landfill Monitoring Well
- FW-4 — City of Fircrest Well
- LC-01 — Leach Creek Sampling Location
- Well Capture Zone–2007
- Groundwater Contour–2007 (Prepared by Pacific Groundwater Group)

GETS TREATMENT PLANT

20/2-13D1 Decomissioned

Leach Creek

0 300 600 1200
SCALE IN FEET

N

TACOMA LANDFILL
EXTRACTION WELLS
CAPTURE ZONES 3rd Qrtr 2008

FIGURE 3–14C

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LEGEND

- EW-14 — Existing Private Drinking Water Well
- W-34 — GETS Extraction Well
- P-3/4 — GETS Performance Monitoring Well
- TL-12 / TL-1a — Tacoma Landfill Monitoring Well
- FW-4 — City of Fircrest Well
- LC-01 — Leach Creek Sampling Location
- Well Capture Zone–2007
- Groundwater Contour–2007 (Prepared by Pacific Groundwater Group)

FW-3 FW-9 FL-2 FW-2 FW-4 FL-3 FW-5 FL-1a FL-1b TL-17b TL-17a TL-16 TL-2 TL-2a,c W-22 TL-1a TL-5,c GETS TREATMENT PLANT TL-3a,c W-21 LW-1 TL-18 TL-18a,c 20/2-13D1 Decomissioned TL-4 W-20 LC-01 TL-5 TL-5a,c, d W-19 W-18 TL-15b,c TL-15a W-17 MW-16-2 MW-16-3 TL-14 W-38 P-9 W-43 W-37 W-6 W-15 TL-10c,d W-14 W-12 TL-10a,b EW-12 P-8 W-36 LC-04 W-42 P-7 W-11 W-10 W-35 TL-8c TL-8b,c TL-25a TL-25b W-9 P-6 W-8 TL-13 TL-13a,c W-34 W-7 P-5 W-33 TL-12 W-5 W-4 P-10 TL-19a P-3/4 TL-19c W-32 TL-9a,b W-3 TL-26a TL-26b W-2 W-31 W-1 TL-11a TL-11b,d P-2 TL-20a,c TL-20 EW-9 W-30 TL-22 TL-23 W-41 TL-28 Pw-1 TL-27b TL-27a W-40 P-11 TL-24 EW-14 TL-21 89.5 LC-02

Leach Creek

0 300 600 1200
SCALE IN FEET

TACOMA LANDFILL
EXTRACTION WELLS
CAPTURE ZONES 4th Qrtr 2008

FIGURE 3–14D

P:\EnvServices\Projects\Landfill\capture zones\landfill wells-WITH CAPTURE ZONES 5-27-09.dwg, 5/29/2009 1:54:20 PM

Figure 3-15 Tacoma Landfill - North Area Transect

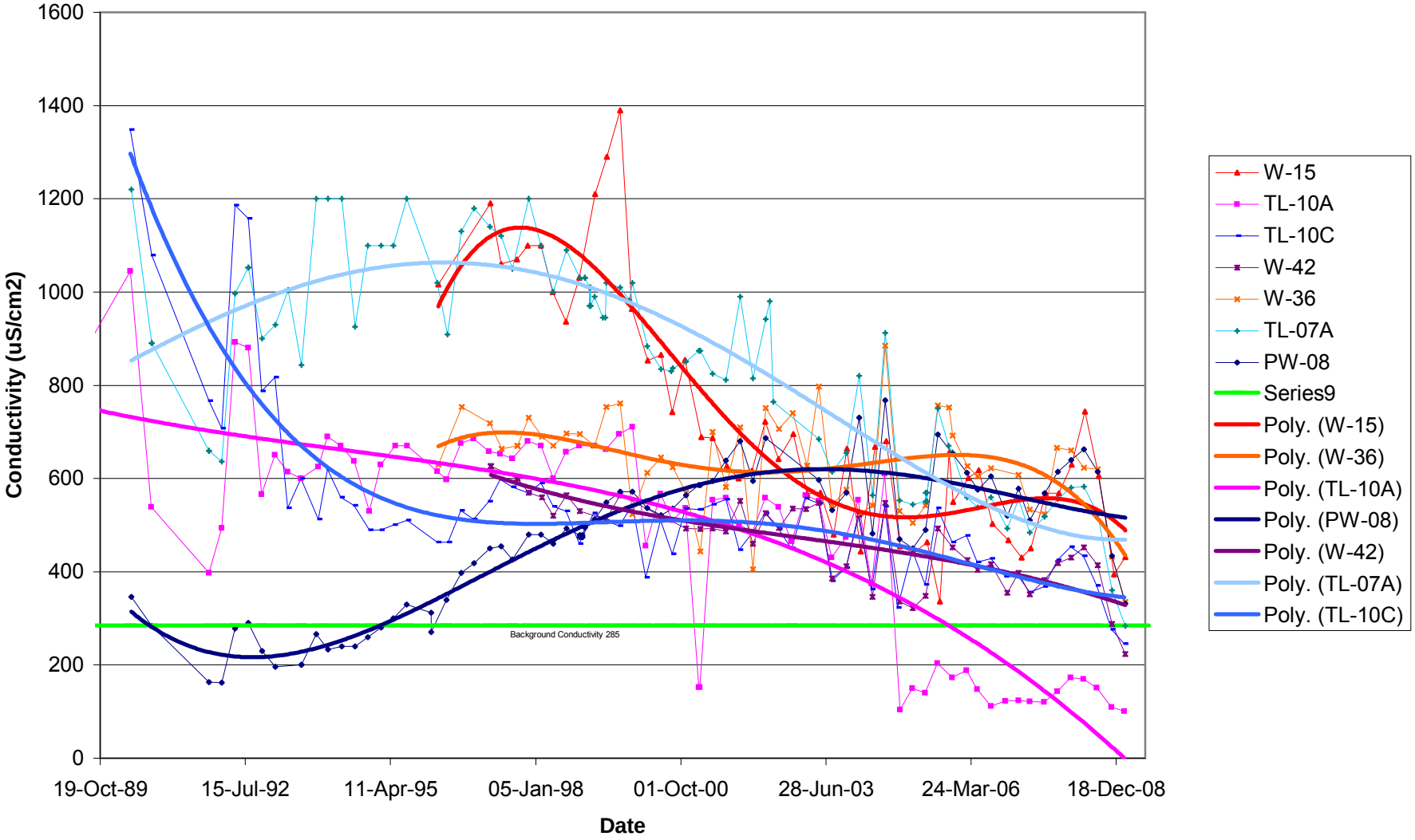
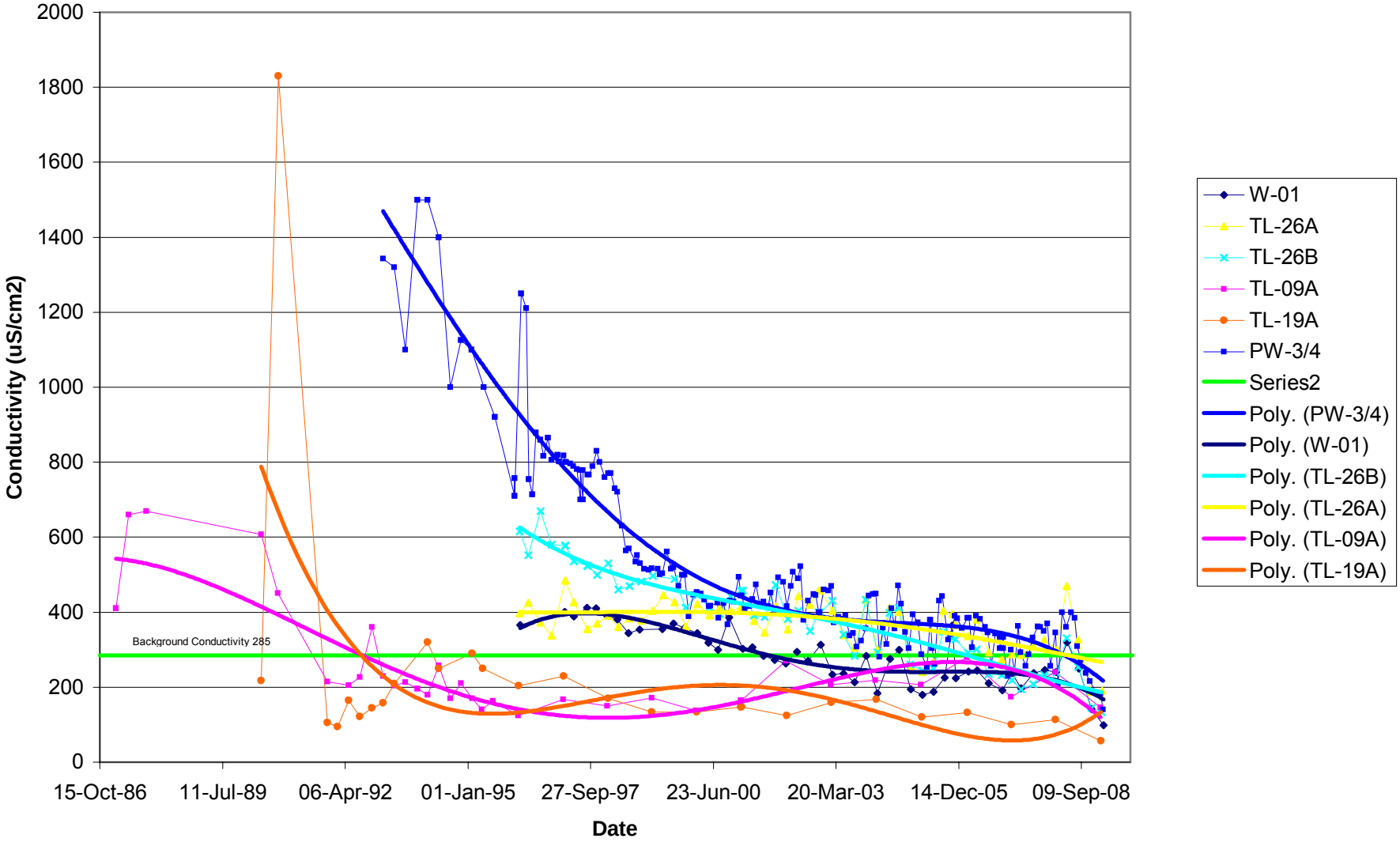
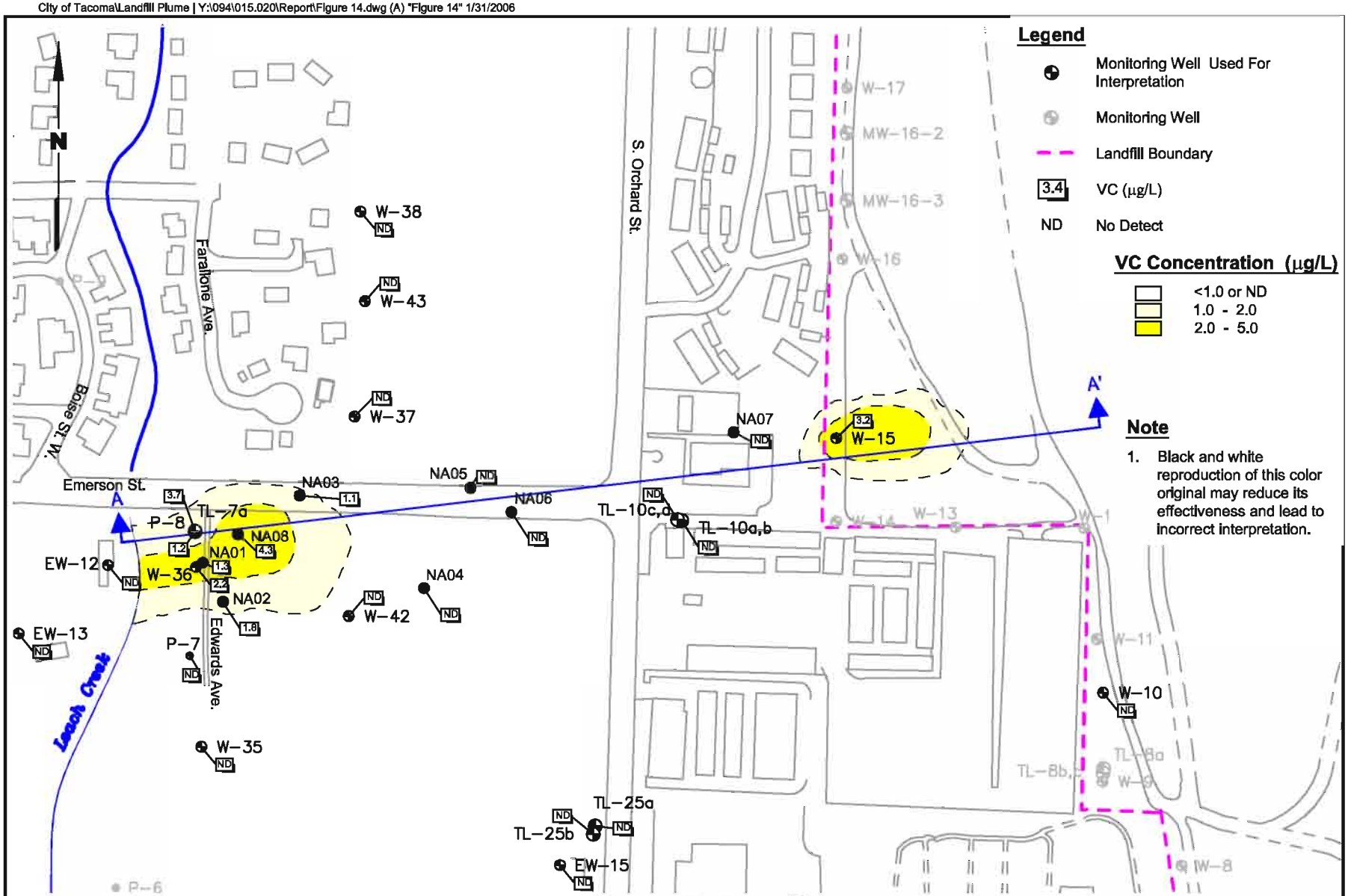


Figure 3-16 Tacoma Landfill - South Area Transect



City of Tacoma\Landfill Plume | Y:\094\015.020\Report\Figure 14.dwg (A) "Figure 14" 1/31/2006



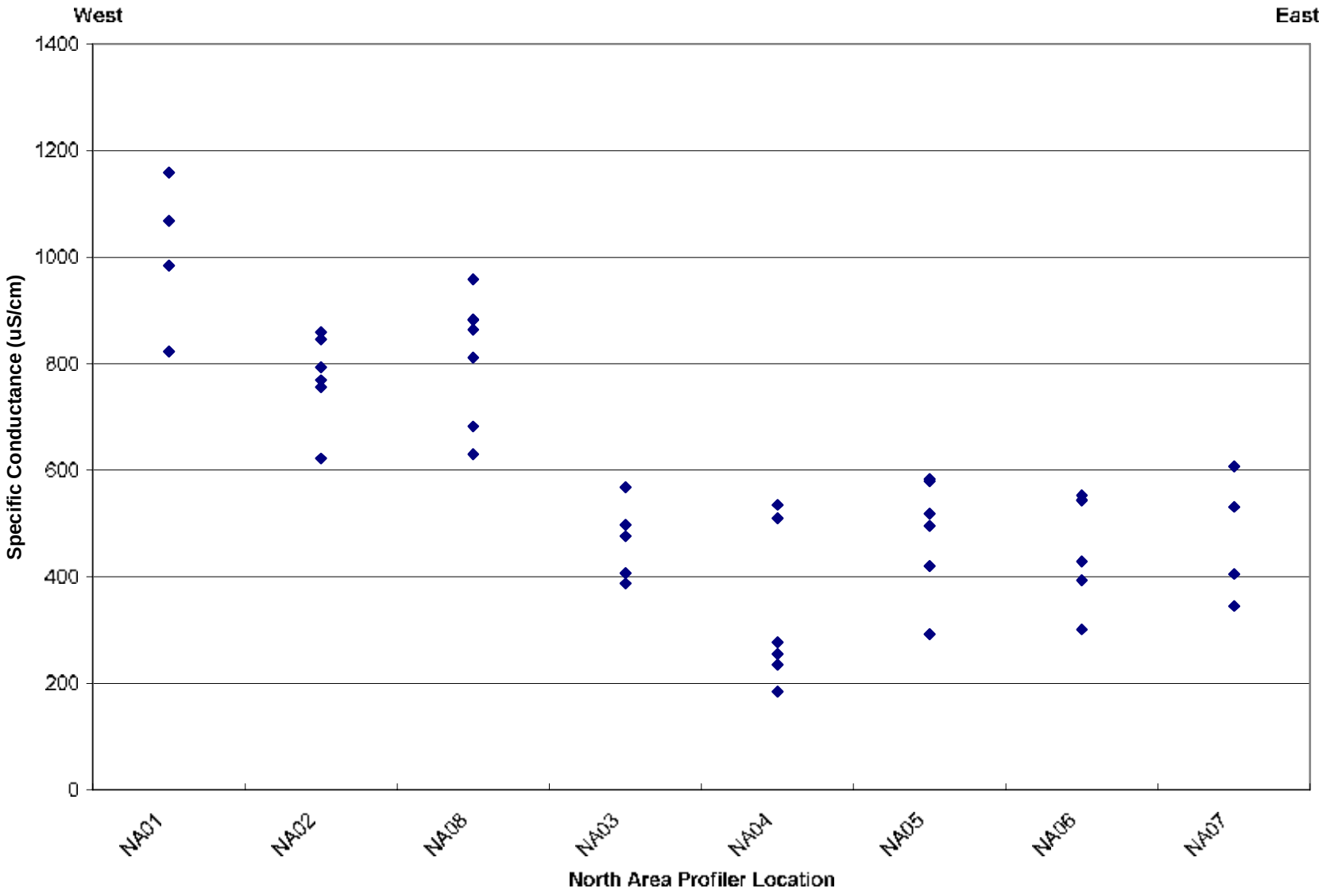
Base map source: City of Tacoma 2004

LANDAU ASSOCIATES

Landfill Plume
City of Tacoma
Tacoma, Washington

Recent Vinyl Chloride Concentrations: North Area Plan View

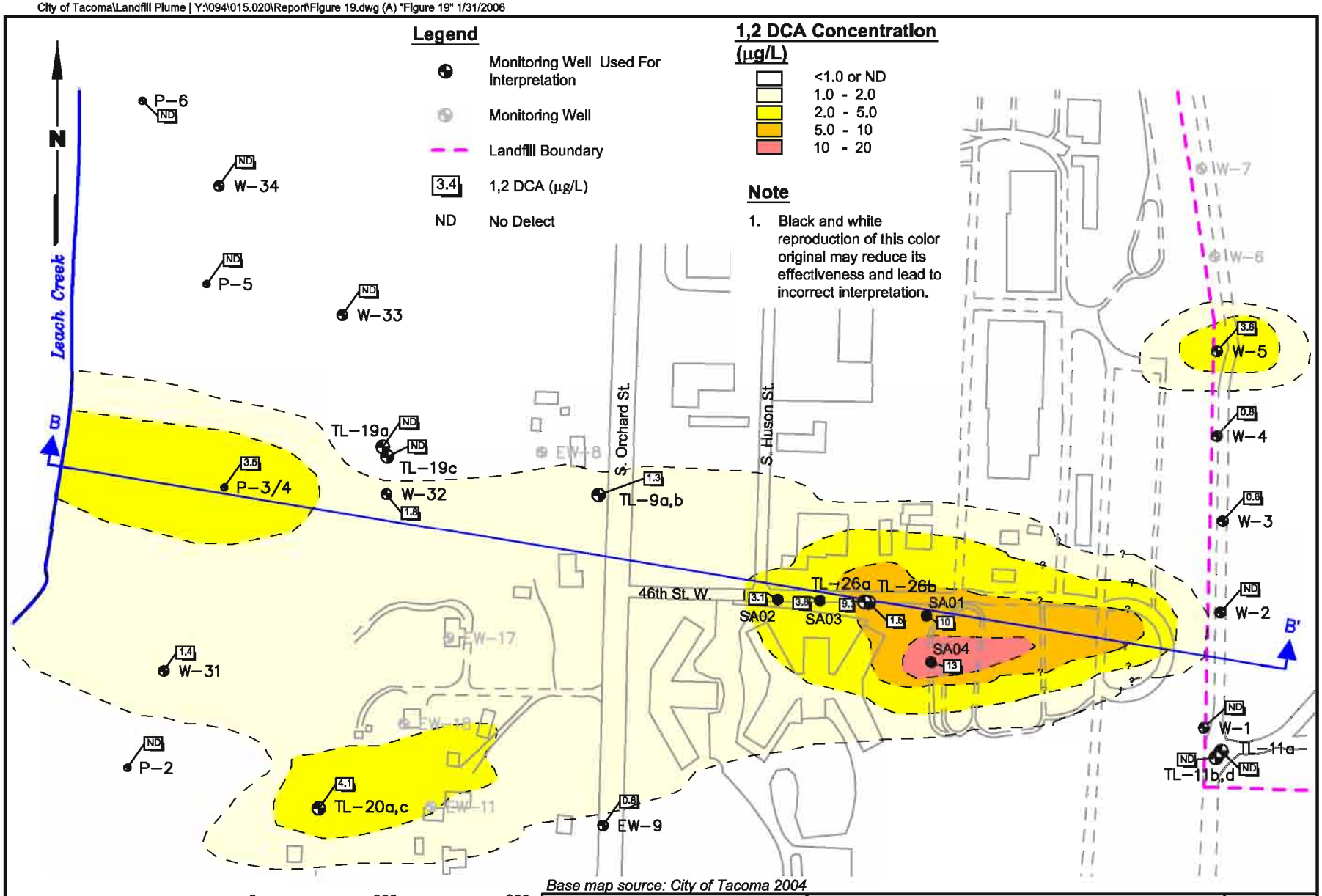
Figure 14



LANDAU ASSOCIATES

Landfill Plume City of Tacoma Tacoma, Washington	**North Area Specific Conductance Data by Profiler Location**	Figure 3-18

City of Tacoma\Landfill Plume | Y:\094\015.020\Report\Figure 19.dwg (A) "Figure 19" 1/31/2006



LANDAU ASSOCIATES

Landfill Plume
City of Tacoma
Tacoma, Washington

Recent 1,2 DCA Concentrations: South Area Plan View

Figure 19

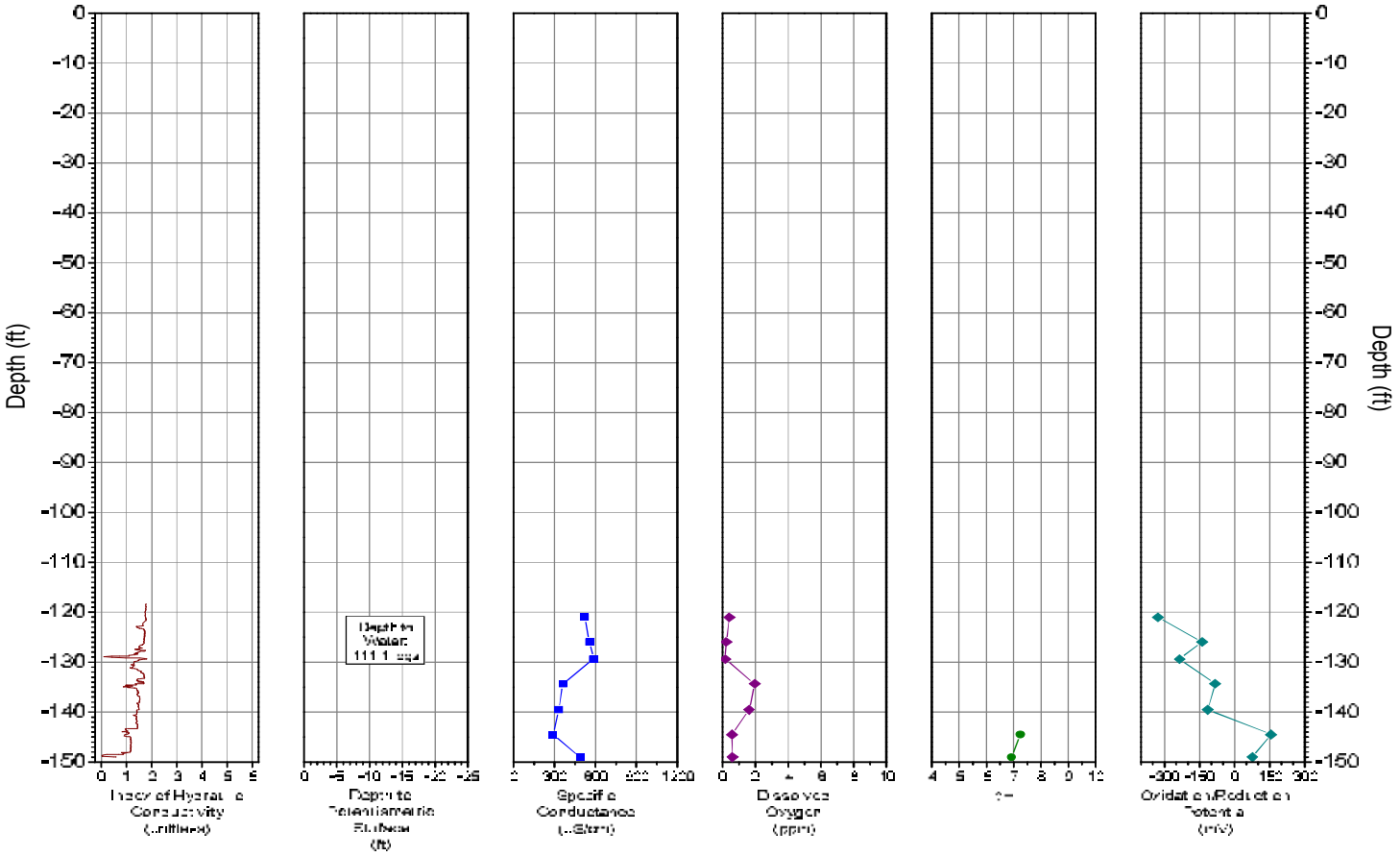


FIGURE SA01, I_z RECORD AND PHYSICO-CHEMICAL PARAMETERS

Dates Sampled : 5/31/2005-6/1/2005

Landau Associates / Tacoma, WA

Figure 3-20

Source: SEI groundwater quality profiling data
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Date: 6/1/05 djl

STONE ENVIRONMENTAL INC

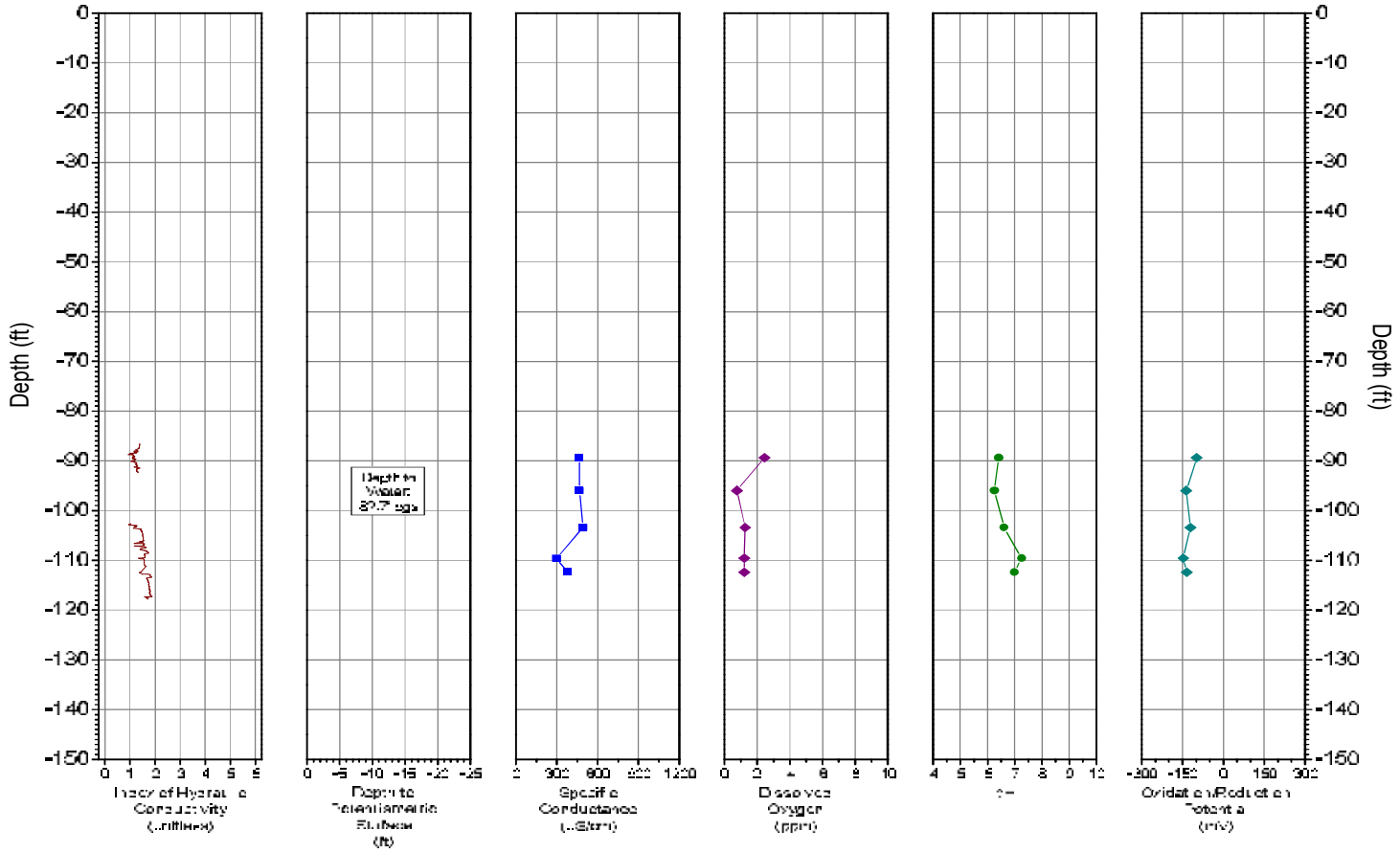


FIGURE SA02, I_c RECORD AND PHYSICO-CHEMICAL PARAMETERS

Dates Sampled : 5/27/2005

Landau Associates / Tacoma, WA

Figure 3-21

Source: SEI groundwater quality profiling data

Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\profiling\orign plots\PhysChem SA02.opj

Date: 5/27/05 djl

STONE ENVIRONMENTAL INC

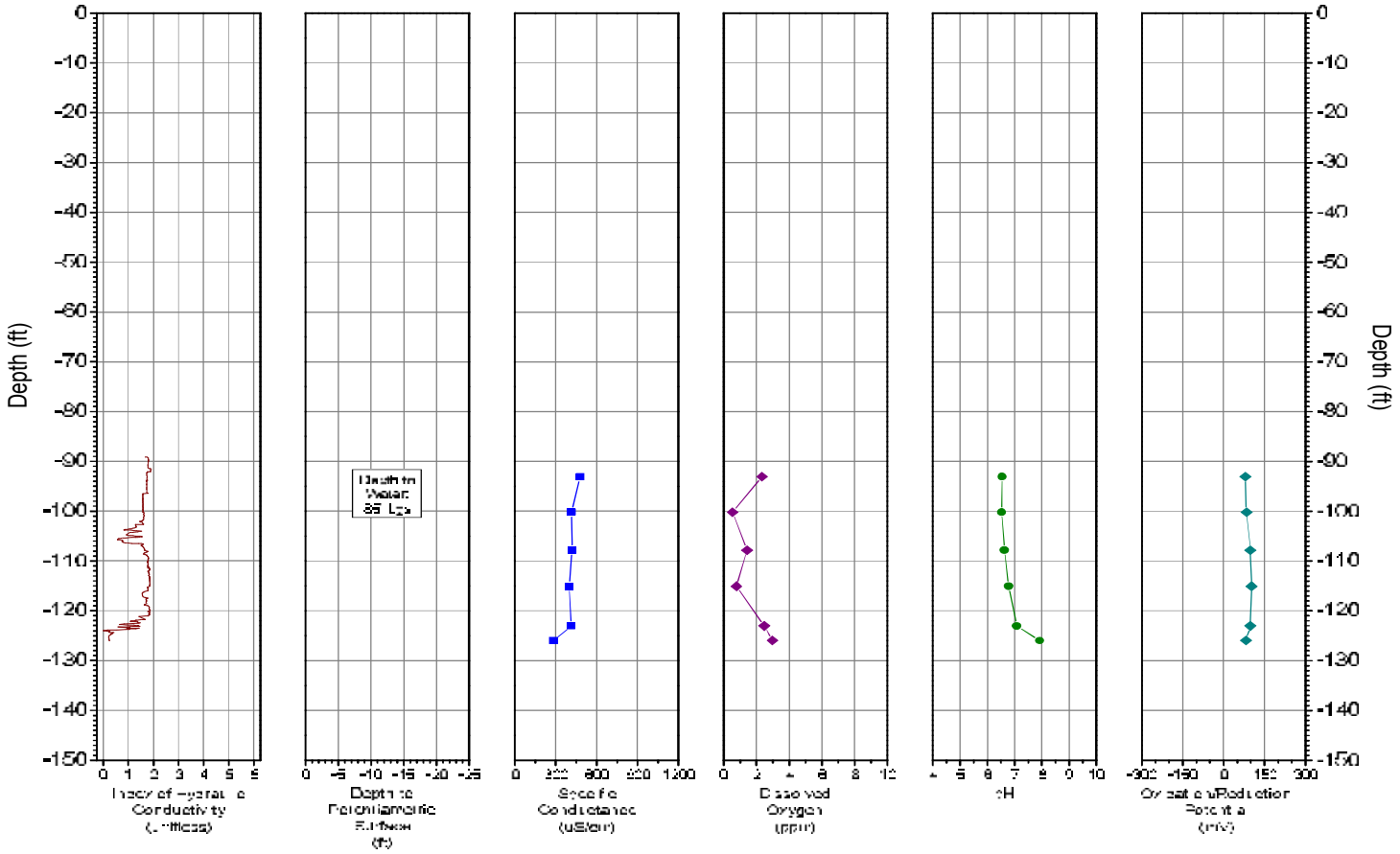


FIGURE SA03, I_K RECORD AND PHYSICO-CHEMICAL PARAMETERS

Dates Sampled : 6/3/2005

Landau Associates / Tacoma, WA

Figure 3-22

Source: SEI groundwater quality profiling data

Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\profiling\origin plots\PhysChem SA03.opj

Date: 6/3/05 djl

STONE ENVIRONMENTAL INC

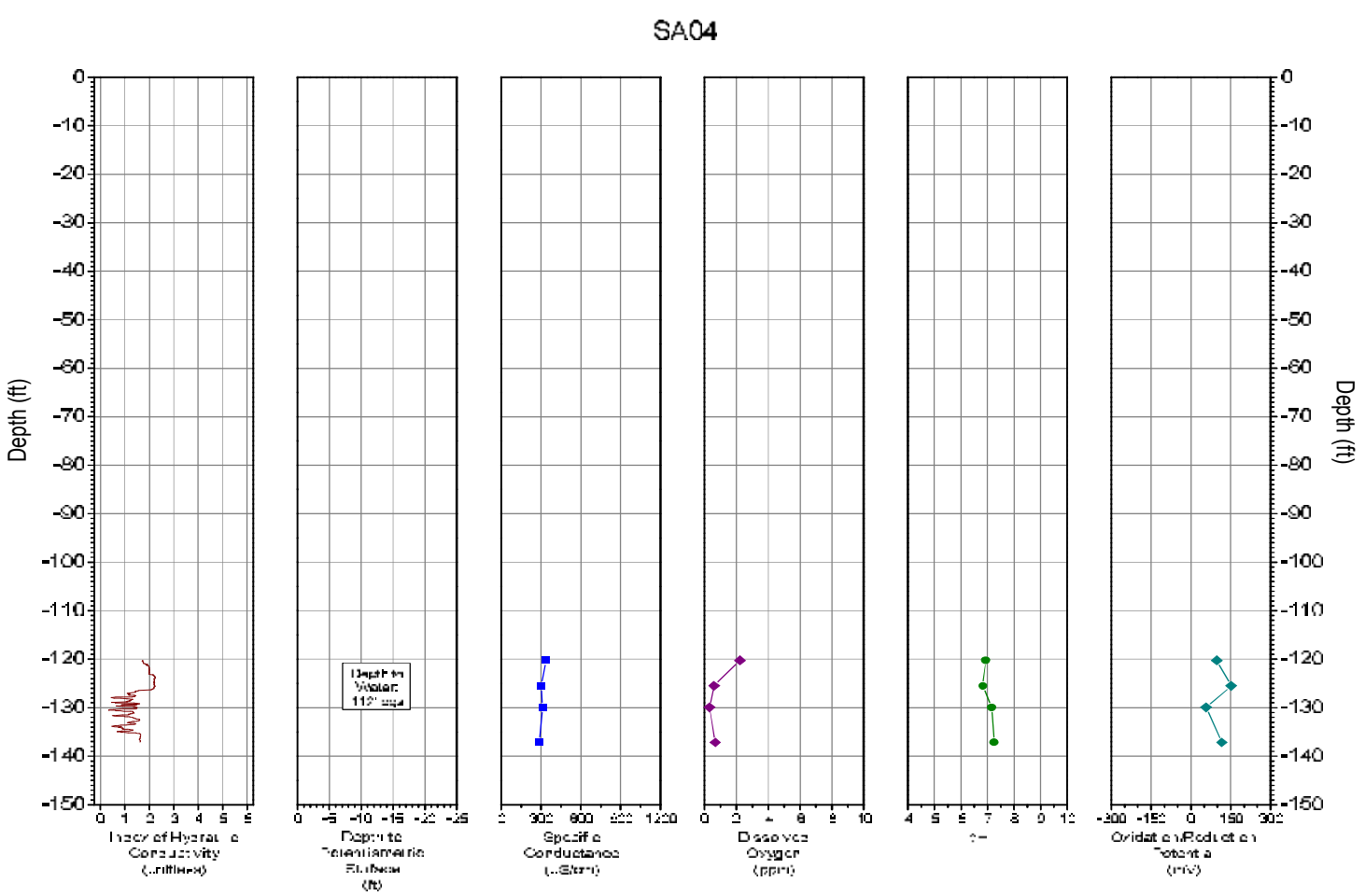


FIGURE SA04, I_z RECORD AND PHYSICO-CHEMICAL PARAMETERS

Dates Sampled : 6/7/2005

Landau Associates / Tacoma, WA

Figure 3-23

Source: SEI groundwater quality profiling data

Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\profiling\origin plots\PhysChem SA04.opj

Date: 6/8/05 djl

STONE ENVIRONMENTAL INC

Figure 3-24
1,1-Dichloroethane
B Completions

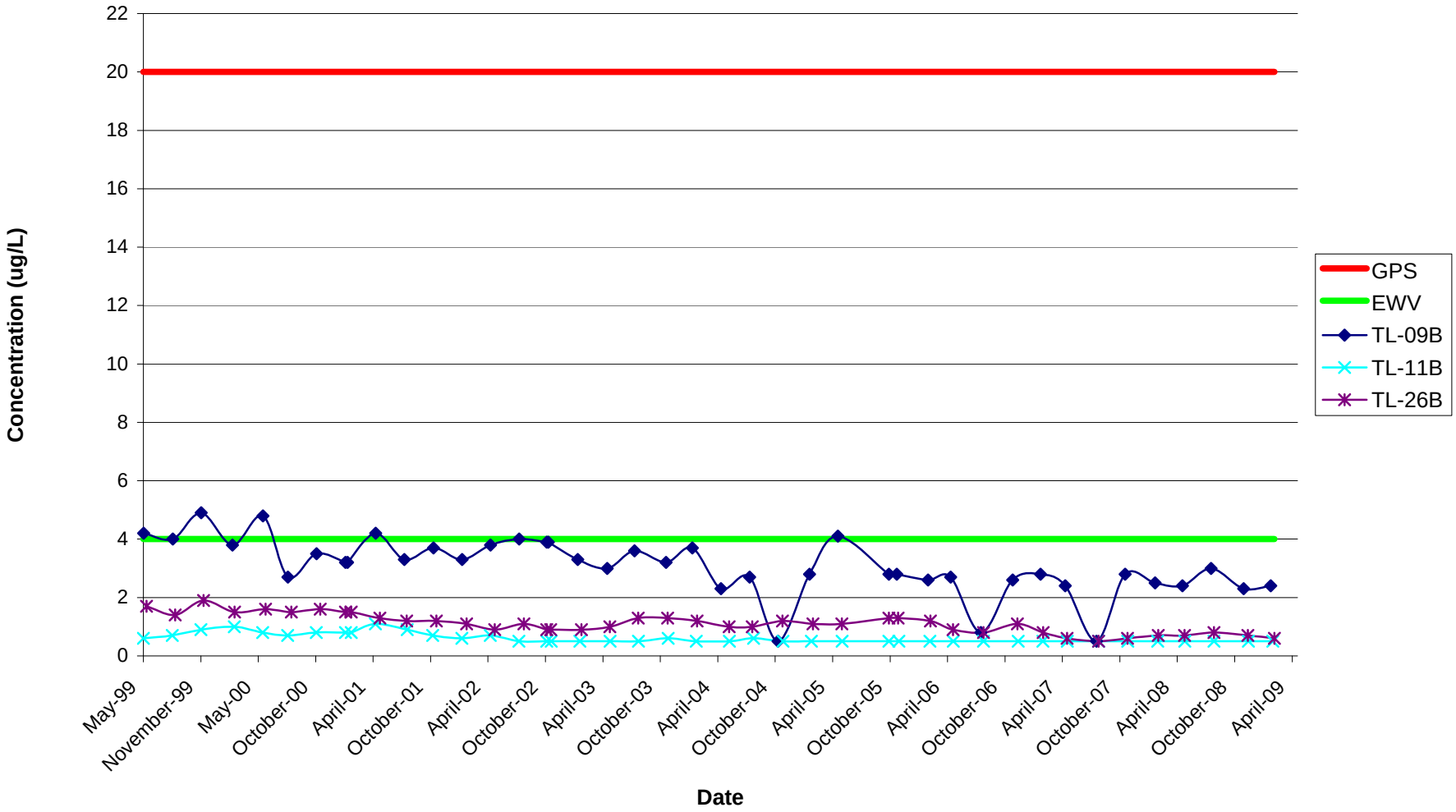


Figure 3-25
1,2-Dichloroethane
B Completions

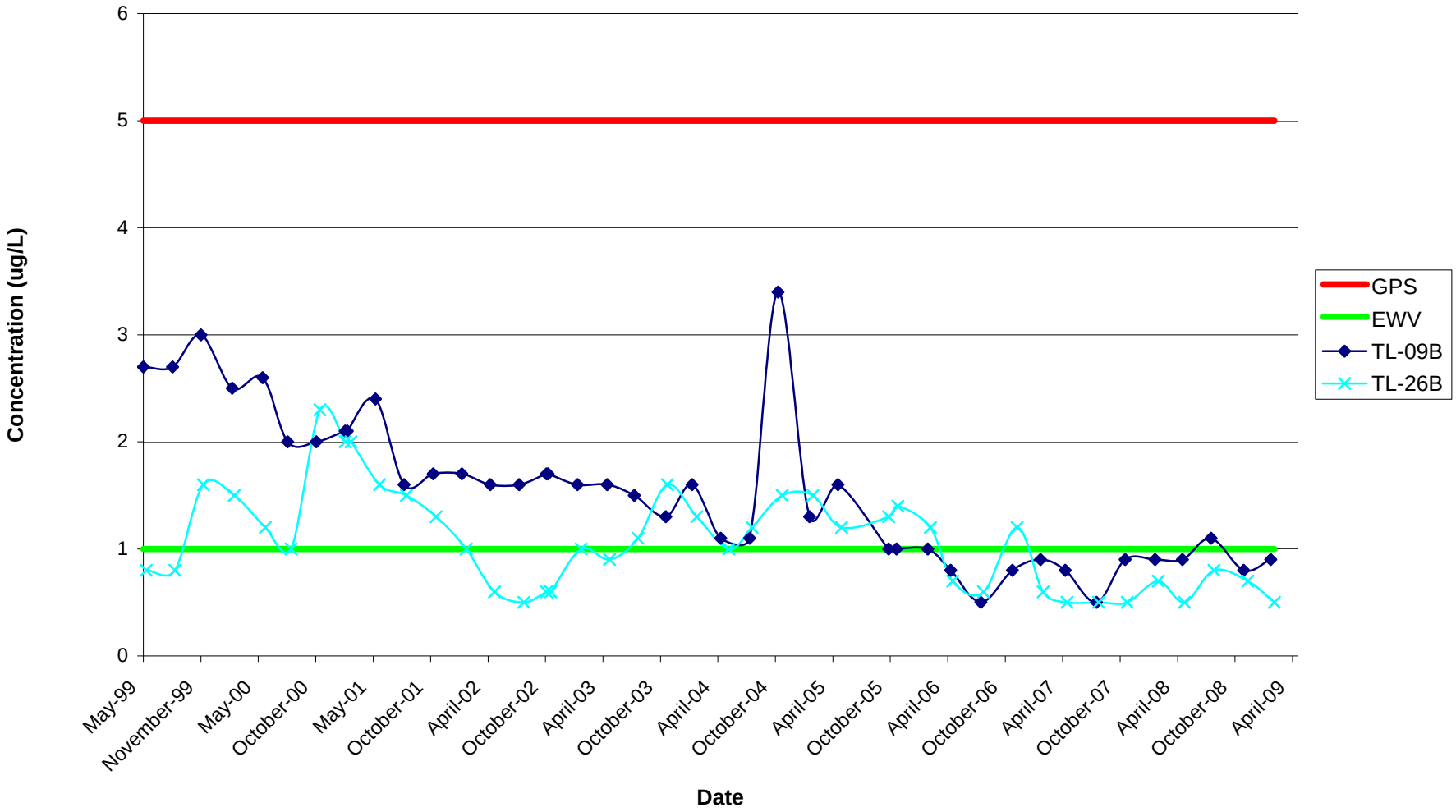


Figure 3-26
1,2-Dichloroethenes, Total
B Completions

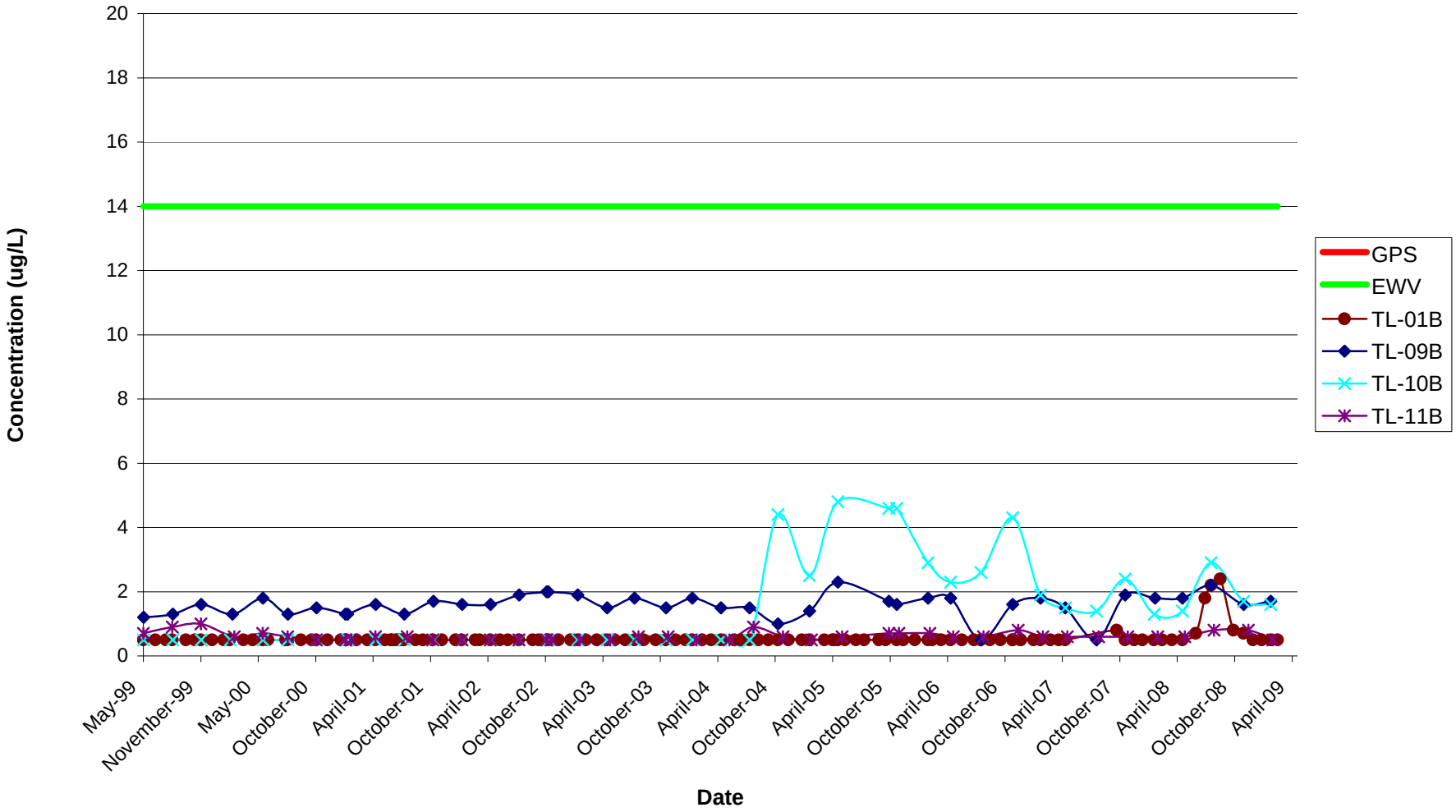


Figure 3-27
Chloroethane
B Completions

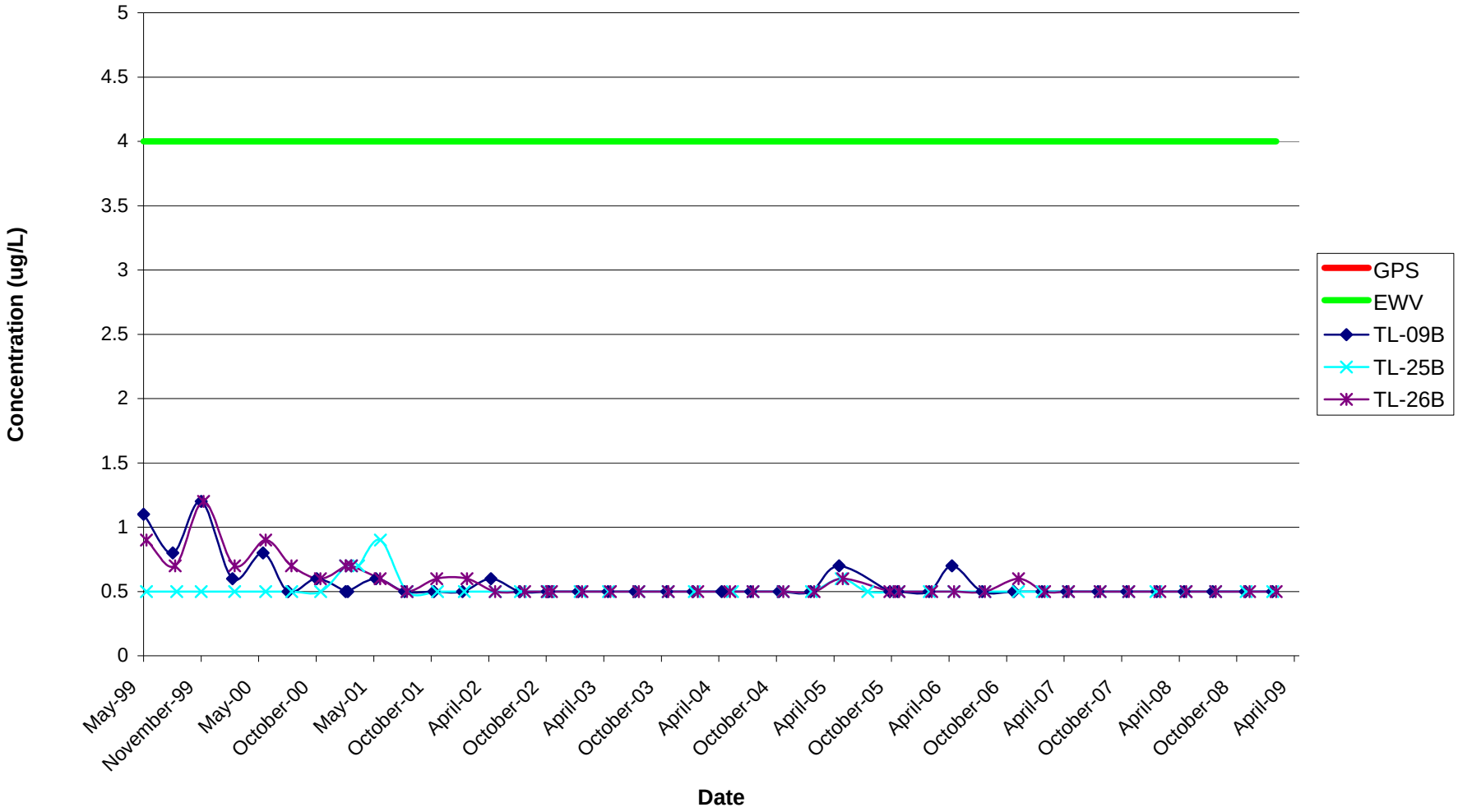


Figure 3-28
Methylene Chloride
B Completions

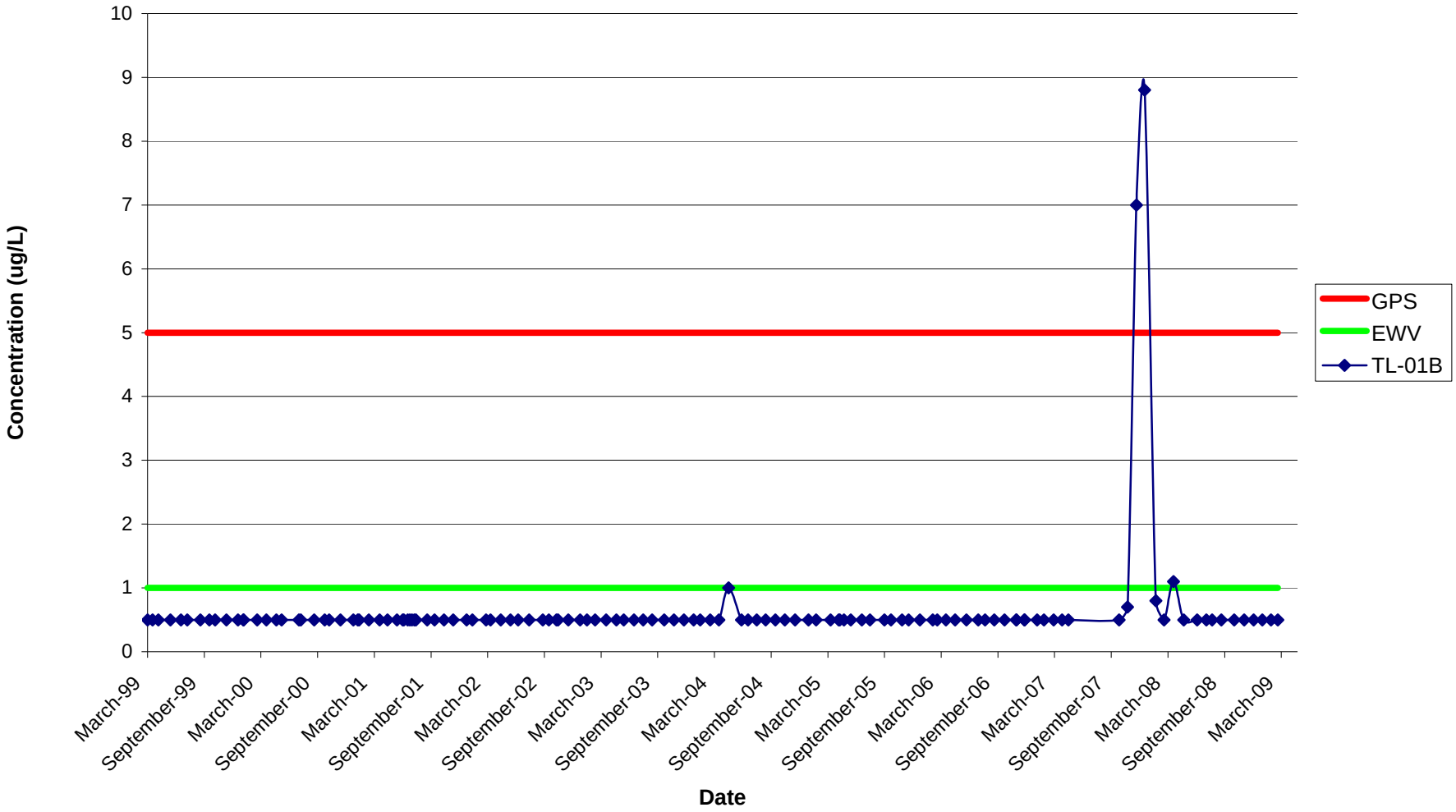


Figure 3-29
Trichloroethene
B Completions

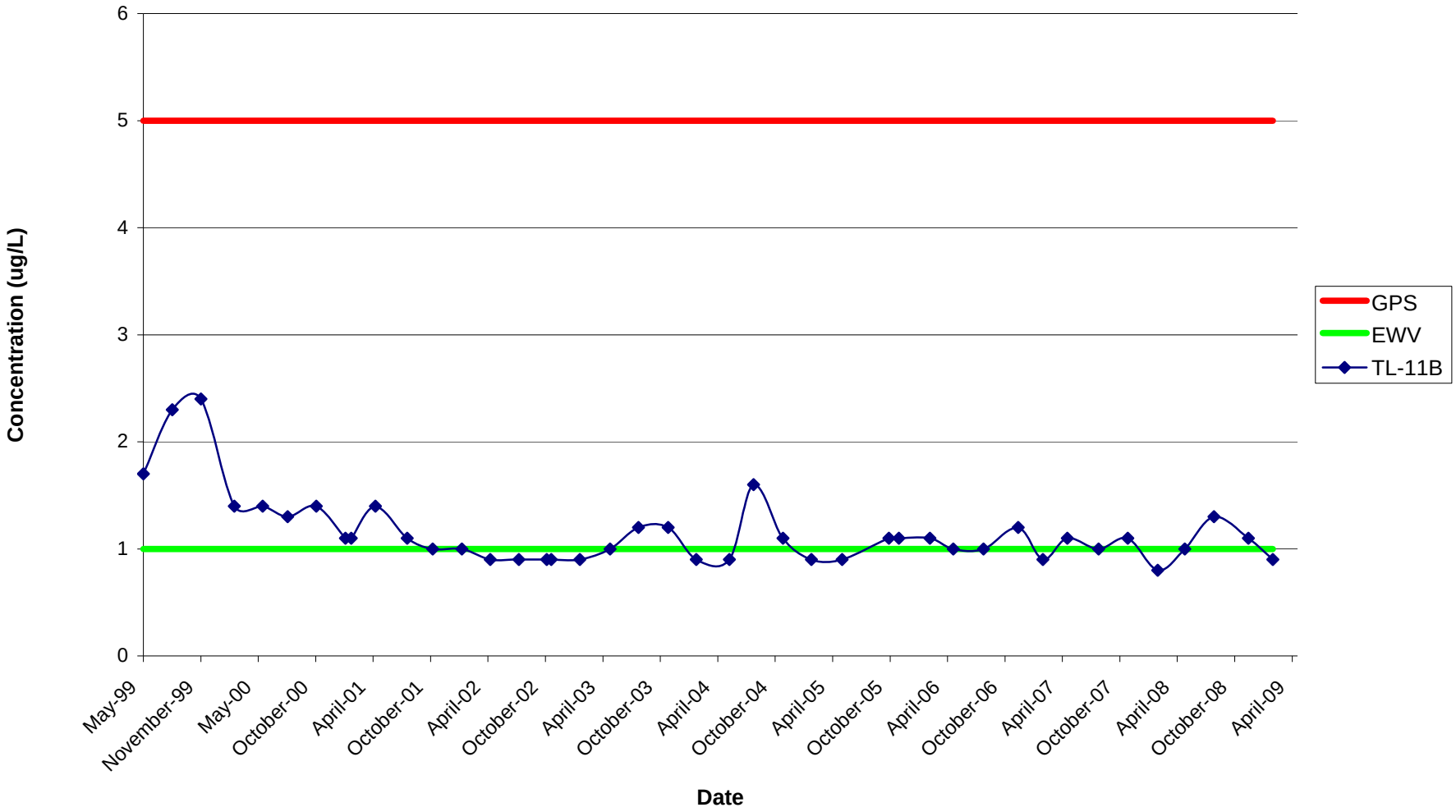


Figure 3-30
Vinyl Chloride
B Completions

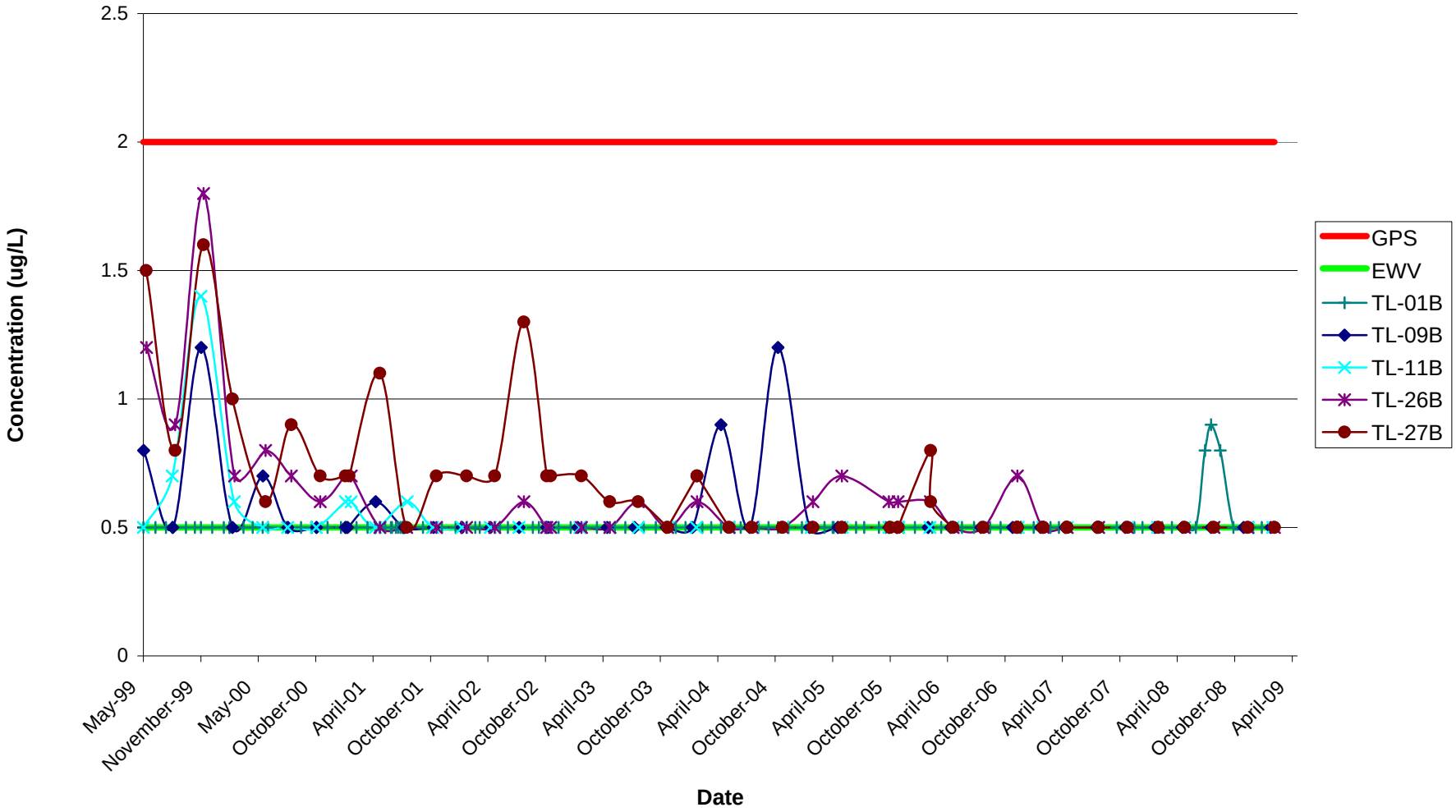


Figure 3-31
Arsenic, Total
B Completions

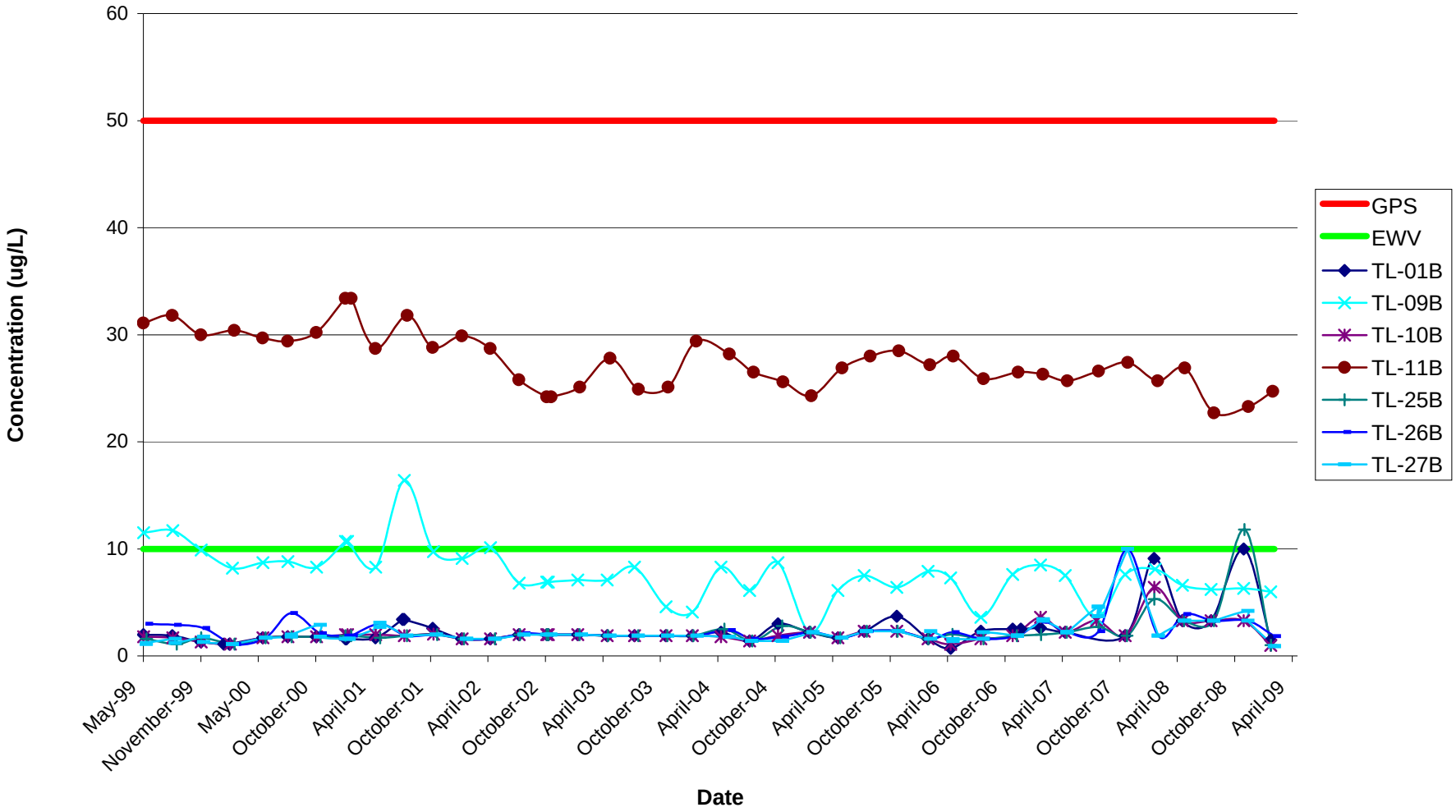


Figure 3-32
1,1,1-Trichloroethane
C Completions

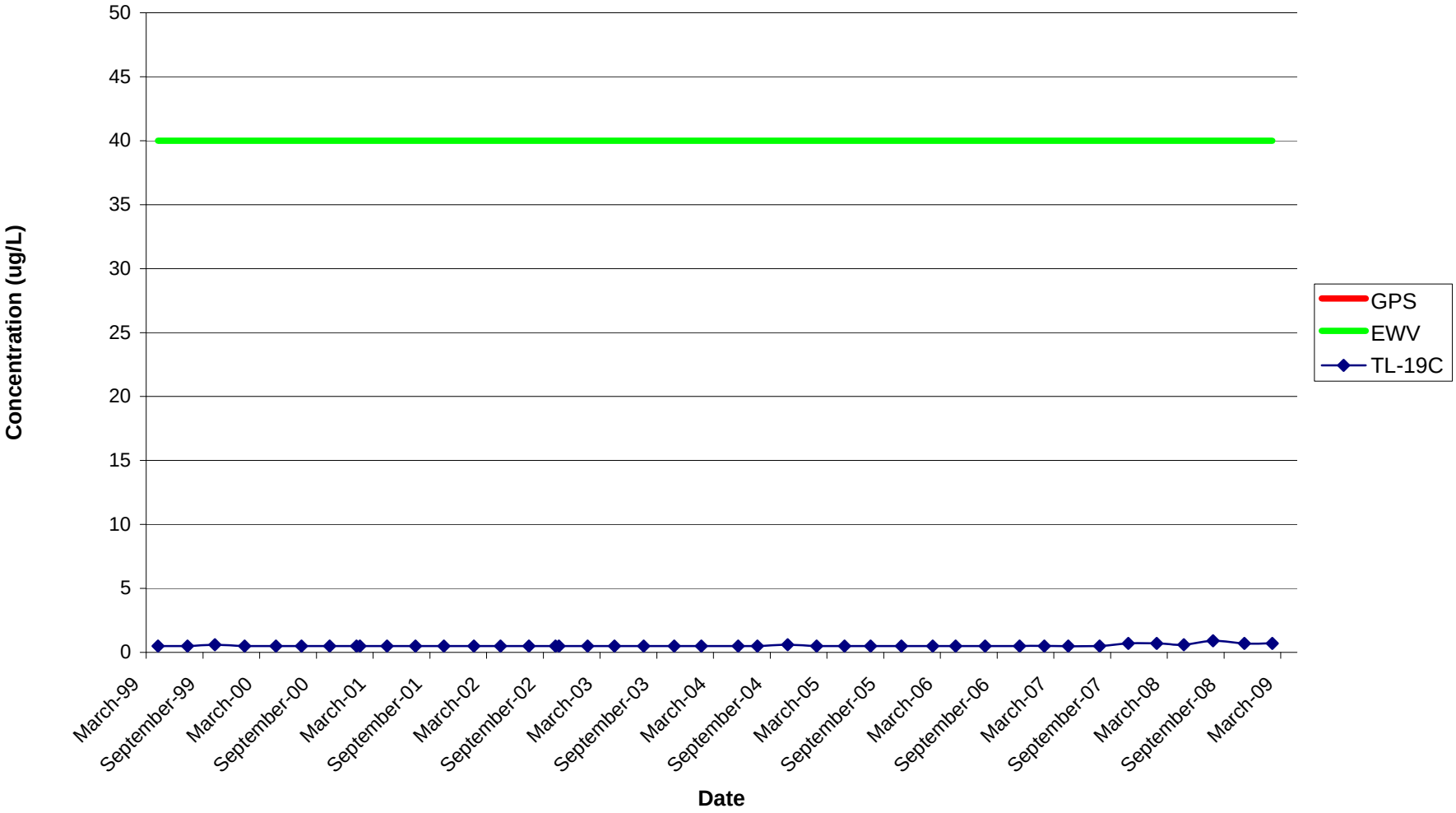


Figure 3-33
1,1-Dichloroethane
C Completions

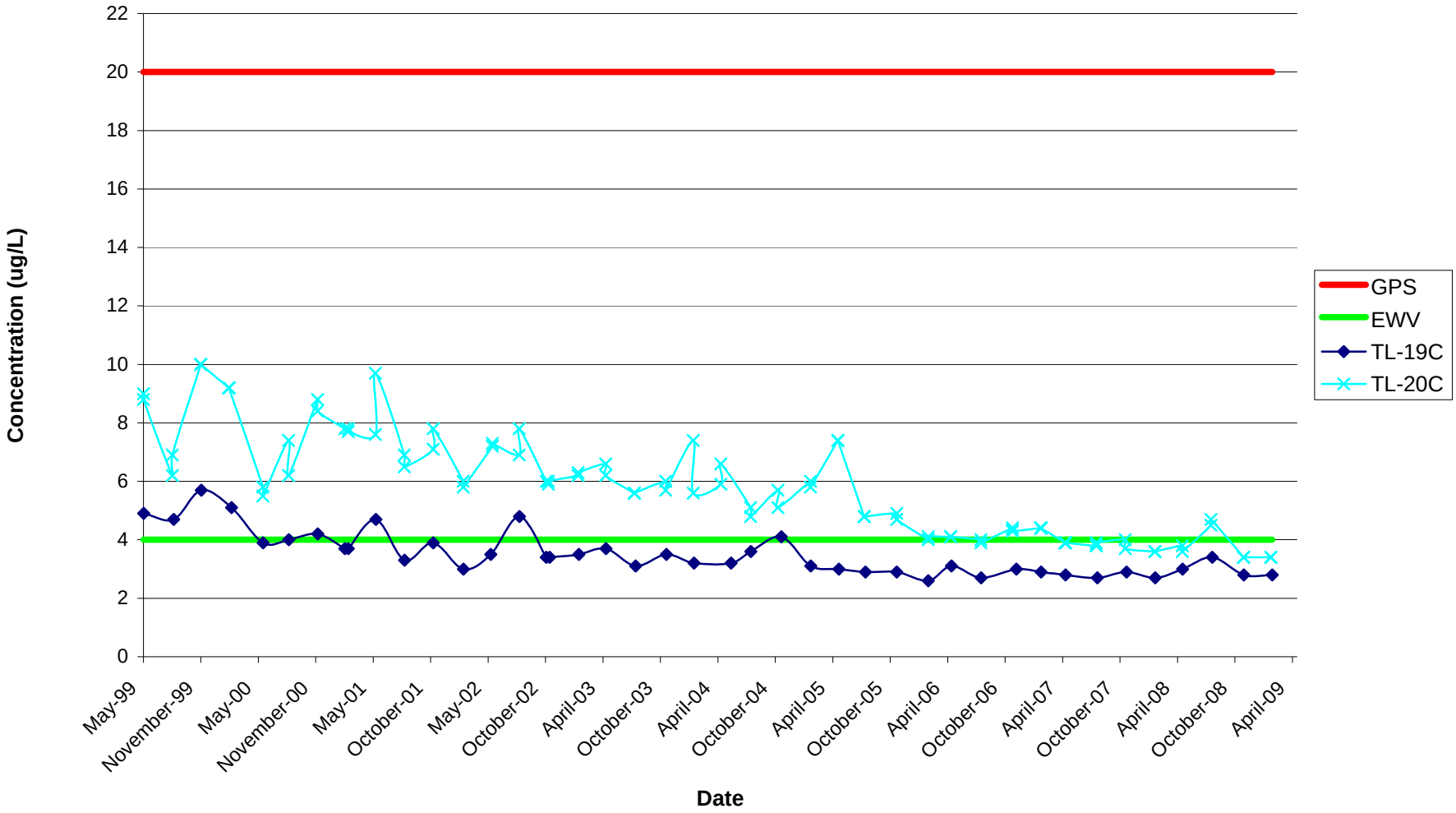


Figure 3-34
1,2-Dichloroethane
C Completions

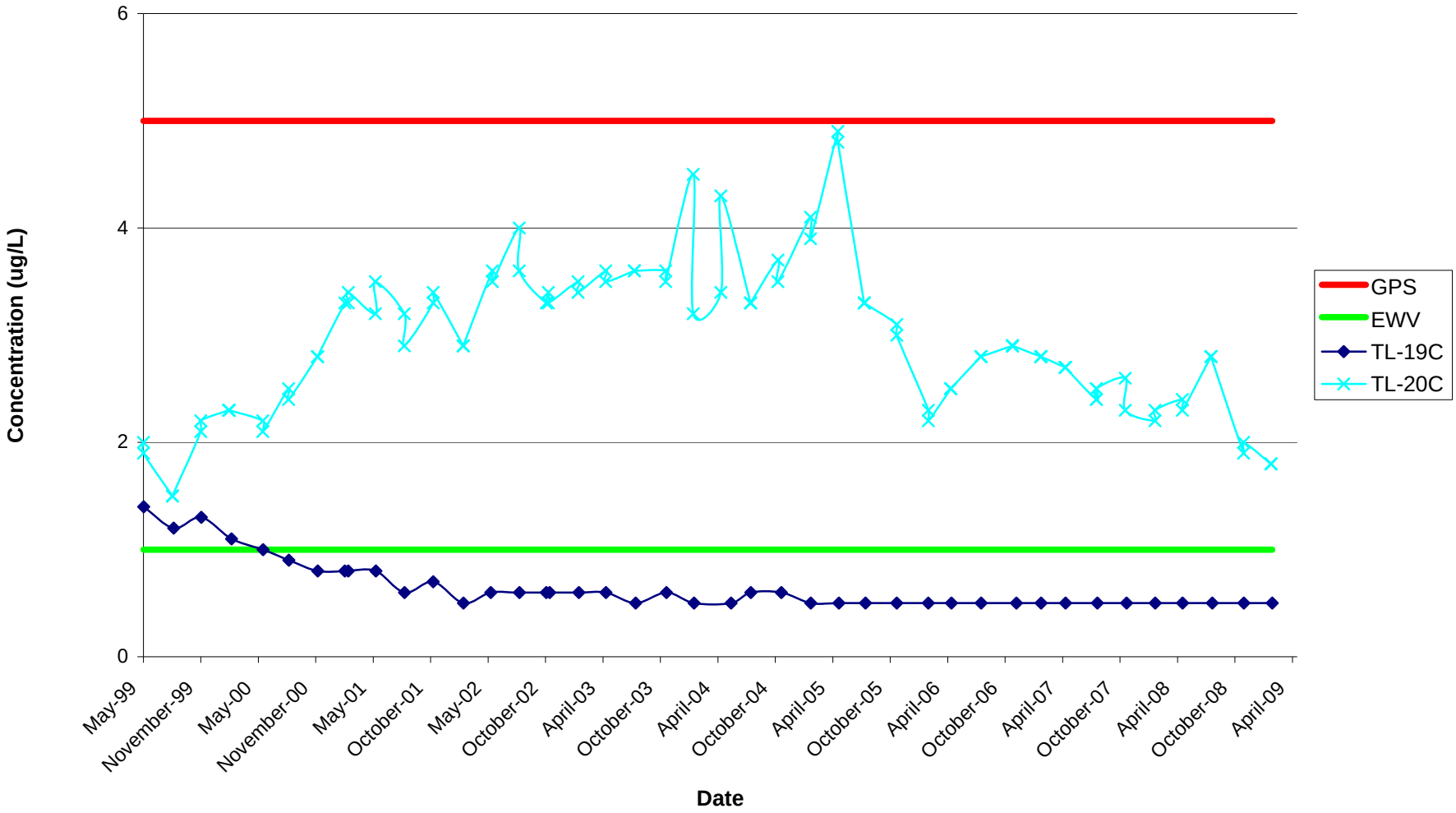


Figure 3-35
1,2-Dichloroethenes, Total
C Completions

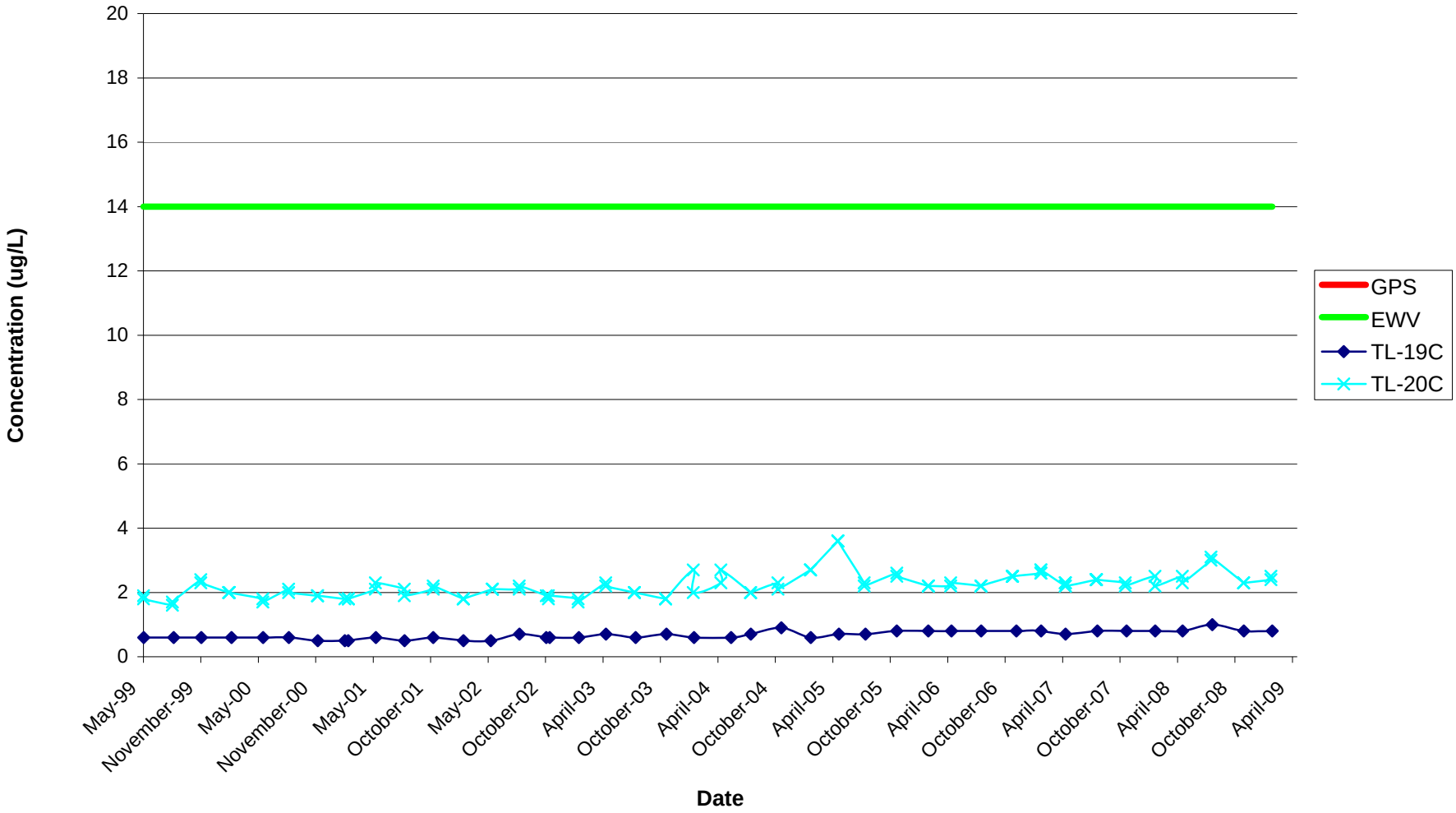


Figure 3-36
Chloroethane
C Completions

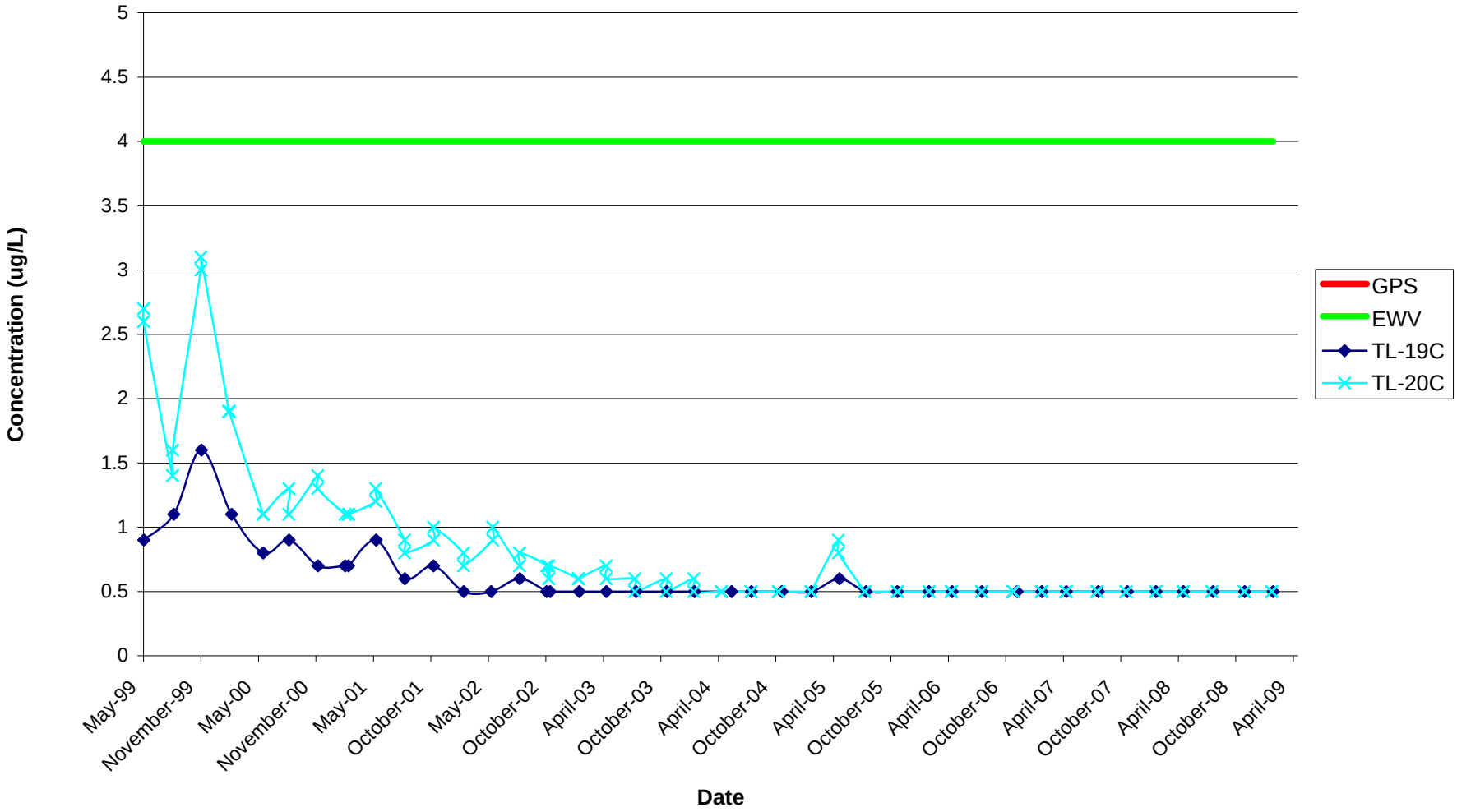


Figure 3-37
Methylene Chloride
C Completions

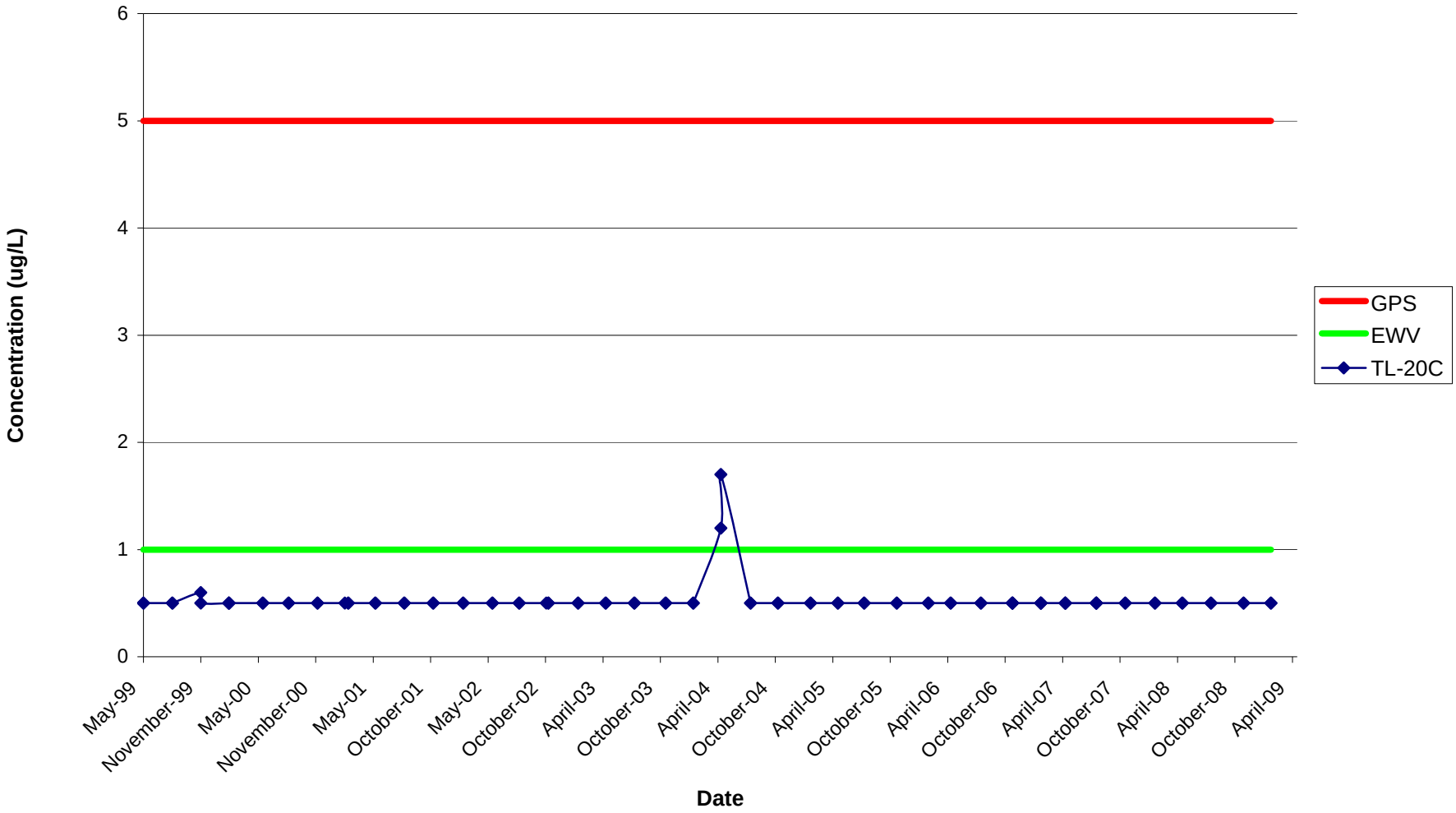


Figure 3-38
Vinyl Chloride
C Completions

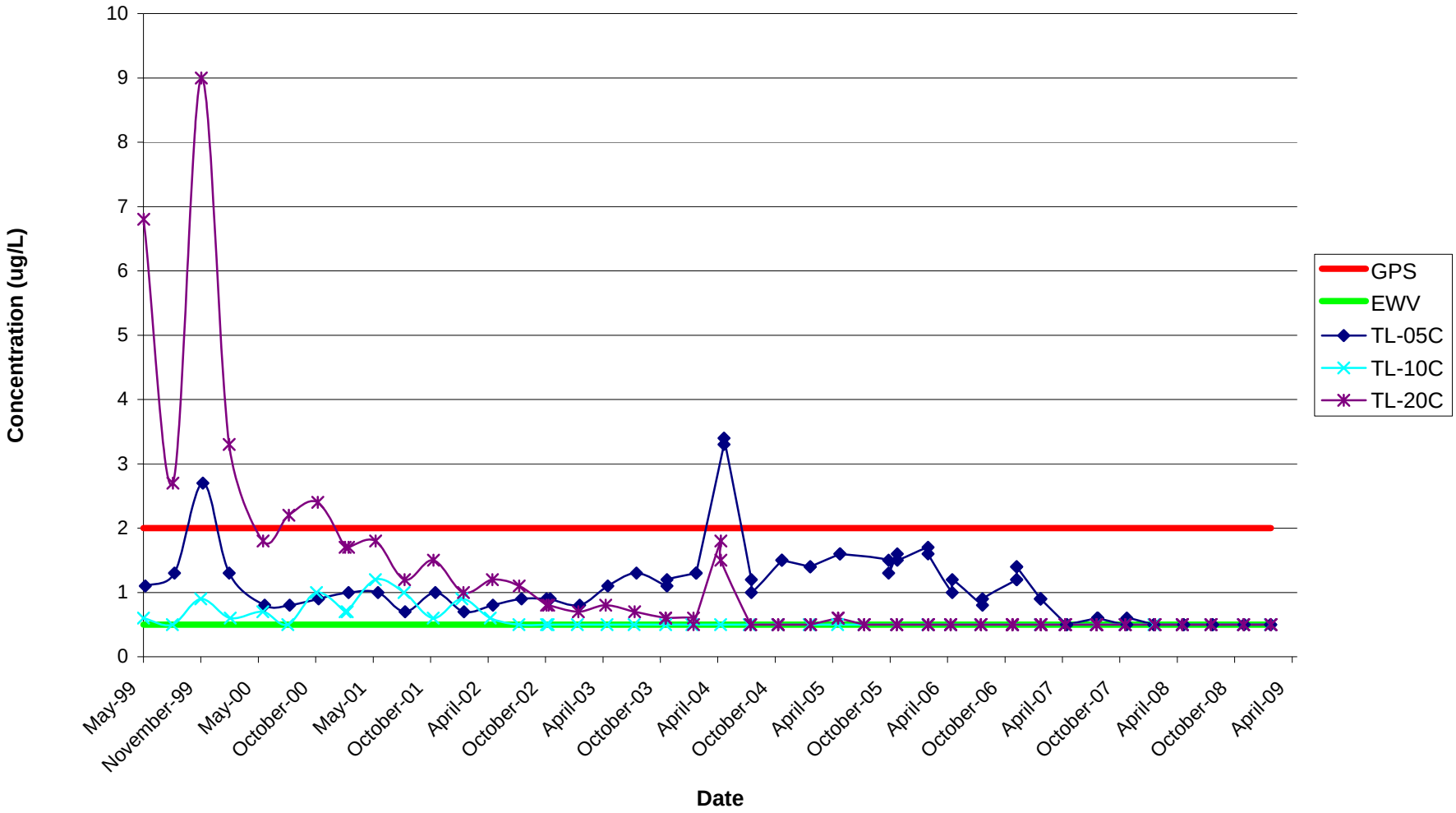
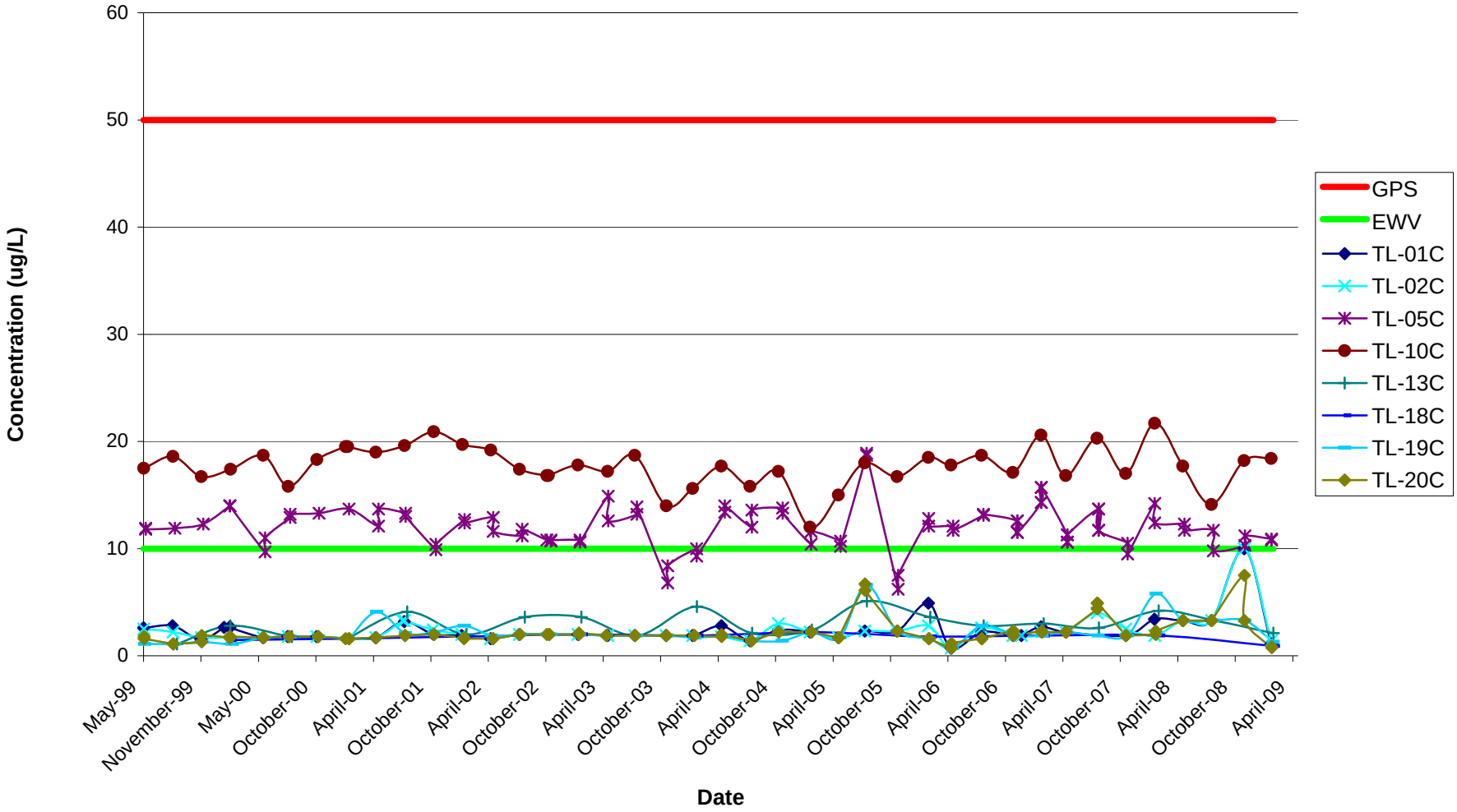
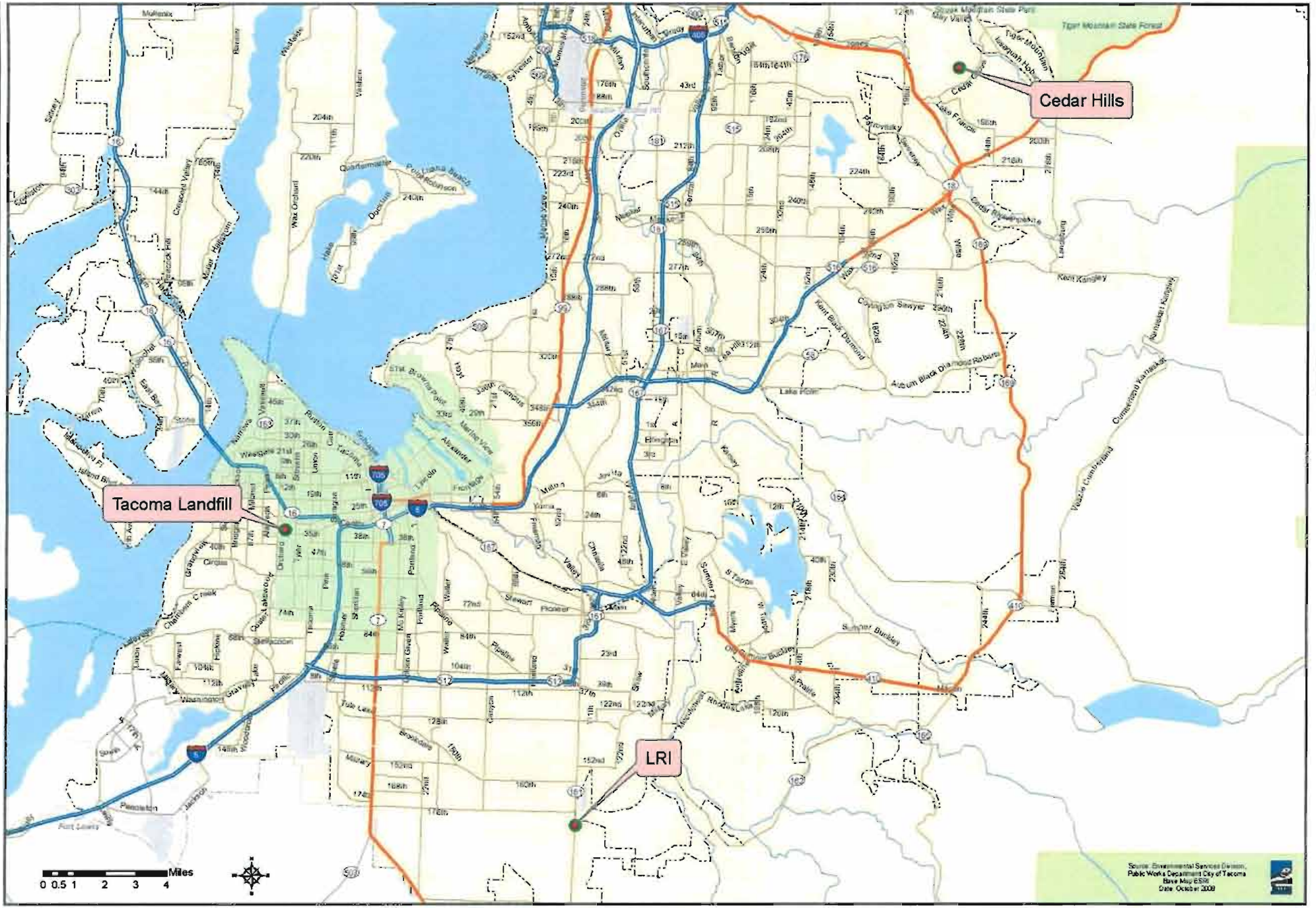


Figure 3-39
Arsenic, Total
C Completions



PUGET SOUND REGION LANDFILLS



Population Density, 2000

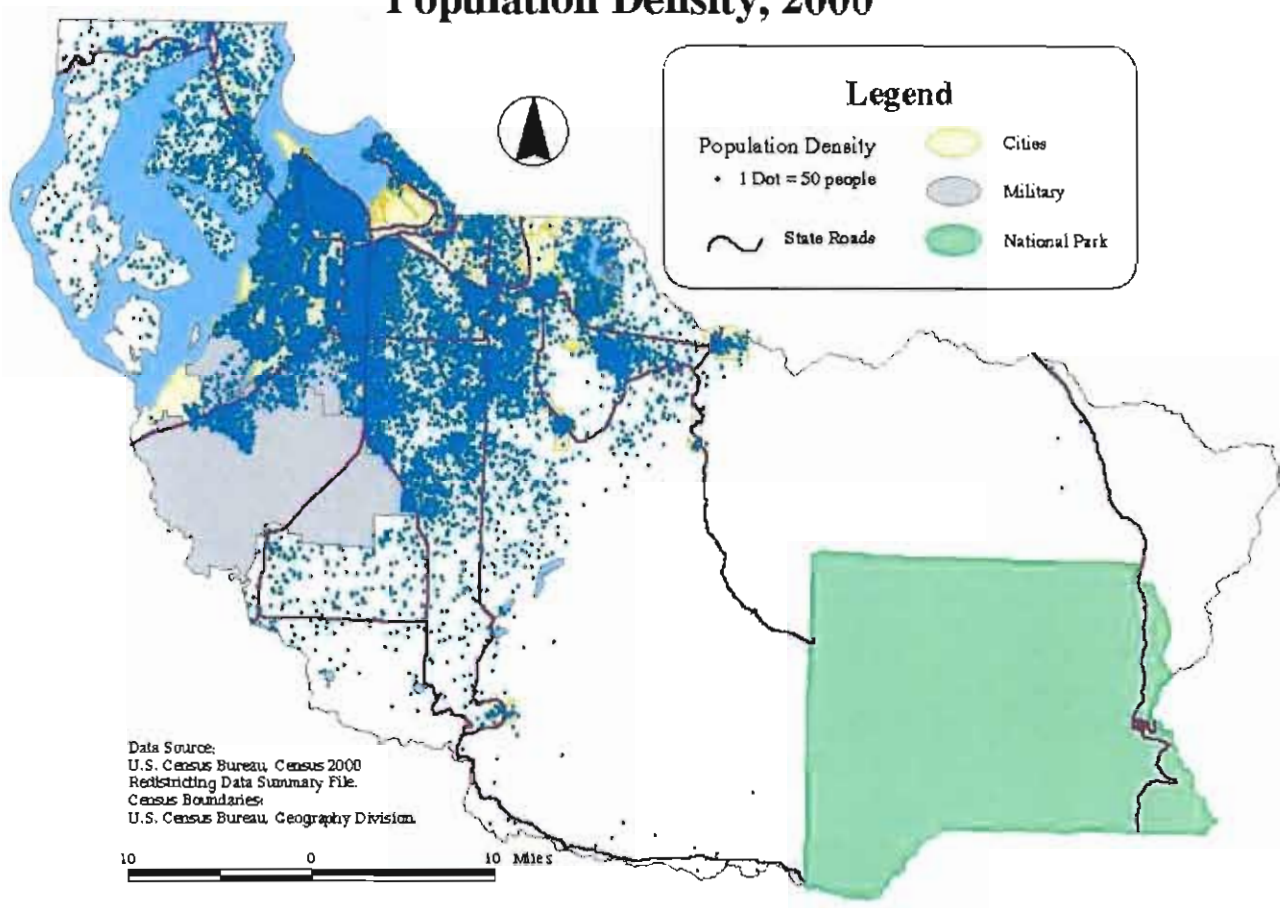


Figure 3-41

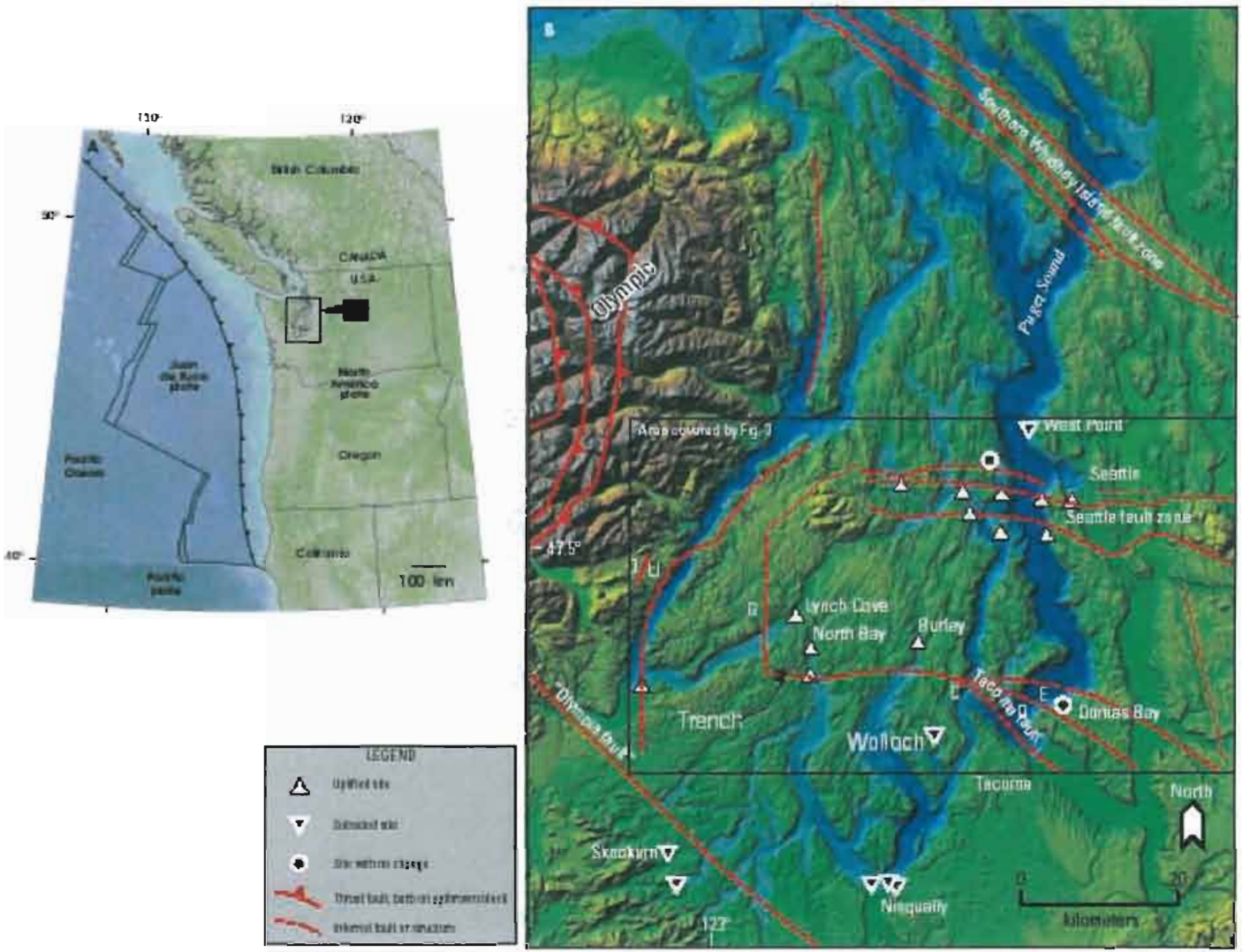


Figure 1. A. Location map of Cascadia, showing relationship of study area to Cascadia subduction zone. B. Location map of Puget Sound, showing sites with evidence for Holocene deformation, trace of geophysical anomaly of the Tacoma fault, and location of scarp along the anomaly. Base map modified from Finlayson, et al. (2001).

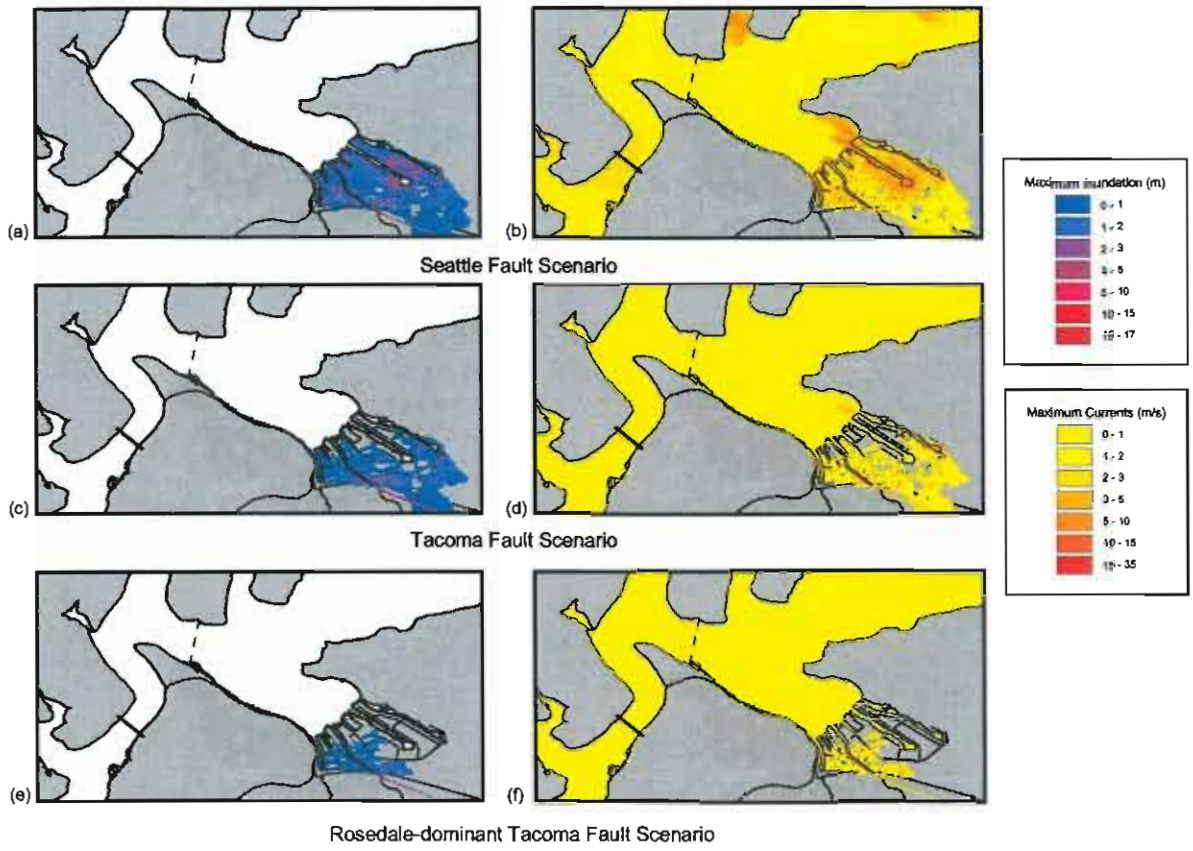


Figure 5: Maximum inundation (a, c, e) and maximum wave speeds (b, d, f) for each source scenario. The Seattle Fault scenario has the most inundation and highest currents. The Tacoma Fault scenario has significant inundation in the Port of Tacoma region, but with smaller amplitudes. The Rosedale-dominant Tacoma Fault scenario depicts the least inundation and lowest current speeds.

5. Discussion of Modeling Results

All three scenarios create significant vertical displacements along their respective fault surfaces. The Seattle Fault scenario creates the most intense currents and inundation (Figs. 5, 6) within the study area due to the large displacement of water in the deepest and widest region of Puget Sound. The Tacoma Fault scenario causes less inundation overall since much less water is displaced in the narrower and shallower regions of Carr Inlet, Colvos Passage, and East Passage. The Rosedale-dominant Tacoma Fault scenario causes the least amount of inundation in the study region due to relatively small displacements in the regional channels.

Most inundation occurs within low-lying, relatively flat regions of the study area such as the Port of Tacoma harbor in Commencement Bay. Minimal inundation occurs along steep topographical slopes. Consequently, the inundation is determined primarily by local topography rather than offshore wave dynamics. This correlates well with previous observations of long period tsunami waves, which lose their energy via bottom friction over long

Figure 3-44

Potential Flood Hazard Area
Pierce County Code Title 18E regulates activities within Flood Hazard Areas.
The boundaries of flood hazard areas are approximate and are intended only to provide an indication of the presence of said areas. Additional hazard areas that have not been mapped may be present.
Source:
Flood Insurance Rate Map (FIRM).
Federal Emergency Management Agency (FEMA)
Notes:
1) FIRM data is for overview purposes only. For administering the National Flood Insurance Program, please see the original FIRM map series.
2) Regulated areas also include areas within 5 vertical feet from the base flood elevation and from the ordinary high water mark of an identified natural watercourse.
Adopted October 19, 2004 - Ordinance No. 2004- 57s
Effective March 1, 2005
Gig Harbor
Tacoma
Fife
Milton
Edgewood
Puyallup
Sumner
Buckley
South Prairie
Wilkeson
Carbonado
Orting
Eatonville
Mt. Rainier National Park
McNeil Island
University Place
Steilacoom
Lakewood
Dupont
Fort Lewis
Roy
Pierce County, Washington
Federal Boundary
State or Federal Route
0 3 6
Dept. of Planning & Land Services
Revision Date: February 23, 2005 Plot Date: February 24, 2005
Pierce County
Potential Flood Hazard Areas

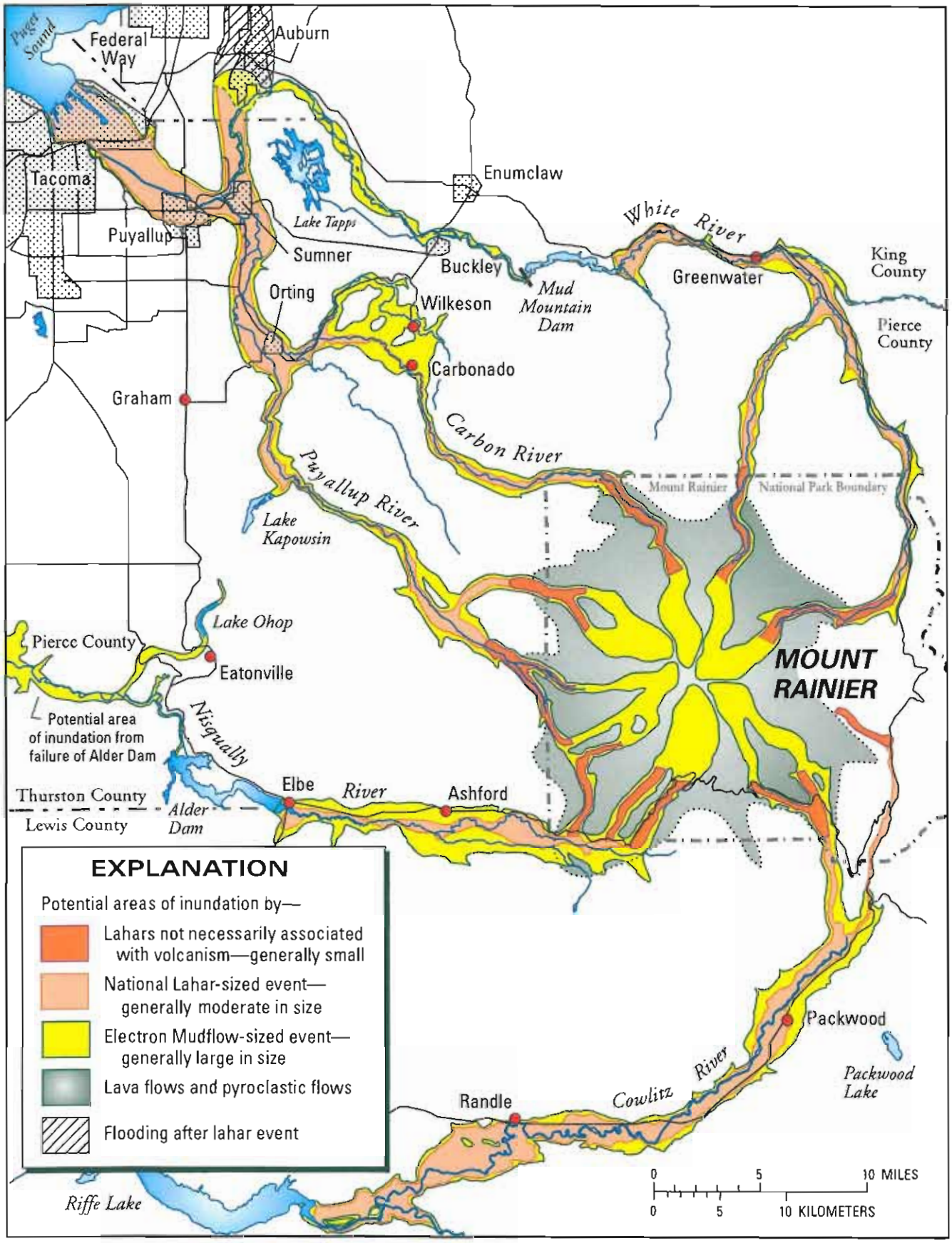


FIGURE 3.—*Hazard zones for lahars, lava flows, and pyroclastic flows from Mount Rainier (Hoblitt and others, 1998; US Geological Survey Open-File Report 98-428). The map shows areas that could be inundated if events similar in size to those of the past occurred today. Lahar hazard is not equal in all valleys. Puyallup Valley is the valley most susceptible to lahars caused by flank collapse. Risk to individual drainages will be refined as scientists learn more about the volcano.*

APPENDICES

Located on enclosed CD.

Tacoma City of Tacoma
Public Works Department

June 8, 2009

Ms. Kris Flint
U.S. Environmental Protection Agency, Region 10
ECL 113
1200 Sixth Avenue, Suite 900
Seattle, WA 98101

Subject: Tacoma Landfill – Third Five-Year Closure Extension Request – Amendment #1

Dear Kris,

In accordance with Section 3.4.2.1 of the Consent Decree Scope of Work, enclosed are three copies (plus two CDs) of the Tacoma Landfill Third Five-Year Closure Extension Request-Amendment #1 for your review and approval. If approved, this would extend the Central Area closure extension to December 31, 2014. The current 2nd Five-Year Extension expires on December 31, 2009.

The City of Tacoma has discussed this closure extension request with you, the Washington State Department of Ecology, and the Tacoma-Pierce County Health Department. The City believes the enclosed document provides the information needed and meets the requirements for the extension request approval.

If you have any questions or require additional information, please contact me at 253-593-7711.

Sincerely,

Calvin D Taylor

Calvin D. Taylor, L.H.G.
Tacoma Landfill Project Coordinator
Science and Engineering Division

CDT:sh (Cover Ltr CE III-Amend #1_8Jun09)

Enclosure

cc: Chris Maurer, Ecology (2)
Dave Bosch, TPCHD (2)
Sharon Gelinas, USACE (1)
Kenneth Tross, Solid Waste Management (1)
Craig Francis, Science and Engineering Division
Karen Bartlett, Science and Engineering Division
Doug Mosich, Legal Department (1)

File: Tacoma Landfill

Landfill Gas Migration Control

Tacoma Landfill

TO: Gary Kato

COPIES: Cal Taylor

FROM: Tom Kraemer/CH2M HILL

DATE: November 12, 2007

This memo describes data from gas monitoring probes and a new gas monitoring well installed in 2006 by the City of Tacoma near the north end of the Tacoma landfill. The new probes and wells were installed specifically to prevent methane migration onto the Home Depot property adjacent to the landfill property. The data from 2006 and 2007 are presented showing effective control of gas movement at the north end of the landfill and steady reduction in methane concentrations in existing gas probes adjacent to and on Home Depot property.

Demonstration of Continuous Methane Capture Across North End Of Tacoma Landfill

In 2005, CH2M HILL analyzed data[1] from existing landfill gas wells and gas monitoring probes near the north end of the Tacoma landfill, including probes on Home Depot property just north of the landfill. The memo concluded that, although there have been fluctuating quantities of methane found north of the landfill on the Home Depot property, the methane may not have originated in the Tacoma landfill or may have originated in the Tacoma landfill at a time long distant, i.e. not from recent migration. CH2M HILL's 2005 memo recommended installation of additional gas monitoring probes interspersed among the gas extraction wells at the north end of the landfill. These wells would be placed at locations between gas extraction wells that would allow Tacoma to determine whether overlapping zones of influence are maintained between adjacent wells across the north end of the landfill, thus capturing any current gas migration.

Tacoma installed the new gas monitoring probes in July 2006. The attached drawings show the locations and construction details of the new gas probes. Drawing 1 shows the new probe locations in relation to the existing gas extraction wells. A 110 foot radius zone of influence around each extraction well was assumed and the new gas probes were located at the north edge of the overlap points formed. Although the 110 foot radius is within a typical range for gas extraction wells, the assumed radius was not based on a computation of the expected radius of influence, but rather simply on the actual spacing between the existing gas extraction wells in this area. Being located at the extreme outside end of the assumed overlap zone, if an influence from either extraction well near each gas probe can be

[1] "Review of Gas Data at North End of Tacoma Landfill," CH2M HILL, April 2005.

demonstrated, then the influence zone of the other well need only be very small to achieve an overlap. The new probes thus are able to demonstrate a continuous "curtain" of gas capture across the north end of the landfill.

Figures 1 through 4 show the vacuum induced in the new gas probes. Figures 5 through 9 show the vacuum in the five extraction wells PW60 through PW62 and PWHD-A and PWHD-B.

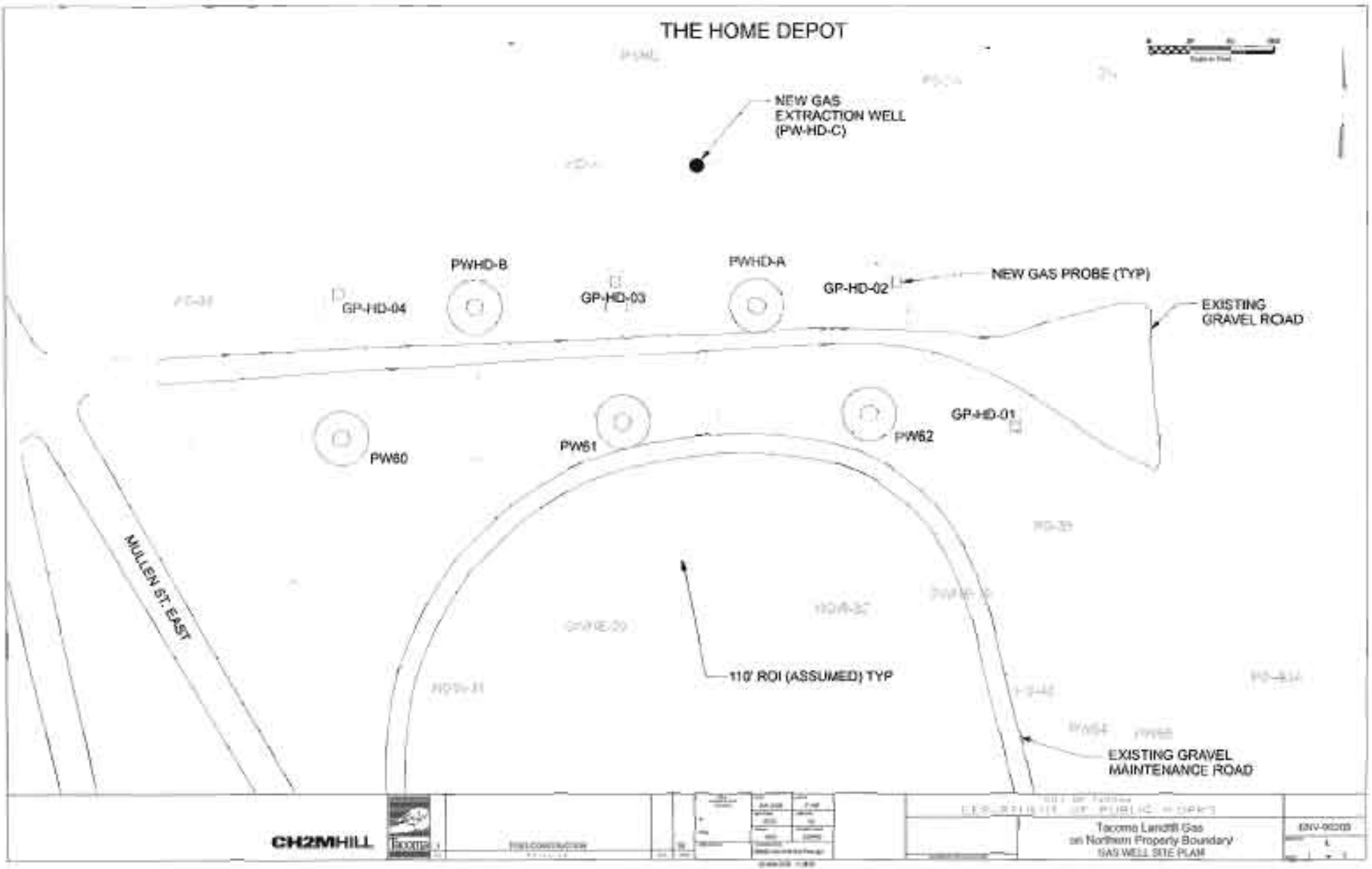
Each of the extraction probes and wells have multiple levels going down to approximately 50 feet below grade for the monitoring probes and somewhat deeper for the extraction wells. (See cross-section A-A' for typical probe level elevations and depth correlation between monitoring probes and extraction wells.) The monitoring probes are labeled from uppermost to lowermost according to the sequence red-orange-yellow-blue, while the extraction wells are labeled from uppermost to lowermost according to the sequence A-B-C.

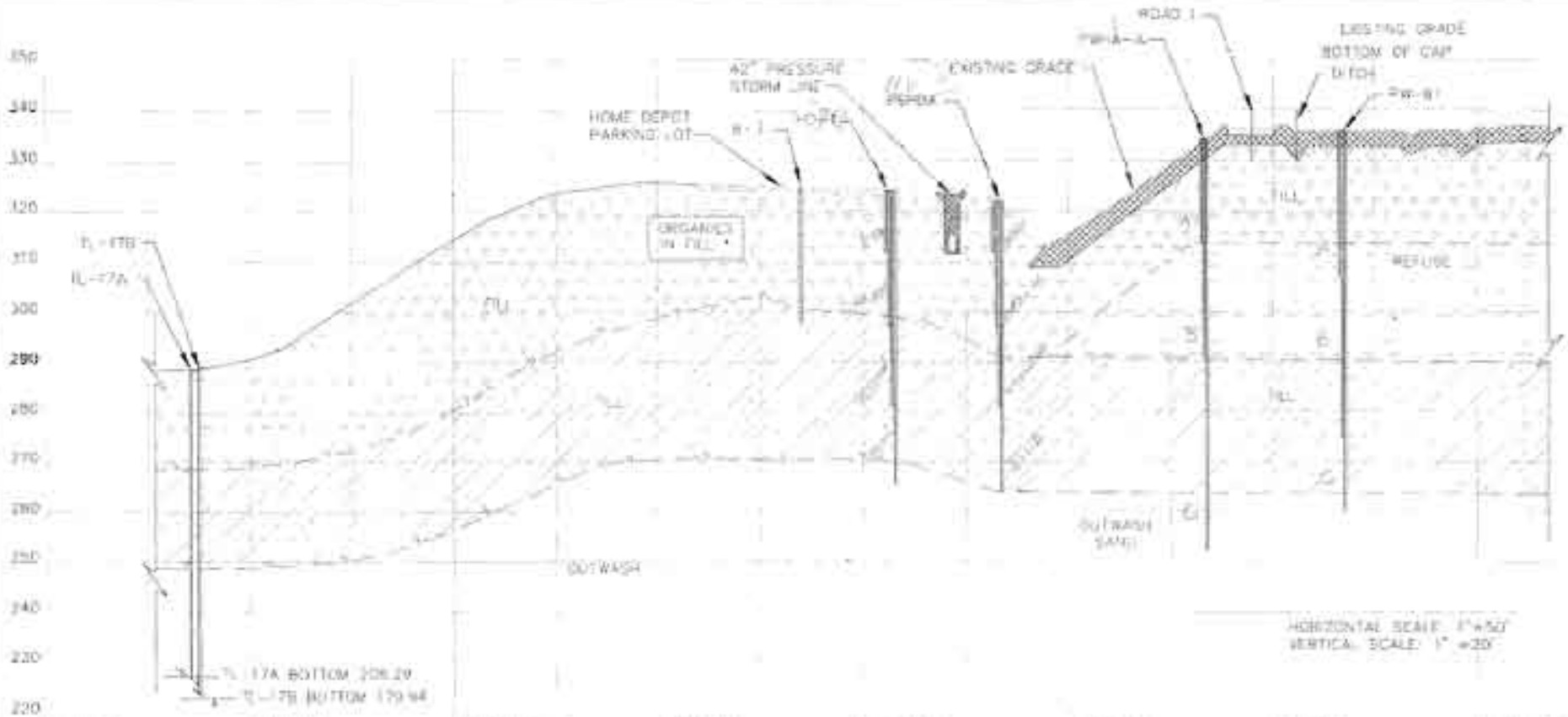
Conclusion: In general, the data show a consistent pattern of increasing vacuum (i.e. pressures farther below zero on the graphs), as the vacuum in the north end extraction wells were increased around year-end 2006. The well vacuums were adjusted at this time as Tacoma implemented a program of adjustments to its landfill gas collection system (to which the north end gas migration are also connected) that allowed them to increase the vacuum in the north end extraction wells at this time. This consistent correlation shows that the extraction wells are exerting a continuous curtain of influence at all elevations across the north end of the landfill.

The one exception to the above conclusion is the "yellow" probe of HD-4, which shows an anomalous increase in methane during January and February of 2007. The "yellow" probe correlates with the "B" levels in the extraction wells. Examination of the "B" level graphs in extraction wells PW-60 and PW HD-B show that there was a period during January 2007 when these wells were either turned off and there were either zero or no vacuum readings recorded. This may have allowed the pressure to increase in the HD-4 probe "yellow" level. In any case, after February 2007 the vacuum in this probe continued to increase through the end of the data set, as the vacuum in the nearby extraction wells continues to be applied.

Demonstration of Effects on Existing Gas Monitoring Probes on Home Depot Property

Tacoma also installed a new extraction well, PW-HD-C in May 2006. The location and construction details of the new extraction well are also shown on the attached drawings. Figure 10 shows the pressures recorded in extraction well HD-C during 2006 and 2007. Figures 11 and 12 show the methane levels in probes HD and HD-A respectively. Figures 13 and 14 show the pressures measured in the same two gas probes. The data show that methane concentrations have decreased in all levels in both of these probes, and that all readings in them since July of 2007 have shown zero methane. Also, both probes show a general trend of increasing vacuum, suggesting the vacuum influence of extraction well HD-C. This shows that the well is effective in removing methane from the general area around probe HD and HD-A, extending onto Home Depot property.


THE HOME DEPOT
NEW GAS EXTRACTION WELL (PW-HD-C)
PWHD-B
PWHD-A
GP-HD-04
GP-HD-03
GP-HD-02
NEW GAS PROBE (TYP)
EXISTING GRAVEL ROAD
GP-HD-01
PW60
PW61
PW62
MULLEN ST. EAST
110' ROI (ASSUMED) TYP
EXISTING GRAVEL MAINTENANCE ROAD
CH2MHILL
Tacoma
Tacoma Landfill Gas on Northern Property Boundary
GAS WELL SITE PLAN



CROSS SECTION A–A'

* ORGANIC MATERIAL LOGGED IN TEST PIT

State of Washington
Licensed Geologist
1480
Calvin D. Taylor

CITY OF TACOMA
DEPARTMENT OF PUBLIC WORKS
HOME DEPOT METHANE GAS INVESTIGATION
CROSS SECTION

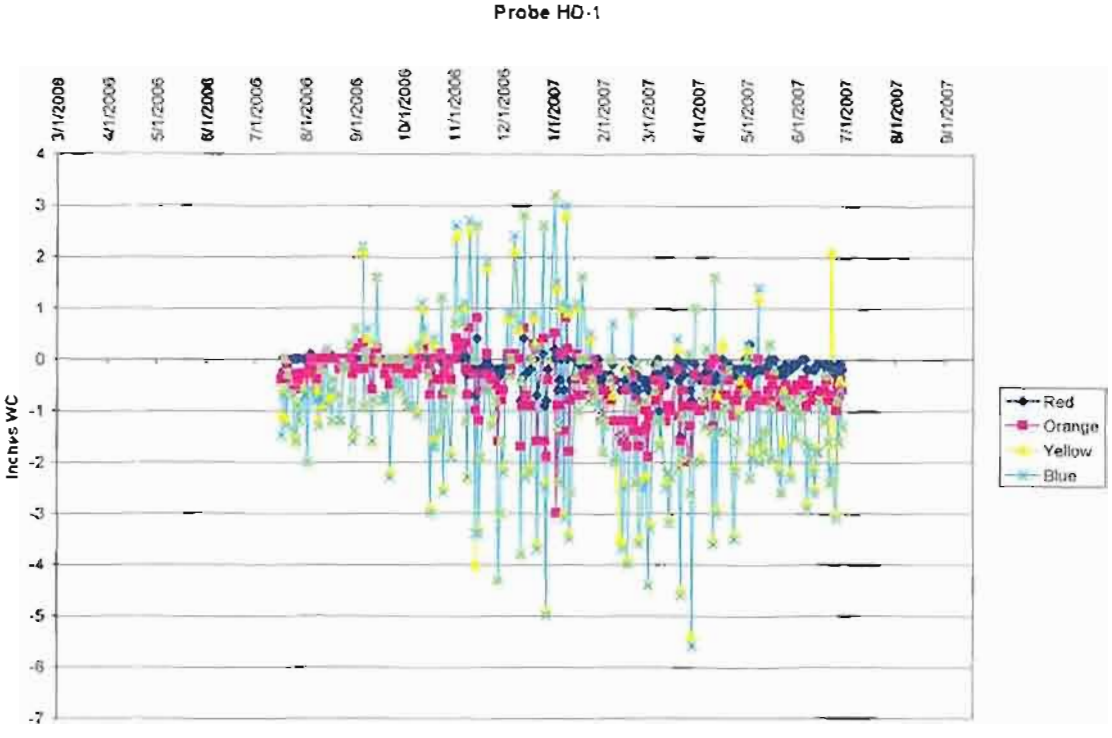


Figure 1. Probe HD-1 Pressure Over Time

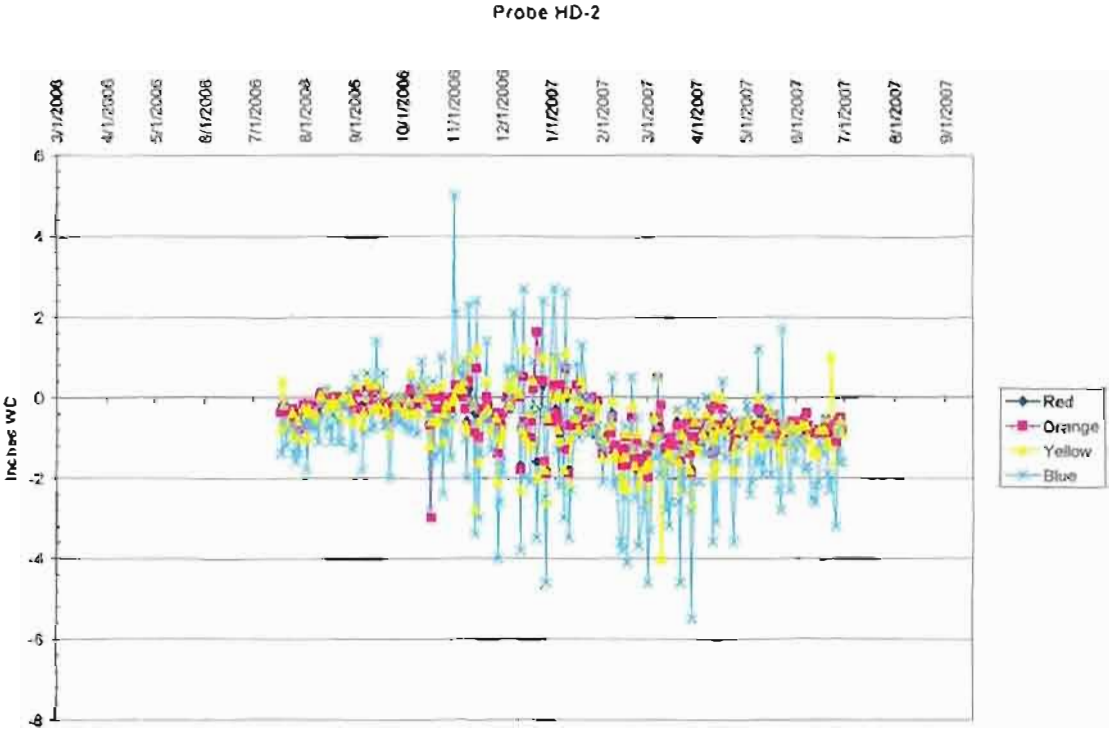


Figure 2. Probe HD-2 Pressure Over Time

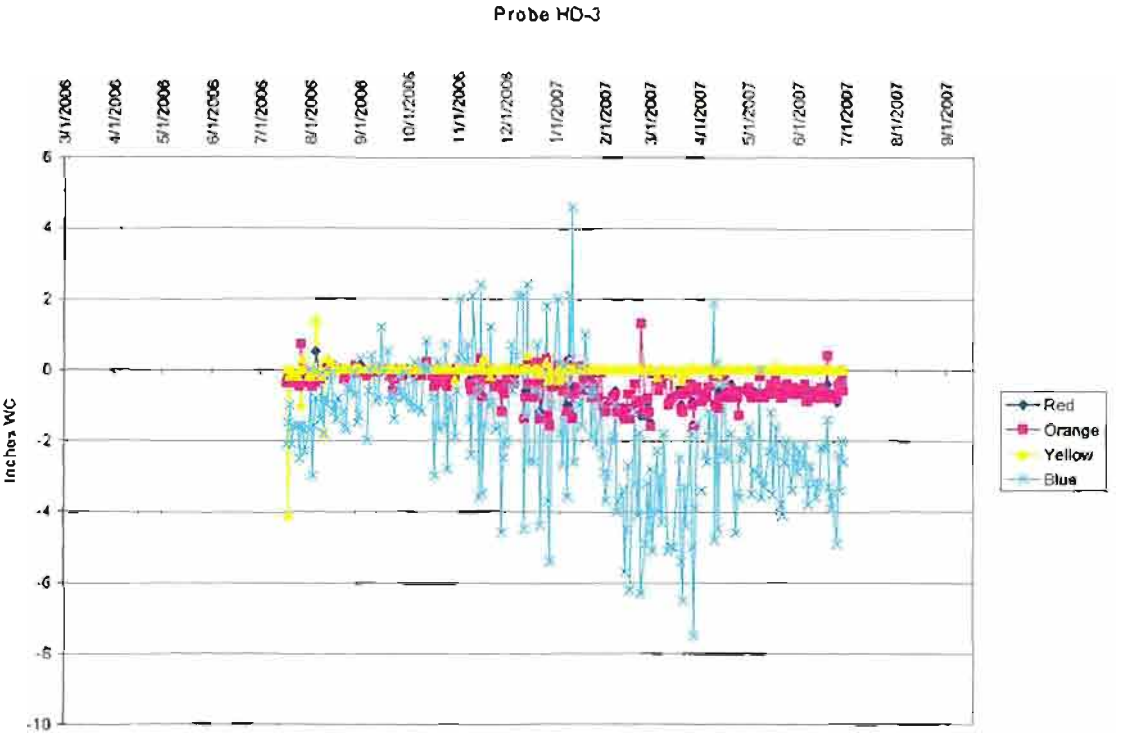


Figure 3. Probe HD-3 Pressure Over Time

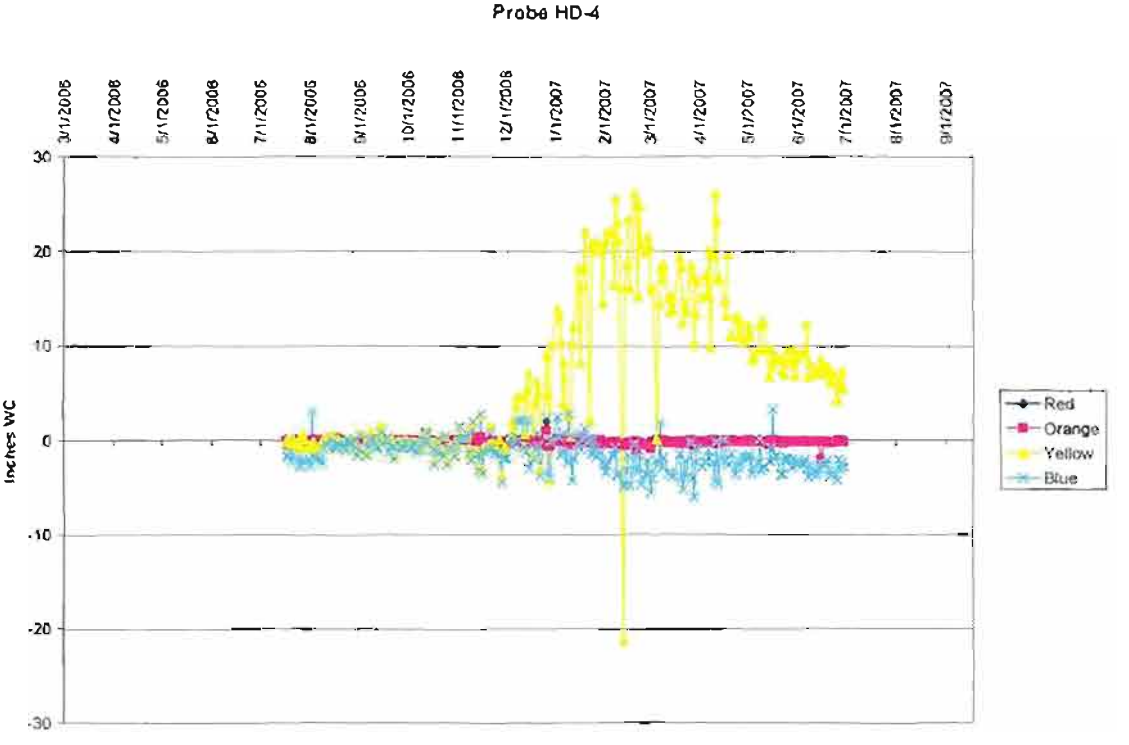


Figure 4. Probe HD-4 Pressure Over Time

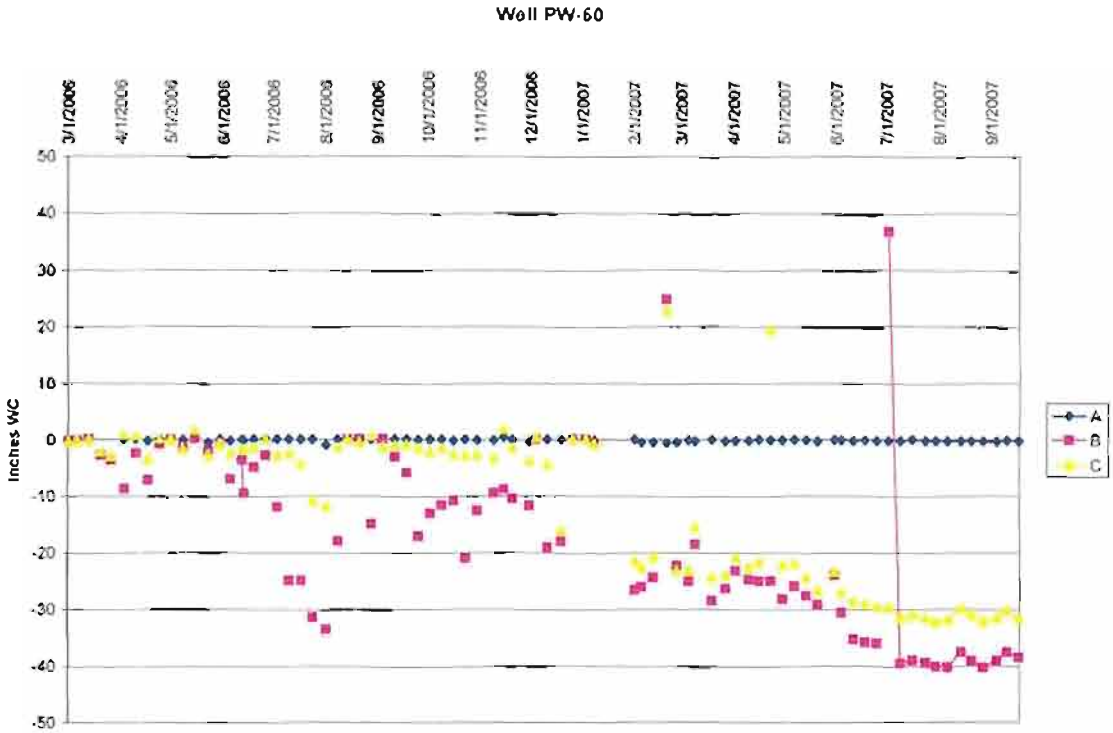


Figure 5. Extraction Well PW-60 Pressure Over Time

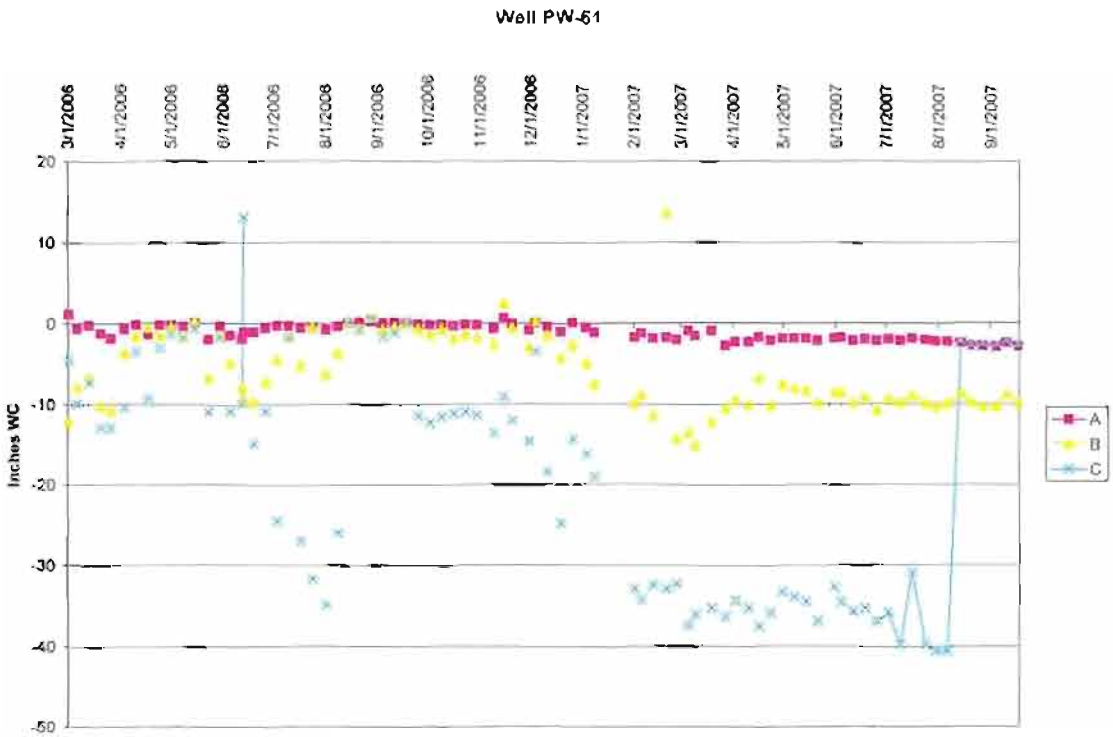


Figure 6. Extraction Well PW-61 Pressure Over Time

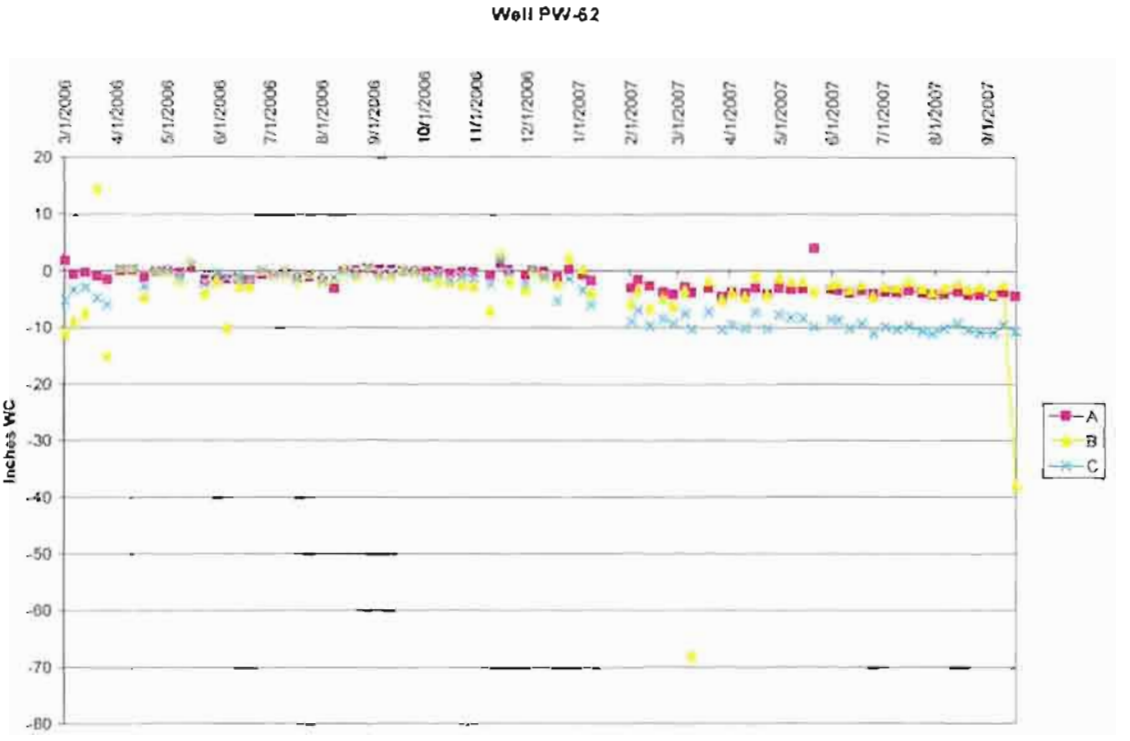


Figure 7. Extraction Well PW-62 Pressure Over Time

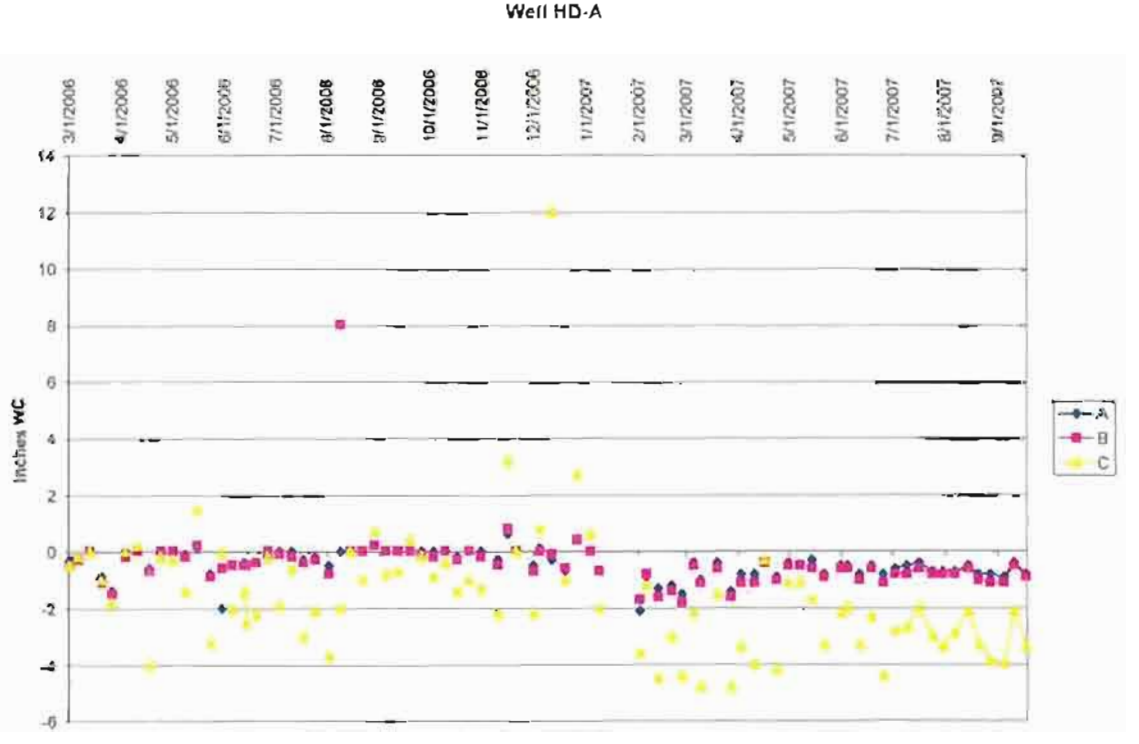


Figure 8. Extraction Well HD-A Pressure Over Time

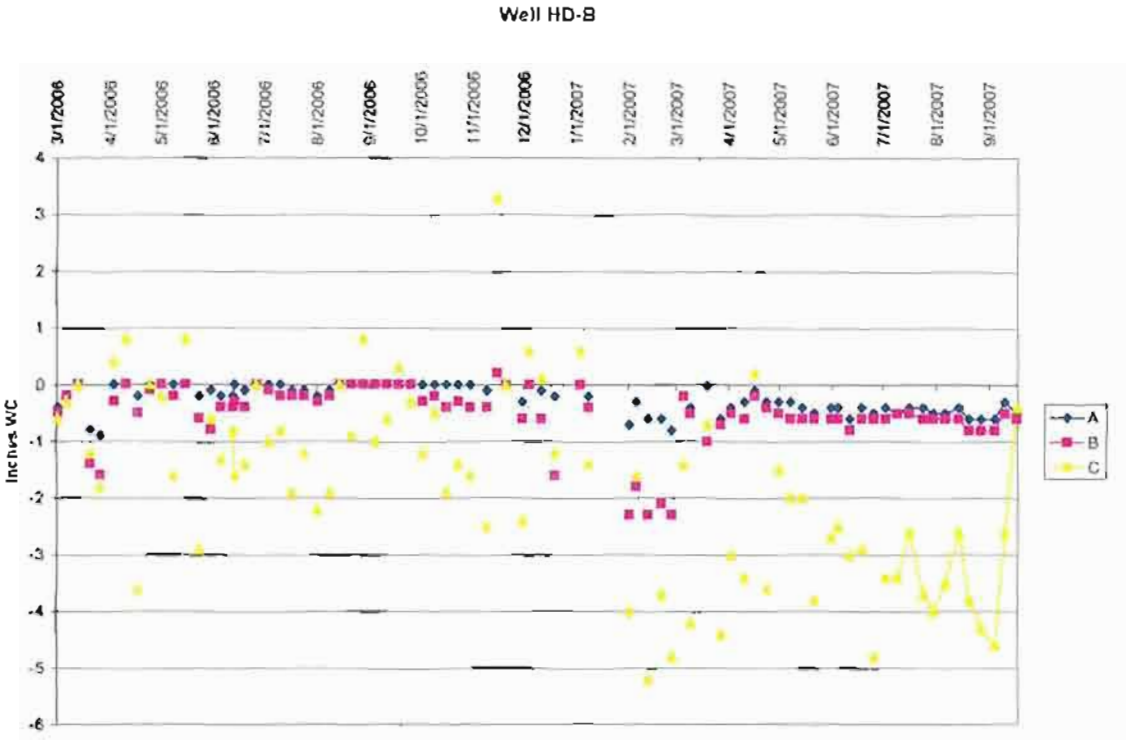


Figure 9. Extraction Well HD-B Pressure Over Time

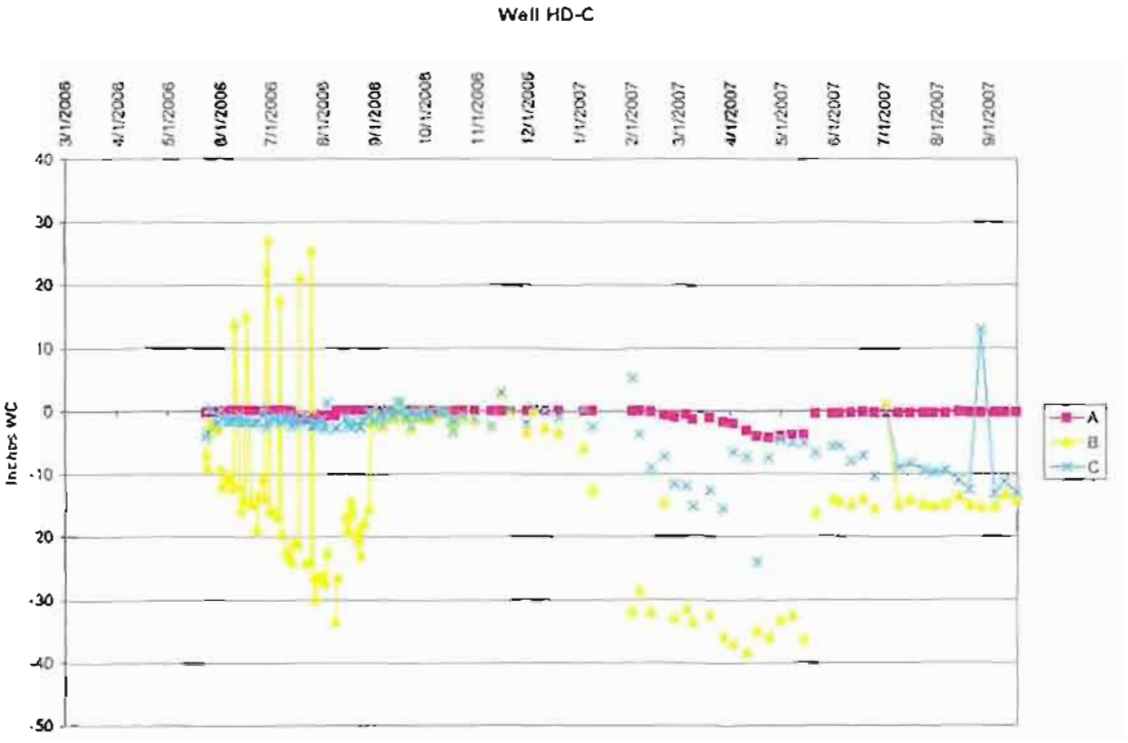


Figure 10. Extraction Well HD-C Pressure Over Time

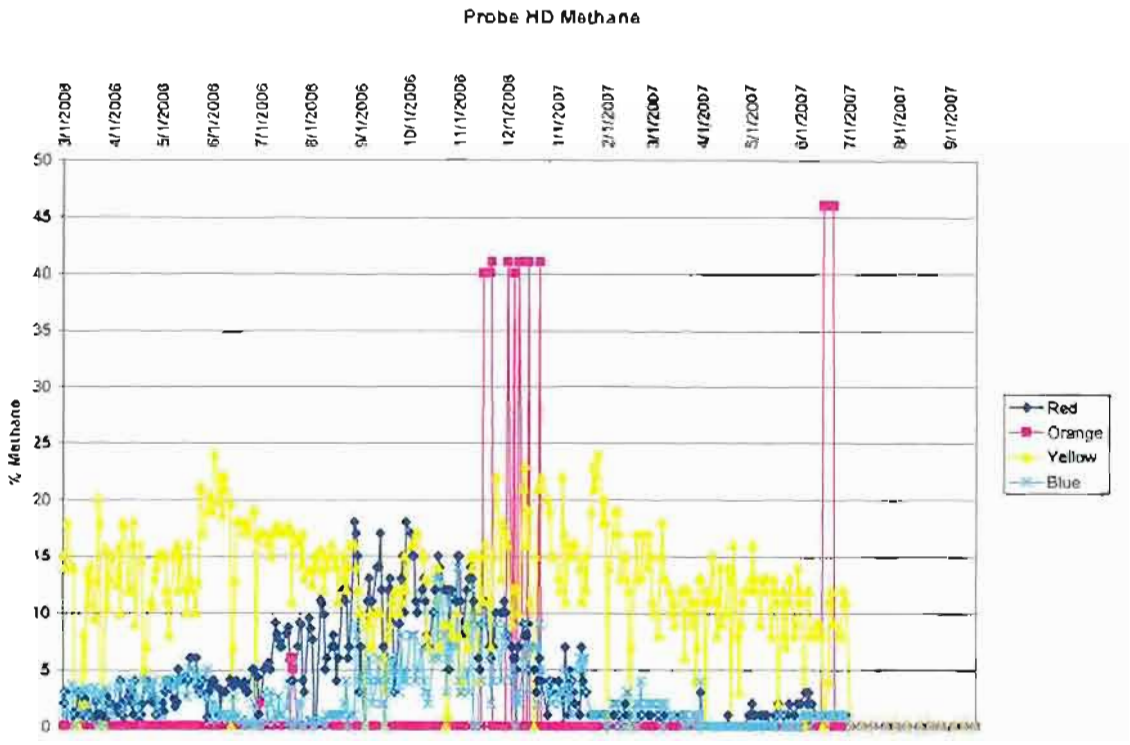


Figure 11. Probe HD Methane Over Time

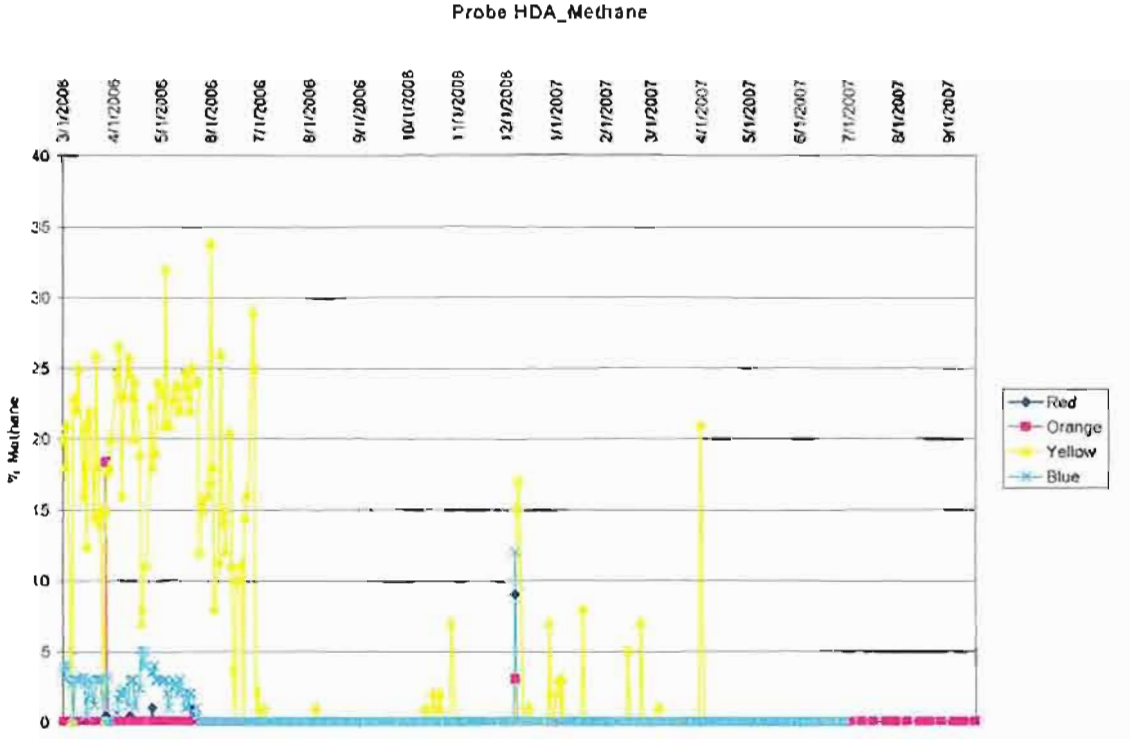


Figure 12. Probe HD-A Methane Over Time

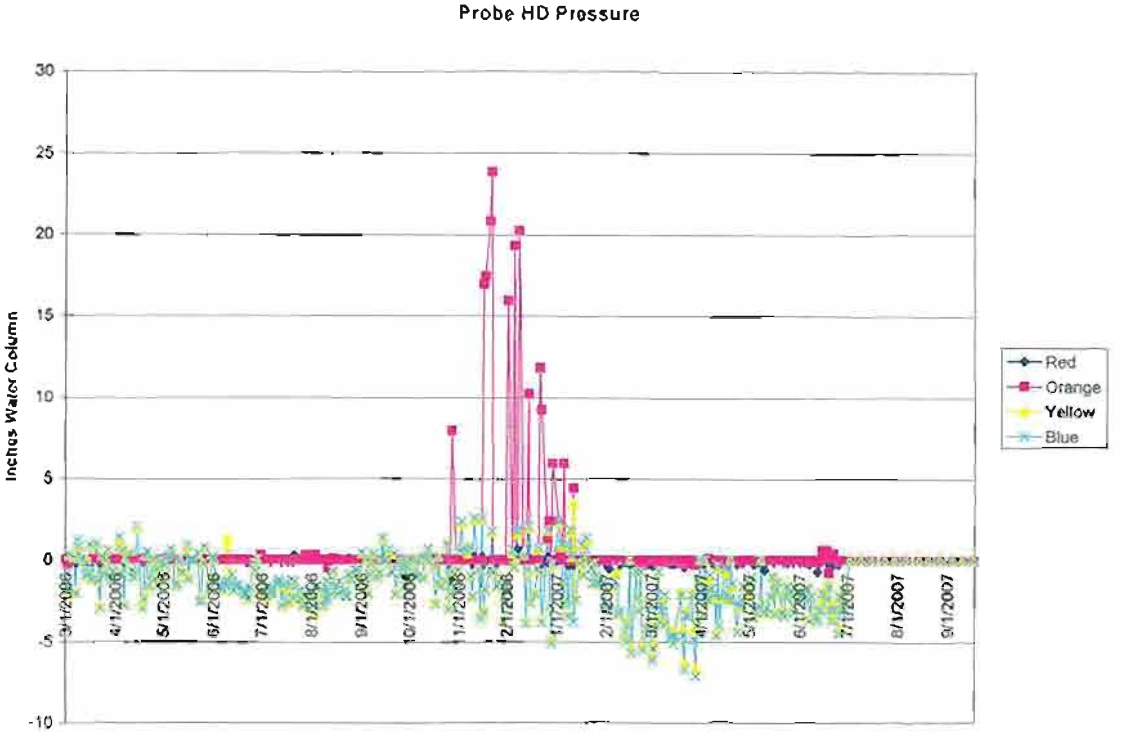


Figure 13. Probe HD Pressure Over Time

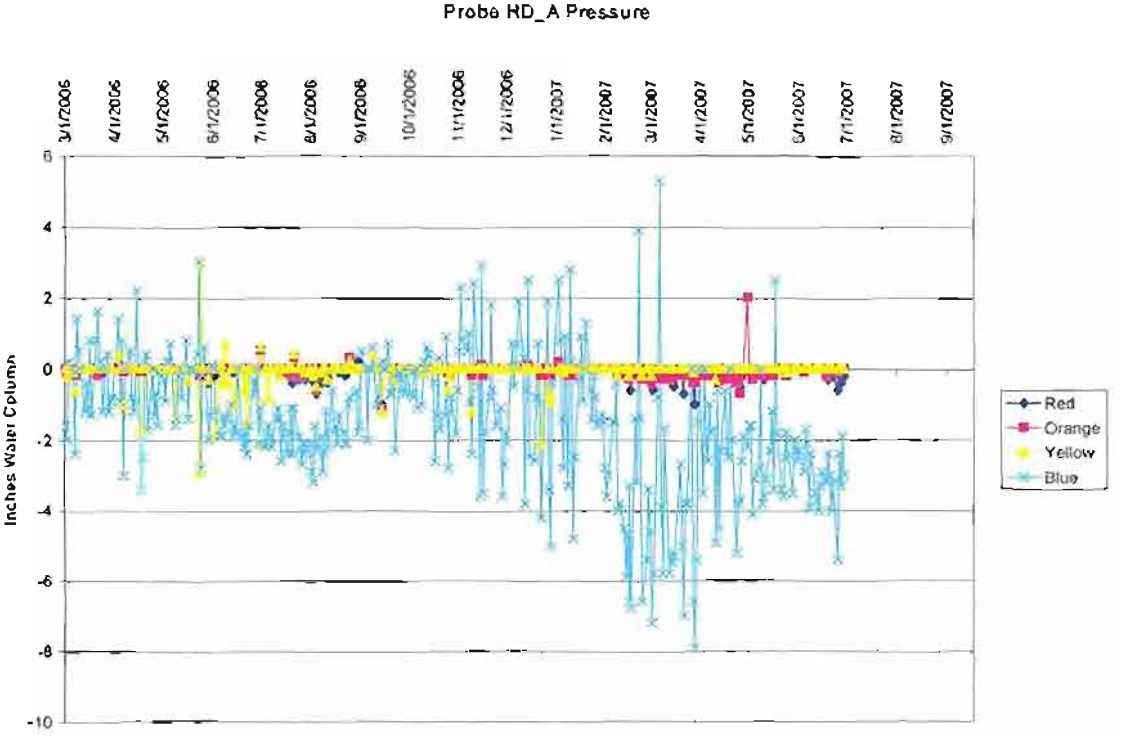


Figure 14. Probe HD-A Presssure Over Time

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

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January 10, 2008
PMX# 555-1564-068 (01/01)

Gary Kato
City of Tacoma Public Works Department
Environmental Services/Science & Engineering
2201 Portland Avenue
Tacoma, WA 98421-2711

Re: Emission Testing Results – Tacoma Landfill Gas Flare

Dear Gary:

This letter summarizes the emission results conducted on the enclosed landfill gas flare at the Tacoma Landfill. The work for this task was conducted in accordance with Emission Testing Plan to determine the flare emissions during normal operations. The emission testing was conducted on July 19-20, 2007.

PROJECT BACKGROUND

The landfill, since 1988, has conducted post-closure operations and maintenance under CERCLA based on Record of Decision (ROD) and Consent Decree between EPA, Ecology, and the City. In 1992, two identical enclosed landfill gas flares were installed under the CERCLA program with consultation by Puget Sound Clean Air Authority (PSCAA). A Notice of Construction air permit was never required for the flares, and the flares are not regulated under NSPS. However, under the ROD, the City is required to periodically conduct emission testing on the flares, as follows:

- Emission testing is required on one of the operating flares
- Speciated VOC concentrations in landfill gas at the flare inlet (under conditions of normal ambient temperature, ambient pressures, and low moister content) using Summa canisters, must be measured.
- Speciated VOC concentrations at the high-temperature flare outlet will be measured using SW-846 Method 0031 (SMVOC Sample Train).
- Outlet concentrations and emission rates for combustion products (NOx, CO, NMOC, and hydrochloric acid) are measured.
- Destruction efficiency for individual toxic air pollutants must be evaluated.
- Based on the emission test results, estimate ambient concentrations at the nearest facility boundary and compare the modeled concentrations to the ASILs, if required.

FACILITY DESCRIPTION

The Tacoma Landfill has been closed since 1991 expect for the Central Area, which is about 30 acres and used primarily for emergencies and/or backup purposes only. Landfill gas is collected from both the Central Area and closed areas and is routed to the flare station for migration and emission control. The present flare station has a design capacity of 2,000 cubic feet per minute (cfm). The two operating flares were constructed by the Perennial

Energy Company and installed in 1992. Each flare is 24 feet tall and 10.5 feet outside diameter. The flare station is operated continuously and requires no supplemental fuel.

Landfill gas generation at the Tacoma Landfill continues to decrease steadily over the years so the City is planning on installing a downsized enclosed flare to handle the current lower methane concentrations and gas flows. The methane concentration and flow rate at the time of testing was 25 percent by volume and approximately 769 cfm, respectively, or approximately 10.5 million BTUH.

EMISSION TEST PLAN

An emission test plan was prepared and submitted to EPA Region 10 and Ecology for their review and approval prior to the testing with no comments. The test plan is provided in Attachment A.

Emission testing methods that were used at the flare inlet and out for each regulated air pollutant is summarized on Table 1.

EMISSION TEST RESULTS

The emission testing was conducted on July 19-20, 2007 by Amtest Air Quality, LLC (Amtest). Amtest's full test report is provided as Attachment B. A brief summary of the favorable test results are provided in the following tables:

- Table 2 lists the average stack-gas concentrations of conventional air pollutants and toxic air pollutants (TAPs) on the flare outlet.
- Table 3 lists the calculated destruction efficiency for the detected TAPs on the flare inlet and/or outlet concentrations.
- Table 4 lists the non methane organic compounds (NMOCs) on the flare outlet.
- Table 5 lists criteria pollutants on the flare outlet.

Since the latest flare emission results of July 19-20, 2007 were similar or surpass previous results, modeling to determine estimated concentrations at the nearest facility boundary was not performed. The flare emissions do not cause any significant air quality impacts beyond the nearest facility boundary, since the flare's outlet concentrations are significantly lower than the regulated allowable limits.

Sincerely,

PARAMETRIX, INC.

Stephen Emge, P.E.
Project Engineer

cc: Karen Bartlett – City of Tacoma

Attachment A – Emission Testing Plan
Attachment B – Amtest's Test Report (3 copies)

Table 1. Emission Test Methods for Tacoma Landfill Flare Testing

Parameter	Flare Inlet		Flare Outlet	
	Test Method	No. of Samples	Test Method	No. of Samples
Test Port Location	Ground-level 10-inch diameter horizontal duct, at ambient temperature, positive pressure, and low moisture		5 feet below top of 24-foot tall, 9.9-foot diameter flare. High temperature, slight negative pressure, high moisture	
Gas Velocity and flow rate	EPA Methods 1, 1A, and 2	3 runs	EPA Methods 1, 1A, and 2	3 runs
Flue gas moisture	ODEQ Method 4 (Psychrometery)	3 runs	ODEQ Method 4 (Gravimetric)	3 runs
Fixed gases	EPA Methods 3C (GC/TCD)	3 runs	EPA Methods 3C (GC/TCD)	3 runs
Combustion gas (CO, CO_2, O_2)	N/A	N/A	EPA Method 3A (Real-time continuous monitors)	3 runs
NOx	N/A	N/A	EPA Method 7E (Real-time chemiluminescent analyzer)	3 runs
SO_2	N/A	N/A	EPA Method 6C (UV analyzer)	3 runs
CO	N/A	N/A	EPA Method 10 (Real-time non-dispersive infrared analyzer - GRC-NDIR)	3 runs
HCL and HF	N/A	N/A	EPA Method 26A (Impingers with ion chromatography)	3 runs
NMOCs	EPA Method 25C (FID analyzer with Summa canisters)	3 runs plus duplicate	EPA Method 25A (Real-time FID analyzer)	3 runs
Speciated TAPs	EPA Method TO-14A (Summa canisters)	3 runs plus duplicate	SW-846 Method 0031(Tenax/Anasorb resin)	3 runs

TABLE 2. SUMMARY OF EMISSION CONCENTRATIONS
TACOMA LANDFILL FLARE

		Perennial #1 Landfill Gas Combuster Outlet			
	Airflow:	Run 1 9792.7 dscf/min	Run 2 10933 dscf/min	Run 3 10551 dscf/min	Average
Analyte		lb/hr	lb/hr	lb/hr	lb/hr
Acetone		**5.94E-04**	**1.26E-03 U**	**1.22E-03 U**	**1.98E-04 J**
Benzene		**6.05E-03 E**	**1.97E-03**	**4.55E-03**	**4.19E-03 E**
Bromobenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Bromochloromethane		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
Bromodichloromethane		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Bromoform		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
Bromomethane		5.74E-04 U	6.31E-04 U	6.10E-04 U	6.05E-04 U
2-Butanone (MEK)		1.15E-03 U	1.26E-03 U	1.22E-03 U	1.21E-03 U
n-Butylbenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
sec-Butylbenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
tert-Butylbenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Carbon Disulfide		**5.36E-05**	**1.26E-04 U**	**1.22E-04 U**	**1.79E-05 J**
Carbon Tetrachloride		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Chlorobenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Chlorodibromomethane		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
Chloroethane		5.74E-04 U	6.31E-04 U	6.10E-04 U	6.05E-04 U
Chloroform		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Chloromethane		**1.12E-04**	**1.34E-04**	**1.06E-04**	**1.17E-04**
2-Chlorotoluene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
4-Chlorotoluene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
1,2 Dibromo-3-chloropropane		5.74E-04 U	6.31E-04 U	6.10E-04 U	6.05E-04 U
1,2-Dibromoethane		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
Dibromomethane		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
1,2-Dichlorobenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
1,3-Dichlorobenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
1,4-Dichlorobenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Dichlorodifluoromethane		**1.76E-04**	**2.67E-04**	**1.17E-04**	**1.87E-04**
1,1-Dichloroethane		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
1,2-Dichloroethane		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
cis-1,3-Dichloroethene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
trans-1,3-Dichloroethene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
1,1-Dichloroethene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
1,2-Dichloropropane		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
1,3-Dichloropropane		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
2,2-Dichloropropane		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
cis-1,3-Dichloropropene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
trans-1,3-Dichloropropene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
1,1-Dichloropropene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Ethylbenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Hexachlorobutadiene		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
2-Hexanone		1.15E-03 U	1.26E-03 U	1.22E-03 U	1.21E-03 U
Isopropylbenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
p-Isopropyltoluene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Methylene Chloride		**4.81E-04**	**2.65E-03**	**3.05E-04 U**	**1.04E-03 J**
4-Methyl-2-Pentanone (MiBK)		1.15E-03 U	1.26E-03 U	1.22E-03 U	1.21E-03 U
Naphalene		**4.76E-05**	**3.15E-04 U**	**3.05E-04 U**	**1.59E-05 J**
n-Propylbenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Styrene		**3.05E-05**	**1.26E-04 U**	**1.22E-04 U**	**1.02E-05 J**
1,1,1,2-Tetrachloroethane		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
1,1,2,2-Tetrachloroethane		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
Tetrachloroethene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Toluene		**1.74E-04**	**1.06E-04**	**1.19E-04**	**1.33E-04**
1,2,3-Trichlorobenzene		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
1,2,4-Trichlorobenzene		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
1,1,1-Trichloroethane		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
1,1,2-Trichloroethane		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
Trichloroethene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Trichlorofluoromethane		**3.21E-03**	**6.31E-04 U**	**1.72E-04**	**1.13E-03 J**
1,2,3-Trichloropropane		**8.76E-05**	**3.15E-04 U**	**3.05E-04 U**	**2.92E-05 J**
1,2,4-Trimethylbenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
1,3,5-Trimethylbenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Vinyl Chloride		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
m- & p-Xylenes		2.30E-04 U	2.52E-04 U	2.44E-04 U	2.42E-04 U
o-Xylene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U

U = Undetected at specified reporting limit (RL).

E = Estimated result; concentration exceeds the calibration range. An E flag is assigned to a run even if just one run is labeled as E.

J = Approximate value. Data is labeled with a J flag when one or more of the results in a set of multiple runs is under the detection limit, but at least one of the other runs is above the detection limit. Runs under the detection limit are represented as in the set average calculation. Zero (0) is used as the value of any undetected run when calculating the average of any run labeled with a J flag.

TABLE 3. TOXIC AIR POLLUTANT DESTRUCTION EFFICIENCY
TACOMA LANDFILL GAS FLARE

Perennial #1 Landfill Gas Combuster Inlet/Outlet Destruction Efficiency

Analyte	Inlet Average lb/hr	Outlet Average lb/hr	DE %
Acetone	**1.18E-03 J**	**1.98E-04 J**	**83.20%**
Benzene	3.81E-03	4.19E-03 E	---
Bromobenzene	NA	1.21E-04 U	---
Bromochloromethane	NA	3.02E-04 U	---
Bromodichloromethane	5.10E-03 U	1.21E-04 U	---
Bromoform	2.36E-02 U	3.02E-04 U	---
Bromomethane	2.96E-03 U	6.05E-04 U	---
2-Butanone (MEK)	2.24E-03 U	1.21E-03 U	---
n-Butylbenzene	NA	1.21E-04 U	---
sec-Butylbenzene	NA	1.21E-04 U	---
tert-Butylbenzene	NA	1.21E-04 U	---
Carbon Disulfide	2.37E-03 U	1.79E-05 J	---
Carbon Tetrachloride	**3.33E-03 J**	**1.21E-04 U**	**>99.99%**
Chlorobenzene	3.50E-03 U	1.21E-04 U	---
Chlorodibromomethane	NA	3.02E-04 U	---
Chloroethane	2.01E-03 U	6.05E-04 U	---
Chloroform	3.72E-03 U	1.21E-04 U	---
Chloromethane	1.57E-03 U	1.17E-04	---
2-Chlorotoluene	NA	1.21E-04 U	---
4-Chlorotoluene	NA	1.21E-04 U	---
1,2 Dibromo-3-chloropropane	NA	6.05E-04 U	---
1,2-Dibromoethane	5.76E-03 U	3.02E-04 U	---
Dibromomethane	NA	3.02E-04 U	---
1,2-Dichlorobenzene	4.58E-03 U	1.21E-04 U	---
1,3-Dichlorobenzene	4.58E-03 U	1.21E-04 U	---
1,4-Dichlorobenzene	4.58E-03 U	1.21E-04 U	---
Dichlorodifluoromethane	3.20E-03 U	1.87E-04	---
1,1-Dichloroethane	3.05E-03 U	1.21E-04 U	---
1,2-Dichloroethane	3.05E-03 U	1.21E-04 U	---
cis-1,3-Dichloroethene	NA	1.21E-04 U	---
trans-1,3-Dichloroethene	NA	1.21E-04 U	---
1,1-Dichloroethene	NA	1.21E-04 U	---
1,2-Dichloropropane	3.52E-03 U	1.21E-04 U	---
1,3-Dichloropropane	NA	1.21E-04 U	---
2,2-Dichloropropane	NA	1.21E-04 U	---
cis-1,3-Dichloropropene	3.39E-03 U	1.21E-04 U	---
trans-1,3-Dichloropropene	3.39E-03 U	1.21E-04 U	---
1,1-Dichloropropene	NA	1.21E-04 U	---
Ethylbenzene	**4.90E-02**	**1.21E-04 U**	**>99.99%**
Hexachlorobutadiene	8.12E-03 U	3.02E-04 U	---
2-Hexanone	3.12E-03 U	1.21E-03 U	---
Isopropylbenzene	NA	1.21E-04 U	---
p-Isopropyltoluene	NA	1.21E-04 U	---
Methylene Chloride	2.65E-03 U	1.04E-03 J	---
4-Methyl-2-Pentanone (MiBK)	3.12E-03 U	1.21E-03 U	---
Naphalene	NA	1.59E-05 J	---
n-Propylbenzene	NA	1.21E-04 U	---
Styrene	3.24E-03 U	1.02E-05 J	---
1,1,1,2-Tetrachloroethane	NA	1.21E-04 U	---
1,1,2,2-Tetrachloroethane	5.23E-03 U	3.02E-04 U	---
Tetrachloroethene	NA	1.21E-04 U	---
Toluene	**1.79E-02**	**1.33E-04**	**99.26%**
1,2,3-Trichlorobenzene	NA	3.02E-04 U	---
1,2,4-Trichlorobenzene	5.65E-03 U	3.02E-04 U	---
1,1,1-Trichloroethane	4.15E-03 U	3.02E-04 U	---
1,1,2-Trichloroethane	4.14E-03 U	3.02E-04 U	---
Trichloroethene	4.08E-03 U	1.21E-04 U	---
Trichlorofluoromethane	3.97E-03 U	1.13E-03 J	---
1,2,3-Trichloropropane	NA	2.92E-05 J	---
1,2,4-Trimethylbenzene	**1.10E-02**	**1.21E-04 U**	**>99.99%**
1,3,5-Trimethylbenzene	**3.08E-03 J**	**1.21E-04 U**	**>99.99%**
Vinyl Chloride	**1.10E-02**	**1.21E-04 U**	**>99.99%**
m- & p-Xylenes	**4.24E-02**	**2.42E-04 U**	**>99.99%**
o-Xylene	**1.06E-02**	**1.21E-04 U**	**>99.99%**

U = Undetected at specified reporting limit (RL).

E = Estimated result; concentration exceeds the calibration range. An E flag is assigned to the average even if just one run is labeled as E.

J = Approximate value. Data is labeled with a J flag when one or more of the results in a set of multiple runs is under the detection limit, but at least one of the other runs is above the detection limit. Runs under the detection limit are represented as in the set average calculation.

--- = This is the label given when any of the following cases occur: the inlet is U; the outlet is greater than the inlet; the compound was not analyzed at the inlet.

If a compound is detected at the inlet, but not detected at the outlet it is assigned a value of >99.99% DE.

Method TO-14A was used to quantify compounds at the inlet and Method 0031 was used to quantify compounds at the outlet. Only compounds that were included on the M0031 list are included in the DE calculations. Compounds that were quantified at the outlet but not at the inlet are shown as NA.

TABLE 4. SUMMARY OF RESULTS - EPA METHODS 25A
NON METHANE ORGANIC COMPOUNDS

	Perennial #1 Landfill Gas Combuster Outlet			
	Run 1	Run 2	Run 3	Average
Date:	7/19/07	7/20/07	7/20/07	
Start Time:	1510	0831	1138	
Stop Time:	1732	1031	1338	
Sample Length (minutes):	240	120	120	
Moisture (B_{ws}):	0.0817	0.0758	0.0867	0.0814
Oxygen (%):	11.7	13.6	11.8	12.3
Stack Gas Airflow (dscf/min):	9792.7	10933	10551	10426
EPA METHOD 25A TOTAL HYDROCARBONS (THC as Methane)				
THC Detection Limit (dry - ppm):	1.0	1.0	1.0	1.0
THC Emission Concentration (wet - ppm):	10.2	12.8	12.4	11.8
THC Emission Concentration (dry - ppm):	11.1	13.8	13.6	12.8
THC Emission Rate (lb/hr):	0.272	0.378	0.358	0.336
EPA METHOD 25A METHANE (CH_4)				
Methane Detection Limit (dry - ppm):	1.0	1.0	1.0	1.0
Methane Emission Concentration (wet - ppm):	11.2	12.5	16.1	13.3
Methane Emission Concentration (dry - ppm):	12.2	13.5	17.6	14.5
Methane Emission Rate (lb/hr):	0.298	0.369	0.465	0.377
EPA METHOD 25A NMOC (as Methane)				
NMOC Detection Limit (ppm):	1.0	1.0	1.0	1.0
NMOC Detection Limit (lb/hr):	0.024	0.027	0.026	0.026
NMOC Emission Rate (lb/hr):	0.024 U	0.009 U	0.026 U	0.020 U
NMOC Emission Concentration (dry - ppm):	1.0 U	0.3 U	1.0 U	0.8 U
EPA METHOD 25A NMOC (as Carbon)				
NMOC Detection Limit (as carbon (ppm)):	1.0	1.0	1.0	1.0
NMOC Detection Limit (as carbon (lb/hr)):	0.018 U	0.020	0.020	0.013
NMOC Emission Concentration (as methane (dry-ppm)):	1.0 U	0.3 U	1.0 U	0.8 U
NMOC Emission Concentration (as carbon (dry-ppm)):	1.0 U	0.3 U	1.0 U	0.8 U
NMOC Emission Rate (lb/hr):	0.018 U	0.007 U	0.020 U	0.015 U

U = Undetected at specified reporting limit.

J = Approximate value. This is assigned when one or more of multiple runs is under the detection limit, but at least one of the other runs is above the detection limit and zero is used for those values under the detection limit in calculating the average.

TABLE 5. SUMMARY OF RESULTS - EPA METHODS 3A, 6C, 7E, AND 10
CRITERIA POLLUTANTS

	Perennial #1 Landfill Gas Combuster Outlet			
	Run 1	Run 2	Run 3	Average
Date:	7/19/07	7/20/07	7/20/07	
Start Time:	1510	0831	1138	
Stop Time:	1732	1031	1338	
Sample Length (minutes):	240	120	120	
Oxygen (%):	11.7	13.6	11.8	12.3
Stack Gas Airflow (dscf/min):	9792.7	10933	10551	10426
EPA METHOD 6C				
SULFUR DIOXIDE (SO_2)				
SO_2 Detection Limit (ppm):	0.1	0.1	0.1	0.1
SO_2 Emission Concentration (ppm):	0.2	3.5	4.2	2.6
SO_2 Emission Rate (lb/hr):	0.022	0.378	0.445	0.282
EPA METHOD 7E				
NITROGEN OXIDES (NO_x)				
NO_x Detection Limit (ppm):	0.1	0.1	0.1	0.1
NO_x Emission Concentration (ppm):	10.6	9.8	13.0	11.1
NO_x Emission Rate (lb/hr):	0.746	0.770	0.980	0.832
EPA METHOD 10				
CARBON MONOXIDE (CO)				
CO Detection Limit (ppm):	1.0	1.0	1.0	1.0
CO Emission Concentration (ppm):	45.9	43.9	59.4	49.7
CO Emission Rate (lb/hr):	1.96	2.09	2.73	2.26

U = Undetected at specified reporting limit.

J = Approximate value. This is assigned when one or more of multiple runs is under the detection limit, but at least one of the other runs is above the detection limit and zero is used for those values under the detection limit in calculating the average.

ATTACHMENT A

Emission Testing Plan

Tacoma City of Tacoma
Public Works Department

June 22, 2007

Ms. Kris Flint
EPA Region 10
1200 Sixth Avenue
Seattle, WA 98101

Mr. Christopher Maurer
Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600

Re: Emission Testing Plan
Tacoma Landfill Gas Flare

Dear Ms. Flint and Mr. Maurer:

The City of Tacoma Public Works Environmental Services Solid Waste Utility (City) has retained Parametrix to conduct an emission test on an enclosed landfill gas flare at the Tacoma Landfill. The emission test will be conducted by Amtest Air Quality, LLC (Amtest) with the test tentatively scheduled for July 19-20, 2007. Emission tests were last performed in 2004 by Amtest. The attached Emission Test Plan, prepared by Amtest, describes the test protocols.

The landfill has been operating since 1988 under CERCLA based on a Record of Decision (ROD) and Consent Decree between EPA, Ecology, and the City. The City also operates under a permit issued by the Tacoma-Pierce County Health Department (TPCHD). In 1992, two identical enclosed Perennial landfill gas flares were installed under the CERCLA program with consultation by Puget Sound Clean Air Authority (PSCAA). A Notice of Construction air permit was not required for the flares, and the flares are not regulated under NSPS. However, under the ROD, the City is required to periodically conduct emission testing on the flares, as follows:

- Emission testing is required on one of the operating flares;
- Speciated VOC concentrations in landfill gas at the flare inlet (under conditions of normal ambient temperature, ambient pressures, and low moister content) using Summa canisters, must be measured;
- Speciated VOC concentrations at the high-temperature flare outlet will be measured using SW-846 Method 0031 (SMVOC Sample Train);
- Outlet concentrations and emission rates for combustion products (NOx, CO, NMOC, and hydrochloric acid) are measured;
- Destruction efficiency for individual toxic air pollutants must be evaluated; and
- Based on the emission test results, estimate ambient concentrations at the nearest facility boundary and compare the modeled concentrations to the ASILs.

The attached Emission Test Plan also describes conventional emission testing protocols including sampling port geometry, velocity traverses, moisture determination, and measurement of conventional combustion products.

Based on the past flare emission results, the City is requesting a variance to the ROD requirements. If the upcoming flare emission test results are equal to or surpass past results, the City is requesting that the modeling required to determine estimated concentrations at the nearest facility boundary not be conducted since past modeling has concluded the flare emissions do not cause any significant air quality impacts beyond the nearest facility boundary.

As stated above, the anticipated emission test is scheduled for July 19-20, 2007. Please provide your comments, if any, and your decision on the requested variance as soon as possible so the emission test can be conducted as scheduled.

Sincerely,

Karen Bartlett
Project Engineer

KAB:sh (Agency Letter_Final)

Attachment – Amtest's Emission Test Protocol

cc: Stephen Emge, P.E.– Parametrix
Cal Taylor – City of Tacoma
Dave Bosch – Tacoma Pierce County Health Department

File: Tacoma Landfill

AMTEST
AIR QUALITY
A DIVISION OF

June 15, 2007

Mr. Steve Emge
Parametrix
411 108th Avenue NE, Suite 1800
Bellevue, Washington 98004

Dear Mr. Emge:

This letter presents AmTest Air Quality's (ATAQ) *test plan* for conducting emissions tests at the City of Tacoma's Public Works Department, Tacoma Landfill. Testing will be conducted on one of the Perennial Energy Company's two landfill gas combustors. This testing is identical in scope to that performed at this same site in April 2004. For this project, emissions tests will be performed simultaneously at the inlet and outlet of the landfill flare. Testing is currently planned for July 19-20, 2007

The parameters to be measured at the **flare inlet** include:

- gas temperature and airflow using EPA Methods 1 and 2
- inlet fixed gases using EPA Method 3C
- gas moisture content using ODEQ Method 4 psychrometry
- non-methane organic compounds (NMOC) using EPA Method 25C
- speciated volatile organic compounds using EPA Method TO-14A

The parameters to be measured at the **flare outlet** include:

- gas temperature and airflow using EPA Methods 1 and 2
- combustion gases and molecular weight using EPA Method 3A
- gas moisture content using EPA Method 4
- sulfur dioxide using EPA Method 6C
- nitrogen oxides using EPA Method 7E
- carbon monoxide using EPA Method 10
- non-methane organic compounds (NMOC) using EPA Method 25A
- hydrogen chloride and hydrogen fluoride using EPA Method 26A
- speciated volatile organic compounds using EPA SW-846 Method 0031

Testing and analysis procedures to be used for this project are presented in the Environmental Protection Agency (EPA) document Title 40, Code of Federal Regulations, Part 60 (40 CFR 60), Appendix A, in the Oregon Department of Environmental Quality (ODEQ), Source Sampling Methods, 1992, in the EPA Test Methods for Evaluating Solid Waste (SW-846), Volume II, Field Manual, in the EPA Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, and EPA Technology Transfer Network Emission Measurement Center (EPA-TTN-EMC) website, Test Methods Section (http://www.epa.gov/ttn/emc/). . A brief description of each test method follows:

Velocity Sample Point Location and Exhaust Flow Determination (Inlet/Outlet)

The flare stack has an inside diameter of 118 inches. There are four sample ports at the same elevation spaced 90 degrees apart around the circumference. EPA Method 1 procedures will be used to assure that representative measurements of volumetric flow rate are obtained by dividing the cross-section of the stack or duct into a number of equal areas, and then locating a traverse point within each of the equal areas. EPA Method 2 will be performed to measure the stack gas velocity using a type S or standard pitot tube, and the gas temperature using a calibrated thermocouple probe connected to a digital thermocouple indicator. The pitot tubes are connected with tubing to a pressure measurement device such as an oil-filled inclined manometer, magnehelic gauges, or a Shortridge® Instruments, Inc. Airdata Multimeter ADM-850 which is a special low flow measurement device. The pitot tube lines are leak-checked and the pressure measurement device is leveled and zeroed prior to use. Appropriate pressure and temperature measurement device calibration information will be included in the final report. *Stack velocity and temperature data will be collected during all test periods.*

Molecular Weight (Inlet)

EPA Method 3C will be performed to determine the fixed gas composition (percent levels) of the flare inlet gas stream. Carbon dioxide, carbon monoxide, oxygen, nitrogen and methane will be analyzed from the gas collected in the Method 25C canisters. The analysis will be performed using a gas chromatograph equipped with a thermal

conductivity detector (GC/TCD). *Gas composition data will be collected during all test periods.*

Molecular Weight (Outlet)

EPA Method 3A will be performed to determine the percent (%) level concentration of oxygen (O_2) and carbon dioxide (CO_2) in the stack gas. O_2 will be measured using a paramagnetic analyzer. CO_2 will be measured using a non-dispersive infrared (NDIR) analyzer. Concentrations will be recorded in dry parts per million (ppm) at least once per minute using a data acquisition system and averaged. Prior to testing, a calibration error check will be performed using low, mid, and high-level EPA Protocol No. 1 calibration gases. Sampling system bias and calibration drift tests will be also be performed before and after the sample runs to check the drift of the analyzers and bias-correct the data. *Molecular weight data will be collected during all emission test periods.*

Moisture Determination (Inlet)

Oregon Department of Environmental Quality (ODEQ) Method 4 psychrometric moisture calculations will be used to calculate moisture using wet bulb and dry bulb stack gas temperatures. *Moisture data will be collected during all test periods.*

Moisture Determination (Outlet)

EPA Method 4 is performed inclusively with Method 26A to measure the moisture content of the stack gas for calculating the volumetric flow rate and molecular weight on a dry basis. The impingers for each high-flow sample train will be weighed before and after each run.

Gaseous Emissions Sampling Points (Outlet)

Prior to beginning of testing for gaseous emissions the stratification check required in Method 7E will be conducted. The stratification check is conducted at twelve (12), Method 1 traverse points. Sampling at each point is conducted for a minimum of twice the system response time. If the variation between the value at any one point and the

mean is not greater than ± 5% or ± 0.5 ppmV (whichever is less restrictive) then the sampling will be conducted at the point closest to the mean average concentration. If the variation between the value at any one point and the mean is not greater than ± 10% or ± 1.0 ppm (whichever is less restrictive) then the sampling can be conducted at three points. Since the stack diameter is greater than 2.4 meters the sample points will be located at 0.4, 1.0 and 2.0 meters along the measurement line that exhibited the greatest degree of stratification. If neither of the preceding criteria is met then sampling will be integrated across all of the Method 1 traverse points. *Since sulfur dioxide, nitrogen dioxide and carbon monoxide are being measured the gas that exhibits the most stratification will determine the sampling points used.*

Sulfur Dioxide (Outlet)

EPA Method 6C will be performed to quantify emissions of sulfur dioxide (SO_2) using an ultraviolet (UV) analyzer. The SO_2 concentration will be recorded in dry parts per million (ppm) once per minute using a data acquisition system. Prior to testing, a calibration error check will be performed using low, mid, and high-level EPA Protocol No. 1 calibration gases. Before and after each test run, a system calibration bias and drift test will be performed to check the drift of the analyzer and biases correct the data. *Three 120-minute Method 6C runs will be performed at the outlet of the flare.*

Nitrogen Oxides (Outlet)

EPA Method 7E will be performed to quantify emissions of nitrogen oxides (NO_x) using a chemiluminescent analyzer. NO_x concentrations will be recorded in dry parts per million (ppm) at least once per minute, using a data acquisition system, and averaged. Prior to testing, a calibration error check will be performed using low, mid, and high-level EPA Protocol No. 1 calibration gases. Before and after each test run, a system calibration bias and drift test will be performed to check the drift of the analyzer and biases correct the data. A Method 7E analyzer NO_2 to NO converter efficiency test will also be completed along with this test series. *Three 120-minute runs will be performed at the outlet of the flare.*

Carbon Monoxide (Outlet)

EPA Method 10 will be performed to quantify emissions of carbon monoxide (CO) using a gas filter correlation non-dispersive infrared (NDIR) analyzer. CO concentrations will be recorded in dry parts per million (ppm) at least once per minute using a data acquisition system, and averaged. Prior to testing, a calibration error check test will be performed using low, mid, and high-level EPA Protocol No. 1 calibration gases. Before and after each test run, a system calibration bias and drift test will be performed to check the drift of the analyzer and biases correct the data. *Three 120-minute runs will be performed at the outlet of the flare.*

Nonmethane Organic Compounds (NMOC) (Inlet)

EPA Method 25C will be used to obtain the concentration of non-methane organic compounds (NMOC) at the inlet to the flare. This method obtains an integrated sample over a two hour time period by using an evacuated sample tank to pull a constant rate sample from the duct into the tank. The NMOC analysis of the tank samples consist of a fore flush and back flush of a gas chromatograph (GC) column followed by an oxidizer, methanizer, and a flame ionization detector (FID). The GC separates the VOC component from the sample, the oxidizer converts the VOC to carbon dioxide, and the methanizer converts the resulting carbon dioxide to methane. The results are determined by the FID in units of parts per million by volume as carbon (ppmC). *Four 120-minute Method 25C samples will be collected at the flare inlet. There will be two single sample runs and one run where duplicate samples are collected.*

Non-methane Organic Compounds (NMOC) (Outlet)

EPA Method 25A will be used to determine the non-methane organic compound emissions concentration. The standard Method 25A procedure for total hydrocarbons would be modified by simultaneously measuring both total hydrocarbons and methane concentrations with a special dual-flame ionization detector. The J.U.M. Model 109A dual-flame ionization detector (FID) analyzer has matched dual hydrogen flame detectors (FID) that separate parts per million (ppm) total hydrocarbons (THC) and methane (CH_4) emissions. This use of a non-methane organic analyzer/flame ionization detector is

discussed as an alternative to Method 25 in the opening paragraphs of Method 25. This modified Method 25A procedure has the advantage of providing real-time NMOC readings. For each test period, NMOC emission concentrations would be calculated by subtracting CH_4 emission concentration from the THC emission concentration. A heated sample line with a minimum operating temperature of 374° F would introduce gas to the analyzer on a hot, wet basis. The stack gas is introduced into the first (#1) detector directly via sample capillary and into the second (#2) detector via a proprietary design non-CH_4 hydrocarbon cutter. The cutter oxidizes and removes all hydrocarbons except CH_4. The outputs of the two (2) detectors are coupled to individual electrometers. The dual detector and electrometer designs provide a real-time analysis of THC and CH_4. Both the THC FID and the CH_4 FID would be calibrated and output as CH_4. THC and CH_4 concentrations would be recorded in wet ppm at least once per minute using a data acquisition system and averaged. Moisture data collected concurrently would be used to convert the wet ppm data to a dry ppm basis. Method 25A samples will be collected at a point of average velocity in the stack. Before testing, an analyzer calibration error test will be performed using zero, low, mid, and high-range CH_4 calibration gases. Before and after each test run, a system calibration bias and drift test would be performed. *Three 120-minute Method 25A runs will be conducted at the flare outlet.*

Hydrogen Chloride, Hydrogen Fluoride (Outlet)

EPA Method 26A will be performed to quantify emissions of hydrogen chloride (HCl) and hydrogen fluoride (HF) using an isokinetic sampling technique and a high flow sample train. The sample train will utilize two (2) impingers containing 0.1 N sulfuric acid (H_2SO_4), followed by an empty impinger and an additional impinger containing silica gel. Because no analysis of chlorine (Cl_2) will be performed, impingers containing 0.1 N sodium hydroxide (NaOH) will not be included in the sample train. The H_2SO_4 solutions are analyzed for chloride and fluoride using ion chromatography (IC) by EPA Method 300.0. A blank solution of H_2SO_4 absorbing reagent is prepared for analysis with the field samples. *Three 120-minute Method 26A runs will be performed at the flare outlet.*

Volatile Organic Compounds (Inlet)

EPA Compendium Method TO-14A analysis will be performed on the samples collected in the Method 25C canisters for speciated VOC analysis. The samples will be analyzed using a gas chromatograph equipped with a mass spectrometer detector (GC/MS) for a selected list of volatile organic compounds.

Volatile Organic Compounds (Outlet)

A sampling method for volatile organic compounds (SMVOC) sample train is detailed in Method 0031 of SW-846. SMVOC sampling is performed by absorbing and concentrating samples in sorbent modules packed with Tenax®-GC/Tenax®-GC/Anasorb®-747 resins. Liquid condensate is collected in an impinger placed between the 2 Tenax-GC traps and the Anasorb-747 trap. The first and second traps contain 1.6 grams (g) of Tenax-GC each, and the third trap (back trap) contains 5.0 g of Anasorb-747. The tubes are prepared and conditioned by the subcontract analytical laboratory. A set of laboratory blanks remain in the laboratory and would be analyzed in the case where high levels of VOCs are found on either of the trip or field blanks.

The glassware which is used in the SMVOC is sonicated for one hour in a solution of laboratory detergent, rinsed thoroughly with hot water, rinsed three times with HPLC grade water, baked at a high temperature in a solvent-free oven, and the ends are capped with glass plugs and stoppers or stainless steel fittings (or precleaned foil) prior to use. A heated glass-lined probe is used to extract a sample from the stack. The probe is connected to an isolation valve and charcoal trap. Once the gas passed through the probe, it enters an ice water-cooled glass coil condenser to cool the gas to below 20° C, through two sorbent tubes packed with Tenex-GC resin, through an empty knock-out trap for condensate removal, through a second water-cooled glass condenser, through a third sorbent tube containing Anasorb-747, through a silica gel drying tube, through a calibrated rotometer, through the sample pump, and through a dry gas meter.

The sample train is assembled and leak checked prior to the start of each run. The probe is positioned at a point of average velocity in the duct. Sampling is started and the

sampling rate is adjusted to a rate of 0.5 liters per minute (Lpm). Forty minutes into the run the first set of tubes is switched out. Before a set of tubes is changed, the dry gas meter reading is recorded and a post-test leak check is performed according to SMVOC procedures. After using a set of tubes, the sorbent modules are sealed and packed in a cooler with ice packs for shipment to the analytical laboratory. The tubes are switched three times during each test run for a total of four sets of tubes for each run. The fourth set of tubes is held as a backup and is analyzed only if there is a problem with one of the other three sets for that run. A field blank sample train and a set of tubes are assembled, leak tested and recovered on-site for analysis to check the integrity of the glassware and preparation of the sample tubes for each run. The ends of the sorbent modules are sealed and the tubes labeled as field blanks. One set of unopened tubes remains in the container, which is used to store and transport the samples. The unexposed set of tubes is labeled as the trip (or transport) blank. The samples will be submitted to Severn-Trent Laboratories of Knoxville, Kentucky for analysis using EPA SW-846, Method 8260B for volatile organic compounds. For each set of tubes, the first two Tenex-GC tubes are combined and analyzed as a single sample. The Anasorb-747 tubes are analyzed individually. *Three Method 0031 test runs, each run consisting of four sets of tubes, will be performed. Each run will be 160 minutes long.*

Process Data

It will be the responsibility of Parametrix/site personnel to provide Am Test with the process data necessary to be included in the final report. The data will include at a minimum the operating temperatures and flow rates for the flares being tested and a qualitative description of the areas in the landfill from which gasses were being drawn.

Site Provisions

Per 40 CFR 60 Subpart A, Section 60.8 the source is responsible for providing at each sample location: 1) Sampling ports which meet EPA minimum requirements for testing; 2) Safe sampling platforms; 3) Safe access to the platforms; 4) Sufficient utilities to perform all necessary testing.

Reporting

Within 45 days after the testing is completed, ATAQ will submit four (4) copies of a final report to Parametrix. Each report will be a formal, bound document containing information about the source, dates and times of each test, details of sampling and analysis procedures, quality assurance procedures, and a discussion of how the results were calculated, along with example calculations. Results will be presented in emission concentration units and mass emission rate units consistent with what was presented in 2003. It will be the responsibility of Parametrix/City of Tacoma to forward a copy of the final report to the appropriate agencies.

Schedule

The field portion of this project would require a four-person test team two days to complete. The first day the test team would travel to Tacoma that morning and set up on the flare to be tested. That afternoon the first run of all methods would be conducted. The samples would be recovered and the equipment secured for the night. The following day the team would return to the site and perform the remaining two runs of all methods, after which the equipment would be packed up and the test team returns to our Preston office.

Please contact me at (425) 503-2357 or jimg@amtestairquality.com if I may provide additional information or clarification.

Sincerely,
AmTest Air Quality
A Division of Hoefler Consulting Group

JAGuenthoer

James A. Guenthoer
Manager
Source Testing Services

(jag\rp07\parametrix@tacoma lf 0607 rp)

ATTACHMENT B

Amtest’s Test Report

AMTEST
AIR QUALITY
A DIVISION OF
HOEFLER CONSULTING GROUP

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Draft Report Issued: August 27, 2007
Final Report Issued: September 19, 2007

PARAMETRIX, INC. @ CITY OF TACOMA LANDFILL GAS COMBUSTOR TESTING TACOMA, WASHINGTON JULY 19-20, 2007 ATAQ PROJECT #8752-001

HCG, Inc. d.b.a. AmTest Air Quality
Preston, Washington

Hoefler
CONSULTING GROUP

CERTIFICATIONS

SENIOR REPORT REVIEW

I certify that the information contained herein is accurate, complete, and representative of the actual emissions to the best of my knowledge.

Kris A. Hansen, QEP
Senior Consultant

I certify that the information contained herein is accurate, complete, and representative of the actual emissions to the best of my knowledge.

James A. Guenthoer
Manager, Source Testing Services

TEST TEAM LEADER

I certify that the information contained herein is accurate, complete, and representative of the actual emissions to the best of my knowledge.

Kevin E. Farwell
Lead Source Test Specialist

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BOVAR Western Research Model 721AT SO_2 Analyzer Specifications	376-379
Thermo Model 42H #1 NO_X Analyzer Specifications	380-382
NO_2 to NO Converter Efficiency Test	383
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Thermo Model 48 CO Analyzer Specifications	385-388
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1.0
INTRODUCTION

The purpose of this project was to determine exhaust emission values of selected pollutants during typical operation of one of the two Perennial Energy Company landfill gas (LFG) combustors (#1 Perennial Flare) at the City of Tacoma Public Works Department's Tacoma Landfill in Tacoma, Washington. The gases produced from the decomposition of buried organic wastes are extracted and piped to the combustors where they are burned prior to emitting the gases to the atmosphere. Parametrix, Inc. contracted AmTest Air Quality (ATAQ) of Preston, Washington, a Division of Hoefler Consulting Group, to perform these tests to demonstrate compliance with Puget Sound Clean Air Agency (PSCAA) air permit requirements. Testing was performed simultaneously at the inlet and outlet of the #1 Perennial Flare on July 19-20, 2007. Three runs of each test method were performed simultaneously at the flare inlet and outlet.

The parameters measured at the **#1 Perennial flare inlet** included:

- gas temperature and airflow using EPA Methods 1A and 2
- inlet fixed gases O_2, CO_2, CO, N_2, and CH_4 using EPA Method 3C
- gas moisture content using Oregon Department of Environmental Quality (ODEQ) Method 4 psychrometry
- non-methane organic compounds (NMOC) using EPA Method 25C
- speciated volatile organic compounds (VOC) using EPA Method TO-14A

The parameters measured at the **#1 Perennial flare outlet** included:

- gas temperature and airflow using EPA Methods 1 and 2
- combustion gases and molecular weight using EPA Method 3A
- gas moisture content using EPA Method 4
- sulfur dioxide (SO_2) using EPA Method 6C
- nitrogen oxides (NO_x) using EPA Method 7E
- carbon monoxide (CO) using EPA Method 10
- non-methane organic compounds (NMOC) using EPA Method 25A
- hydrogen chloride (HCl) and hydrogen fluoride (HF) using EPA Method 26A
- speciated VOC using EPA SW-846 Method 0031

Testing and analysis procedures used for this project are presented in the Environmental Protection Agency (EPA) document Title 40, Code of Federal Regulations, Part 60 (40 CFR 60), Appendix A, Methods 1, 1A, 2, 3A, 3C, 4, 6C, 7E, 10, 25A, 25C, and 26A; in the ODEQ Source Sampling Methods, 1992; in the EPA Test Methods for Evaluating Solid Waste (SW-846), Volume II, Field Manual, Method 0031; in the EPA Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Method TO-14A; and the EPA Technology Transfer Network Emission Measurement Center (EPA-TTN-EMC) website, Test Methods Section (www.epa.gov/ttn/emc/).

EPA Methods 1, 1A, and 2 were performed to measure the stack gas velocity and temperature for calculating the volumetric flow rate. EPA Method 3A was performed to determine the molecular weight of the stack gas based on measurements of the O_2 and CO_2 concentration at the flare outlet. EPA Method 3C was performed to determine the molecular weight of the flare inlet gas based on percent levels of fixed gases (O_2, CO_2, CO, nitrogen (N_2), and methane (CH_4)). The 3C analysis was performed on the integrated samples collected in electropolished SUMMA® canisters for TO-14A analysis. EPA Method 4 was performed to measure the moisture content of the stack gas at the flare outlet. Moisture content of the flare inlet gas was determined using psychrometry. EPA Method 6C was performed to quantify SO_2 emissions at the flare outlet using an ultraviolet analyzer. EPA Method 7E was performed to quantify NO_x emissions at the flare outlet using a chemiluminescent analyzer. EPA Method 10 was performed to quantify CO emissions at the flare outlet using a gas filter correlation non-dispersive infrared (NDIR) analyzer. EPA Method 25C was performed to quantify non-methane organic compounds (NMOC) from the integrated samples collected at the flare inlet for TO-14A analysis. EPA Method 26A was performed at the flare outlet to quantify emissions of HCl and HF. VOC were collected at the flare inlet using Method TO-14A. VOC were collected at the flare outlet using Method 0031.

Mr. Kevin E. Farwell, Mr. Ryan D. Radonski, Mr. Kevin E. Farwell, Jr., and Mr. Trevor W. Gray of ATAQ conducted the field sampling. ATAQ's laboratory, technical writing, and management staff performed the sample recovery, laboratory analysis, data reduction, report preparation, and quality assurance review. Laboratory analyses were performed by Atmospheric Analysis and Consulting, Inc. (AAC) of Ventura, California and Severn Trent Laboratories of Knoxville, Tennessee. Mr. Steve Emge of Parametrix, Inc. coordinated this project on behalf of the City of Tacoma Public Works Department. Mr. Mike Gore represented the City of Tacoma.

2.0
SUMMARY OF RESULTS

The following subsections of this report present the results for this emission evaluation. The order of presentation is by method number in most cases. Inlet data are presented before outlet data. Summary tables are included for each type of analysis and present the results from each run and the average for each set of three runs. Refer to the Table of Contents to locate specific information. The summary tables in this section contain information obtained from computer printouts of results for each individual run which are included in Appendix A of this report. Appendix B of this report contains copies of the original laboratory data. Appendix C of this report contains example calculations of results and copies of the original field data sheets and raw gaseous emission data. Appendix D of this report contains miscellaneous supporting information and schematics of the sample trains utilized. An overview of the quality assurance requirements; discussions of any exceptions to the test plan, sampling, or analysis; and/or any process difficulties may be found in Section 3.0, "Project Overview/Exceptions," of this report.

It should be noted throughout the following data tables that if the result for a single run is flagged with the letter "U" (indicating it was undetected, or less than the detection limit (DL)), the result for that run is presented as the calculated detection limit flagged with the letter "U" and that run is counted as zero (0) in the 3-run average. When all three runs are reported as "U," the average is reported as the average detection limit and is flagged with a "U." If some, but not all of the runs are "U" then the average is presented as an estimated value and is flagged with the letter "J."

2.1 Velocity, Temperature, and Airflow - Flare Inlet

The results of the nine moisture and airflow runs performed at the inlet to the #1 Perennial Flare on July 19-20, 2007 are summarized on the following computer printouts titled "Summary of Results - EPA Methods 1, 2, 3C, and 4." Three inlet airflow runs (labeled A, B, and C) were performed concurrently with each M0031 run at the outlet. Each set of three runs (A, B, and C) was averaged to obtain the overall run average.

The average temperature of gas at the flare inlet was 93.3°F. The moisture of the inlet gas was measured using psychrometry. The velocity of the gas at the inlet to the flare averaged 25.1 feet per second, and the average airflow of landfill gas into the flare was 769.3 dry standard cubic feet per minute (dscf/min).

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SUMMARY OF RESULTS - EPA METHODS 1, 2, 3C, AND 4
PSYCHROMETRIC MOISTURE
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX@CTL-M1-4 INLET
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington

	Perennial #1 Landfill Gas Combuster Inlet			
	Run 1A	Run 1B	Run 1C	Average R1
Lab #:	—	—	—	
Date:	7/19/07	7/19/07	7/19/07	
Start Time:	1510	1620	1730	
Stop Time:	1520	1630	1740	
Wet Bulb Temperature (°F):	78.0	78.0	78.0	
Dry Bulb Temperature (°F):	96.4	96.4	96.4	
Psychrometric Moisture (%):	2.55	2.55	2.55	2.55
Barometric Pressure ("Hg):	29.70	29.7	29.7	29.70
Static Pressure ("H_2O):	5.8	6.4	6.2	6.1
Stack Pressure ("Hg):	30.13	30.17	30.16	30.15
Stack Temperature (°F):	104.6	101.3	96.2	100.7
Stack Temperature (°R):	564.6	561.3	556.2	560.7
Average Concentration O_2 (%):	3.4	3.4	3.4	3.4
Average Concentration CO_2 (%):	22.3	22.3	22.3	22.3
Average Concentration CH_4 (%):	24.7	24.7	24.7	24.7
Molecular Weight (dry, g/g-mole):	28.74	28.74	28.74	28.74
Molecular Weight (wet, g/g-mole):	28.47	28.47	28.47	28.47
Average Velocity Head ("H_2O):	0.149	0.143	0.146	0.146
Pitot Tube C_p:	0.99	0.99	0.99	
Stack Gas Velocity (ft/sec):	26.5	25.9	26.1	26.1
Stack Area (ft^2):	0.545	0.545	0.545	
Stack Gas Airflow (dscf/min):	795.9	782.8	794.8	791.2
Stack Gas Airflow (acf/min):	867.4	846.9	852.5	855.6

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SUMMARY OF RESULTS - EPA METHODS 1, 2, 3C, AND 4
PSYCHROMETRIC MOISTURE
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX@CTL-M1-4 INLET
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington

	Perennial #1 Landfill Gas Combuster Inlet			
	Run 2A	Run 2B	Run 2C	Average R2
Lab #:	---	---	---	
Date:	7/20/07	7/20/07	7/20/07	
Start Time:	0831	0931	1031	
Stop Time:	0841	0941	1041	
Wet Bulb Temperature (°F):	76.0	76.0	76.0	
Dry Bulb Temperature (°F):	87.9	87.9	87.9	
Psychrometric Moisture (%):	2.58	2.58	2.58	2.58
Barometric Pressure ("Hg):	29.65	29.65	29.65	29.65
Static Pressure ("H_2O):	6.2	6.2	6.2	6.2
Stack Pressure ("Hg):	30.11	30.11	30.11	30.11
Stack Temperature (°F):	84.5	85.9	100.6	90.3
Stack Temperature (°R):	544.5	545.9	560.6	550.3
Average Concentration O_2 (%):	3.1	3.1	3.1	3.1
Average Concentration CO_2 (%):	22.7	22.7	22.7	22.7
Average Concentration CH_4 (%):	25.4	25.4	25.4	25.4
Molecular Weight (dry, g/g-mole):	28.71	28.71	28.71	28.71
Molecular Weight (wet, g/g-mole):	28.43	28.43	28.43	28.43
Average Velocity Head ("H_2O):	0.135	0.125	0.136	0.132
Pitot Tube C_p:	0.99	0.99	0.99	
Stack Gas Velocity (ft/sec):	24.8	23.9	25.3	24.6
Stack Area (ft^2):	0.545	0.545	0.545	
Stack Gas Airflow (dscf/min):	770.1	740.4	763.9	758.2
Stack Gas Airflow (acf/min):	810.1	781.0	827.3	806.1

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SUMMARY OF RESULTS - EPA METHODS 1, 2, 3C, AND 4
PSYCHROMETRIC MOISTURE
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX@CTL-M1-4 INLET
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington

	Perennial #1 Landfill Gas Combuster Inlet			
	Run 3A	Run 3B	Run 3C	Average R3
Lab #:	---	---	---	
Date:	7/20/07	7/20/07	7/20/07	
Start Time:	1138	1238	1338	
Stop Time:	1148	1248	1348	
Wet Bulb Temperature (°F):	80.0	80.0	80.0	
Dry Bulb Temperature (°F):	93.3	93.3	93.3	
Psychrometric Moisture (%):	2.95	2.95	2.95	2.95
Barometric Pressure ("Hg):	29.65	29.65	29.65	29.65
Static Pressure ("H_2O):	6.4	6.3	6.5	6.4
Stack Pressure ("Hg):	30.12	30.11	30.13	30.12
Stack Temperature (°F):	87.0	87.2	92.7	89.0
Stack Temperature (°R):	547.0	547.2	552.7	549.0
Average Concentration O_2 (%):	3.3	3.3	3.3	3.3
Average Concentration CO_2 (%):	22.6	22.6	22.6	22.6
Average Concentration CH_4 (%):	25.1	25.1	25.1	25.1
Molecular Weight (dry, g/g-mole):	28.74	28.74	28.74	28.74
Molecular Weight (wet, g/g-mole):	28.42	28.42	28.42	28.42
Average Velocity Head ("H_2O):	0.133	0.126	0.138	0.133
Pitot Tube C_p:	0.99	0.99	0.99	
Stack Gas Velocity (ft/sec):	24.7	24.1	25.3	24.7
Stack Area (ft^2):	0.545	0.545	0.545	
Stack Gas Airflow (dscf/min):	761.8	742.4	771.7	758.6
Stack Gas Airflow (acf/min):	807.8	787.6	826.7	807.4

2.2 EPA Method 3C and 25C, Flare Inlet

Fixed gases, including oxygen (O_2), carbon dioxide (CO_2), carbon monoxide (CO), nitrogen (N_2), and methane (CH_4), were quantified in percent levels at the inlet to the flare by Atmospheric Analysis and Consulting, Inc. using the gas collected in SUMMA® canisters for TO-14A analysis. Three runs were performed at the flare inlet on July 19-20, 2007. During run 3, a duplicate SUMMA® canister was collected simultaneously. The samples were labeled runs 3A and 3B. The results are summarized on the following computer printout titled "Summary of Results - EPA Methods 3C and 25C."

Copies of the original laboratory analysis data supplied by Atmospheric Analysis and Consulting, Inc. are included in Appendix B of this report and are presented in percent (%) or parts per million (ppm). The four inlet gas samples were analyzed for fixed gases using a gas chromatograph equipped with a thermal conductivity detector (TCD) by EPA Method 3C. Non-methane organic compounds as methane (NMOC as CH_4) were analyzed using a gas chromatograph equipped with a flame ionization detector (GC-FID) by EPA Method 25C.

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SUMMARY OF RESULTS - EPA METHOD 3C AND 25C
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX@CTL GASSUM-INLET
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington

	Perennial #1 Landfill Gas Combuster Inlet			
	Run 1	Run 2	Run3	Average
Date:	7/19/07	7/20/07	7/20/07	
Start Time:	1510	0831	1138	
Stop Time:	1730	1031	1338	
Sample Length (minutes):	120	120	120	
Stack Gas Airflow (dscf/min):	791.2	758.2	758.6	769.3
OXYGEN (O_2)				
O_2 Detection Limit (%):	0.1	0.1	0.1	0.1
O_2 Emission Concentration (%):	3.4	3.1	3.3	3.3
O_2 Emission Concentration (ppm):	34000	31000	33000	32667
O_2 Emission Rate (lb/hr):	134.1	117.1	124 8	125.3
NITROGEN (N_2)				
N_2 Detection Limit (%):	0.1	0.1	0.1	0.1
N_2 Emission Concentration (%):	49.5	48.7	48.9	49.0
N_2 Emission Concentration (ppm):	495000	487000	489000	490333
N_2 Emission Rate (lb/hr):	1708.4	1610.5	1618.2	1645.7
CARBON DIOXIDE (CO_2)				
CO_2 Detection Limit (%):	0.1	0.1	0.1	0.1
CO_2 Emission Concentration (%):	22.30	22.7	22 7	22 6
CO_2 Emission Concentration (ppm):	223000	227000	226500	225500
CO_2 Emission Rate (lb/hr):	1209.3	1179.5	1177.7	1188.8
CARBON MONOXIDE (CO)				
CO Detection Limit (%):	0.1	0.1	0.1	0.1
CO Emission Concentration (%):	0.1 U	0.1 U	0.1 U	0 1 U
CO Emission Concentration (ppm):	1000 U	1000 U	1000 U	1000 U
CO Emission Rate (lb/hr):	3.45 U	3.31 U	3.31 U	3 36 U
METHANE (CH_4)				
CH_4 Detection Limit (%):	0.1	0.1	0.1	0.1
CH_4 Emission Concentration (%):	24.7	25.4	25.2	25.1
CH_4 Emission Concentration (ppm):	247000	254000	251500	250833
CH_4 Emission Rate (lb/hr):	488 2	481.0	476.6	481 9
NON-METHANE ORGANIC COMPOUNDS (NMOC)				
NMOC Detection Limit as CH_4 (ppm):	1.0	1 0	1.0	1.0
NMOC Emission Concentration as CH_4 (ppm):	738	756	454	649
NMOC Emission Rate as CH_4 (lb/hr):	1.46	1 43	0.860	1 25

U = Undetected at specified reporting limit.
J = Approximate value. This is assigned when one or more of multiple runs is under the detection limit, but at least one of the other runs is above the detection limit and zero is used for those values under the detection limit in calculating the average.

2.3 EPA Methods 3A, 6C, 7E, 10, and 25A, Flare Outlet

Three 120 to -240-minute EPA Method 3A, 6C, 7E, 10, and 25A runs were performed at the flare outlet to quantify emissions of sulfur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), total hydrocarbons (THC), and methane (CH_4). The results are summarized on the following computer printouts titled "Summary of Results - EPA Methods 3A, 6C, 7E, and 10" and "Summary of Results - EPA Methods 3A and 25A."

SO_2, NO_x, and CO concentration were measured in dry parts per million (ppm) and CH_4 and THC concentrations were measured in wet ppm as CH_4 continuously during each test period using instrumental analyzers. Percent (%) levels of oxygen (O_2) and carbon dioxide (CO_2) were also measured. O_2, CO_2, SO_2, NO_x, CO, CH_4, and THC emission concentrations were recorded at least once per minute during each test period and averaged. A system calibration bias and drift check was performed before and after each run. The bias-corrected averages are reported and used in emission rate calculations. Stack gas moisture data from concurrent Method 26A runs were used to convert CH_4 and THC data from a wet basis to a dry basis. CH_4 and THC emission concentrations and emissions rates were reported as methane (CH_4). Airflow data were utilized to calculate SO_2, NO_x, CO, CH_4, and THC emission rates in units of pounds per hour (lb/hr). Non-methane organic compounds (NMOC) results were calculated by subtracting CH_4 emission rates from THC emission rates, in pounds per hour (lb/hr).

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SUMMARY OF RESULTS - EPA METHODS 3A, 6C, 7E, AND 10
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX@CTL GASSUM-OUT
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington

	Perennial #1 Landfill Gas Combuster Outlet			
	Run 1	Run 2	Run 3	Average
Date:	7/19/07	7/20/07	7/20/07	
Start Time:	1510	0831	1138	
Stop Time:	1732	1031	1338	
Sample Length (minutes):	240	120	120	
Oxygen (%):	11.7	13.6	11.8	12.3
Stack Gas Airflow (dscf/min):	9792.7	10933	10551	10426
EPA METHOD 6C				
SULFUR DIOXIDE (SO_2)				
SO_2 Detection Limit (ppm):	0.1	0.1	0.1	0.1
SO_2 Emission Concentration (ppm):	0.2	3.5	4.2	2.6
SO_2 Emission Rate (lb/hr):	0.022	0.378	0.445	0.282
EPA METHOD 7E				
NITROGEN OXIDES (NO_x)				
NO_x Detection Limit (ppm):	0.1	0.1	0.1	0.1
NO_x Emission Concentration (ppm):	10.6	9.8	13.0	11.1
NO_x Emission Rate (lb/hr):	0.746	0.770	0.980	0.832
EPA METHOD 10				
CARBON MONOXIDE (CO)				
CO Detection Limit (ppm):	1.0	1.0	1.0	1.0
CO Emission Concentration (ppm):	45.9	43.9	59.4	49.7
CO Emission Rate (lb/hr):	1.96	2.09	2.73	2.26

U = Undetected at specified reporting limit.
J = Approximate value. This is assigned when one or more of multiple runs is under the detection limit, but at least one of the other runs is above the detection limit and zero is used for those values under the detection limit in calculating the average.

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SUMMARY OF RESULTS - EPA METHOD 25A
NON METHANE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX@CTL GASSUM-OUT
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington

	Perennial #1 Landfill Gas Combuster Outlet			
	Run 1	Run 2	Run 3	Average
Date:	7/19/07	7/20/07	7/20/07	
Start Time:	1510	0831	1138	
Stop Time:	1732	1031	1338	
Sample Length (minutes):	240	120	120	
Moisture (B_{ws}):	0.0817	0.0758	0.0867	0.0814
Oxygen (%):	11.7	13.6	11.8	12.3
Stack Gas Airflow (dscf/min):	9792.7	10933	10551	10426
EPA METHOD 25A TOTAL HYDROCARBONS (THC as Methane)				
THC Detection Limit (dry - ppm):	1.0	1.0	1.0	1.0
THC Emission Concentration (wet - ppm):	10.2	12.8	12.4	11.8
THC Emission Concentration (dry - ppm):	11.1	13.8	13.6	12.8
THC Emission Rate (lb/hr):	0.272	0 378	0.358	0.336
EPA METHOD 25A METHANE (CH_4)				
Methane Detection Limit (dry - ppm):	1.0	1.0	1.0	1.0
Methane Emission Concentration (wet - ppm):	11.2	12 5	16.1	13.3
Methane Emission Concentration (dry - ppm):	12.2	13.5	17.6	14.5
Methane Emission Rate (lb/hr):	0.298	0.369	0.465	0.377
EPA METHOD 25A NMOC (as Methane)				
NMOC Detection Limit (ppm):	1.0	1.0	1.0	1.0
NMOC Detection Limit (lb/hr):	0.024	0.027	0.026	0.026
NMOC Emission Rate (lb/hr):	0.024 U	0.009 U	0.026 U	0.020 U
NMOC Emission Concentration (dry - ppm):	1.0 U	0.3 U	1.0 U	0.8 U
EPA METHOD 25A NMOC (as Carbon)				
NMOC Detection Limit (as carbon (ppm)):	1 0	1.0	1.0	1.0
NMOC Detection Limit (as carbon (lb/hr)):	0.018 U	0 020	0.020	0.013
NMOC Emission Concentration (as methane (dry-ppm)):	1.0 U	0.3 U	1.0 U	0.8 U
NMOC Emission Concentration (as carbon (dry-ppm)):	1.0 U	0.3 U	1.0 U	0.8 U
NMOC Emission Rate (lb/hr):	0.018 U	0.007 U	0.020 U	0.015 U

U = Undetected at specified reporting limit.
J = Approximate value. This is assigned when one or more of multiple runs is under the detection limit, but at least one of the other runs is above the detection limit and zero is used for those values under the detection limit in calculating the average.

2.4 Destruction Efficiency - Non-Methane Organic Compounds (NMOC)

To calculate the non-methane organic compound destruction efficiency (DE) of the flare, NMOC emission rates at the flare inlet were compared to the NMOC emission rates at the flare outlet. The destruction efficiency is the amount of VOC destroyed through incineration, expressed on a percentage basis. Destruction efficiencies were calculated based on the average emission rate of NMOC in pounds per hour (lb/hr) at the inlet (using EPA Method 25C) compared to the outlet (as measured using EPA Method 25A). Results are summarized on the following computer printout titled, "VOC Destruction Efficiency - EPA Methods 25C and 25A."

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VOC DESTRUCTION EFFICIENCY (DE)

EPA METHODS 25C AND 25A
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

Client: 8752-001\PX@CTL GASSUM-INLET
Location: Parametrix @ City of Tacoma Landfill
Date: 7/19/07

	Perennial #1 Landfill Gas Combuster Inlet			
	Run 1	Run 2	Run 3	Average
NMOC Emission Rate (lb/hr):	1.46	1.43	0.860	1.25

	Perennial #1 Landfill Gas Combuster Outlet							
	Run 1		Run 2		Run 3		Average	
NMOC Emission Rate (lb/hr):	0.018	U	0.007	U	0.020	U	0.015	U

	VOC DESTRUCTION EFFICIENCY (DE)			
	>99.99%	>99.99%	>99.99%	>99.99%

Example Calculations: VOC Destruction Efficiency (DE)

VOC Destruction Efficiency (DE) = (Inlet (lb/hr) - Outlet (lb/hr)) / Inlet (lb/hr) * 100 %

VOC DE = (1.46 - 0.018) / 1.46 * 100 %

= >99.99%

Note - If the inlet is U then DE = --- ; if the inlet is detected and the outlet is U then DE = >99.99%.

2.5 EPA Method 26A - Gaseous Chloride (HCl) and Gaseous Fluoride (HF), Flare Outlet

Three 120-minute EPA Method 1, 2, 3A, 4, and 26A samples were collected at the #1 Perennial Flare Outlet on July 19-20, 2007. The Method 26A sample train utilizes 0.1 N sulfuric acid (H_2SO_4) solution in a series of impingers which scrub hydrogen chloride (HCl) and hydrogen fluoride (HF) from the gas stream. The sulfuric acid solution from each train was recovered and analyzed for hydrogen chloride and hydrogen fluoride using ion chromatography (IC). The data was presented by the laboratory as chloride and fluoride, which was converted to HCl and HF using a ratio of molecular weights. The HCl and HF emission results are summarized on the following computer printout titled "Summary of Results - Methods 1, 2, 3A, 4, and 26A."

Copies of the laboratory analysis results in units of micrograms (µg) per sample are presented in Appendix B of this report. The laboratory results were converted to emission concentrations of milligrams per dry standard cubic meter (mg/dscm) and parts per million (ppm). Emission rates were calculated in pounds per hour (lb/hr). Blank correcting the results was unnecessary because the blank results were less than the detection limit.

AMTEST AIR QUALITY, LLC

SUMMARY OF RESULTS - EPA METHODS 1, 2, 3, 4, AND 26A - HYDROGEN CHLORIDE (HCl)
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX@CTL M26A - SUM
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington

	Perennial #1 Landfill Gas Combuster Outlet				
	Run 1	Run 2	Run 3	Average	Blank
Lab #:	4504	4505	4506		
Date:	7/19/07	7/20/07	7/20/07		
Start Time:	1510	0831	1138		
Stop Time:	1745	1042	1351		
Sample Length (minutes):	120	120	120		
Volume Sampled (ft^3):	84.358	95.598	88.208	89.388	
Volume Sampled (dscf):	82.062	94.142	85.260	87.154	
Volume Sampled (dscm):	2.324	2.666	2.415	2.468	2.468
Stack Gas Moisture (%):	8.17	7.58	8.67	8.14	
Barometric Pressure ("Hg):	29.70	29.65	29.65	29.67	
Static Pressure ("H_2O):	-0.01	-0.01	-0.01	-0.01	
Stack Pressure ("Hg):	29.70	29.65	29.65	29.67	
Stack Temperature (°F):	1397.4	1287.9	1411.1	1365.5	
Stack Temperature (°R):	1857.4	1747.9	1871.1	1825.5	
Average Concentration O_2 (%):	11.7	13.6	11.8	12.4	12.4
Average Concentration CO_2 (%):	7.80	6.30	7.70	7.27	
Molecular Weight (dry, g/g-mole):	29.72	29.55	29.70	29.66	
Molecular Weight (wet, g/g-mole):	28.76	28.68	28.69	28.71	
Average Velocity Head ("H_2O):	0.006	0.007	0.007	0.007	
Pitot Tube C_p:	0.84	0.84	0.84		
Stack Gas Velocity (ft/sec):	8.29	8.67	9.07	8.68	
Stack Area (ft^2):	75.9	75.9	75.9		
Stack Gas Airflow (dscf/min):	9792.7	10933	10551	10425	10425
Nozzle Diameter (inches):	0.974	0.974	0.974		
Isokinetics (%):	103	105	99		
Hydrogen Chloride (HCl) Emission Concentration Results					
HCl Emission Concentration (mg/dscm):	0.974	0.694	0.894	0.854	0.008 U
HCl Emission Concentration (ppm):	0.642	0.458	0.590	0.563	0.005 U
HCl Emission Rate (lb/hr):	0.036	0.028	0.035	0.033	0.0003 U
Hydrogen Fluoride (HF) Emission Concentration Results					
HF Emission Concentration (mg/dscm):	0.770	0.514	0.523	0.602	0.009 U
HF Emission Concentration (ppm):	0.926	0.617	0.629	0.724	0.010 U
HF Emission Rate (lb/hr):	0.028	0.021	0.021	0.023	0.0003 U

Results are blank corrected. If the blank is U, then 0 is subtracted from the sample results. If the sample minus the blank is U, then the result is the detection limit
U = Undetected at specified reporting limit.
J = Estimated value. This is assigned when one or more of multiple runs is under the detection limit, but at least one of the other runs is above the detection limit. Zero is used for those values under the detection limit in calculating the average.

2.6 EPA Method TO-14A - Volatile Organic Compounds (VOC), Flare Inlet

Three 120-minute EPA Method TO-14A samples were collected at the flare inlet on June 19-20, 2007 to quantify volatile organic compound (VOC) emissions. During run 3, a duplicate SUMMA® canister was collected simultaneously. The samples were labeled runs 3A and 3B. VOC emission rates were calculated in units of pounds per hour (lb/hr). VOC emission rate calculations were performed using the laboratory analysis data provided by Atmospheric Analysis and Consulting, Inc., and from airflow data collected concurrently. The VOC results are summarized on the following computer printouts titled "Summary of Average Results - TO-14A Volatile Organic Compounds," "Summary of Emission Concentration Results - TO-14A Volatile Organic Compounds," and "Summary of Emission Rate Results - TO-14A Volatile Organic Compounds." The emission results compared to the detection limits for each individual run are presented on the computer printouts included in Appendix A of this report. Copies of the VOC laboratory analysis results in emission concentration units of micrograms per cubic meter ($\mu g/m^3$) are included in Appendix B of this report.

AMTEST
AIR QUALITY, LLC

SUMMARY OF AVERAGE RESULTS
TO-14A VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX@CTL TO-15 - OVERALL SUM
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Sample Date: 7/19-20/07

	#1 Perennial Combuster Inlet	
ANALYTE	Average µg/m³	Average lb/hr
Chlorodifluoromethane	1,975	5 7E-03
Propylene	4,745	1 4E-02
Dichlorodifluoromethane	1,115 U	3 2E-03 U
Chloromethane	547 U	1 6E-03 U
1,2-Dichloro-1,1,2,2-Tetrafluoroethane	1,852 U	5 3E-03 U
Vinyl Chloride	1,100	3 2E-03
Methanol	1,735 U	5 0E-03 U
1,3-Butadiene	586 U	1 7E-03 U
Bromomethane	1,029 U	3 0E-03 U
Chloroethane	699 U	2 0E-03 U
Dichlorofluoromethane	1,115 U	3.2E-03 U
Ethanol	998 U	2 9E-03 U
Vinyl Bromide	1,159 U	3 3E-03 U
Acetone	398 J	1 2E-03 J
Trichlorofluoromethane	1,381 U	4 0E-03 U
Isopropyl Alcohol	1,302 U	3 7E-03 U
Acrylonitrile	575 U	1 7E-03 U
1,1-Dichloroethylene	1,040 U	3 0E-03 U
Methylene Chloride	921 U	2 6E-03 U
Allyl Chloride (Chloroprene)	829 U	2 4E-03 U
Carbon Disulfide	825 U	2.4E-03 U
1,1,2-Trichloro-1,2,2-Trifluoroethane	2,030 U	5 8E-03 U
t-1,2-Dichloroethylene	1,050 U	3 0E-03 U
1,1-Dichloroethane	1,062 U	3 1E-03 U
MTBE	955 U	2 7E-03 U
Vinyl Acetate	933 U	2 7E-03 U
2-Butanone (MEK)	781 U	2 2E-03 U
cis-1,2- Dichloroethene	1,040 U	3 0E-03 U
Hexane	2,765	8 0E-03
Chloroform	1,295 U	3 7E-03 U
Ethyl Acetate	955 U	2 7E-03 U
Tetrahydrofuran	993	2 9E-03
1,2-Dichloroethane	1,062 U	3 1E-03 U
1,1,1-Trichloroethane	1,446 U	4 2E-03 U
Benzene	1,325	3 8E-03
Carbon Tetrachloride	1,668 U	4 8E-03 U
Cyclohexane	1,523	4 4E-03
1,2-Dichloropropane	1,224 U	3 5E-03 U
Bromodichloromethane	1,775 U	5 1E-03 U
1,4-Dioxane	955 U	2 7E-03 U
Trichloroethene	1,419 U	4 1E-03 U
2,2,4-Trimethylpentane	1,238 U	3 6E-03 U
Heptane	3,890	1 1E-02
cis-1,3-Dichloropropene	1,181 U	3 4E-03 U
4-Methyl-2-Pentanone (MiBK)	1,085 U	3 1E-03 U
t-1,3-Dichloropropene	1,181 U	3 4E-03 U
1,1,2-Trichloroethane	1,441 U	4 1E-03 U
Toluene	6,243	1 8E-02
2-Hexanone	1,085 U	3 1E-03 U
Dibromochloromethane	2,256 U	6 5E-03 U
1,2-Dibromoethane	2,004 U	5 8E-03 U
Tetrachloroethylene	1,796 U	5 2E-03 U
Chlorobenzene	1,219 U	3 5E-03 U
Ethylbenzene	17,050	4 9E-02
m- & p-Xylenes	14,750	4 2E-02
Bromoform	8,213 U	2 4E-02 U
Styrene	1,128 U	3 2E-03 U
1,1,2,2-Tetrachloroethane	1,820 U	5 2E-03 U
o-Xylene	3,683	1 1E-02
4-Ethyltoluene	1,302 U	3 7E-03 U
1,3,5-Trimethylbenzene	1,068 J	3 1E-03 J
1,2,4-Trimethylbenzene	3,840	1 1E-02
Benzyl Chloride	6,856 U	2 0E-02 U
1,3-Dichlorobenzene	1,592 U	4 6E-03 U
1,4-Dichlorobenzene	1,592 U	4 6E-03 U
1,2-Dichlorobenzene	1,592 U	4 6E-03 U
1,2,4-Trichlorobenzene	1,968 U	5 6E-03 U
Hexachlorobutadiene	2,825 U	8 1E-03 U

U = undetected at specified detection limit (DL)

AMTEST AIR QUALITY, LLC

SUMMARY OF EMISSION CONCENTRATION RESULTS
TO-14A VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001WPX@CTL TO-15
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Sample Date: 7/19-20/07

	#1 Perennial Combuster Inlet				
ANALYTE	Run 1 µg/m³	Run 2 µg/m³	Run 3a µg/m³	Run 3b µg/m³	Average µg/m³
Chlorodifluoromethane	1870	2080	2070	1900	1975
Propylene	4580	4950	4930	4540	4745
Dichlorodifluoromethane	1178 U	1062 U	1131 U	1069 U	1115 U
Chloromethane	578 U	531 U	555 U	524 U	547 U
1,2-Dichloro-1,1,2,2-Tetrafluoroethane	1957 U	1797 U	1877 U	1775 U	1852 U
Vinyl Chloride	991	1180	1160	1070	1100
Methanol	1834 U	1684 U	1760 U	1663 U	1735 U
1,3-Butadiene	619 U	569 U	594 U	562 U	586 U
Bromomethane	1087 U	998 U	1043 U	988 U	1029 U
Chloroethane	738 U	678 U	709 U	670 U	699 U
Dichlorofluoromethane	1178 U	1062 U	1131 U	1069 U	1115 U
Ethanol	1055 U	969 U	1012 U	957 U	998 U
Vinyl Bromide	1224 U	1124 U	1175 U	1111 U	1159 U
Acetone	1590	1221 U	1278 U	1208 U	398 J
Trichlorofluoromethane	1460 U	1340 U	1401 U	1324 U	1381 U
Isopropyl Alcohol	1378 U	1264 U	1320 U	1248 U	1302 U
Acrylonitrile	607 U	558 U	583 U	551 U	575 U
1,1-Dichloroethylene	1099 U	1009 U	1055 U	997 U	1040 U
Methylene Chloride	973 U	894 U	934 U	883 U	921 U
Allyl Chloride (Chloroprene)	878 U	805 U	841 U	795 U	829 U
Carbon Disulfide	872 U	800 U	836 U	791 U	825 U
1,1,2-Trichloro-1,2,2-Trifluoroethane	2145 U	1970 U	2058 U	1946 U	2030 U
t-1,2-Dichloroethylene	1110 U	1019 U	1065 U	1007 U	1050 U
1,1-Dichloroethane	1122 U	1030 U	1077 U	1018 U	1062 U
MTBE	1009 U	927 U	968 U	915 U	955 U
Vinyl Acetate	988 U	905 U	946 U	894 U	933 U
2-Butanone (MEK)	825 U	758 U	792 U	749 U	781 U
cis-1,2- Dichloroethene	1099 U	1009 U	1055 U	997 U	1040 U
Hexane	3100	2770	2690	2500	2765
Chloroform	1368 U	1256 U	1313 U	1241 U	1295 U
Ethyl Acetate	1009 U	926 U	968 U	915 U	955 U
Tetrahydrofuran	1010	1020	1020	920	993
1,2-Dichloroethane	1122 U	1030 U	1077 U	1018 U	1062 U
1,1,1-Trichloroethane	1526 U	1403 U	1466 U	1386 U	1446 U
Benzene	1360	1330	1360	1230	1325
Carbon Tetrachloride	1783 U	1619 U	1692 U	1599 U	1666 U
Cyclohexane	1740	1510	1510	1330	1523
1,2-Dichloropropane	1294 U	1188 U	1241 U	1173 U	1224 U
Bromodichloromethane	1875 U	1722 U	1800 U	1701 U	1775 U
1,4-Dioxane	1009 U	926 U	968 U	915 U	955 U
Trichloroethene	1500 U	1377 U	1439 U	1360 U	1419 U
2,2,4-Trimethylpentane	1308 U	1201 U	1255 U	1186 U	1238 U
Heptane	4340	3890	3890	3440	3890
cis-1,3-Dichloropropene	1248 U	1146 U	1197 U	1132 U	1181 U
4-Methyl-2-Pentanone (MIBK)	1147 U	1053 U	1100 U	1040 U	1085 U
t-1,3-Dichloropropene	1248 U	1146 U	1197 U	1132 U	1181 U
1,1,2-Trichloroethane	1522 U	1398 U	1461 U	1381 U	1441 U
Toluene	6370	6360	6480	5740	6243
2-Hexanone	1147 U	1053 U	1100 U	1040 U	1085 U
Dibromochloromethane	2384 U	2190 U	2288 U	2163 U	2256 U
1,2-Dibromoethane	2118 U	1945 U	2032 U	1921 U	2004 U
Tetrachloroethylene	1900 U	1745 U	1823 U	1724 U	1798 U
Chlorobenzene	1288 U	1183 U	1236 U	1168 U	1219 U
Ethylbenzene	16900	17500	18200	15600	17050
m- & p-Xylenes	14700	15200	15700	13400	14750
Bromoform	8680 U	7971 U	8329 U	7873 U	8213 U
Styrene	1192 U	1095 U	1144 U	1081 U	1128 U
1,1,2,2-Tetrachloroethane	1923 U	1766 U	1845 U	1744 U	1820 U
o-Xylene	3760	3780	3870	3320	3683
4-Ethyltoluene	1378 U	1264 U	1320 U	1248 U	1302 U
1,3,5-Trimethylbenzene	1420	1370	1480	1246 U	1068 J
1,2,4-Trimethylbenzene	4030	3810	4150	3370	3840
Benzyl Chloride	7245 U	6654 U	6953 U	6572 U	6856 U
1,3-Dichlorobenzene	1683 U	1545 U	1615 U	1526 U	1592 U
1,4-Dichlorobenzene	1683 U	1545 U	1615 U	1526 U	1592 U
1,2-Dichlorobenzene	1683 U	1545 U	1615 U	1526 U	1592 U
1,2,4-Trichlorobenzene	2077 U	1908 U	1993 U	1884 U	1968 U
Hexachlorobutadiene	2985 U	2741 U	2864 U	2708 U	2825 U

U = undetected at specified reporting limit (DL)
J = Approximate value. Data is labeld with a J flag when one or more of the results in a set of multiple runs is under the detection limit, but at least one of the other runs is above the detection limit. Runs under the detection limit are represented as in the set average calculation

AMTEST
AIR QUALITY, LLC

SUMMARY OF EMISSION RATE RESULTS
TO-14A VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 6752-001\PX@CTL TO-15
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Sample Date: 7/19-20/07

	#1 Perennial Combuster Inlet				
ANALYTE	Run 1 lb/hr	Run 2 lb/hr	Run 3a lb/hr	Run 3b lb/hr	Average lb/hr
Chlorodifluoromethane	5 54E-03	5 85E-03	5 88E-03	5 40E-03	5 67E-03
Propylene	1 35E-02	1 41E-02	1 40E-02	1 29E-02	1 36E 02
Dichlorodifluoromethane	3 49E-03 U	3 07E-03 U	3 21E-03 U	3 04E-03 U	3 20E-03 U
Chloromethane	1 71E-03 U	1 51E-03 U	1 58E-03 U	1 49E-03 U	1 57E-03 U
1,2-Dichloro-1,1,2,2-Tetrafluoroethane	5 80E-03 U	5 10E-03 U	5 33E-03 U	5 04E-03 U	5 32E-03 U
Vinyl Chloride	2 94E-03	3 35E-03	3 30E-03	3 04E-03	3 16E-03
Methanol	5 44E-03 U	4 78E-03 U	5 00E-03 U	4 73E-03 U	4 99E-03 U
1,3-Butadiene	1 83E-03 U	1 62E-03 U	1 69E-03 U	1 60E-03 U	1 68E-03 U
Bromomethane	3 22E-03 U	2 83E-03 U	2 96E-03 U	2 80E-03 U	2 96E-03 U
Chloroethane	2 19E-03 U	1 93E-03 U	2 01E-03 U	1 90E-03 U	2 01E-03 U
Dichlorofluoromethane	3 49E-03 U	3 07E-03 U	3 21E-03 U	3 04E-03 U	3 20E-03 U
Ethanol	3 13E-03 U	2 75E-03 U	2 88E-03 U	2 72E-03 U	2 87E-03 U
Vinyl Bromide	3 63E-03 U	3 19E-03 U	3 34E-03 U	3 16E-03 U	3 33E-03 U
Acetone	4 71E-03	3 47E-03 U	3 63E-03 U	3 43E-03 U	1 18E-03 J
Trichlorofluoromethane	4 33E-03 U	3 81E-03 U	3 98E-03 U	3 76E-03 U	3 97E-03 U
Isopropyl Alcohol	4 08E-03 U	3 59E-03 U	3 75E-03 U	3 55E-03 U	3 74E-03 U
Acrylonitrile	1 80E-03 U	1 58E-03 U	1 66E-03 U	1 57E-03 U	1 65E-03 U
1,1-Dichloroethylene	3 26E-03 U	2 87E-03 U	3 00E-03 U	2 83E-03 U	2 99E-03 U
Methylene Chloride	2 68E-03 U	2 64E-03 U	2 65E-03 U	2 51E-03 U	2 65E-03 U
Allyl Chloride (Chloroprene)	2 60E-03 U	2 29E-03 U	2 39E-03 U	2 26E-03 U	2 38E-03 U
Carbon Disulfide	2 58E-03 U	2 27E-03 U	2 38E-03 U	2 25E-03 U	2 37E-03 U
1,1 2-Trichloro-1,2,2-Trifluoroethane	6 36E-03 U	5 60E-03 U	5 85E-03 U	5 53E-03 U	5 83E-03 U
t-1,2-Dichloroethylene	3 29E-03 U	2 89E-03 U	3 03E-03 U	2 86E-03 U	3 02E-03 U
1,1-Dichloroethane	3 33E-03 U	2 93E-03 U	3 06E-03 U	2 89E-03 U	3 05E-03 U
MTBE	2 99E-03 U	2 63E-03 U	2 75E-03 U	2 60E-03 U	2 74E-03 U
Vinyl Acetate	2 92E-03 U	2 57E-03 U	2 69E-03 U	2 54E-03 U	2 68E-03 U
2-Butanone (MEK)	2 45E-03 U	2 15E-03 U	2 25E-03 U	2 13E-03 U	2 24E-03 U
cis-1 2- Dichloroethene	3 26E-03 U	2 87E-03 U	3 00E-03 U	2 83E-03 U	2 99E-03 U
Hexane	9 19E-03	7 87E-03	7 64E-03	7 10E-03	7 95E-03
Chloroform	4 05E-03 U	3 57E-03 U	3 73E-03 U	3 53E-03 U	3 72E-03 U
Ethyl Acetate	2 99E-03 U	2 63E-03 U	2 75E-03 U	2 60E-03 U	2 74E-03 U
Tetrahydrofuran	2 99E-03	2 90E-03	2 90E-03	2 61E-03	2 85E-03
1,2-Dichloroethane	3 33E-03 U	2 93E-03 U	3 06E-03 U	2 89E-03 U	3 05E-03 U
1,1,1-Trichloroethane	4 53E-03 U	3 98E-03 U	4 17E-03 U	3 94E-03 U	4 15E-03 U
Benzene	4 09E-03	3 76E-03	3 86E-03	3 50E-03	3 81E-03
Carbon Tetrachloride	5 23E-03 U	4 60E-03 U	4 81E-03 U	4 54E-03 U	4 79E-03 U
Cyclohexane	5 16E-03	4 29E-03	4 29E-03	3 76E-03	4 38E-03
1,2-Dichloropropane	3 84E-03 U	3 37E-03 U	3 53E-03 U	3 33E-03 U	3 52E-03 U
Bromodichloromethane	5 56E-03 U	4 89E-03 U	5 12E-03 U	4 83E-03 U	5 10E-03 U
1,4-Dioxane	2 99E-03 U	2 63E-03 U	2 75E-03 U	2 60E-03 U	2 74E-03 U
Trichloroethene	4 45E-03 U	3 91E-03 U	4 09E-03 U	3 86E-03 U	4 08E-03 U
2 2 4-Trimethylpentane	3 68E-03 U	3 41E-03 U	3 57E-03 U	3 37E-03 U	3 56E-03 U
Heptane	1 29E-02	1 10E-02	1 11E-02	9 76E-03	1 12E-02
cis-1,3-Dichloropropene	3 70E-03 U	3 25E-03 U	3 40E-03 U	3 22E-03 U	3 39E-03 U
4-Methyl-2-Pentanone (MIBK)	3 40E-03 U	2 99E-03 U	3 13E-03 U	2 96E-03 U	3 12E-03 U
t-1,3-Dichloropropene	3 70E-03 U	3 25E-03 U	3 40E-03 U	3 22E-03 U	3 39E-03 U
1,1,2-Trichloroethane	4 51E-03 U	3 97E-03 U	4 15E-03 U	3 92E-03 U	4 14E-03 U
Toluene	1 89E-02	1 61E-02	1 64E-02	1 63E-02	1 79E-02
2-Hexanone	3 40E-03 U	2 99E-03 U	3 13E-03 U	2 96E-03 U	3 12E-03 U
Dibromochloromethane	7 07E-03 U	6 22E-03 U	6 50E-03 U	6 15E-03 U	6 48E-03 U
1,2-Dibromoethane	6 26E-03 U	5 52E-03 U	5 77E-03 U	5 46E-03 U	5 76E-03 U
Tetrachloroethylene	5 63E-03 U	4 96E-03 U	5 18E-03 U	4 90E-03 U	5 17E-03 U
Chlorobenzene	3 82E-03 U	3,36E-03 U	3 51E-03 U	3 32E-03 U	3 50E-03 U
Ethylbenzene	5 01E-02	4 97E-02	5 17E-02	4 43E-02	4 90E-02
m- & p-Xylenes	4 36E-02	4 32E-02	4 46E-02	3 81E-02	4 24E-02
Bromoform	2 57E-02 U	2 26E-02 U	2 37E-02 U	2 24E-02 U	2 36E-02 U
Styrene	3 53E-03 U	3 11E-03 U	3 25E-03 U	3 07E-03 U	3 24E-03 U
1,1,2,2-Tetrachloroethane	5 70E-03 U	5 02E-03 U	5 24E-03 U	4 96E-03 U	5 23E-03 U
o-Xylene	1 11E-02	1 07E-02	1 10E-02	9 44E-03	1 06E-02
4-Ethyltoluene	4 08E-03 U	3 58E-03 U	3 75E-03 U	3 55E-03 U	3 74E-03 U
1,3,5-Trimethylbenzene	4 21E-03	3 69E-03	4 21E-03	3 54E-03 U	3 08E-03 J
1,2,4-Trimethylbenzene	1 19E-02	1 06E-02	1 18E-02	9 58E-03	1 10E-02
Benzyl Chloride	2 15E-02 U	1 89E-02 U	1 98E-02 U	1 87E-02 U	1 97E-02 U
1,3-Dichlorobenzene	4 99E-03 U	4 39E-03 U	4 59E-03 U	4 34E-03 U	4 58E-03 U
1,4-Dichlorobenzene	4 99E-03 U	4,39E-03 U	4 59E-03 U	4 34E-03 U	4 58E-03 U
1,2-Dichlorobenzene	4 99E-03 U	4 39E-03 U	4 59E-03 U	4 34E-03 U	4 58E-03 U
1,2,4-Trichlorobenzene	6 16E-03 U	5,42E-03 U	5 66E-03 U	5 35E-03 U	5 65E-03 U
Hexachlorobutadiene	8 65E-03 U	7 78E-03 U	8 14E-03 U	7 70E-03 U	8 12E-03 U

U = undetected at specified reporting limit (DL)

J = Approximate value. Data is labeld with a J flag when one or more of the results in a set of multiple runs is under the detection limit, but at least one of the other runs is above the detection limit. Runs under the detection limit are represented as in the set average calculation.

2.7 EPA SW-846 Method 0031 - Volatile Organic Compounds (VOC), Flare Outlet

Three 120-minute EPA SW-846 Method 0031 runs were performed at the flare outlet on July 19-20, 2007 to quantify volatile organic compounds (VOC) emissions. Each run consisted of three (3) 40-minute sampling periods. Each sampling period utilized a tube set consisting of a front and back portion of Tenax® sorbent material followed by one portion of Anasorb® material. The resulting total of nine analytical data points were added together on a weight per sample basis (micrograms ((μg)) for a total sample train concentration for each compound. These results were then calculated to present emission concentrations of micrograms per cubic meter of gas sampled ($\mu g/m^3$) and emission rates of pounds per hour (lb/hr). A field blank sample was collected with every test run.

The test results are summarized on the following computer printouts entitled "Summary of Emission Concentration Results - EPA Method 0031 - Volatile Organic Compounds," and "Summary of Emission Rate Results - EPA Method 0031 -Volatile Organic Compounds."

AMTEST GROUP
AIR QUALITY, LLC

SUMMARY OF EMISSION CONCENTRATION RESULTS
EPA METHOD 0031 - VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX @ CTL M0031
Client: Parameter @ City of Tacoma Landfill
Location: Tacoma, Washington
Sample Dates: 7/19/07 - 7/20/07

	Perennial #1 Landfill Gas Combuster Outlet			
Analyte	Run 1 µg/dscm	Run 2 µg/dscm	Run 3 µg/dscm	Average µg/dscm
Acetone	16.2	30.8 U	30.8 U	5.40 J
Benzene	165.0 E	48.1	115.1	109.4 E
Bromobenzene	3.13 U	3.08 U	3.08 U	3.10 U
Bromochloromethane	7.83 U	7.70 U	7.71 U	7.75 U
Bromodichloromethane	3.13 U	3.08 U	3.08 U	3.10 U
Bromoform	7.83 U	7.70 U	7.71 U	7.75 U
Bromomethane	15.7 U	15.4 U	15.4 U	15.5 U
2-Butanone (MEK)	31.3 U	30.8 U	30.8 U	31.0 U
n-Butylbenzene	3.13 U	3.08 U	3.08 U	3.10 U
sec-Butylbenzene	3.13 U	3.08 U	3.08 U	3.10 U
tert-Butylbenzene	3.13 U	3.08 U	3.08 U	3.10 U
Carbon Disulfide	1.46	3.08 U	3.08 U	0.49 J
Carbon Tetrachloride	3.13 U	3.08 U	3.08 U	3.10 U
Chlorobenzene	3.13 U	3.08 U	3.08 U	3.10 U
Chlorodibromomethane	7.83 U	7.70 U	7.71 U	7.75 U
Chloroethane	15.7 U	15.4 U	15.4 U	15.5 U
Chloroform	3.13 U	3.08 U	3.08 U	3.10 U
Chloromethane	3.04	3.28	2.68	3.00
2-Chlorotoluene	3.13 U	3.08 U	3.08 U	3.10 U
4-Chlorotoluene	3.13 U	3.08 U	3.08 U	3.10 U
1,2 Dibromo-3-chloropropane	15.7 U	15.4 U	15.4 U	15.5 U
1,2-Dibromoethane	7.83 U	7.70 U	7.71 U	7.75 U
Dibromomethane	7.83 U	7.70 U	7.71 U	7.75 U
1,2-Dichlorobenzene	3.13 U	3.08 U	3.08 U	3.10 U
1,3-Dichlorobenzene	3.13 U	3.08 U	3.08 U	3.10 U
1,4-Dichlorobenzene	3.13 U	3.08 U	3.08 U	3.10 U
Dichlorodifluoromethane	4.80	8.52	2.97	4.76
1,1-Dichloroethane	3.13 U	3.08 U	3.08 U	3.10 U
1,2-Dichloroethane	3.13 U	3.08 U	3.08 U	3.10 U
cis-1,3-Dichloroethene	3.13 U	3.08 U	3.08 U	3.10 U
trans-1,3-Dichloroethene	3.13 U	3.08 U	3.08 U	3.10 U
1,1-Dichloroethene	3.13 U	3.08 U	3.08 U	3.10 U
1,2-Dichloropropane	3.13 U	3.08 U	3.08 U	3.10 U
1,3-Dichloropropane	3.13 U	3.08 U	3.08 U	3.10 U
2,2-Dichloropropane	3.13 U	3.08 U	3.08 U	3.10 U
cis-1,3-Dichloropropene	3.13 U	3.08 U	3.08 U	3.10 U
trans-1,3-Dichloropropene	3.13 U	3.08 U	3.08 U	3.10 U
1,1-Dichloropropene	3.13 U	3.08 U	3.08 U	3.10 U
Ethylbenzene	3.13 U	3.08 U	3.08 U	3.10 U
Hexachlorobutadiene	7.83 U	7.70 U	7.71 U	7.75 U
2-Hexanone	31.3 U	30.8 U	30.8 U	31.0 U
Isopropylbenzene	3.13 U	3.08 U	3.08 U	3.10 U
p-Isopropyltoluene	3.13 U	3.08 U	3.08 U	3.10 U
Methylene Chloride	13.1	64.6	7.71 U	28.9 J
4 Methyl-2-Pentanone (MIBK)	31.3 U	30.8 U	30.8 U	31.0 U
Naphalene	1.30	7.70 U	7.71 U	0.433 J
n-Propylbenzene	3.13 U	3.08 U	3.08 U	3.10 U
Styrene	0.831	3.08 U	3.08 U	0.277 J
1,1,1,2-Tetrachloroethane	3.13 U	3.08 U	3.08 U	3.10 U
1,1,2,2-Tetrachloroethane	7.83 U	7.70 U	7.71 U	7.75 U
Tetrachloroethene	3.13 U	3.08 U	3.08 U	3.10 U
Toluene	4.74	2.58	3.02	3.45
1,2,3-Trichlorobenzene	7.83 U	7.70 U	7.71 U	7.75 U
1,2,4-Trichlorobenzene	7.83 U	7.70 U	7.71 U	7.75 U
1,1,1-Trichloroethane	7.83 U	7.70 U	7.71 U	7.75 U
1,1,2-Trichloroethane	7.83 U	7.70 U	7.71 U	7.75 U
Trichloroethene	3.13 U	3.08 U	3.08 U	3.10 U
Trichlorofluoromethane	87.5	15.4 U	4.36	30.8 J
1,2,3-Trichloropropane	2.39	7.70 U	7.71 U	0.796 J
1,2,4-Trimethylbenzene	3.13 U	3.08 U	3.08 U	3.10 U
1,3,5-Trimethylbenzene	3.13 U	3.08 U	3.08 U	3.10 U
Vinyl Chloride	3.13 U	3.08 U	3.08 U	3.10 U
m- & p-Xylenes	6.26 U	6.16 U	6.17 U	6.20 U
o-Xylene	3.13 U	3.08 U	3.08 U	3.10 U

U = Undetected at specified reporting limit (RL).
E = Estimated result, concentration exceeds the calibration range. An E flag is assigned to a run even if just one run is labeled as E.
J = Approximate value. Data is labeled with a J flag when one or more of the results in a set of multiple runs is under the detection limit, but at least one of the other runs is above the detection limit. Runs under the detection limit are represented as in the set average calculation. Zero (0) is used as the value of any undetected run when calculating the average of any run labeled with a J flag.

AMTEST
AIR QUALITY, LLC

SUMMARY OF EMISSION RATE RESULTS
EPA METHOD 0031 - VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001PX @ CTL M0031
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Sample Dates: 7/19/07 - 7/20/07

		Perennial #1 Landfill Gas Combuster Outlet			
Analyte	Airflow:	Run 1 9792.7 dscf/min lb/hr	Run 2 10933 dscf/min lb/hr	Run 3 10551 dscf/min lb/hr	Average lb/hr
Acetone		6.94E-04	1.26E-03 U	1.22E-03 U	1.98E-04 J
Benzene		8.05E-03 E	1.97E-03	4.55E-03	4.19E-03 E
Bromobenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Bromochloromethane		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
Bromodichloromethane		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Bromoform		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
Bromomethane		5.74E-04 U	6.31E-04 U	6.10E-04 U	6.05E-04 U
2-Butanone (MEK)		1.15E-03 U	1.26E-03 U	1.22E-03 U	1.21E-03 U
n-Butylbenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
sec-Butylbenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
tert-Butylbenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Carbon Disulfide		5.36E-05	1.26E-04 U	1.22E-04 U	1.78E-05 J
Carbon Tetrachloride		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Chlorobenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Chlorodibromomethane		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
Chloroethane		5.74E-04 U	6.31E-04 U	6.10E-04 U	6.05E-04 U
Chloroform		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Chloromethane		1.12E-04	1.34E-04	1.06E-04	1.17E-04
2-Chlorotoluene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
4-Chlorotoluene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
1,2 Dibromo-3-chloropropane		5.74E-04 U	6.31E-04 U	6.10E-04 U	6.05E-04 U
1,2-Dibromoethane		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
Dibromomethane		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
1,2-Dichlorobenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
1,3-Dichlorobenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
1,4-Dichlorobenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Dichlorodifluoromethane		1.76E-04	2.67E-04	1.17E-04	1.87E-04
1,1-Dichloroethane		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
1,2-Dichloroethene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
cis-1,3-Dichloroethene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
trans-1,3-Dichloroethene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
1,1-Dichloroethene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
1,2-Dichloropropane		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
1,3-Dichloropropane		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
2,2-Dichloropropane		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
cis-1,3-Dichloropropene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
trans-1,3-Dichloropropene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
1,1-Dichloropropane		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Ethylbenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Hexachlorobutadiene		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
2-Hexanone		1.15E-03 U	1.26E-03 U	1.22E-03 U	1.21E-03 U
Isopropylbenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
p-Isopropyltoluene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Methylene Chloride		4.81E-04	2.65E-03	3.05E-04 U	1.04E-03 J
4-Methyl-2-Pentanone (MIBK)		1.15E-03 U	1.26E-03 U	1.22E-03 U	1.21E-03 U
Naphalene		4.75E-05	3.15E-04 U	3.05E-04 U	1.59E-05 J
n-Propylbenzene		1.19E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Styrene		3.06E-05	1.26E-04 U	1.22E-04 U	1.02E-05 J
1,1,1,2-Tetrachloroethane		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
1,1,2,2-Tetrachloroethane		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
Tetrachloroethene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Toluene		1.74E-04	1.06E-04	1.19E-04	1.33E-04
1,2,3-Trichlorobenzene		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
1,2,4-Trichlorobenzene		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
1,1,1-Trichloroethane		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
1,1,2-Trichloroethane		2.87E-04 U	3.15E-04 U	3.05E-04 U	3.02E-04 U
Trichloroethene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Trichlorofluoromethane		3.21E-03	6.31E-04 U	1.72E-04	1.13E-03 J
1,2,3-Trichloropropane		8.78E-05	3.15E-04 U	3.05E-04 U	2.92E-05 J
1,2,4-Trimethylbenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
1,3,5-Trimethylbenzene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
Vinyl Chloride		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U
m- & p-Xylenes		2.30E-04 U	2.52E-04 U	2.44E-04 U	2.42E-04 U
o-Xylene		1.15E-04 U	1.26E-04 U	1.22E-04 U	1.21E-04 U

U = Undetected at specified reporting limit (RL).
E = Estimated result: concentration exceeds the calibration range. An E flag is assigned to a run even if just one run is labeled as E.
J = Approximate value. Data is labeled with a J flag when one or more of the results in a set of multiple runs is under the detection limit, but at least one of the other runs is above the detection limit. Runs under the detection limit are represented as 0 in the set average calculation. Zero (0) is used as the value of any undetected run when calculating the average of any run labeled with a J flag.

2.8 Destruction Efficiency - Speciated Volatile Organic Compounds

To calculate the speciated volatile organic compound (VOC) destruction efficiency (DE) of the flare, speciated VOC emission rates at the flare inlet were compared to speciated VOC emission rates at the flare outlet. The destruction efficiency is the amount of vapors destroyed through incineration, expressed on a percentage basis. The percent destruction efficiency for each volatile organic compound analyzed in the gas at the #1 Perennial Flare at the Tacoma Landfill is presented on the following computer printout titled "Volatile Organic Compounds Destruction Efficiency Results." Destruction efficiencies were calculated based on the average emission rate of each compound detected in pounds per hour (lb/hr) at the inlet compared to the outlet. It should be noted that Method TO-14A (inlet) and Method 0031 (outlet) measure different lists of VOCs, so only the VOCs common to both lists were compared. If a compound was not analyzed it is noted as NA.

When a specific VOC compound was undetected at both the inlet and the outlet, the destruction efficiency is not calculated and is presented with dashes (---). When the outlet is greater than the inlet, the destruction efficiency is not calculated and is presented with dashes (---). When a VOC compound is present at the inlet and undetected at the outlet, then the destruction efficiency is labeled as greater than (>) 99.99%.

AMTEST AIR QUALITY, LLC

VOLATILE ORGANIC COMPOUNDS DESTRUCTION EFFICIENCY RESULTS
INLET METHOD TO14A AND OUTLET METHOD 0031
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 6752-001PX @ CTL M003:
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Sample Dates: 7/19/07 - 7/20/07

Perennial #1 Landfill Gas Combuster Inlet/Outlet Destruction Efficiency

Analyte	Inlet Average lb/hr	Outlet Average lb/hr	DE %
Acetone	1.18E-03 J	1.98E-04 J	83.20%
Benzene	3.81E-03	4.19E-03 E	—
Bromobenzene	NA	1.21E-04 U	—
Bromochloromethane	NA	3.02E-04 U	—
Bromodichloromethane	5.10E-03 U	1.21E-04 U	—
Bromoform	2.36E-02 U	3.02E-04 U	—
Bromomethane	2.96E-03 U	6.05E-04 U	—
2-Butanone (MEK)	2.24E-03 U	1.21E-03 U	—
n-Butylbenzene	NA	1.21E-04 U	—
sec-Butylbenzene	NA	1.21E-04 U	—
tert-Butylbenzene	NA	1.21E-04 U	—
Carbon Disulfide	2.37E-03 U	1.79E-05 J	—
Carbon Tetrachloride	3.33E-03 J	1.21E-04 U	>99.99%
Chlorobenzene	3.50E-03 U	1.21E-04 U	—
Chlorodibromomethane	NA	3.02E-04 U	—
Chloroethane	2.01E-03 U	6.05E-04 U	—
Chloroform	3.72E-03 U	1.21E-04 U	—
Chloromethane	1.57E-03 U	1.17E-04	—
2-Chlorotoluene	NA	1.21E-04 U	—
4-Chlorotoluene	NA	1.21E-04 U	—
1,2 Dibromo-3-chloropropane	NA	6.05E-04 U	—
1,2-Dibromoethane	5.76E-03 U	3.02E-04 U	—
Dibromomethane	NA	3.02E-04 U	—
1,2-Dichlorobenzene	4.58E-03 U	1.21E-04 U	—
1,3-Dichlorobenzene	4.58E-03 U	1.21E-04 U	—
1,4-Dichlorobenzene	4.58E-03 U	1.21E-04 U	—
Dichlorodifluoromethane	3.20E-03 U	1.87E-04	—
1,1-Dichloroethane	3.05E-03 U	1.21E-04 U	—
1,2-Dichloroethane	3.05E-03 U	1.21E-04 U	—
cis-1,2-Dichloroethene	NA	1.21E-04 U	—
trans-1,2-Dichloroethene	NA	1.21E-04 U	—
1,1-Dichloroethene	NA	1.21E-04 U	—
1,2-Dichloropropane	3.52E-03 U	1.21E-04 U	—
1,3-Dichloropropane	NA	1.21E-04 U	—
2,2-Dichloropropane	NA	1.21E-04 U	—
cis-1,3-Dichloropropene	3.39E-03 U	1.21E-04 U	—
trans-1,3-Dichloropropene	3.39E-03 U	1.21E-04 U	—
1,1-Dichloropropene	NA	1.21E-04 U	—
Ethylbenzene	4.90E-02	1.21E-04 U	>99.99%
Hexachlorobutadiene	6.12E-03 U	3.02E-04 U	—
2-Hexanone	3.12E-03 U	1.21E-03 U	—
Isopropylbenzene	NA	1.21E-04 U	—
p-Isopropyltoluene	NA	1.21E-04 U	—
Methylene Chloride	2.65E-03 U	1.04E-03 J	—
4-Methyl-2-Pentanone (MIBK)	3.12E-03 U	1.21E-03 U	—
Naphthalene	NA	1.58E-05 J	—
n-Propylbenzene	NA	1.21E-04 U	—
Styrene	3.24E-03 U	1.02E-05 J	—
1,1,1,2-Tetrachloroethane	NA	1.21E-04 U	—
1,1,2,2-Tetrachloroethane	5.23E-03 U	3.02E-04 U	—
Tetrachloroethene	NA	1.21E-04 U	—
Toluene	1.79E-02	1.33E-04	99.26%
1,2,3-Trichlorobenzene	NA	3.02E-04 U	—
1,2,4-Trichlorobenzene	5.65E-03 U	3.02E-04 U	—
1,1,1-Trichloroethane	4.15E-03 U	3.02E-04 U	—
1,1,2-Trichloroethane	4.14E-03 U	3.02E-04 U	—
Trichloroethene	4.08E-03 U	1.21E-04 U	—
Trichlorofluoromethane	3.97E-03 U	1.13E-03 J	—
1,2,3-Trichloropropane	NA	2.92E-05 J	—
1,2,4-Trimethylbenzene	1.10E-02	1.21E-04 U	>99.99%
1,3,5-Trimethylbenzene	3.68E-03 J	1.21E-04 U	>99.99%
Vinyl Chloride	1.10E-02	1.21E-04 U	>99.99%
m- & p-Xylenes	4.24E-02	2.42E-04 U	>99.99%
o-Xylene	1.06E-02	1.21E-04 U	>99.99%

U = Undetected at specified reporting limit (RL)
E = Estimated result, concentration exceeds the calibration range. An E flag is assigned to the average even if just one run is labeled as E
J = Approximate value. Data is labeled with a J flag when one or more of the results in a set of multiple runs is under the detection limit, but at least one of the other runs is above the detection limit. Runs under the detection limit are represented as in the set average calculation
— = This is the label given when any of the following cases occur: the inlet is U, the outlet is greater than the inlet, the compound was not analyzed at the inlet
If a compound is detected at the inlet, but not detected at the outlet it is assigned a value of >99.99% DE.
Method TO-14A was used to quantify compounds at the inlet and Method 0031 was used to quantify compounds at the outlet. Only compounds that were included on the M0031 list are included in the DE calculations. Compounds that were quantified at the outlet but not at the inlet are shown as NA

3.0
PROJECT OVERVIEW/EXCEPTIONS

An acceptable leak check of less than 0.02 cubic feet per minute (cfm) at the highest vacuum rate (or greater) used during the test preceded and followed each Method 26A run. The average percentage isokinetics for each run were within the acceptable limits of 100 ± 10%.

During the testing on July 19, 2007 the flare tripped off at 1530; after a 20-minute pause testing resumed. The generator being used on site to power the test equipment ran out of propane at 1716 so testing was paused while a new fuel tank was connected.

No condensate was found in any of the Method 0031 traps for any run.

Both a bubble meter and a dry gas meter calibrated for low flows were used to monitor the Method 0031 sample rate. The bubble meter flow rate was used in the calculations, because it is a primary standard.

The Method 0031 Run 1C Tenax tube was broken in the field prior to shipment, so it was carefully wrapped in Teflon tape to seal the contents and was submitted to the lab. The Tenax sample tubes had to be analyzed separately versus in tandem as was done for the other samples. Sample J3LEP1AA corresponds to Tenax tube 1 and sample J3LEP2AA corresponds to Tenax tube 2. The only compound detected in Tube 1 was methylene chloride, so the concentration was added to the concentration in tube 2. The results for run 1C could be biased low because the tube was broken.

One surrogate recovery for Method 0031 samples Run 3A Tenax tube and Run 3B Tenax tube were outside QA limits. Reanalysis of the associated samples was not possible since the entire sample was consumed during analysis. Since the recoveries were low, the results for run 3A and 3B may be biased low.

The concentration of benzene was greater than the calibration range for Method 0031 sample Run 1A Tenax tube. Reanalysis of the sample was not possible since the entire sample was consumed during analysis. The concentration of benzene for Method 0031 run 1 may be biased low.

The VOC lab data presented by STL flags some values with the letter J and the letter E. J is an estimated result that is lower than the reporting limit; therefore, ATAQ treats values flagged as J as non-detected values. E is an estimated result meaning the actual result exceeds the calibration range. These results are used in the calculations and are flagged with the letter E, but the results may be biased low for data flagged with an E.

Prior to beginning the testing, a gaseous stratification check was conducted in the flare outlet stack per Method 7E. The stratification check was conducted at six (6) Method 1 traverse points in each of the two (2) sample ports. Sampling at each point was performed for three minutes, which was at least twice the system response time. None of the gases at any of the sample points displayed concentrations that varied by more than 5% or ± 0.5 ppmV (whichever is less restrictive) difference from the mean concentration for that gas. Therefore, gaseous emission sampling was performed at a single point of average concentration in the stack.

ATAQ used two approved EPA alternative calibration procedures for this project. The first procedure is Alternative Method 009 (ALT-009) titled "Alternative Method 5 Post-

Test Calibration." This procedure uses a calculation to check the meter box calibration factor rather than requiring a physical post-test meter box calibration using a standard dry gas meter. The average calculated meter box percent (%) error for the tests resulted in a percent error of within ±5% as allowed by Alternative Method 009; therefore, a physical post-test meter box calibration was not required. The second procedure ATAQ used is Alternative Method 011 (ALT-011) titled "Alternative Method 2 Thermocouple Calibration Procedure." This procedure involves a single-point in-field check using a reference thermometer to confirm that the thermocouple used to measure the stack gas temperature was operating properly. This check eliminates the need to conduct a two-point post-test calibration.

4.0
SOURCE OPERATION

The City of Tacoma installed a gas extraction system in July of 1986 consisting of 128 extraction wells and 66 gas monitoring probe stations with a temporary landfill gas combustor (flare). The temporary flare was replaced in November of 1986 with two (2) Sur-Lite flares with a combined capacity of 2000 standard cubic feet per minute (scfm) of methane. Each probe station consists of one to five probes completed at different depths to allow measurements of methane concentration and pressure at various depths below the ground surface. The landfill gas combustor stack consists of a refractory-lined steel shell with a landfill gas burner at the base. A blower/flare station, centrally located at the landfill, provides the vacuum for the gas collection. Centrifugal blowers create the necessary vacuum in the gas collection wells and trenches to extract the gas and vent it through the combustor burners. This facility includes tow (20 40 hp Haulk centrifugal blowers, each designed to handle 100 percent of the 2000 scfm landfill gas system capacity. The system was designed to provide a minimum residence time of 0.5 seconds at 1400°F.

In 1988, the City installed an additional 82 deep landfill gas extraction wells, 11 off-site landfill gas monitoring probe stations, and 6,000 linear fee of additional collection header piping. In 1992, the City upgraded the existing flare station to increase capacity and improve system reliability. The Sur-Lite flares were renovated and placed on a newly constructed foundation along with (2) new flares manufactured by the Perennial Energy Company. Contaminated groundwater at the landfill is remediated with a groundwater extraction and treatment system. Two air stripping towers were installed in 1992 with space reserved to add a third tower. The system utilized an acid wash unit to periodically remove scale deposits on the packing material. One tower is in continuous operation

while the second tower is reserved for times during which maintenance or acid washing of the operating tower is required. The extraction system consists of a network of groundwater extraction wells to contain migration of the plume and remove groundwater contaminated with volatile organic compounds (VOCs) and certain inorganic constituents. The treatment system employs air stripping technology to remove VOCs from the extracted groundwater. Each air stripping tower was designed with a groundwater flow capacity of 1100 gallons per minute (gpm) and an airflow capacity of greater than 8000 cfm.

5.0
SAMPLING AND ANALYSIS PROCEDURES

5.1 EPA Methods 1, 1A, and 2 - Velocity, Temperature, and Airflow

EPA Methods 1, 1A and 2 were performed to measure the stack gas velocity and temperature for calculating the volumetric flow rate. Since the inner diameter (id) of the flare inlet duct is approximately 10 inches, the protocol for small duct testing outlined in Method 1A was employed. This protocol involves measuring the velocity simultaneously at a location downstream of the sampling location. The ports and traverse points at the velocity location were configured identically with those at the sampling location. Because the gas flow was measured at least eight stack diameters downstream of the sampling location, the gas flow had the opportunity to resume a laminar flow pattern, and the measurements at the velocity location were equivalent to those at the sampling location. Stack gas velocity was measured using a pitot tube (either standard pitot or S-type pitot) connected to an inclined manometer. The pitot tube lines were leak checked prior to sampling and manometer was leveled and zeroed prior to use. Stack gas temperature and other necessary temperatures were measured using K-type thermocouple probes attached to digital thermocouple indicators.

EPA Method 1 procedures were used to assure that representative measurements of volumetric flow rate were obtained by dividing the cross-section of the flare outlet into a number of equal areas, and then locating a traverse point within each of the equal areas. Refer to the "Stack Schematic and Location of Sample Points" data sheet and/or the figure titled, "Location of Sampling Ports and Traverse Points," located in the appendices of this report for a schematic of the flare outlet and the point locations selected for testing.

EPA Method 2 was performed to measure the stack gas velocity using a type S or a standard pitot tube, and the gas temperature using a calibrated thermocouple probe connected to a digital thermocouple indicator. Calibration information for each pressure and temperature measurement device used is included in the appendices of this report. Temperatures were measured using calibrated thermocouple probes connected to Fluke® digital thermocouple indicators. A schematic of the ducts and the point locations selected for testing is included in the appendices of this report.

5.2 EPA Method 3A and Fixed Gas Analysis

The concentration of fixed gases at the inlet sample site (carbon dioxide (CO_2), carbon monoxide (CO), oxygen (O_2), nitrogen (N_2), and methane (CH_4)) was quantified by Atmospheric Analysis and Consulting, Inc. using the gas collected in SUMMA® canisters for TO-14A analysis. A gas chromatograph equipped with a thermal conductivity detector (GC-TCD) was used for this analysis, which detects percent levels of these compounds. The fixed gas data were used to calculate the molecular weight of the flare inlet gas for use in volumetric flow rate calculations.

EPA Method 3A was performed to determine the molecular weight of the stack gas based on percent-level measurements of the concentration of O_2 and CO_2. EPA Method 3A uses instrumental analyzers to measure O_2 and CO_2. A paramagnetic analyzer was used to measure the percent (%) O_2 and a non-dispersive infrared (NDIR) analyzer was used to measure the % CO_2. The manufacturer and model number for the specific analyzers used for this test were recorded on a form titled "Continuous Analyzer Checklist," which is included in the appendices of this report. This form was used to determine which specifications to include in the appendices of this report. Several EPA Protocol No. 1 calibration gases were utilized to check the calibration of the analyzers for this test. A form titled "Calibration Gas Checklist" is included in the appendices of this report. This

form was used to determine which certificates of analysis to include in the appendices of this report.

The Method 3A sample system is illustrated in the figure titled "EPA Method 3A, 6C, 7E, 10, and 25A Sample Train" in the appendices of this report. Gaseous emission samples were collected at a point of average concentration in the stack, unless otherwise noted. An effluent gas sample was drawn through a stainless steel sampling probe and out-of-stack filter, which were sufficiently heated to prevent condensation. A sampling tee was connected to the inlet of the probe for the purpose of introducing calibration gas to flood the probe. The gas sample passed through a refrigerator-type moisture removal system, which continuously removed condensate from the sample gas. A Teflon® sample line was used to transport the gas sample to the continuous monitoring system. A Teflon®-coated leak-free pump was utilized to pull the sample gas through the system at a flow rate sufficient to minimize the response time of the measurement system. A sample flow rate control valve and rotameter were used to maintain a constant sampling rate within 10 percent. Prior to testing, probes, sample tubing, conditioning equipment, analyzers, and pumps were determined to be leak-free. The sampling system was leak checked by capping off the end of the sample line and pulling at least 10 inches of mercury (Hg) vacuum in the system and observing the rotameter drop to zero.

After the measurement system was prepared for use, a calibration error check was performed by introducing low-level, mid-level, and high-level EPA Protocol No. 1 calibration gases to the measurement system upstream of the analyzers. No adjustments were made to the system except those necessary to achieve the correct calibration gas flow rate to the analyzers. A data acquisition system named STRATA recorded the responses and calculated whether the concentration displayed by the analyzers exceeded ± 2% of the span for any of the calibration gases. If this specification was exceeded, the

data was flagged by STRATA and the analyzer calibration error check was repeated until acceptable performance was achieved.

Before the first run, a sampling system bias check was performed by introducing calibration gases at the sampling tee installed at the outlet of the sampling probe. The low-level gas and either the mid-level or high-level gas, whichever most closely approximated the effluent concentration, were used for this check. The measurement system response time was determined by observing the times required to achieve a stable response for both the low and upscale gases. The longer of the two times was used as the response time and was taken into consideration when performing other calibration checks. STRATA recorded the responses and calculated whether the concentration displayed by the analyzers exceeded ± 5% of the span for either the low or upscale calibration gas. If this specification was exceeded, the data was flagged by STRATA, the sampling system underwent troubleshooting to discover and correct the problem, and then the sampling system bias check was repeated until acceptable performance was achieved.

Once the testing commenced, measurements from the instruments were recorded at least once per minute using STRATA, which automatically averages the data at the end of each run. After each run, low and upscale bias and drift tests were performed to check the drift of the analyzer and to collect data to allow STRATA to bias-correct the average result based on the amount of drift from the beginning to the end of the run. STRATA recorded the responses and calculated whether the concentration displayed by the analyzers exceeded ± 3% of the previous average span value for either the low-level or upscale calibration gas. If this specification was exceeded, the data was flagged by STRATA, the sampling system underwent troubleshooting to discover and correct the problem, and then the calibration error check and the sampling system bias check were repeated before repeating the run.

When both the low-level and upscale calibration values were within the sampling system bias specification, the average gas concentration was calculated by STRATA from the average gas concentration displayed by the gas analyzer, adjusted for the low-level and upscale sampling system bias checks. An example calculation of this bias-correction calculation is included in the appendices of this report.

5.3 EPA Method 4 - Moisture

The moisture content of the inlet stack gas was calculated using psychrometry equations referenced in State of Oregon Department of Environmental Quality (ODEQ) Method 4. Wet bulb and dry bulb stack gas temperatures were measured and used for these calculations. An example calculation of the psychrometric moisture calculation is included in Appendix C of this report.

EPA Method 4 was performed inclusively with Method 26A at the outlet to quantify moisture. The impingers were weighed to 0.1 grams before and after each test on a digital top-loading balance. The net weight (final minus initial) was used to calculate the amount of moisture condensed from the known volume of stack gas collected.

5.4 EPA Method 6C - Sulfur Dioxide

Sulfur dioxide (SO_2) emissions were measured using EPA Method 6C, which is an instrumental method. An ultraviolet analyzer was used to measure the parts per million (ppm) SO_2 on a dry basis. The manufacturer and model number for the specific analyzers used for this test were recorded on a form titled "Continuous Analyzer Checklist," which is included in the appendices of this report. This form was used to determine which specifications to include in the appendices of this report. Several EPA Protocol No. 1 calibration gases were utilized to check the calibration of the analyzers for this test. A

form titled "Calibration Gas Checklist" is included in the appendices of this report. This form was used to determine which certificates of analysis to include in the appendices of this report.

The Method 6C sample train is illustrated in the figure titled "EPA Method 3A, 6C, 7E, 10, and 25A Sample Train" in the appendices of this report. An effluent gas sample was drawn through the same sample conditioning system described for Method 3A testing. Gaseous emission samples were collected at a point of average concentration in the stack unless otherwise noted. After the measurement system was prepared for use, a calibration error check was performed by introducing low-level, mid-level, and high-level EPA Protocol No. 1 calibration gases to the measurement system upstream of the analyzers. No adjustments were made to the system except those necessary to achieve the correct calibration gas flow rate to the analyzers. A data acquisition system named STRATA recorded the responses and calculated whether the concentration displayed by the analyzers exceeded ± 2% of the span for any of the calibration gases. If this specification was exceeded, the data was flagged by STRATA and the analyzer calibration error check was repeated until acceptable performance was achieved.

Before the first run, a sampling system bias check was performed by introducing calibration gases at the sampling tee installed at the outlet of the sampling probe. A low-level gas and either the mid-level or high-level gas, whichever most closely approximated the effluent concentration, were used for this check. The measurement system response time was determined by observing the times required to achieve a stable response for both the low-level and upscale gases. The longer of the two times was used as the response time and was taken into consideration when performing other calibration checks. STRATA recorded the responses and calculated whether the concentration displayed by the analyzers exceeded ± 5% of the span for either the low-level or upscale calibration gas.

If this specification was exceeded, the data was flagged by STRATA, the sampling system underwent troubleshooting to discover and correct the problem, and then the sampling system bias check was repeated until acceptable performance was achieved

Once the testing commenced, measurements from the instruments were recorded at least once per minute using STRATA, which automatically averages the data at the end of each run. After each run, a low-level and calibration drift test was performed to check the drift of the analyzer and to collect data to allow STRATA to bias-correct the average result based on the amount of drift from the beginning to the end of the run. STRATA recorded the responses and calculated whether the concentration displayed by the analyzers exceeded ± 5% of the previous average span value for either the low-level or upscale calibration gas. If this specification was exceeded, the data was flagged by STRATA, the sampling system underwent troubleshooting to discover and correct the problem, and then the calibration error check and the sampling system bias check were repeated before repeating the run.

When both the low-level and upscale calibration values were within the sampling system bias specification, the average gas concentration was calculated by STRATA from the average gas concentration displayed by the gas analyzer, adjusted for the low-level and upscale sampling system bias checks. An example calculation of this bias-correction calculation is included in the appendices of this report.

5.5 EPA Method 7E - Nitrogen Oxides

Nitrogen oxides (NO_x) data were collected using EPA Method 7E, which is an instrumental method. A chemiluminescent analyzer was used to measure the parts per million (ppm) NO_x as nitrogen oxide (NO) on a dry basis. The manufacturer and model number for the specific analyzers used for this test were recorded on a form titled

"Continuous Analyzer Checklist," which is included in the appendices of this report. This form was used to determine which specifications to include in the appendices of this report. Several EPA Protocol No. 1 calibration gases were utilized to check the calibration of the analyzers for this test. A form titled "Calibration Gas Checklist" is included in the appendices of this report. This form was used to determine which certificates of analysis to include in the appendices of this report.

The Method 7E sample train is illustrated in the figure titled "EPA Method 3A, 6C, 7E, 10, and 25A Sample Train" in the appendices of this report. An effluent gas sample was drawn through the same sample conditioning system described for Method 3A testing. Gaseous emission samples were collected at a point of average concentration in the stack unless otherwise noted. After the measurement system was prepared for use, a calibration error check was performed by introducing low-level, mid-level, and high-level EPA Protocol No. 1 calibration gases to the measurement system upstream of the analyzers. No adjustments were made to the system except those necessary to achieve the correct calibration gas flow rate to the analyzers. A data acquisition system named STRATA recorded the responses and calculated whether the concentration displayed by the analyzers exceeded ± 2% of the span for any of the calibration gases. If this specification was exceeded, the data was flagged by STRATA and the analyzer calibration error check was repeated until acceptable performance was achieved.

Before the first run, a sampling system bias check was performed by introducing calibration gases at the sampling tee installed at the outlet of the sampling probe. The low-level gas and either the mid-level or high-level gas, whichever most closely approximated the effluent concentration, were used for this check. The measurement system response time was determined by observing the times required to achieve a stable response for both the low-level and upscale gases. The longer of the two times was used

as the response time and was taken into consideration when performing other calibration checks. STRATA recorded the responses and calculated whether the concentration displayed by the analyzers exceeded ± 5% of the span for either the low-level or upscale calibration gas. If this specification was exceeded, the data was flagged by STRATA, the sampling system underwent troubleshooting to discover and correct the problem, and then the sampling system bias check was repeated until acceptable performance was achieved.

Once the testing commenced, measurements from the instruments were recorded at least once per minute using STRATA, which automatically averages the data at the end of each run. After each run, bias and drift tests were performed to check the drift of the analyzer and to collect data to allow STRATA to bias-correct the average result based on the amount of drift from the beginning to the end of the run. STRATA recorded the responses and calculated whether the concentration displayed by the analyzers exceeded ± 5% of the previous average span value for either the low-level or upscale calibration gas. If this specification was exceeded, the data was flagged by STRATA, the sampling system underwent troubleshooting to discover and correct the problem, and then the calibration error check and the sampling system bias check were repeated before repeating the run.

When both the low-level and upscale calibration values were within the sampling system bias specification, the average gas concentration was calculated by STRATA from the average gas concentration displayed by the gas analyzer, adjusted for the low-level and upscale sampling system bias checks. An example calculation of this bias-correction calculation is included in the appendices of this report.

An NO_2 to NO conversion efficiency test discussed in Paragraph 8.2.4.1 of Method 7E was performed on-site for the analyzer used for this project. The analyzer response was stable with less than a 2% decrease in NO_x analyzer response over a 30-minute period,

demonstrating acceptable converter efficiency response. A copy of the NO_2 to NO conversion efficiency test is included in the appendices of this report.

An interference response test for the NO_x and diluent analyzers used on this project has been performed in ATAQ's laboratory. For the interference test, approximately 500 ppm CO, 200 ppm SO_2, 10% CO_2, and 21% O_2 were introduced to the analyzer and the responses were noted to be within the required limits. Documentation of the interference check is provided in the appendices of this report.

5.6 EPA Method 10 - Carbon Monoxide

Carbon monoxide (CO) emissions were measured using EPA Method 10, which is an instrumental method. A gas filter correlation non-dispersive infrared analyzer (GFC-NDIR) was used to measure the parts per million (ppm) CO on a dry basis. The manufacturer and model number for the specific analyzers used for this test were recorded on a form titled "Continuous Analyzer Checklist," which is included in the appendices of this report. This form was used to determine which specifications to include in the appendices of this report. Several EPA Protocol No. 1 calibration gases were utilized to check the calibration of the analyzers for this test. A form titled "Calibration Gas Checklist" is included in the appendices of this report. This form was used to determine which certificates of analysis to include in the appendices of this report.

The Method 10 sample train is illustrated in the figure titled "EPA Method 3A, 6C, 7E, 10, and 25A Sample Train" in the appendices of this report. An effluent gas sample was drawn through the same sample conditioning system described for Method 3A testing. Gaseous emission samples were collected at a point of average concentration in the stack unless otherwise noted. ATAQ conducts EPA Method 10 testing with the same rigorous bias and drift requirements as found in EPA Method 6C. After the measurement system

was prepared for use, a calibration error check was performed by introducing low-level, mid-level, and high-level EPA Protocol No. 1 calibration gases to the measurement system upstream of the analyzers. No adjustments were made to the system except those necessary to achieve the correct calibration gas flow rate to the analyzers. A data acquisition system named STRATA recorded the responses and calculated whether the concentration displayed by the analyzers exceeded ± 2% of the span for any of the calibration gases. If this specification was exceeded, the data was flagged by STRATA and the analyzer calibration error check was repeated until acceptable performance was achieved.

Before the first run, a sampling system bias check was performed by introducing calibration gases at the sampling tee installed at the outlet of the sampling probe. A low-level gas and either the mid-level or high-level gas, whichever most closely approximated the effluent concentration, were used for this check. The measurement system response time was determined by observing the times required to achieve a stable response for both the low-level and upscale gases. The longer of the two times was used as the response time and was taken into consideration when performing other calibration checks. STRATA recorded the responses and calculated whether the concentration displayed by the analyzers exceeded ± 5% of the span for either the low-level or upscale calibration gas. If this specification was exceeded, the data was flagged by STRATA, the sampling system underwent troubleshooting to discover and correct the problem, and then the sampling system bias check was repeated until acceptable performance was achieved.

Once the testing commenced, measurements from the instruments were recorded at least once per minute using STRATA, which automatically averages the data at the end of each run. After each run, bias and calibration drift tests were performed to check the drift of the analyzer and to collect data to allow STRATA to bias-correct the average result based

on the amount of drift from the beginning to the end of the run. STRATA recorded the responses and calculated whether the concentration displayed by the analyzers exceeded ± 3% of the previous average span value for either the low-level or upscale calibration gas. If this specification was exceeded, the data was flagged by STRATA, the sampling system underwent troubleshooting to discover and correct the problem, and then the calibration error check and the sampling system bias check were repeated before repeating the run.

When both the low-level and upscale calibration values were within the sampling system bias specification, the average gas concentration was calculated by STRATA from the average gas concentration displayed by the gas analyzer, adjusted for the low-level and upscale sampling system bias checks. An example calculation of this bias-correction calculation is included in the appendices of this report.

5.7 EPA Method 25A - Total Hydrocarbons (THC), Methane (CH_4), and Non-Methane Organic Compounds (NMOC) - Flare Outlet

To quantify non-methane organic compound (NMOC) emissions, a portion of the stack gas was continuously extracted and passed through a J.U.M. Model 109A analyzer which is equipped with matched dual hydrogen flame ionization detectors (FID) to separate total hydrocarbon (THC) and methane (CH_4). The manufacturer and model number for the specific analyzer used for this test were recorded on a form titled "Continuous Analyzer Checklist," which is included in the appendices of this report. This form was used to determine which specifications to include in the appendices of this report. Several EPA Protocol No. 1 calibration gases were utilized to check the calibration of the analyzer for this test. A form titled "Calibration Gas Checklist" is included in the appendices of this report. This form was used to determine which certificates of analysis to include in the appendices of this report. This analyzer is typically calibrated with propane or methane and expressed as the appropriate equivalent.

The Method 25A sample train is illustrated in the figure titled "EPA Method 3A, 6C, 7E, 10, and 25A Sample Train" in the appendices of this report. The Method 25A sample system is separate from the Method 3A, 6C, 7E, and 10 sample conditioning system because the gas is introduced to the Method 25A analyzer on a hot, wet basis. Gas being sampled using Method 3A, 6C, 7E, and 10 enters a moisture removal system prior to being analyzed on a cold, dry basis.

For this combined hot/wet and cold/dry sampling, an effluent gas sample was drawn through a stainless steel sampling probe and out-of-stack filter, which were sufficiently heated to prevent condensation. A sampling tee was connected to the inlet of the probe for the purpose of introducing calibration gas to flood the probe. The gas was routed to the instrument van through a heated Teflon®-lined sample line which was maintained at 150°C. The hot, wet gas was introduced directly into the Method 25A analyzer into the first (#1) detector directly via sample capillary, and into the second (#2) detector via a proprietary design non-CH_4 hydrocarbon cutter. The cutter oxidizes and removes all hydrocarbons except CH_4. Detector #1 detects THC including CH_4, and detector #2 detects only CH_4. The outputs of the two (2) detectors are coupled to individual electrometers. The dual detector and electrometer designs provide a real-time analysis of THC and CH_4. A slipstream of the stack gas was routed to the Method 3A, 6C, 7E, and 10 sample system by passing the gas through a refrigerator-type moisture removal system, which continuously removed condensate from the sample gas. Once the moisture was removed, the gas continued into the other analyzers. A Teflon®-coated leak-free pump was utilized to pull the sample gas through the system at a flow rate sufficient to minimize the response time of the measurement system. A sample flow rate control valve and rotameter were used to maintain a constant sampling rate within 10 percent. Prior to testing, probes, sample tubing, conditioning equipment, analyzers, and pumps were

determined to be leak-free. The sampling system was leak checked by capping off the end of the sample line and pulling at least 10 inches of mercury (Hg) vacuum in the system and observing the rotameter drop to zero.

Gaseous emission samples were collected at a single point in the stack. After the measurement system was prepared for use, a calibration error check was performed by introducing low, mid, and high-level EPA Protocol No. 1 calibration gases to the measurement system upstream of the analyzers. No adjustments were made to the system except those necessary to achieve the correct calibration gas flow rate to the analyzers. A data acquisition system named STRATA recorded the responses and calculated whether the concentration displayed by the analyzers exceeded ± 2% of the span for any of the calibration gases. If this specification was exceeded, the data was flagged by STRATA and the analyzer calibration error check was repeated until acceptable performance was achieved.

Before the first run, a sampling system bias check was performed by introducing calibration gases at the sampling tee installed at the outlet of the sampling probe. A low-level gas and either the mid-level or high-level gas, whichever most closely approximated the effluent concentration, were used for this check. The measurement system response time was determined by observing the times required to achieve a stable response for both the low-level and upscale gases. The longer of the two times was used as the response time and was taken into consideration when performing other calibration checks. STRATA recorded the responses and calculated whether the concentration displayed by the analyzers exceeded ± 5% of the span for either the low-level or upscale calibration gas. If this specification was exceeded, the data was flagged by STRATA, the sampling system underwent troubleshooting to discover and correct the problem, and then the sampling system bias check was repeated until acceptable performance was achieved.

Once the testing commenced, measurements from the instruments were recorded at least once per minute using STRATA, which automatically averages the data at the end of each run. After each run, a low-level and calibration drift test was performed to check the drift of the analyzer and to collect data to allow STRATA to bias-correct the average result based on the amount of drift from the beginning to the end of the run. STRATA recorded the responses and calculated whether the concentration displayed by the analyzers exceeded ± 3% of the previous average span value for either the low-level or upscale calibration gas. If this specification was exceeded, the data was flagged by STRATA, the sampling system underwent troubleshooting to discover and correct the problem, and then the calibration error check and the sampling system bias check were repeated before repeating the run.

When both the low-level and upscale calibration values were within the sampling system bias specification, the average gas concentration was calculated by STRATA from the average gas concentration displayed by the gas analyzer, adjusted for the low-level and upscale sampling system bias checks. An example calculation of this bias-correction calculation is included in the appendices of this report.

5.8 EPA Method 25C - Non-Methane Organic Compounds (NMOC) - Flare Inlet

Integrated samples of the gas at the inlet to the flare were collected in evacuated SUMMA® canisters using Compendium Method TO-14A. The samples were analyzed for non-methane organic compounds (NMOC). Additional information about sample collection and handling is detailed in Section 5.10 (EPA Method TO-14A) of this report. Non-methane organic compounds (NMOC) were quantified using a gas chromatograph equipped with a thermal conductivity detector (GC-TCD).

5.9 EPA Method 26A - Hydrogen Chloride (HCl) and Hydrogen Fluoride (HF)

The sample train used for chloride sampling was an EPA Method 26A design as illustrated in the figure titled "Method 26A Sample Train" in the appendices of this report. The "Sample Train Information Sheet" (also in the appendices) details the type of nozzle, probe, probe liner, and filter used along with the contents of the sample train impingers. To quantify hydrogen chloride (HCl) and hydrogen fluoride (HF) emissions, the stack gas was withdrawn isokinetically from the stack and passed through a filter. A glass filter assembly was enclosed in a temperature-controlled heated sample box. The temperature of the probe liner was monitored to assure that condensation did not occur within the probe liner. The probe sheath has type S pitot tubes attached, along with a thermocouple sensor for monitoring the stack gas temperature. The thermocouple sensors were connected to a digital thermocouple indicator to monitor temperature throughout testing. The assembly of the nozzle, probe liner, prefilter connective glassware, and filter is often referred to as the "front-half" of the sample train. Following the filter was a condenser section which, by convention, is referred to as the "back-half." The impinger section was maintained at a temperature below 68°F by keeping ice on the impingers. The temperature at the outlet of the silica gel bubbler was monitored to verify that it did not exceed 68°F during a test. Note: Some subparts or methods specify alternate temperatures for the probe liner, filter holder box, and impinger ice bath. The "Sample Train Information Sheet" details any exceptions.

The sample train was connected to a control box by means of an umbilical cord which contains a vacuum hose, pitot lines, thermocouple wires and a 4-wire electrical cord. The control box (meter box) is used to monitor stack conditions. The control box contains a leak-free pump used to pull the stack gas through the sample train, fine, and coarse metering valves to control the sampling rate, a vacuum gauge which measures the pressure drop from the sampling nozzle to the metering valves and a calibrated dry gas meter

readable to 0.001 cubic feet. The dry gas meter inlet and outlet temperatures were monitored by thermocouples which are connected to the multichannel thermocouple indicator. The dry gas meter calibration factor, Y, is determined by calibrating the meter against a standard laboratory dry gas meter.

Stack condition measurements were made prior to collecting a sample, including measurements of velocity, temperature and a check for cyclonic flow in the stack. A sample nozzle was chosen and isokinetic operating parameters were established utilizing a Hewlett-Packard programmable calculator. The sampling nozzle, probe, and prefilter connective glassware were cleaned and rinsed prior to use. The sample train was assembled and determined to be leak free following the procedures outlined in Method 5. Before each test, a final check was made to assure that the process was operating at the desired production rate and operating parameters. A final check was made of the sample box and probe heat temperatures. Crushed ice was added to the condenser section. The sample nozzle was positioned in the stack at the first sample point. The sample pump was then turned on and the gas sampling rate was adjusted for isokinetic sampling. Isokinetic sampling proceeded at each of the traverse points. Upon completion of the test, the sample probe was removed from the stack and a post-test leak check was performed according to Method 5 procedures. Care was taken to assure that the nozzle tip did not touch the port nipple.

The bubblers and impingers utilized for the condenser section or "back-half" of the sample train were weighed with a readability of 0.1 grams before and after sampling using an electronic top loading balance. The difference between the initial and final weights of the condenser section constitutes the amount of moisture gain during the run. The contents of the first two (2) impingers containing condensate and 0.1 N H_2SO_4 were quantitatively transferred to a sample bottle. The impingers and connecting glassware were rinsed with

deionized water and these rinses were added to the impinger solution in the sample bottle. The solutions in the third and fourth impingers containing 0.1 N NaOH (used to scrub chlorine) were discarded. The sulfuric acid solution from each run was analyzed for chlorides and fluorides using ion chromatography by EPA Method 300.0. The laboratory reported the data as chloride (Cl^-) and fluoride (F^-).

5.10 EPA Method TO-14A - Volatile Organic Compounds

Integrated samples were collected at the flare inlet using Compendium Method TO-14A for analysis. The TO-14A sample train is illustrated in the figure titled "TO-14A Sample System Schematic" in the appendices of this report. This ambient air testing method was used for this source testing project to collect integrated samples of gas in evacuated SUMMA® electropolished stainless steel canisters. The integrated samples were analyzed using EPA Method TO-14A, which utilizes a gas chromatograph equipped with a mass spectrometer (GC-MS) to quantify a standard list of volatile organic compounds.

The TO-14A sampling apparatus included a stainless steel probe, a mechanical critical orifice flow regulator or metering valve, and a 0-30 inch vacuum gauge to monitor canister vacuum. The system is specifically designed to collect uniformly integrated air samples over a predetermined time period. A stainless steel probe was inserted into the port to pull a gas sample through the flow controller and into the evacuated canister. The Telfon® sample line was attached to a stainless steel "T" connection, with the side branch connected to a vacuum gauge atop the SUMMA® canister; the other end of the "T" was connected to a valve with a sample pump attached. The sample train was evacuated to approximately one inch above absolute pressure. A leak check was performed by observing the vacuum gauge for one (1) minute. The SUMMA® canister valve was opened and the initial vacuum was recorded. The sample line valve was then opened until the canister vacuum was zero.

AAC, Inc., the outside contract laboratory used to analyze these samples, own and maintain the integrity of the SUMMA® passivated canisters and perform leak tests to assure that they can contain a gas sample over time. To prepare the canisters, the contract laboratory heated them in an isothermal oven to 100°C. Once heated, the canisters were evacuated and maintained under vacuum for several hours. At the end of the heated/evacuation cycle, the canisters were pressurized with humid zero air and were quality assurance checked with a gas chromatograph equipped with a flame ionization detector. Once certified clean, the canisters were reevacuated and remained in the evacuated state until they were used.

Each canister was labeled with an identification tag before it was returned to the contract laboratory for analysis. Upon return receipt of the canisters by the contract laboratory, the pressure of each canister was checked by attaching a pressure gauge to the canister inlet and opening the valve briefly to note the pressure. The sample canister was connected to the inlet of the GC-MS-SCAN analytical system. A mass flow controller was placed on the canister and the canister valve was opened. Following preliminary flushing, the canister flow was vented past a tee inlet to the analytical system. The sample was preconcentrated in a cryogenic trap, and then the trapped analytes were thermally desorbed onto the head of the column to be separated and scanned. Primary identification is based on retention time and relative abundance of eluting ions as compared to the spectral library stored on the hard disk of the GC-MS data system. The concentration of each compound was calculated using the previously established response factors. Analysis of the gas contained in the canisters was accomplished using GC-MS as described in Method TO-14A.

5.11 EPA Method 0031 - Volatile Organic Compounds

A sampling method for volatile organic compounds (VOC) is detailed in Method 0031 of SW-846. VOC sampling was performed by absorbing and concentrating samples in sorbent modules packed with Tenax®-GC/Tenax®-GC/Anasorb®-747 resins. Liquid condensate was collected in an impinger placed between the 2 Tenax-GC traps and the Anasorb-747 trap. The first and second traps contained 1.6 grams (g) of Tenax-GC each, and the third trap (back trap) contained 5.0 g of Anasorb-747. The tubes were prepared and conditioned by the subcontract analytical laboratory. The tubes were capped until they were used, and were capped immediately after sample collection and refrigerated until they were analyzed. A set of field blanks were exposed to ambient air for the time it took to switch tubes during a run. A set of trip blanks, which did not have the end caps removed, accompanied the tubes to and from the laboratory to assure that no contamination of the samples occurred during shipment. A set of laboratory blanks remained in the laboratory and would be analyzed in the case where high levels of VOC were found on either of the trip or field blanks.

The glassware which is used in the VOC was sonicated for one hour in a solution of laboratory detergent, rinsed thoroughly with hot water, rinsed three times with HPLC grade water, and baked at a high temperature in a solvent-free oven. The ends were capped with glass plugs and stoppers or stainless steel fittings (or pre-cleaned foil) prior to use. A heated glass-lined probe was used to extract a sample from the stack. The probe was connected to an isolation valve and charcoal trap. Once the gas passed through the probe, it entered an ice water-cooled glass coil condenser to cool the gas to below 20° C, through two sorbent tubes packed with Tenax-GC resin, through an empty knock-out trap for condensate removal, through a second water-cooled glass condenser, through a third sorbent tube containing Anasorb-747, through a silica gel drying tube, through a calibrated rotameter, through the sample pump, and through a dry gas meter.

The sample train was assembled and leak checked prior to the start of each run. The probe was positioned at a point of average velocity in the duct. Sampling was started and the sampling rate was adjusted to a rate of 0.5 liters per minute (Lpm) for 40 minutes. Before a set of tubes was switched, the dry gas meter reading was recorded and a post-test leak check was performed according to VOC procedures. After using a set of tubes, the sorbent modules were sealed and packed in a cooler with ice packs for shipment to the analytical laboratory. The tubes were switched three (3) times during each test run for three (3) sets of tubes. A field blank sample train and a set of tubes was assembled, leak tested, and recovered on-site for analysis to check the integrity of the glassware and preparation of the sample tubes for each run. The ends of the sorbent modules were sealed and labeled as field blanks. One set of field blank tubes was collected during each run. One set of unopened tubes remained in the container, which was used to store and transport the samples. The unexposed set of tubes was labeled as the trip (or transport) blank. A set of media check tubes (laboratory blanks) was also analyzed. The tubes were analyzed by purge and trap GCMS. The tubes were desorbed using SW-846 Method 5041A, "Analysis for Desorption of Sorbent Cartridges from Volatile Organic Sampling Train (VOST)." Analysis of the sorbent traps for volatile organic compounds was performed using SW-846 Method 8260B, "Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)."

6.0
QUALITY ASSURANCE PLAN

The purpose of the quality assurance plan is to provide guidelines for achieving quality control in air pollution measurements. The detailed procedures, which are utilized, are included in the Environmental Protection Agency's (EPA's) reference manual titled Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 3, EPA-600/4-77-027b. These procedures are followed throughout equipment preparation, field sampling, sample recovery, analysis, and data reduction. ATAQ's quality assurance procedures are discussed below.

6.1 Calibration Procedures and Frequency

Field equipment utilized for on-site measurements is calibrated at a frequency recommended by the equipment manufacturer or industry practice. Prior to field use, each instrument due for calibration is calibrated and the calibration value is recorded. If any measuring or test device requiring calibration cannot immediately be removed from service, the Project Manager may extend the calibration cycle providing a review of the equipment's history warrants the issuance of an extension. Equipment is not extended more than twice a calibration cycle, nor will the extension exceed one-half the prescribed calibration cycle. Test equipment consistently found to be out of calibration is repaired or replaced.

- The sample nozzles used to collect isokinetic samples were calibrated on-site before sampling using dial or digital inside calipers (micrometer) readable to 0.001 inch. Three (3) measurements were taken at varying points around the inside of the nozzle tip and averaged together. The tester verified that the difference between the high and low measurements did not exceed 0.004 inches. If nozzles are nicked, dented, or corroded they are replaced. Since ATAQ performs an in-field nozzle calibration; the sample nozzles are not marked with a unique identifier as discussed in Section 10.1 of Method 5.

- The dry gas meters (mounted inside of the meter boxes) used to accurately measure sample volumes are calibrated at 6-month intervals using a standardized laboratory dry gas meter. A copy of the current calibration for each dry gas meter used on this project is included in the appendices of this report. ATAQ typically follows the EPA's Emission Measurement Center Alternative Method 5 Post-Test Calibration (ALT-009) procedure to check the meter box calibration for each project. If the calculations in ALT-009 do not meet the ±5% criterion, a post-test meter box calibration is performed. If a post-test calibration of the meter was performed, a copy of the calibration is included in the appendices of this report.

- The standard dry gas meters used for the periodic recalibrations discussed above remain in the ATAQ laboratory and are sent to Homer R. Dulin Company for recalibration against an N.I.S.T. traceable spirometer annually as discussed in Section 16.1 of Method 5. A copy of the standard dry gas meter used to calibrate the meter box dry gas meter is included in the appendices of the report.

- The type S pitot tubes utilized for velocity determination are calibrated using Method 2, Section 10.1, and are inspected regularly for wear. Each type S pitot tube is marked with a unique identification number. A copy of the current calibration for each type S pitot tube used on this project is included in the appendices of this report. If a standard pitot tube was used, the Cp is 0.99 and no calibration information is included in the report.

- The magnehelic gauges used for differential pressure measurements are calibrated against an oil-filled manometer. These gauges are permanently mounted in a meter box or in a separate magnehelic box. They are recalibrated when they are put into service, when they fail, or when the control boxes are overhauled.

- The digital thermocouple indicators used to provide a digital readout of temperatures from the sample train have a readability of 1 degree Fahrenheit. These temperature indicators are permanently mounted in the meter boxes, so they are identified by the meter box ID number. They are sent to the manufacturer for recalibration when they fail or the meter box is overhauled.

- Each thermocouple probe used to monitor stack gas temperature is calibrated when it is put into service at three (3) temperature settings (ice bath, boiling water, and boiling oil). An in-field check was performed for the stack temperature thermocouple at ambient temperature as allowed by the EPA's Emission Measurement Center Alternative Method 2 Thermocouple Calibration Procedure (ALT-011). The stack gas temperature thermocouple was compared to a thermometer that has been calibrated against an ASTM reference thermometer at ambient temperature. The temperatures must agree within ±2°F. The in-field thermometers are periodically checked against the ASTM reference thermometer and the difference is recorded on a log that is kept in the ATAQ laboratory.

- Thermocouple probes used to monitor the temperature at the inlet and outlet of the dry gas meters are calibrated against a mercury-in-glass thermometer when a meter box is built or overhauled or when the dry gas meter is recalibrated. Copies of the calibrations for these thermocouples are included with the dry gas meter calibration in the appendices of this report.

- A barometer readable to 0.01 inches of mercury was used in the field to obtain barometric pressure readings. The in-field barometers are periodically checked against a NOVA mercury-filled barometer (primary standard, ID #0439) that is mounted in the ATAQ laboratory in Preston, Washington. The difference is recorded on a log that is kept next to the barometer.

- Top loading analytical balances readable to 0.1 grams were used to weigh the impingers before and after each run where a moisture determination was made. These balances have an internal calibration procedure that is performed prior to each weighing session. The calibration of the top-loading balances is checked on a yearly basis using an outside contractor.

- The Mettler AE163 electronic balance used to obtain particulate matter weights is set to a time integrating mode (100,000 readings per minute) with a readability of 0.01 milligrams. This balance is kept in a temperature and humidity controlled weighing laboratory and sits on a high-density composite table to reduce weighing errors. The balance is calibrated using an internal calibration procedure and audited with class S weights prior to every weighing session. The calibration and audit results are recorded in a bound laboratory notebook that is kept in the ATAQ laboratory. The calibration of the analytical balances is checked on a yearly basis using an outside contractor.

Copies of calibration information for each measurement device used are included in the appendices of this report. All reagents used for this project conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society, or the best available grade.

The gaseous measurement systems are capable of meeting the system performance specifications detailed in 40 CFR 60, Appendix A, Method 6C, Section 4. For meeting these specifications, the analyzer's calibration error must be less than ± 2% of span for the low-level, mid-level, and high-level calibration gases. The sampling system bias must be less than ± 5% of span for the low-level and mid- or high-level calibration gases. The low-level and calibration drift must be less than ± 3% of the span over the period of each run.

Copies of certificates of analysis for each tank of calibration gas used are included in the appendices of this report. The calibration gases were analyzed following the EPA Traceability Protocol No. 1, or next best available. Purified nitrogen was utilized as zero gas.

Support equipment is defined as all equipment, not previously discussed, that is required for completing an environmental monitoring or measurement task. This equipment may include storage and transportation containers, sample recovery glassware, and communications gear. Support equipment is periodically inspected to maintain the performance standards necessary for proper and efficient execution of all tasks and responsibilities.

During a project, a systems audit is performed, consisting of an on-site qualitative inspection and review of the total measurement system. The Project Leader conducts this inspection on a daily basis. During the systems audit, the auditor observes the procedures and techniques of the field team in the following general areas:

- Setting up and leak testing the sample train
- Isokinetic sampling check (if applicable)
- Final leak check of the sample train
- Sample recovery

Visual inspections of pitot tubes, glassware, and other equipment are also made. The main purpose of a systems audit is to ensure that the measurement system will generate valid data, if operated properly.

6.2 Sample Recovery and Field Documentation

Data collected during each test, were immediately inspected for completeness and placed under the custody of the Project Leader until custody was transferred when the samples were returned to the Air Quality laboratory. Sample recovery was carried out in a suitable area free from particulate matter and other outside contamination. Each sample was assigned an identifying lab number to assist the chemists in tracking the sample.

6.3 Chain of Custody

The history of each sample was documented from collection through all transfers of custody until it was transferred to the analytical laboratory. Copies of the chain of custody forms are included in the appendices of this report. Internal laboratory records document the custody of the samples through their final disposition. Care was taken to record precisely the sample type, sample time, and sample location and to help ensure that the sample number on the label exactly matches those numbers on the sample log sheet and the chain-of-custody record. The persons undertaking the actual sampling in the field were responsible for the care and custody of the samples collected until they were properly transferred or dispatched. Sample labels were completed for each sample bottle using waterproof ink.

6.4 Transfer of Custody and Shipment

All sample-shipping containers were accompanied by an analysis request or chain-of-custody record form when they left the site. When transferring the possession of samples, the individuals relinquishing and receiving the samples signed, dated, and noted the time on the record. This record documents sample custody transfer from the sampler, often through another person, to the analyst in the laboratory.

The laboratory representative who accepted the incoming sample shipment signed and dated the chain-of-custody record, completing the sample transfer process. It is the laboratory's responsibility to maintain internal logbooks and custody records throughout sample preparation and analysis in accordance with the laboratory's written QA Plan.

It is important to maintain the integrity of the samples from the time of collection until the analyses are performed. The samples were preserved during transportation and storage to prevent or retard degradation or modification of chemicals in samples. The samples were kept cool with blue ice packets placed in the coolers the sample were shipped in. Empty space in the box or cooler was filled with bubble pack and Styrofoam to prevent damage during shipment. The samples were shipped via courier for next day delivery.

6.5 Data Reduction, Validation, and Reporting

Raw data are handled according to strict guidelines when being transposed into computer files or to other logs. The guidelines include document receipt control procedures, file review, and sign-off by a project assistant. Raw data were entered into the appropriate computer spreadsheet by a "processor," then the entered figures were checked for accuracy by a "checker," different from the "processor." Any mistakes were corrected, and figures were rechecked and signed off by the "checker." In addition, a by-hand calculation check of each spreadsheet was made using a hand-held calculator to validate the computer output. The "senior reviewer" reviewed all of the data generated by each phase of the laboratory or field-sampling program. The "senior reviewer" signed off on the data package prior to releasing the data for report preparation.

The test results were calculated according to EPA 40 CFR 60 criteria. Copies of the pertinent equations used to obtain these results are included in the appendices of this report. Standard conditions are 68°F and 29.92 inches of mercury. The average values

from instrumental analyzer readings were computed and bias-corrected for each test period. The average gas effluent concentration was determined from the average gas concentration displayed by the analyzer, adjusted for the low-level and upscale sample system bias checks. Calculations are on a dry basis (except THC and CH_4) using the following equation:

$$C_{gas} = (C - C_o) * (C_{ma}/(C_m - C_o))$$

where:

C_{gas} = Effluent gas concentration, dry basis
C = Average gas concentration indicated by analyzer, dry basis
C_o = Average of initial and final sample system bias check responses for the low-level gas
C_{ma} = Actual concentration of the upscale calibration gas
C_m = Average of initial and final sample system bias check responses for the upscale calibration gas

7.0
METHODOLOGY REFERENCES

EPA. Title 40 Code of Federal Regulations, Part 60 (40 CFR 60), Appendix A, Reference Methods 1, 1A, 2, 3A, 4, 6C, 7E, 10, 25A, 25C, and 26A. July 1, 2007.

ODEQ. State of Oregon Department of Environmental Quality (ODEQ), Air Quality Division, Source Sampling Manual, Volume 1, Method 4. January 1992.

EPA. Compendium of Methods for the Determination of Toxic Organic in Ambient Air, Method TO-14A, Second Edition, U. S. Environmental Protection Agency, Research Triangle Park, NC, EPA 600/625/R-96/010b.

EPA Test Methods for Evaluating Solid Waste. SW-846, November 1986 and updates, Method 0031.

EPA. EPA APTI Course, "Course 468 - Source Sampling For Gaseous Pollutants."

EPA. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 3, EPA-60/4-77-027b.

EPA. Technology Transfer Network Emission Measurement Center (EPA-TTN-EMC) website, Test Methods Section (www.epa.gov/ttn/emc/).

APPENDIX A

Computer Printouts of Results

EPA METHODS 1, 2, 3C, AND 4
PSYCHROMETRIC MOISTURE
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX@CTL-M1-4 INLET	**Lab #:**	---	
Client:	Parametrix @ City of Tacoma Landfill	**Start Time:**	1510	hours
Location:	Tacoma, Washington	**Stop Time:**	1520	hours
Sample Site:	Perennial #1 Landfill Gas Combuster Inlet			
Sample Date:	7/19/07			
Run #:	1A - Method 2			
Operators:	TWG			

Wet Bulb Temperature (T_w):	78.0	° F
Dry Bulb Temperature (T_d):	96.4	° F
Vapor Pressure (VP):	0.7683	inches Hg
Saturated Vapor Pressure (SVP):	0.9671	inches Hg
Moisture:	2.55	%
Bws:	0.0255	
Pitot Tube C_p:	0.99	
Stack Width:		inches
Stack Length:		inches
Stack Diameter:	10.0	inches
Stack Area:	0.545	ft^2
Barometric Pressure:	29.70	Inches Hg
Static Pressure:	5.8	inches H_2O
Stack Pressure:	30.13	inches Hg
Average Conc. O_2:	3.4	percent
Average Conc. CO_2:	22.3	percent
Average Conc. CH_4:	24.7	percent
Molecular Weight:	28.74	g/g-mole-dry
Molecular Weight:	28.47	g/g-mole-wet

Sample Point	Velocity (" of H_2O)	Temperature °F	Sample Point	Velocity (" of H_2O)	Temperature °F
6	0.10	104.6			
5	0.15	104.5			
4	0.16	104.8			
3	0.17	104.9			
2	0.16	104.7			
1	0.16	104.3			

Stack Gas Temperature:	104.6 °F	564.6 °R
Average Velocity Head:	0.149 " of H_2O	
Stack Gas Velocity:		26.5 ft/second
Stack Gas Airflow:	867.4 acf/min	795.9 dscf/min

EPA METHODS 1, 2, 3C, AND 4
PSYCHROMETRIC MOISTURE
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX@CTL-M1-4 INLET	**Lab #:**	----	
Client:	Parametrix @ City of Tacoma Landfill	**Start Time:**	1620	hours
Location:	Tacoma, Washington	**Stop Time:**	1630	hours
Sample Site:	Perennial #1 Landfill Gas Combuster Inlet			
Sample Date:	7/19/07			
Run #:	1B - Method 2			
Operators:	TWG			

Wet Bulb Temperature (T_w):	78.0	° F
Dry Bulb Temperature (T_d):	96.4	° F
Vapor Pressure (VP):	0.7680	inches Hg
Saturated Vapor Pressure (SVP):	0.9671	inches Hg
Moisture:	2.55	%
Bws:	0.0255	
Pitot Tube C_p:	0.99	
Stack Width:		inches
Stack Length:		inches
Stack Diameter:	10.0	inches
Stack Area:	0.545	ft^2
Barometric Pressure:	29.70	inches Hg
Static Pressure:	6.4	inches H_2O
Stack Pressure:	30.17	inches Hg
Average Conc. O_2:	3.4	percent
Average Conc. CO_2:	22.3	percent
Average Conc. CH_4:	24.7	percent
Molecular Weight:	28.74	g/g-mole-dry
Molecular Weight:	28.47	g/g-mole-wet

Sample Point	Velocity (" of H_2O)	Temperature °F	Sample Point	Velocity (" of H_2O)	Temperature °F
6	0.12	100.6			
5	0.14	100.9			
4	0.15	101.6			
3	0.15	101.7			
2	0.16	101.7			
1	0.14	101.3			

Stack Gas Temperature:	101.3 °F	561.3 °R
Average Velocity Head:	0.143 " of H_2O	
Stack Gas Velocity:		25.9 ft/second
Stack Gas Airflow:	846.9 acf/min	782.8 dscf/min

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EPA METHODS 1, 2, 3C, AND 4
PSYCHROMETRIC MOISTURE
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX@CTL-M1-4 INLET	Lab #:	---	
Client:	Parametrix @ City of Tacoma Landfill	Start Time:	1730	hours
Location:	Tacoma, Washington	Stop Time:	1740	hours
Sample Site:	Perennial #1 Landfill Gas Combuster Inlet			
Sample Date:	7/19/07			
Run #:	1C - Method 2			
Operators:	TWG			

Wet Bulb Temperature (T_w):	78.0	° F
Dry Bulb Temperature (T_d):	96.4	° F
Vapor Pressure (VP):	0.7681	inches Hg
Saturated Vapor Pressure (SVP):	0.9671	inches Hg
Moisture:	2.55	%
Bws:	0.0255	
Pitot Tube C_p:	0.99	
Stack Width:		inches
Stack Length:		inches
Stack Diameter:	10.0	inches
Stack Area:	0.545	ft^2
Barometric Pressure:	29 70	inches Hg
Static Pressure:	6.2	inches H_2O
Stack Pressure:	30.16	inches Hg
Average Conc. O_2:	3.4	percent
Average Conc. CO_2:	22.3	percent
Average Conc. CH_4:	24.7	percent
Molecular Weight:	28.74	g/g-mole-dry
Molecular Weight:	28.47	g/g-mole-wet

Sample Point	Velocity (" of H_2O)	Temperature °F	Sample Point	Velocity (" of H_2O)	Temperature °F
6	0.12	96.1			
5	0.13	96.2			
4	0.16	96.8			
3	0.15	96.7			
2	0.16	96.3			
1	0.16	95.3			

Stack Gas Temperature:	96.2	°F	556.2	°R
Average Velocity Head:	0.146	" of H_2O		
Stack Gas Velocity:			26.1	ft/second
Stack Gas Airflow:	852.5	acf/min	794.8	dscf/min

EPA METHODS 1, 2, 3C, AND 4
PSYCHROMETRIC MOISTURE
AMTEST AIR QUALITY, A DIVISION DF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX@CTL-M1-4 INLET	**Lab #:**	--	
Client:	Parametrix @ City of Tacoma Landfill	**Start Time:**	0831	hours
Location:	Tacoma, Washington	**Stop Time:**	0841	hours
Sample Site:	Perennial #1 Landfill Gas Combuster Inlet			
Sample Date:	7/20/07			
Run #:	2A - Method 2			
Operators:	TWG			

Wet Bulb Temperature (T_w):	76.0	° F
Dry Bulb Temperature (T_d):	87.9	° F
Vapor Pressure (VP):	0.7766	inches Hg
Saturated Vapor Pressure (SVP):	0.9053	inches Hg
Moisture:	2.58	%
Bws:	0.0258	
Pitot Tube C_p:	0.99	
Stack Width:		inches
Stack Length:		inches
Stack Diameter:	10.0	inches
Stack Area:	0.545	ft^2
Barometric Pressure:	29.65	inches Hg
Static Pressure:	6.2	inches H_2O
Stack Pressure:	30.11	inches Hg
Average Conc. O_2:	3.1	percent
Average Conc. CO_2:	22.7	percent
Average Conc. CH_4:	25.4	percent
Molecular Weight:	28.71	g/g-mole-dry
Molecular Weight:	28.43	g/g-mole-wet

Sample Point	Velocity (" of H_2O)	Temperature °F	Sample Point	Velocity (" of H_2O)	Temperature °F
6	0.11	83.9			
5	0.13	84.4			
4	0.15	84 9			
3	0.15	85.0			
2	0.15	84.5			
1	0.12	84.0			

Stack Gas Temperature:	84.5	°F	544.5	°R
Average Velocity Head:	0.135	" of H_2O		
Stack Gas Velocity:			24.8	ft/second
Stack Gas Airflow:	810.1	acf/min	770.1	dscf/min

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EPA METHODS 1, 2, 3C, AND 4
PSYCHROMETRIC MOISTURE
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX@CTL-M1-4 INLET	**Lab #:**	----	
Client:	Parametrix @ City of Tacoma Landfill	**Start Time:**	0931	hours
Location:	Tacoma, Washington	**Stop Time:**	0941	hours
Sample Site:	Perennial #1 Landfill Gas Combuster Inlet			
Sample Date:	7/20/07			
Run #:	2B - Method 2			
Operators:	TWG			

Wet Bulb Temperature (T_w):	76.0	° F
Dry Bulb Temperature (T_d):	87.9	° F
Vapor Pressure (VP):	0.7766	inches Hg
Saturated Vapor Pressure (SVP):	0.9053	inches Hg
Moisture:	2.58	%
Bws:	0.0258	
Pitot Tube C_p:	0.99	
Stack Width:		inches
Stack Length:		inches
Stack Diameter:	10.0	inches
Stack Area:	0.545	ft^2
Barometric Pressure:	29.65	inches Hg
Static Pressure:	6.2	inches H_2O
Stack Pressure:	30 11	inches Hg
Average Conc. O_2:	3.1	percent
Average Conc. CO_2:	22.7	percent
Average Conc. CH_4:	25.4	percent
Molecular Weight:	28.71	g/g-mole-dry
Molecular Weight:	28.43	g/g-mole-wet

Sample Point	Velocity (" of H_2O)	Temperature °F	Sample Point	Velocity (" of H_2O)	Temperature °F
6	0.10	85.2			
5	0.12	85.9			
4	0.13	86.3			
3	0.13	86.4			
2	0.14	86.2			
1	0.13	85.5			

Stack Gas Temparature:	85.9	°F	545.9	°R
Average Velocity Head:	0.125	" of H_2O		
Stack Gas Velocity:			23.9	ft/second
Stack Gas Airflow:	781.0	acf/min	740.4	dscf/min

EPA METHODS 1; 2, 3C, AND 4
PSYCHROMETRIC MOISTURE
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX@CTL-M1-4 INLET	**Lab #:**	--	
Client:	Parametrix @ City of Tacoma Landfill	**Start Time:**	1031	hours
Location:	Tacoma, Washington	**Stop Time:**	1041	hours
Sample Site:	Perennial #1 Landfill Gas Combuster Inlet			
Sample Date:	7/20/07			
Run #:	2C - Method 2			
Operators:	TWG			

Wet Bulb Temperature (T_w):	76.0	° F
Dry Bulb Temperature (T_d):	87.9	° F
Vapor Pressure (VP):	0.7766	inches Hg
Saturated Vapor Pressure (SVP):	0.9053	Inches Hg
Moisture:	2.58	%
Bws:	0.0258	
Pitot Tube C_p:	0.99	
Stack Width:		inches
Stack Length:		Inches
Stack Diameter:	10.0	inches
Stack Area:	0.545	ft^2
Barometric Pressure:	29.65	inches Hg
Static Pressure:	6 2	inches H_2O
Stack Pressure:	30.11	inches Hg
Average Conc. O_2:	3.1	percent
Average Conc. CO_2:	22 7	percent
Average Conc. CH_4:	25.4	percent
Molecular Weight:	28.71	g/g-mole-dry
Molecular Weight:	28.43	g/g-mole-wet

Sample Point	Velocity (" of H_2O)	Temperature °F	Sample Point	Velocity (" of H_2O)	Temperature °F
6	0.11	104.3			
5	0.16	104.5			
4	0.14	107.4			
3	0.14	113.5			
2	0.14	86.9			
1	0.13	86.8			

Stack Gas Temperature:	100 6 °F	560.6	°R
Average Velocity Head:	0.136 " of H_2O		
Stack Gas Velocity:		25.3	ft/second
Stack Gas Airflow:	827.3 acf/min	763.9	dscf/min

L-8

EPA METHODS 1, 2, 3C, AND 4
PSYCHROMETRIC MOISTURE
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX@CTL-M1-4 INLET	Lab #:	----	
Client:	Parametrix @ City of Tacoma Landfill	Start Time:	1138	hours
Location:	Tacoma, Washington	Stop Time:	1148	hours
Sample Site:	Perennial #1 Landfill Gas Combuster Inlet			
Sample Date:	7/20/07			
Run #:	3A - Method 2			
Operators:	TWG			

Wet Bulb Temperature (T_w):	80.0	° F
Dry Bulb Temperature (T_d):	93.3	° F
Vapor Pressure (VP):	0.8891	inches Hg
Saturated Vapor Pressure (SVP):	1.0326	inches Hg
Moisture:	2.95	%
Bws:	0.0295	
Pitot Tube C_p:	0.99	
Stack Width:		inches
Stack Length:		inches
Stack Diameter:	10.0	inches
Stack Area:	0.545	ft^2
Barometric Pressure:	29.65	inches Hg
Static Pressure:	6.4	inches H_2O
Stack Pressure:	30.12	inches Hg
Average Conc. O_2:	3.3	percent
Average Conc. CO_2:	22.6	percent
Average Conc. CH_4:	25.1	percent
Molecular Weight:	28.74	g/g-mole-dry
Molecular Weight:	28.42	g/g-mole-wet

Sample Point	Velocity (" of H_2O)	Temperature °F	Sample Point	Velocity (" of H_2O)	Temperature °F
6	0.12	86.3			
5	0.13	86.8			
4	0.14	87.5			
3	0.14	87.7			
2	0.15	87.3			
1	0.12	86.4			

Stack Gas Temperature:	87.0 °F	547.0	°R
Average Velocity Head:	0.133 " of H_2O		
Stack Gas Velocity:		24.7	ft/second
Stack Gas Airflow:	807.8 acf/min	761.8	dscf/min

EPA METHODS 1, 2, 3C, AND 4
PSYCHROMETRIC MOISTURE
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX@CTL-M1-4 INLET	Lab #:	--	
Client:	Parametrix @ City of Tacoma Landfill	Start Time:	1238	hours
Location:	Tacoma, Washington	Stop Time:	1248	hours
Sample Site:	Perennial #1 Landfill Gas Combuster Inlet			
Sample Date:	7/20/07			
Run #:	3B - Method 2			
Operators:	TWG			

Wet Bulb Temperature (T_w):	80.0	° F
Dry Bulb Temperature (T_d):	93.3	° F
Vapor Pressure (VP):	0.8892	Inches Hg
Saturated Vapor Pressure (SVP):	1.0326	Inches Hg
Moisture:	2.95	%
Bws:	0.0295	
Pitot Tube C_p:	0.99	
Stack Width:		inches
Stack Length:		inches
Stack Diameter:	10.0	inches
Stack Area:	0.545	ft^2
Barometric Pressure:	29.65	Inches Hg
Static Pressure:	6.3	inches H_2O
Stack Pressure:	30.11	Inches Hg
Average Conc. O_2:	3.3	percent
Average Conc. CO_2:	22.6	percent
Average Conc. CH_4:	25.1	percent
Molecular Weight:	28.74	g/g-mole-dry
Molecular Weight:	28.42	g/g-mole-wet

Sample Point	Velocity (" of H_2O)	Temperature °F	Sample Point	Velocity (" of H_2O)	Temperature °F
6	0.11	85.3			
5	0.13	86.5			
4	0.13	87.9			
3	0.13	88.3			
2	0.14	88.1			
1	0.12	86.9			

Stack Gas Temperature:	87.2 °F	547.2 °R
Average Velocity Head:	0.126 " of H_2O	
Stack Gas Velocity:		24.1 ft/second
Stack Gas Airflow:	787.6 acf/min	742.4 dscf/min

EPA METHODS 1, 2, 3C, AND 4
PSYCHROMETRIC MOISTURE
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX@CTL-M1-4 INLET	**Lab #:**	----	
Client:	Parametrix @ City of Tacoma Landfill	**Start Time:**	1338	hours
Location:	Tacoma, Washington	**Stop Time:**	1348	hours
Sample Site:	Perennial #1 Landfill Gas Combuster Inlet			
Sample Date:	7/20/07			
Run #:	3C - Method 2			
Operators:	TWG			

Wet Bulb Temperature (T_w):	80.0	° F
Dry Bulb Temperature (T_d):	93.3	° F
Vapor Pressure (VP):	0.8691	inches Hg
Saturated Vapor Pressure (SVP):	1.0326	inches Hg
Moisture:	2.95	%
Bws:	0.0295	
Pitot Tube C_p:	0.99	
Stack Width:		inches
Stack Length:		inches
Stack Diameter:	10.0	inches
Stack Area:	0.545	ft^2
Barometric Pressure:	29 65	inches Hg
Static Pressure:	6.5	inches H_2O
Stack Pressure:	30.13	inches Hg
Average Conc. O_2:	3.3	percent
Average Conc. CO_2:	22.6	percent
Average Conc. CH_4:	25.1	percent
Molecular Weight:	28.74	g/g-mole-dry
Molecular Weight:	28.42	g/g-mole-wet

Sample Point	Velocity (" of H_2O)	Temperature °F	Sample Point	Velocity (" of H_2O)	Temperature °F
6	0.12	92.5			
5	0.15	92.7			
4	0.13	92.9			
3	0.14	93.0			
2	0.16	92.9			
1	0.13	92.3			

Stack Gas Temperature:	92.7 °F	552.7 °R
Average Velocity Head:	0.138 " of H_2O	
Stack Gas Velocity:		25.3 ft/second
Stack Gas Airflow:	826.7 acf/min	771.7 dscf/min

INPUT PAGE: EPA METHOD 3C AND 25C
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

Gas Sum File Name:	8752-001\PX@CTL GASSUM-INLET
Client:	Parametrix @ City of Tacoma Landfill
Location:	Tacoma, Washington
Site Location:	Perennial #1 Landfill Gas Combuster Inlet

Run #	Date	Sample Length (minutes)	Airflow (dscf/min)
1	7/19/07	120	791.2
2	7/20/07	120	758.2
3A&B	7/20/07	120	758.6

Run #	Start Time	Stop Time	O_2 (%)	N_2 (%)	CO_2 (%)	CO (%)	CH_4 (%)	NMOC ppm
1	1510	1730	3.4	49.5	22.3	0.1	24.7	738
2	0831	1031	3.1	48.7	22.7	0.1	25.4	756
3A	1138	1338	3.3	49.0	22.6	0.1	25.1	446
3B	1138	1338	3.3	48.8	22.7	0.1	25.2	462
3A&B	1138	1338	3.3	48.9	22.7	0.1	25.2	454

Run #		O_2 (%)	N_2 (%)	CO_2 (%)	CO (%)	CH_4 (%)	NMOC ppm
1	Detection Limits	0.1	0.1	0.1	0.1	0.1	1.0
2	Detection Limits	0.1	0.1	0.1	0.1	0.1	1.0
3A&B	Detection Limits	0.1	0.1	0.1	0.1	0.1	1.0

Run #		O_2 (%)	N_2 (%)	CO_2 (%)	CO (%)	CH_4 (%)	NMOC ppm
1	Concentrations	3.4	49.5	22.3	0.1	24.7	738
2	Concentrations	3.1	48.7	22.7	0.1	25.4	756
3A&B	Concentrations	3.3	48.9	22.7	0.1	25.2	454

STRATA BIAS-CORRECTED DATA INPUT PAGE
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

Gas Sum File Name: 8752-001\PX@CTL GASSUM-OUT
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Site Location: Perennial #1 Landfill Gas Combuster Outlet

Run #	Sample Length	O_2 (%) Correction	Moisture B_{ws}	Airflow dscf/min	Hours per Year
1	240	NA	0.0817	9792 7	8760
2	120	NA	0.0758	10933	8760
3	120	NA	0.0867	10551	8760

For NMOC Calculations ONLY
From M25A (JUM) Analyzer

Date	Run #	Start Time	Stop Time	O_2 (%)	CO_2 (%)		CO (ppm)	SO_2 (ppm)	NO_x (ppm)	THC as CH_4 (wet - ppm)	METHANE (wet - ppm)
7/19/07	1	1510	1732	11.652	7.758		45.9	0.23	10.63	10.2	11.2
7/20/07	2	0831	1031	13.552	6.270		43.9	3.47	9.83	12.8	12.5
7/20/07	3	1138	1338	11.772	7.726		59.4	4.23	12.96	12.4	16.1

High Range of Span:	Run #	1	1000	100	100	1000	1000
High Range of Span:	Run #	2	1000	100	100	1000	1000
High Range of Span:	Run #	3	1000	100	100	1000	1000
DL % of Span (Normally 0.1%):			0.1%	0.1%	0.1%	0.1%	0.1%
DL ppm	Run #	1	1.0	0.1	0.1	1.0	1.0
DL ppm	Run #	2	1.0	0.1	0.1	1.0	1.0
DL ppm	Run #	3	1.0	0.1	0 1	1.0	1.0

CO (ppm)	SO2 (ppm)	NOx (ppm)	THC as CH_4 (wet - ppm)	METHANE (wet - ppm)
45.9	0.23	10.63	10.2	11.2
43.9	3.47	9.83	12.8	12.5
59.4	4.23	12.96	12.4	16.1

EPA METHODS 1, 2, 3, 4, AND 26A
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	6752-001\PX@CTL M26A	Lab #:	4504	
Client:	Parsmetrix @ City of Tacoma Landfill	Start Time:	1510	hours
Location:	Tacoma, Washington	Stop Time:	1745	hours
		Sample Length:	120	minutes
Sample Site:	Perennial #1 Landfill Gas Combustor Outlet			
Sample Date:	7/19/07			
Run #:	1 - Method 26A			
Operators:	Farwell Jr., Radonski			

Impinger Weights

Final grams	Initial grams	Net grams
645 9	549 6	96 3
675 0	643 4	31 6
583 8	576 4	7 4
972 7	953 2	19 5
Total H_2O Gain:		154.8
Total Volume (scf):		7.30
Measured Moisture (%):		8.17
Measured Bws:		0 0817
Psychrometric Moisture (%):		NA
Actual Moisture (%):		8.17
Actual Bws:		0 0817

Pitot Tube C_p:	0 84		
Nozzle Diameter:	0 974	inches	
Nozzle Area:	0 0052	ft^2	
Stack Width:		inches	
Stack Length:		inches	
Stack Diameter:	118 0	inches	
Stack Area:	75 9	ft^2	
Meter Temperature:	82 5	°F	
Barometric Pressure:	29 70	inches Hg	
Static Pressure:	-0.01	inches H_2O	
Stack Pressure:	29.70	inches Hg	
Orifice Pressure:	1 570	inches H_2O	
Meter Pressure:	29 82	inches Hg	
Initial Meter Volume (ft^3):	28 476		
Final Meter Volume (ft^3):	112 834		
Volume Sampled (ft^3):	84 358		
Standard Volume (dscf):	82 062		
Standard Volume (dscm):	2 324		
Y Factor:	1 003		
Delta H @:	1 941		
Average Conc. O_2:	11 7	percent	
Average Conc. CO_2:	7 8	percent	
Molecular Weight:	29.72	g/g-mole-dry	
Molecular Weight:	28 78	g/g-mole-wet	
Y Factor Cal. Check:	0 983		
Percent Error:	-4 2	%	

Sample Point	Velocity (" of H_2O)	Temperature °F	Sample Point	Velocity (" of H_2O)	Temperature °F
A 4	0 005	1440	C 4	0 006	1410
3	0.009	1427	3	0 008	1375
2	0.009	1474	2	0 007	1349
1	0 006	1467	1	0 006	1390
B 4	0 002	1451	D 4	0.003	1382
3	0.007	1438	3	0 005	1450
2	0 007	1329	2	0 003	1401
1	0 010	1238	1	0 009	1338

Percent Isokinetics:	103	%		
Stack Gas Temperature:	1397.4	°F	1857.4	°R
Average Velocity Head:	0 006	" of H_2O		
Stack Gas Velocity:			8.29	ft/second
Stack Gas Airflow:	37792	acf/min	9792.7	dscf/min

Hydrogen Chloride (HCl) Emissions

Chloride Detection Limit (g/mL):	0 05	
Total Volume of Sample (mL):	475	
Total Volume of Blank (mL):	400	
Dilution Factor:	1	
Chloride Sample Detection Limit (g):	24	
Chloride Blank Detection Limit (g):	20	
Chloride Concentration in Sample (g):	2200	
Chloride Concentration in Sample (mg):	2 20	
Chloride Concentration in Blank (g):	20	U
Chloride Concentration in Blank (mg):	0 020	U

Blank Corrected Results

Chloride Concentration in Sample (mg):	2 20	
HCl Concentration in Sample (mg):	2 28	
HCl Concentration in Air (mg/dscm):	0 974	
HCl Emission Concentration (ppm):	0 642	

Hydrogen Fluoride (HF) Emissions

Fluoride Detection Limit (g/mL):	0 05	
Total Volume of Sample (mL):	475	
Total Volume of Blank (mL):	400	
Dilution Factor:	1	
Fluoride Sample Detection Limit (g):	24	
Fluoride Blank Detection Limit (g):	20	
Fluoride Concentration in Sample (g):	1700	
Fluoride Concentration in Sample (mg):	1 70	
Fluoride Concentration in Blank (g):	20	U
Fluoride Concentration in Blank (mg):	0 020	U

Blank Corrected Results

Fluoride Concentration in Sample (mg):	1 70	
HF Concentration in Sample (mg):	1 79	
HF Concentration in Air (mg/dscm):	0 770	
HF Emission Concentration (ppm):	0 926	

EPA METHODS 1, 2, 3, 4, AND 26A
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX@CTL M26A	Lab #:	4505	
Client:	Parametrix @ City of Tacoma Landfill	Start Time:	0831	hours
Location:	Tacoma, Washington	Stop Time:	1042	hours
		Sample Length:	120	minutes
Sample Site:	Perennial #1 Landfill Gas Combuster Outlet			
Sample Date:	7/20/07			
Run #:	2 - Method 26A			
Operators:	Farwell Jr , Redonski			

Impinger Weights

Final grams	Initial grams	Net grams
972 1	875 0	97 1
768 0	728 4	39 6
576 4	572 4	4 0
913 9	890 9	23 0
Total H_2O Gain,		163 7

Total Volume (scf):	7 72		
Measured Moisture (%)	7 56		
Measured Bws:	0.0758		
Psychrometric Moisture (%).	NA		
Actual Moisture (%)	7 56		
Actual Bws	0 0758		
Initial Meter Volume (ft^3):	113 278		
Final Meter Volume (ft^3):	208 876		
Volume Sampled (ft^3)	95 598		
Standard Volume (dscf):	94 142		
Standard Volume (dscm):	2.666		
Y Factor:	1 003		
Delta H @:	1 941		
Pitot Tube C_p:	0.84		
Nozzle Diameter:	0 974	inches	
Nozzle Area:	0 0032	ft^2	
Stack Width:		inches	
Stack Length:		inches	
Stack Diameter:	118 0	inches	
Stack Area.	75 9	ft^2	
Meter Temperature:	75 6	°F	
Barometric Pressure:	29 85	inches Hg	
Static Pressure:	-0 01	inches H_2O	
Stack Pressure.	29.85	inches Hg	
Orifice Pressure.	2 026	inches H_2O	
Meter Pressure.	29.80	inches Hg	
Average Conc. O_2:	13 6	percent	
Average Conc. CO_2:	6 3	percent	
Molecular Weight:	29 55	g/g-mole-dry	
Molecular Weight:	28 68	g/g-mole-wet	
Y Factor Cal. Check:	0 962		
Percent Error:	-4 3	%	

Sample Point	Velocity (" of H_2O)	Temperature °F	Sample Point	Velocity (" of H_2O)	Temperature °F
A 4	0 007	1270	C 4	0 010	1225
3	0 005	1230	3	0 006	1258
2	0 010	1373	2	0 007	1379
1	0 006	1282	1	0 009	1362
B 4	0 006	1165	D 4	0 006	1182
3	0 007	1251	3	0 006	1491
2	0 007	1164	2	0 005	1445
1	0 006	1307	1	0 010	1223

Percent Isokinetics:	105	%		
Stack Gas Temperature:	1287 9	°F	1747 9	°R
Average Velocity Head	0 007	" of H_2O		
Stack Gas Velocity			8 67	ft/second
Stack Gas Airflow	39519	acf/min	10933	dscf/min

Hydrogen Chloride (HCl) Emissions

Chloride Detection Limit (g/mL):	0 05
Total Volume of Sample (mL):	459
	400
	1
Chloride Sample Detection Limit (g):	23
Chloride Blank Detection Limit (g):	20
Chloride Concentration in Sample (g)	1800
Chloride Concentration in Sample (mg).	1 80
Chloride Concentration in Blank (g).	20 U
Chloride Concentration in Blank (mg)	0 020 U

Blank Corrected Results

Chloride Concentration in Sample (mg):	1 80
HCl Concentration in Sample (mg).	1 85
HCl Concentration in Air (mg/dscm):	0 694
HCl Emission Concentration (ppm).	0 456

Hydrogen Fluoride (HF) Emissions

Fluoride Detection Limit (g/mL).	0 05
Total Volume of Sample (mL):	459
	400
	1
Fluoride Sample Detection Limit (g).	23
Fluoride Blank Detection Limit (g).	20
Fluoride Concentration in Sample (g)	1300
Fluoride Concentration in Sample (mg)	1 30
Fluoride Concentration in Blank (g)	20 U
Fluoride Concentration in Blank (mg):	0 020 U

Blank Corrected Results

Fluoride Concentration in Sample (mg):	1 30
HF Concentration in Sample (mg)	1 37
HF Concentration in Air (mg/dscm)	0 514
HF Emission Concentration (ppm)	0 617

EPA METHODS 1, 2, 3, 4, AND 26A
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001WPX@CTL M26A	Lab #:	4506	
Client:	Parametrix @ City of Tacoma Landfill	Start Time:	1138	hours
Location:	Tacoma, Washington	Stop Time:	1351	hours
		Sample Length:	120	minutes
Sample Site:	Perennial #1 Landfill Gas Combuster OutCet			
Sample Date:	7/20/07			
Run #:	3 - Method 26A			
Operators:	Farwell Jr , Radonski			

Impinger Weights

Final grams	Initial grams	Net grams
813 0	711 6	101 4
669 4	638 9	30 5
500 8	495 6	5 2
957 6	923 0	34 6
Total H_2O Gain:		171 7

Total Volume (scf)	8 10	
Measured Moisture (%)	8.87	
Measured Bws	0 0887	
Psychrometric Moisture (%)	NA	
Actual Moisture (%)	8 87	
Actual Bws	0 0887	
Initial Meter Volume (ft^3)	209 227	
Final Meter Volume (ft^3)	297 435	
Volume Sampled (ft^3)	88 208	
Standard Volume (dscf)	85 260	
Standard Volume (dscm)	2 415	
Y Factor	1 003	
Delta H @	1 941	

Pitot Tube C_p	0 84	
Nozzle Diameter	0 974	inches
Nozzle Area	0 0052	ft^2
Stack Width		inches
Stack Length		inches
Stack Diameter	116 0	inches
Stack Area	75 9	ft^2
Meter Temperature	85 5	°F
Barometric Pressure	29 85	inches Hg
Static Pressure	-0 01	inches H_2O
Stack Pressure	29 65	inches Hg
Orifice Pressure	1 894	inches H_2O
Meter Pressure	29 79	inches Hg
Average Conc. O_2	11 8	percent
Average Conc. CO_2	7 7	percent
Molecular Weight	29 70	g/g-mole-dry
Molecular Weight	28 69	g/g-mole-wet
Y Factor Cal Check	1 015	
Percent Error	1 2	%

Sample Point	Velocity (" of H_2O)	Temperature °F	Sample Point	Velocity (" of H_2O)	Temperature °F
A 4	0 005	1480	C 4	0 004	1373
3	0.009	1508	3	0 004	1545
2	0.010	1444	2	0 008	1419
1	0 007	1361	1	0 008	1334
B 4	0 007	1480	D 4	0 011	1393
3	0 005	1376	3	0 010	1322
2	0 010	1403	2	0 005	1345
1	0 010	1365	1	0 006	1410

Percent Isokinetics	99	%		
Stack Gas Temperature	1411.1	°F	1871 1	°R
Average Velocity Head	0 007	" of H_2O		
Stack Gas Velocity			9 07	ft/second
Stack Gas Airflow	41314	acf/min	10551	dscf/min

Hydrogen Chloride (HCl) Emissions

Chloride Detection Limit (g/mL)	0 05
Total Volume of Sample (mL)	460
	400
	1
Chloride Sample Detection Limit (g)	23
Chloride Blank Detection Limit (g)	20
Chloride Concentration in Sample (g)	2'00
Chloride Concentration in Sample (mg)	2 10
Chloride Concentration in Blank (g)	20 U
Chloride Concentration in Blank (mg)	0 020 U

Blank Corrected Results

Chloride Concentration in Sample (mg)	2.10
HCl Concentration in Sample (mg)	2 16
HCl Concentration in Air (mg/dscm)	0 894
HCl Emission Concentration (ppm)	0 590

Hydrogen Fluoride (HF) Emissions

Fluoride Detection Limit (g/mL)	0 05
Total Volume of Sample (mL)	460
	400
	1
Fluoride Sample Detection Limit (g)	23
Fluoride Blank Detection Limit (g)	20
Fluoride Concentration in Sample (g)	1200
Fluoride Concentration in Sample (mg)	1 20
Fluoride Concentration in Blank (g)	20 U
Fluoride Concentration in Blank (mg)	0 020 U

Blank Corrected Results

Fluoride Concentration in Sample (mg)	1 20
HF Concentration in Sample (mg)	1 26
HF Concentration in Air (mg/dscm)	0 523
HF Emission Concentration (ppm)	0 620

EMISSION CONCENTRATION RESULTS
TO-14A VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX@CTL TO-15	**Lab Number(s):**	4507	ATAQ
Client:	Parametrix @ City of Tacoma Landfill		I70784-27273	AAC
Location:	Tacoma, Washington			
Sample Dates:	7/19/07			
Sample Times:	1510 - 1730	**Airflow:**	791.2	dscf/min

ANALYTE	#1 Perennial Combuster Inlet Sample Run 1 µg/m³		#1 Perennial Combuster Inlet DL Run 1 µg/m³
Chlorodifluoromethane	1870		990
Propylene	4560		482
Dichlorodifluoromethane	1178	U	1178
Chloromethane	578	U	578
1,2-Dichloro-1,1,2,2-Tetrafluoroethane	1957	U	1957
Vinyl Chloride	991		715
Methanol	1834	U	1834
1,3-Butadiene	619	U	619
Bromomethane	1087	U	1087
Chloroethane	738	U	738
Dichlorofluoromethane	1178	U	1178
Ethanol	1055	U	1055
Vinyl Bromide	1224	U	1224
Acetone	1590		1330
Trichlorofluoromethane	1460	U	1460
Isopropyl Alcohol	1376	U	1376
Acrylonitrile	607	U	607
1,1-Dichloroethylene	1099	U	1099
Methylene Chloride	973	U	973
Allyl Chloride (Chloroprene)	876	U	876
Carbon Disulfide	872	U	872
1,1,2-Trichloro-1,2,2-Trifluoroethane	2145	U	2145
t-1,2-Dichloroethylene	1110	U	1110
1,1-Dichloroethane	1122	U	1122
MTBE	1009	U	1009
Vinyl Acetate	986	U	986
2-Butanone (MEK)	825	U	825
cis-1,2- Dichloroethene	1099	U	1099
Hexane	3100		987
Chloroform	1368	U	1368
Ethyl Acetate	1009	U	1009
Tetrahydrofuran	1010		825
1,2-Dichloroethane	1122	U	1122
1,1,1-Trichloroethane	1528	U	1528
Benzene	1380		893
Carbon Tetrachloride	1763	U	1763
Cyclohexane	1740		963
1,2-Dichloropropane	1294	U	1294
Bromodichloromethane	1675	U	1675
1,4-Dioxane	1009	U	1009
Trichloroethene	1500	U	1500
2,2,4-Trimethylpentane	1308	U	1308
Heptane	4340		1147
cis-1,3-Dichloropropene	1248	U	1248
4-Methyl-2-Pentanone (MiBK)	1147	U	1147
t-1,3-Dichloropropene	1248	U	1248
1,1,2-Trichloroethane	1522	U	1522
Toluene	6370		1053
2-Hexanone	1147	U	1147
Dibromochloromethane	2384	U	2384
1,2-Dibromoethane	2118	U	2118
Tetrachloroethylene	1900	U	1900
Chlorobenzene	1288	U	1288
Ethylbenzene	16900		1213
m- & p-Xylenes	14700		2427
Bromoform	8680	U	8680
Styrene	1192	U	1192
1,1,2,2-Tetrachloroethane	1923	U	1923
o-Xylene	3760		1213
4-Ethyltoluene	1376	U	1376
1,3,5-Trimethylbenzene	1420		1374
1,2,4-Trimethylbenzene	4030		1374
Benzyl Chloride	7245	U	7245
1,3-Dichlorobenzene	1683	U	1683
1,4-Dichlorobenzene	1683	U	1683
1,2-Dichlorobenzene	1683	U	1683
1,2,4-Trichlorobenzene	2077	U	2077
Hexachlorobutadiene	2985	U	2985

U = undetected at specified detection limit (DL)

EMISSION CONCENTRATION RESULTS
TO-14A VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX@CTL TO-15	**Lab Number(s):**	4508	ATAQ
Client:	Parametrix @ City of Tacoma Landfill		70785-27274	AAC
Location:	Tacoma, Washington			
Sample Dates:	7/20/07			
Sample Times:	0831 - 1031	**Airflow:**	758.2	dscf/min

ANALYTE	#1 Perennial Combuster Inlet Sample Run 2 µg/m³		DL Run 2 µg/m³
Chlorodifluoromethane	2060		909
Propylene	4950		442
Dichlorodifluoromethane	1082	U	1082
Chloromethane	531	U	531
1,2-Dichloro-1,1,2,2-Tetrafluoroethane	1797	U	1797
Vinyl Chloride	1180		657
Methanol	1684	U	1684
1,3-Butadiene	569	U	569
Bromomethane	998	U	998
Chloroethane	678	U	678
Dichlorofluoromethane	1082	U	1082
Ethanol	969	U	969
Vinyl Bromide	1124	U	1124
Acetone	1221	U	1221
Trichlorofluoromethane	1340	U	1340
Isopropyl Alcohol	1264	U	1264
Acrylonitrile	558	U	558
1,1-Dichloroethylene	1009	U	1009
Methylene Chloride	894	U	894
Allyl Chloride (Chloroprene)	805	U	805
Carbon Disulfide	800	U	800
1,1,2-Trichloro-1,2,2-Trifluoroethane	1970	U	1970
t-1,2-Dichloroethylene	1019	U	1019
1,1-Dichloroethane	1030	U	1030
MTBE	927	U	927
Vinyl Acetate	905	U	905
2-Butanone (MEK)	758	U	758
cis-1,2- Dichloroethene	1009	U	1009
Hexane	2770		906
Chloroform	1256	U	1256
Ethyl Acetate	926	U	926
Tetrahydrofuran	1020		758
1,2-Dichloroethane	1030	U	1030
1,1,1-Trichloroethane	1403	U	1403
Benzene	1330		820
Carbon Tetrachloride	1619	U	1619
Cyclohexane	1510		885
1,2-Dichloropropane	1188	U	1188
Bromodichloromethane	1722	U	1722
1,4-Dioxane	926	U	926
Trichloroethene	1377	U	1377
2,2,4-Trimethylpentane	1201	U	1201
Heptane	3890		1053
cis-1,3-Dichloropropene	1146	U	1146
4-Methyl-2-Pentanone (MiBK)	1053	U	1053
t-1,3-Dichloropropene	1146	U	1146
1,1,2-Trichloroethane	1398	U	1398
Toluene	6380		967
2-Hexanone	1053	U	1053
Dibromochloromethane	2190	U	2190
1,2-Dibromoethane	1945	U	1945
Tetrachloroethylene	1745	U	1745
Chlorobenzene	1183	U	1183
Ethylbenzene	17500		1114
m- & p-Xylenes	15200		2229
Bromoform	7971	U	7971
Styrene	1095	U	1095
1,1,2,2-Tetrachloroethane	1766	U	1766
o-Xylene	3780		1114
4-Ethyltoluene	1264	U	1264
1,3,5-Trimethylbenzene	1370		1262
1,2,4-Trimethylbenzene	3810		1262
Benzyl Chloride	6654	U	6654
1,3-Dichlorobenzene	1545	U	1545
1,4-Dichlorobenzene	1545	U	1545
1,2-Dichlorobenzene	1545	U	1545
1,2,4-Trichlorobenzene	1908	U	1908
Hexachlorobutadiene	2741	U	2741

U = undetected at specified detection limit (DL)

EMISSION CONCENTRATION RESULTS
TO-14A VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX@CTL TO-15	Lab Number(s):	4509	ATAQ
Client:	Parametrix @ City of Tacoma Landfill		70784-27275	AAC
Location:	Tacoma, Washington			
Sample Dates:	7/20/07			
Sample Times:	1138 - 1338	Airflow:	758.6	dscf/mn

	#1 Perennial Combuster Inlet			
	Sampla Run 3a		DL Run 3a	
ANALYTE	µg/m³		µg/m³	
Chlorodifluoromethane	2070		950	
Propylene	4930		462	
Dichlorodifluoromethane	1131	U	1131	
Chloromethane	555	U	555	
1,2-Dichloro-1,1,2,2-Tetrafluoroethane	1877	U	1877	
Vinyl Chloride	1160		667	
Methanol	1760	U	1760	
1,3-Butadiene	594	U	594	
Bromomethane	1043	U	1043	
Chloroethane	709	U	709	
Dichlorofluoromethane	1131	U	1131	
Ethanol	1012	U	1012	
Vinyl Bromide	1175	U	1175	
Acetone	1276	U	1276	
Trichlorofluoromethane	1401	U	1401	
Isopropyl Alcohol	1320	U	1320	
Acrylonitrile	583	U	583	
1,1-Dichloroethylene	1055	U	1055	
Methylene Chloride	934	U	934	
Allyl Chloride (Chloroprene)	841	U	841	
Carbon Disulfide	836	U	836	
1,1,2-Trichloro-1,2,2-Trifluoroethane	2058	U	2058	
t-1,2-Dichloroethylene	1065	U	1065	
1,1-Dichloroethane	1077	U	1077	
MTBE	968	U	968	
Vinyl Acetate	946	U	946	
2-Butanone (MEK)	792	U	792	
cis-1,2- Dichloroethene	1055	U	1055	
Hexane	2690		947	
Chloroform	1313	U	1313	
Ethyl Acetate	968	U	968	
Tetrahydrofuran	1020		792	
1,2-Dichloroethane	1077	U	1077	
1,1,1-Trichloroethane	1466	U	1466	
Benzene	1360		857	
Carbon Tetrachloride	1692	U	1692	
Cyclohexane	1510		924	
1,2-Dichloropropane	1241	U	1241	
Bromodichloromethane	1800	U	1800	
1,4-Dioxane	968	U	968	
Trichloroethene	1439	U	1439	
2,2,4-Trimethylpentane	1255	U	1255	
Heptane	3890		1101	
cis-1,3-Dichloropropene	1197	U	1197	
4-Methyl-2-Pentanone (MIBK)	1100	U	1100	
t-1,3-Dichloropropene	1197	U	1197	
1,1,2-Trichloroethane	1461	U	1461	
Toluene	6460		1011	
2-Hexanone	1100	U	1100	
Dibromochloromethane	2288	U	2288	
1,2-Dibromoethane	2032	U	2032	
Tetrachloroethylene	1823	U	1823	
Chlorobenzene	1236	U	1236	
Ethylbenzene	18200		1164	
m- & p-Xylenes	15700		2329	
Bromoform	8329	U	8329	
Styrene	1144	U	1144	
1,1,2,2-Tetrachloroethane	1845	U	1845	
o-Xylene	3870		1164	
4-Ethyltoluene	1320	U	1320	
1,3,5-Trimethylbenzene	1480		1318	
1,2,4-Trimethylbenzene	4150		1318	
Benzyl Chloride	6953	U	6953	
1,3-Dichlorobenzene	1615	U	1615	
1,4-Dichlorobenzene	1615	U	1615	
1,2-Dichlorobenzene	1615	U	1615	
1,2,4-Trichlorobenzene	1993	U	1993	
Hexachlorobutadiene	2864	U	2864	

U = undetected at specified detection limit (DL)

EMISSION CONCENTRATION RESULTS
TO-14A VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001PX@CTL TO-15	Lab Number(s):	4510	ATAO
Client:	Parametrix @ City of Tacoma Landfill		70764-27276	AAC
Location:	Tacoma, Washington			
Sample Dates:	7/20/07			
Sample Times:	1138 - 1338	Airflow:	758.6	dscf/min

ANALYTE	#1 Perennial Combuster Inlet Sample Run 3b µg/m³		DL Run 3b µg/m³
Chlorodifluoromethane	1900		898
Propylene	4540		437
Dichlorodifluoromethane	1069	U	1069
Chloromethane	524	U	524
1,2-Dichloro-1,1,2,2-Tetrafluoroethane	1775	U	1775
Vinyl Chloride	1070		649
Methanol	1663	U	1663
1,3-Butadiene	562	U	562
Bromomethane	986	U	986
Chloroethane	670	U	670
Dichlorofluoromethane	1069	U	1069
Ethanol	957	U	957
Vinyl Bromide	1111	U	1111
Acetone	1206	U	1206
Trichlorofluoromethane	1324	U	1324
Isopropyl Alcohol	1248	U	1248
Acrylonitrile	551	U	551
1,1-Dichloroethylene	997	U	997
Methylene Chloride	883	U	883
Allyl Chloride (Chloroprene)	795	U	795
Carbon Disulfide	791	U	791
1,1,2-Trichloro-1,2,2-Trifluoroethane	1946	U	1946
t-1,2-Dichloroethylene	1007	U	1007
1,1-Dichloroethane	1018	U	1018
MTBE	915	U	915
Vinyl Acetate	894	U	894
2-Butanone (MEK)	749	U	749
cis-1,2- Dichloroethene	997	U	997
Hexane	2500		895
Chloroform	1241	U	1241
Ethyl Acetate	915	U	915
Tetrahydrofuran	920		749
1,2-Dichloroethane	1018	U	1018
1,1,1-Trichloroethane	1386	U	1386
Benzene	1230		810
Carbon Tetrachloride	1599	U	1599
Cyclohexane	1330		874
1,2-Dichloropropane	1173	U	1173
Bromodichloromethane	1701	U	1701
1,4-Dioxane	915	U	915
Trichloroethene	1360	U	1360
2,2,4-Trimethylpentane	1186	U	1186
Heptane	3440		1041
cis-1,3-Dichloropropene	1132	U	1132
4-Methyl-2-Pentanone (MIBK)	1040	U	1040
t-1,3-Dichloropropene	1132	U	1132
1,1,2-Trichloroethane	1381	U	1381
Toluene	5740		955
2-Hexanone	1040	U	1040
Dibromochloromethane	2163	U	2163
1,2-Dibromoethane	1921	U	1921
Tetrachloroethylene	1724	U	1724
Chlorobenzene	1168	U	1168
Ethylbenzene	15600		1101
m- & p-Xylenes	13400		2201
Bromoform	7873	U	7873
Styrene	1081	U	1081
1,1,2,2-Tetrachloroethane	1744	U	1744
o-Xylene	3320		1101
4-Ethyltoluene	1248	U	1248
1,3,5-Trimethylbenzene	1246	U	1246
1,2,4-Trimethylbenzene	3370		1246
Benzyl Chloride	6572	U	6572
1,3-Dichlorobenzene	1526	U	1526
1,4-Dichlorobenzene	1526	U	1526
1,2-Dichlorobenzene	1526	U	1526
1,2,4-Trichlorobenzene	1884	U	1884
Hexachlorobutadiene	2708	U	2708

U = undetected at specified detection limit (DL).

EMISSION RATE RESULTS
TO-14A VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752 001PX@CTL TO-15	**Lab Number(s):**	4507	ATAG
Client:	Parametrix @ City of Tacoma Landfill		0784-27273	AAC
Location:	Tacoma, Washington			
Sample Dates:	7/19/07			
Sample Times:	1510 - 1730	**Airflow:**	791 2	dscf/min

	#1 Perennial Combuster Inlet	
	Sample Run 1	OL Run 1
ANALYTE	lb/hr	lb/hr
Chlorodifluoromethane	5 54E-03	2 93E-03
Propylene	1 35E-02	1 43E-03
Dichlorodifluoromethane	3 49E-03 U	3 49E-03
Chloromethane	1.71E-03 U	1 71E-03
1,2-Dichloro-1,1,2,2-Tetrafluoroethane	5 80E-03 U	5 80E-03
Vinyl Chloride	2 94E-03	2 12E-03
Methanol	5 44E-03 U	5 44E-03
1,3-Butadiene	1 83E-03 U	1 83E-03
Bromomethane	3.22E-03 U	3 22E-03
Chloroethane	2 19E-03 U	2 19E-03
Dichlorofluoromethane	3.49E-03 U	3 49E-03
Ethanol	3 13E-03 U	3 13E-03
Vinyl Bromide	3 63E-03 U	3 63E-03
Acetone	4 71E-03	3 94E-03
Trichlorofluoromethane	4 33E-03 U	4 33E-03
Isopropyl Alcohol	4 08E-03 U	4 08E-03
Acrylonitrile	1.80E-03 U	1 80E-03
1,1-Dichloroethylene	3 26E-03 U	3 26E-03
Methylene Chloride	2 88E-03 U	2 88E-03
Allyl Chloride (Chloroprene)	2 60E-03 U	2 60E-03
Carbon Disulfide	2 58E-03 U	2 58E-03
1,1,2-Trichloro-1,2,2-Trifluoroethane	6 36E-03 U	6 36E-03
t-1,2-Dichloroethylene	3 29E-03 U	3 29E-03
1,1-Dichloroethane	3 33E-03 U	3 33E-03
MTBE	2 99E-03 U	2 99E-03
Vinyl Acetate	2 92E-03 U	2.92E-03
2-Butanone (MEK)	2 45E-03 U	2 45E-03
cis-1,2- Dichloroethene	3.26E-03 U	3 26E-03
Hexane	9 19E-03	2 93E-03
Chloroform	4.05E-03 U	4 05E-03
Ethyl Acetate	2 99E-03 U	2 99E-03
Tetrahydrofuran	2 99E-03	2 45E-03
1,2-Dichloroethane	3 33E-03 U	3 33E-03
1,1,1-Trichloroethane	4 53E-03 U	4 53E-03
Benzene	4 09E-03	2 65E-03
Carbon Tetrachloride	5.23E-03 U	5 23E-03
Cyclohexane	5.15E-03	2 85E-03
1,2-Dichloropropane	3 84E-03 U	3 84E-03
Bromodichloromethane	5 56E-03 U	5 56E-03
1,4-Dioxane	2 99E-03 U	2 99E-03
Trichloroethene	4 45E-03 U	4 45E-03
2,2,4-Trimethylpentane	3 88E-03 U	3 88E-03
Heptane	1.29E-02	3 40E-03
cis-1,3-Dichloropropene	3 70E-03 U	3 70E-03
4-Methyl-2-Pentanone (MIBK)	3 40E-03 U	3 40E-03
t-1,3-Dichloropropene	3 70E-03 U	3 70E-03
1,1,2-Trichloroethane	4 51E-03 U	4 51E-03
Toluene	1 89E-02	3 12E-03
2-Hexanone	3.40E-03 U	3 40E-03
Dibromochloromethane	7.07E-03 U	7 07E-03
1,2-Dibromoethane	6 28E-03 U	6 28E-03
Tetrachloroethylene	5 63E-03 U	5 63E-03
Chlorobenzene	3 82E-03 U	3 82E-03
Ethylbenzene	5 01E-02	3 60E-03
m- & p-Xylenes	4 36E-02	7 19E-03
Bromoform	2 57E-02 U	2 57E-02
Styrene	3 53E-03 U	3 53E-03
1,1,2,2-Tetrachloroethane	5 70E-03 U	5 70E-03
o-Xylene	1 11E-02	3 60E-03
4-Ethyltoluene	4 08E-03 U	4 08E-03
1,3,5-Trimethylbenzene	4 21E-03	4 07E-03
1,2,4-Trimethylbenzene	1 19E-02	4 07E-03
Benzyl Chloride	2.15E-02 U	2 15E-02
1,3-Dichlorobenzene	4 99E-03 U	4 99E-03
1,4-Dichlorobenzene	4 99E-03 U	4 99E-03
1,2-Dichlorobenzene	4 99E-03 U	4 99E-03
1,2,4-Trichlorobenzene	6 16E-03 U	6 16E-03
Hexachlorobutadiene	8 85E-03 U	8 85E-03

U = undetected at specified detection limit (DL)

EMISSION RATE RESULTS
TO-14A VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX@CTL TO-15	**Lab Number(s):**	4508	ATAQ
Client:	Parametrix @ City of Tacoma Landfill		0785-27274	AAC
Location:	Tacoma, Washington			
Sample Dates:	7/20/07			
Sample Times:	0831 - 1031	**Airflow:**	758.2	dscf/mn

	#1 Perennial Combuster Inlet	
	Sample Run 2	DL Run 2
ANALYTE	lb/hr	lb/hr
Chlorodifluoromethane	5.85E-03	2.58E-03
Propylene	1.41E-02	1.26E-03
Dichlorodifluoromethane	3.07E-03 U	3.07E-03
Chloromethane	1.51E-03 U	1.51E-03
1,2-Dichloro-1,1,2,2-Tetrafluoroethane	5.10E-03 U	5.10E-03
Vinyl Chloride	3.35E-03	1.87E-03
Methanol	4.78E-03 U	4.78E-03
1,3-Butadiene	1.62E-03 U	1.62E-03
Bromomethane	2.83E-03 U	2.83E-03
Chloroethane	1.93E-03 U	1.93E-03
Dichlorofluoromethane	3.07E-03 U	3.07E-03
Ethanol	2.75E-03 U	2.75E-03
Vinyl Bromide	3.18E-03 U	3.18E-03
Acetone	3.47E-03 U	3.47E-03
Trichlorofluoromethane	3.81E-03 U	3.81E-03
Isopropyl Alcohol	3.59E-03 U	3.59E-03
Acrylonitrile	1.58E-03 U	1.58E-03
1,1-Dichloroethylene	2.87E-03 U	2.87E-03
Methylene Chloride	2.54E-03 U	2.54E-03
Allyl Chloride (Chloroprene)	2.29E-03 U	2.29E-03
Carbon Disulfide	2.27E-03 U	2.27E-03
1,1,2-Trichloro-1,2,2-Trifluoroethane	5.60E-03 U	5.60E-03
t-1,2-Dichloroethylene	2.89E-03 U	2.89E-03
1,1-Dichloroethane	2.93E-03 U	2.93E-03
MTBE	2.63E-03 U	2.63E-03
Vinyl Acetate	2.57E-03 U	2.57E-03
2-Butanone (MEK)	2.15E-03 U	2.15E-03
cis-1,2- Dichloroethene	2.87E-03 U	2.87E-03
Hexane	7.87E-03	2.57E-03
Chloroform	3.57E-03 U	3.57E-03
Ethyl Acetate	2.63E-03 U	2.63E-03
Tetrahydrofuran	2.90E-03	2.15E-03
1,2-Dichloroethane	2.93E-03 U	2.93E-03
1,1,1-Trichloroethane	3.98E-03 U	3.98E-03
Benzene	3.78E-03	2.33E-03
Carbon Tetrachloride	4.60E-03 U	4.60E-03
Cyclohexane	4.29E-03	2.51E-03
1,2-Dichloropropane	3.37E-03 U	3.37E-03
Bromodichloromethane	4.69E-03 U	4.69E-03
1,4-Dioxane	2.63E-03 U	2.63E-03
Trichloroethene	3.91E-03 U	3.91E-03
2,2,4-Trimethylpentane	3.41E-03 U	3.41E-03
Heptane	1.10E-02	2.99E-03
cis-1,3-Dichloropropene	3.25E-03 U	3.25E-03
4-Methyl-2-Pentanone (MIBK)	2.99E-03 U	2.99E-03
t-1,3-Dichloropropene	3.25E-03 U	3.25E-03
1,1,2-Trichloroethane	3.97E-03 U	3.97E-03
Toluene	1.61E-02	2.75E-03
2-Hexanone	2.99E-03 U	2.99E-03
Dibromochloromethane	6.22E-03 U	6.22E-03
1,2-Dibromoethane	5.52E-03 U	5.52E-03
Tetrachloroethylene	4.96E-03 U	4.96E-03
Chlorobenzene	3.36E-03 U	3.36E-03
Ethylbenzene	4.97E-02	3.16E-03
m- & p-Xylenes	4.32E-02	6.33E-03
Bromoform	2.26E-02 U	2.26E-02
Styrene	3.11E-03 U	3.11E-03
1,1,2,2-Tetrachloroethane	5.02E-03 U	5.02E-03
o-Xylene	1.07E-02	3.18E-03
4-Ethyltoluene	3.59E-03 U	3.59E-03
1,3,5-Trimethylbenzene	3.89E-03	3.58E-03
1,2,4-Trimethylbenzene	1.08E-02	3.58E-03
Benzyl Chloride	1.89E-02 U	1.89E-02
1,3-Dichlorobenzene	4.39E-03 U	4.39E-03
1,4-Dichlorobenzene	4.39E-03 U	4.39E-03
1,2-Dichlorobenzene	4.39E-03 U	4.39E-03
1,2,4-Trichlorobenzene	5.42E-03 U	5.42E-03
Hexachlorobutadiene	7.78E-03 U	7.78E-03

U = undetected at specified detection limit (DL)

EMISSION RATE RESULTS
TO-14A VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX@CTL TO-15	**Lab Number(s):**	4509	ATAQ
Client:	Parametrix @ City of Tacoma Landfill		0784-27275	AAC
Location:	Tacoma, Washington			
Sample Dates:	7/20/07			
Sample Times:	1138 - 1338	**Airflow:**	758 6	dscf/mn

	#1 Perennial Combuster Inlet	
	Sample Run 3a	DL Run 3a
ANALYTE	lb/hr	lb/hr
Chlorodifluoromethane	5 88E-03	2 70E-03
Propylene	1 40E-02	1 31E-03
Dichlorodifluoromethane	3 21E-03 U	3 21E-03
Chloromethane	1 58E-03 U	1 58E-03
1,2-Dichloro-1,1 2,2-Tetrafluoroethane	5 33E-03 U	5 33E-03
Vinyl Chloride	3 30E-03	1 95E-03
Methanol	5 00E-03 U	5 00E-03
1,3-Butadiene	1 69E-03 U	1 69E-03
Bromomethane	2 96E-03 U	2 96E-03
Chloroethane	2 01E-03 U	2 01E-03
Dichlorofluoromethane	3 21E-03 U	3 21E-03
Ethanol	2 88E-03 U	2 88E-03
Vinyl Bromide	3 34E-03 U	3 34E-03
Acetone	3 63E-03 U	3 63E-03
Trichlorofluoromethane	3 98E-03 U	3 98E-03
Isopropyl Alcohol	3 75E-03 U	3 75E-03
Acrylonitrile	1 66E-03 U	1 66E-03
1,1-Dichloroethylene	3 00E-03 U	3 00E-03
Methylene Chloride	2 65E-03 U	2 65E-03
Allyl Chloride (Chloroprene)	2.39E-03 U	2 39E-03
Carbon Disulfide	2 38E-03 U	2 38E-03
1,1,2-Trichloro-1,2,2-Trifluoroethane	5 85E-03 U	5 85E-03
t-1 2-Dichloroethylene	3 03E-03 U	3 03E-03
1,1-Dichloroethane	3 06E-03 U	3 06E-03
MTBE	2.75E-03 U	2 75E-03
Vinyl Acetate	2 69E-03 U	2 69E-03
2-Butanone (MEK)	2 25E-03 U	2 25E-03
cis-1,2- Dichloroethene	3 00E-03 U	3 00E-03
Hexane	7 64E-03	2 69E-03
Chloroform	3.73E-03 U	3 73E-03
Ethyl Acetate	2.75E-03 U	2 75E-03
Tetrahydrofuran	2 90E-03	2 25E-03
1 2-Dichloroethane	3 06E-03 U	3 06E-03
1,1,1-Trichloroethane	4 17E-03 U	4 17E-03
Benzene	3 66E-03	2 44E-03
Carbon Tetrachloride	4 81E-03 U	4 81E-03
Cyclohexane	4 29E-03	2 63E-03
1,2-Dichloropropane	3.53E-03 U	3 53E-03
Bromodichloromethane	5 12E-03 U	5 12E-03
1,4-Dioxane	2.75E-03 U	2 75E-03
Trichloroethene	4 09E-03 U	4 09E-03
2,2,4-Trimethylpentane	3 57E-03 U	3 57E-03
Heptane	1 11E-02	3 13E-03
cis-1,3-Dichloropropene	3 40E-03 U	3 40E-03
4-Methyl-2-Pentanone (MIBK)	3 13E-03 U	3 13E-03
t-1,3-Dichloropropene	3 40E-03 U	3 40E-03
1 1,2-Trichloroethene	4 15E-03 U	4 15E-03
Toluene	1 84E-02	2 87E-03
2-Hexanone	3 13E-03 U	3 13E-03
Dibromochloromethane	6 50E-03 U	6 50E-03
1,2-Dibromoethene	5 77E-03 U	5 77E-03
Tetrachloroethylene	5 18E-03 U	5 18E-03
Chlorobenzene	3 51E-03 U	3 51E-03
Ethylbenzene	5 17E-02	3 31E-03
m- & p-Xylenes	4 48E-02	6 62E-03
Bromoform	2 37E-02 U	2 37E-02
Styrene	3 25E-03 U	3 25E-03
1,1,2,2-Tetrachloroethane	5 24E-03 U	5 24E-03
o-Xylene	1 10E-02	3 31E-03
4-Ethyltoluene	3 75E-03 U	3 75E-03
1,3,5-Trimethylbenzene	4.21E-03	3 75E-03
1,2,4-Trimethylbenzene	1 18E-02	3 75E-03
Benzyl Chloride	1 98E-02 U	1 98E-02
1,3-Dichlorobenzene	4 59E-03 U	4 59E-03
1,4-Dichlorobenzene	4 59E-03 U	4 59E-03
1,2-Dichlorobenzene	4 59E-03 U	4 59E-03
1,2,4-Trichlorobenzene	5 66E-03 U	5 66E-03
Hexachlorobutadiene	8 14E-03 U	8 14E-03

U = undetected at specified detection limit (DL)

EMISSION RATE RESULTS
TO-14A VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX@CTL TO-15	**Lab Number(s):**	4510	ATAQ
Client:	Parametrix @ City of Tacoma Landfill		0784-27278	AAC
Location:	Tacoma, Washington			
Sample Dates:	7/20/07			
Sample Times:	1138 - 1338	**Airflow:**	758 8	dscf/min

	#1 Perennial Combuster Inlet	
	Sample Run 3b lb/hr	DL Run 3b lb/hr
ANALYTE		
Chlorodifluoromethane	5 40E-03	2 55E-03
Propylene	1 29E-02	1 24E-03
Dichlorodifluoromethane	3 04E-03 U	3 04E-03
Chloromethane	1 49E-03 U	1 49E-03
1,2-Dichloro-1,1,2,2-Tetrafluoroethane	5.04E-03 U	5 04E-03
Vinyl Chloride	3 04E-03	1 84E-03
Methanol	4.73E-03 U	4 73E-03
1,3-Butadiene	1 60E-03 U	1 60E-03
Bromomethane	2 80E-03 U	2 80E-03
Chloroethane	1 90E-03 U	1 90E-03
Dichlorofluoromethane	3 04E-03 U	3 04E-03
Ethanol	2 72E-03 U	2 72E-03
Vinyl Bromide	3 16E-03 U	3 16E-03
Acetone	3 43E-03 U	3 43E-03
Trichlorofluoromethane	3.76E-03 U	3 76E-03
Isopropyl Alcohol	3.55E-03 U	3 55E-03
Acrylonitrile	1 57E-03 U	1 57E-03
1,1-Dichloroethylene	2 83E-03 U	2 83E-03
Methylene Chloride	2 51E-03 U	2 51E-03
Allyl Chloride (Chloroprene)	2 26E-03 U	2 26E-03
Carbon Disulfide	2 25E-03 U	2 25E-03
1,1,2-Trichloro-1,2,2-Trifluoroethane	5 53E-03 U	5 53E-03
t-1,2-Dichloroethylene	2 86E-03 U	2 86E-03
1,1-Dichloroethane	2 89E-03 U	2 89E-03
MTBE	2.60E-03 U	2 60E-03
Vinyl Acetate	2 54E-03 U	2 54E-03
2-Butanone (MEK)	2 13E-03 U	2 13E-03
cis-1,2- Dichloroethene	2 83E-03 U	2 83E-03
Hexane	7.10E-03	2 54E-03
Chloroform	3.53E-03 U	3 53E-03
Ethyl Acetate	2.60E-03 U	2 60E-03
Tetrahydrofuran	2 61E-03	2 13E-03
1,2-Dichloroethane	2 89E-03 U	2 89E-03
1,1,1-Trichloroethane	3 94E-03 U	3 94E-03
Benzene	3 50E-03	2 30E-03
Carbon Tetrachloride	4 54E-03 U	4 54E-03
Cyclohexane	3.78E-03	2 48E-03
1,2-Dichloropropane	3 33E-03 U	3 33E-03
Bromodichloromethane	4 83E-03 U	4 83E-03
1,4-Dioxane	2 60E-03 U	2 60E-03
Trichloroethene	3.86E-03 U	3 86E-03
2 2,4-Trimethylpentane	3.37E-03 U	3 37E-03
Heptane	9.78E-03	2 96E-03
cis-1,3-Dichloropropene	3 22E-03 U	3 22E-03
4-Methyl-2-Pentanone (MIBK)	2 96E-03 U	2 96E-03
t-1,3-Dichloropropene	3 22E-03 U	3 22E-03
1,1 2-Trichloroethane	3 92E-03 U	3 92E-03
Toluene	1 83E-02	2 71E-03
2-Hexanone	2 96E-03 U	2 96E-03
Dibromochloromethane	8 15E-03 U	6 15E-03
1,2-Dibromoethane	5 46E-03 U	5 46E-03
Tetrachloroethylene	4 90E-03 U	4 90E-03
Chlorobenzene	3 32E-03 U	3 32E-03
Ethylbenzene	4 43E-02	3 13E-03
m- & p-Xylenes	3 81E-02	6 26E-03
Bromoform	2 24E-02 U	2 24E-02
Styrene	3 07E-03 U	3 07E-03
1,1,2,2-Tetrachloroethane	4 96E-03 U	4 96E-03
o-Xylene	9 44E-03	3 13E-03
4-Ethyltoluene	3 55E-03 U	3 55E-03
1,3,5-Trimethylbenzene	3 54E-03 U	3 54E-03
1 2,4-Trimethylbenzene	9 58E-03	3 54E-03
Benzyl Chloride	1 87E-02 U	1 87E-02
1,3-Dichlorobenzene	4 34E-03 U	4 34E-03
1,4-Dichlorobenzene	4 34E-03 U	4 34E-03
1,2-Dichlorobenzene	4 34E-03 U	4 34E-03
1,2,4-Trichlorobenzene	5 35E-03 U	5 35E-03
Hexachlorobutadiene	7 70E-03 U	7 70E-03

U = undetected at specified detection limit (DL)

SUMMARY OF SW-846 METHOD 0031 SAMPLE VOLUMES
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX @ CTL M0031
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington

	Perennial #1 Landfill Gas Combuster Outlet			
	Run 1A	Run 1B	Run 1C	Average
Lab #:	4511	4512	4513	
Date:	7/19/07	7/19/07	7/19/07	
Start Time:	1510	1620	1719	
Stop Time:	1610	1700	1759	
Sample Length (minutes):	40	40	40	
Volume Sampled (dscm):	0.0193	0.0191	0.0191	0.0192
Stack Gas Moisture (%):	8.17	8.17	8.17	8.17
Barometric Pressure ("Hg):	29.70	29.70	29.70	29.70
Stack Gas Airflow (dscf/min):	9792.7	9792.7	9792.7	9792.7

SUMMARY OF SW-846 METHOD 0031 SAMPLE VOLUMES
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX @ CTL M0031
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington

	Perennial #1 Landfill Gas Combuster Outlet			
	Run 2A	Run 2B	Run 2C	Average
Lab #:	4514	4515	4516	
Date:	7/20/07	7/20/07	7/20/07	
Start Time:	0831	0926	1028	
Stop Time:	0911	1006	1108	
Sample Length (minutes):	40	40	40	
Volume Sampled (dscm):	0.0195	0.0193	0.0197	0.0195
Stack Gas Moisture (%):	7.58	7.58	7.58	7.58
Barometric Pressure ("Hg):	29.65	29.65	29.65	29.65
Stack Gas Airflow (dscf/min):	10933	10933	10933	10933

SUMMARY OF SW-846 METHOD 0031 SAMPLE VOLUMES
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX @ CTL M0031
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington

	Perennial #1 Landfill Gas Combuster Outlet			
	Run 3A	Run 3B	Run 3C	Average
Lab #:	4517	4518	4519	
Date:	7/20/07	7/20/07	7/20/07	
Start Time:	1138	1232	1325	
Stop Time:	1218	1312	1405	
Sample Length (minutes):	40	40	40	
Volume Sampled (dscm):	0.0199	0.0191	0.0194	0.0195
Stack Gas Moisture (%):	8.67	8.67	8.67	8.67
Barometric Pressure ("Hg):	29.65	29.65	29.65	29.65
Stack Gas Airflow (dscf/min):	10551	10551	10551	10551

SW-846 METHOD 0031 SAMPLE VOLUMES
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	**Lab #:**	4511	
Client:	Parametrix @ City of Tacoma Landfill	**Start Time:**	1510	hours
Location:	Tacoma, Washington	**Stop Time:**	1610	hours
Sample Site:	Perennial #1 Landfill Gas Combuster Outlet	**Sample Length:**	40	minutes
Sample Date:	7/19/07			
Run #:	1A			
Operators:	RDR/KJR			

Airflow:	9792.7	dscf/min	Vapor Pressure:	0.6675	inches Hg
Moisture (%):	8.17	percent	Volume Sampled:	19.8	Liters
Barometric Pressure:	29.70	inches Hg	Volume Sampled:	0.0198	m^3
Ambient Temperature:	67.0	°F	Std. Volume Sampled:	0.0193	dscm
Average Flow Rate:	495.1	cc/min	Bws:	0.0817	

SW-846 METHOD 0031 SAMPLE VOLUMES
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	**Lab #:**	4512	
Client:	Parametrix @ City of Tacoma Landfill	**Start Time:**	1620	hours
Location:	Tacoma, Washington	**Stop Time:**	1700	hours
Sample Site:	Perennial #1 Landfill Gas Combuster Outlet	**Sample Length:**	40	minutes
Sample Date:	7/19/07			
Run #:	1B			
Operators:	RDR/KJR			

Airflow:	9792.7	dscf/min	Vapor Pressure:	0.6909	inches Hg
Moisture (%):	8.17	percent	Volume Sampled:	19.7	Liters
Barometric Pressure:	29.70	inches Hg	Volume Sampled:	0.0197	m^3
Ambient Temperature:	68.0	°F	Std. Volume Sampled:	0.0191	dscm
Average Flow Rate:	491.9	cc/min	Bws:	0.0817	

SW-846 METHOD 0031 SAMPLE VOLUMES
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031		**Lab #:**	4513	
Client:	Parametrix @ City of Tacoma Landfill		**Start Time:**	1719	hours
Location:	Tacoma, Washington		**Stop Time:**	1759	hours
Sample Site:	Perennial #1 Landfill Gas Combuster Outlet		**Sample Length:**	40	minutes
Sample Date:	7/19/07				
Run #:	1C				
Operators:	ROR/KJR				

Airflow:	9792.7	dscf/min	Vapor Pressure:	0.7150	
Moisture (%):	8.17	percent	Volume Sampled:	19.8	Liters
Barometric Pressure:	29.70	inches Hg	Volume Sampled:	0.0198	m^3
Ambient Temperature:	69.0	°F	Std. Volume Sampled:	0.0191	dscm
Average Flow Rate:	495.1	cc/min	Bws:	0.0817	

SW-846 METHOD 0031 SAMPLE VOLUMES
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	**Lab #:**	4514	
Client:	Parametrix @ City of Tacoma Landfill	**Start Time:**	0831	hours
Location:	Tacoma, Washington	**Stop Time:**	0911	hours
Sample Site:	Perennial #1 Landfill Gas Combuster Outlet	**Sample Length:**	40	minutes
Sample Date:	7/20/07			
Run #:	2A			
Operators:	RDR/KJR			

Airflow:	10933	dscf/min	Vapor Pressure:	0.4688	inches Hg
Moisture (%):	7.58	percent	Volume Sampled:	19.6	Liters
Barometric Pressure:	29.65	inches Hg	Volume Sampled:	0.0196	m^3
Ambient Temperature:	57.0	°F	Std. Volume Sampled:	0.0195	dscm
Average Flow Rate:	489.8	cc/min	Bws:	0.0758	

SW-846 METHOD 0031 SAMPLE VOLUMES
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	**Lab #:**	4515	
Client:	Parametrix @ City of Tacoma Landfill	**Start Time:**	0926	hours
Location:	Tacoma, Washington	**Stop Time:**	1006	hours
Sample Site:	Perennial #1 Landfill Gas Combuster Outlet	**Sample Length:**	40	minutes
Sample Date:	7/20/07			
Run #:	2B			
Operators:	RDR/KJR			

Airflow:	10933	dscf/min	Vapor Pressure:	0.5222	inches Hg
Moisture (%):	7.58	percent	Volume Sampled:	19.5	Liters
Barometric Pressure:	29.65	inches Hg	Volume Sampled:	0.0195	m^3
Ambient Temperature:	60.0	°F	Std. Volume Sampled:	0.0193	dscm
Average Flow Rate:	487.0	cc/min	Bws:	0.0758	

SW-846 METHOD 0031 SAMPLE VOLUMES
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Lab #:	4516	
Client:	Parametrix @ City of Tacoma Landfill	Start Time:	1028	hours
Location:	Tacoma, Washington	Stop Time:	1108	hours
Sample Site:	Perennial #1 Landfill Gas Combuster Outlet	Sample Length:	40	minutes
Sample Date:	7/20/07			
Run #:	2C			
Operators:	RDR/KJR			

Airflow:	10933	dscf/min	Vapor Pressure:	0.5411	
Moisture (%):	7.58	percent	Volume Sampled:	19.9	Liters
Barometric Pressure:	29.65	inches Hg	Volume Sampled:	0.0199	m^3
Ambient Temperature:	61.0	°F	Std. Volume Sampled:	0.0197	dscm
Average Flow Rate:	498.4	cc/min	Bws:	0.0758	

SW-846 METHOD 0031 SAMPLE VOLUMES
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	**Lab #:**	4517	
Client:	Parametrix @ City of Tacoma Landfill	**Start Time:**	1138	hours
Location:	Tacoma, Washington	**Stop Time:**	1218	hours
Sample Site:	Perennial #1 Landfill Gas Combuster Outlet	**Sample Length:**	40	minutes
Sample Date:	7/20/07			
Run #:	3A			
Operators:	RDR/KJR			

Airflow:	10551	dscf/min	Vapor Pressure:	0.5411	inches Hg
Moisture (%):	8.67	percent	Volume Sampled:	20.2	Liters
Barometric Pressure:	29.65	inches Hg	Volume Sampled:	0.0202	m^3
Ambient Temperature:	61.0	°F	Std. Volume Sampled:	0.0199	dscm
Average Flow Rate:	505.5	cc/min	Bws:	0.0867	

SW-846 METHOD 0031 SAMPLE VOLUMES
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031		**Lab #:**	4518	
Client:	Parametrix @ Cily of Tacoma Landfill		**Start Time:**	1232	hours
Location:	Tacoma, Washington		**Stop Time:**	1312	hours
Sample Site:	Perennial #1 Landfill Gas Combuster Outlet		**Sample Length:**	40	minutes
Sample Date:	7/20/07				
Run #:	3B				
Operators:	RDR/KJR				

Airflow:	10551	dscf/min	Vapor Pressure:	0.5411	inches Hg
Moisture (%):	8.67	percent	Volume Sampled:	19.3	Liters
Barometric Pressure:	29.65	inches Hg	Volume Sampled:	0.0193	m^3
Ambient Temperature:	61.0	°F	Std. Volume Sampled:	0.0191	dscm
Average Flow Rate:	483.4	cc/min	Bws:	0.0867	

SW-846 METHOD 0031 SAMPLE VOLUMES
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	**Lab #:**	4519	
Client:	Parametrix @ City of Tacoma Landfill	**Start Time:**	1325	hours
Location:	Tacoma, Washington	**Stop Time:**	1405	hours
Sample Site:	Perennial #1 Landfill Gas Combuster Outlet	**Sample Length:**	40	minutes
Sample Date:	7/20/07			
Run #:	3C			
Operators:	RDR/KJR			

Airflow:	10551	dscf/min	Vapor Pressure:	0.5411	
Moisture (%):	8.67	percent	Volume Sampled:	19.7	Liters
Barometric Pressure:	29.65	inches Hg	Volume Sampled:	0.0197	m^3
Ambient Temperature:	61.0	°F	Std. Volume Sampled:	0.0194	dscm
Average Flow Rate:	491.4	cc/min	Bws:	0.0867	

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/19/07
Client:	Parametrix @ City of Tacoma Landfill		
Location:	Tacoma, Washington		
Run Number:	1FB	Volume Sampled	0 0192 dscm
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet		

	Run 1 - Field Blank			*Reporting Limit*	*MDL*
Analyte	Tenax Tube FB µg/dscm	Anasorb Tube FB µg/dscm	TOTAL FB µg/dscm	*TOTAL* FB µg/dscm	*TOTAL* FB µg/dscm
Acetone	5.22 U	5 22 U	10.4 U	10.4	10.4
Benzene	0 522 U	0.522 U	1.04 U	1.04	1.04
Bromobenzene	0.522 U	0 522 U	1.04 U	1 04	1 04
Bromochloromethane	1.30 U	1.30 U	2 61 U	2.61	2 61
Bromodichloromethane	0 522 U	0 522 U	1 04 U	1 04	1.04
Bromoform	1.30 U	1.30 U	2 61 U	2 61	2.61
Bromomethane	2.61 U	2.61 U	5 22 U	5.22	5.22
2-Butanone (MEK)	5.22 U	5.22 U	10.4 U	10 4	10.4
n-Butylbenzene	0.522 U	0.522 U	1 04 U	1.04	1.04
sec-Butylbenzene	0.522 U	0.522 U	1.04 U	1.04	1.04
tert-Butylbenzene	0 522 U	0.522 U	1 04 U	1.04	1 04
Carbon Disulfide	0.522 U	0.522 U	1 04 U	1 04	1.04
Carbon Tetrachloride	0.522 U	0 522 U	1 04 U	1 04	1 04
Chlorobenzene	0.522 U	0.522 U	1 04 U	1.04	1 04
Chlorodibromomethane	1.30 U	1.30 U	2.61 U	2 61	2.61
Chloroethane	2.61 U	2.61 U	5.22 U	5 22	5 22
Chloroform	0 522 U	0 522 U	1.04 U	1.04	1 04
Chloromethane	2.61 U	2 61 U	5.22 U	5.22	5 22
2-Chlorotoluene	0.522 U	0.522 U	1.04 U	1.04	1 04
4-Chlorotoluene	0.522 U	0.522 U	1 04 U	1 04	1.04
1,2 Dibromo-3-chloropropane	2 61 U	2.61 U	5.22 U	5.22	5 22
1,2-Dibromoethane	1.30 U	1.30 U	2 61 U	2 61	2 61
Dibromomethane	1.30 U	1.30 U	2 61 U	2.61	2.61
1,2-Dichlorobenzene	0.522 U	0.522 U	1.04 U	1.04	1 04
1,3-Dichlorobenzene	0.522 U	0.522 U	1 04 U	1 04	1 04
1,4-Dichlorobenzene	0.522 U	0.522 U	1 04 U	1.04	1 04
Dichlorodifluoromethane	1 30 U	1 30 U	2 61 U	2.61	2 61
1,1-Dichloroethane	0.522 U	0.522 U	1 04 U	1 04	1 04
1,2-Dichloroethane	0.522 U	0 522 U	1 04 U	1.04	1 04
cis-1,3-Dichloroethene	0.522 U	0.522 U	1 04 U	1 04	1 04
trans-1,3-Dichloroethene	0.522 U	0.522 U	1 04 U	1.04	1 04
1,1-Dichloroethene	0.522 U	0.522 U	1 04 U	1 04	1 04
1,2-Dichloropropane	0.522 U	0 522 U	1.04 U	1 04	1.04
1,3-Dichloropropane	0.522 U	0.522 U	1 04 U	1 04	1 04
2,2-Dichloropropane	0.522 U	0.522 U	1 04 U	1.04	1.04
cis-1,3-Dichloropropene	0.522 U	0.522 U	1 04 U	1 04	1 04
trans-1,3-Dichloropropene	0.522 U	0.522 U	1 04 U	1.04	1.04
1,1-Dichloropropene	0.522 U	0.522 U	1 04 U	1.04	1.04
Ethylbenzene	0.522 U	0 522 U	1.04 U	1 04	1.04
Hexachlorobutadiene	1 30 U	1 30 U	2 61 U	2 61	2.61
2-Hexanone	5 22 U	5.22 U	10 4 U	10 4	10 4
Isopropylbenzene	0.522 U	0.522 U	1 04 U	1 04	1.04
p-Isopropyltoluene	0.522 U	0.522 U	1 04 U	1 04	1 04
Methylene Chloride	1 30 U	1.30 U	2 61 U	2 61	2 61
4-Methyl-2-Pentanone (MIBK)	5.22 U	5.22 U	10 4 U	10 4	10.4
Naphalene	1.30 U	1.30 U	2.61 U	2 61	2.61
n-Propylbenzene	0 522 U	0.522 U	1 04 U	1 04	1.04
Styrene	0.522 U	0.522 U	1 04 U	1 04	1 04
1,1,1,2-Tetrachloroethane	0.522 U	0.522 U	1 04 U	1 04	1.04
1,1,2,2-Tetrachloroethane	1 30 U	1 30 U	2.61 U	2 61	2 61
Tetrachloroethene	0 522 U	0.522 U	1 04 U	1 04	1.04
Toluene	0 543 U	0.543 U	1 09 U	1 09	1 09
1,2,3-Trichlorobenzene	1.30 U	1.30 U	2.61 U	2 61	2 61
1,2,4-Trichlorobenzene	1 30 U	1 30 U	2 61 U	2 61	2.61
1,1,1-Trichloroethane	1 30 U	1.30 U	2 61 U	2.61	2 61
1,1,2-Trichloroethane	1 30 U	1 30 U	2 61 U	2 61	2 61
Trichloroethene	0 522 U	0.522 U	1 04 U	1 04	1 04
Trichlorofluoromethane	2.61 U	2.61 U	5.22 U	5 22	5 22
1,2,3-Trichloropropane	1.30 U	1.30 U	2.61 U	2 61	2 61
1,2,4-Trimethylbenzene	0.522 U	0.522 U	1 04 U	1 04	1 04
1,3,5-Trimethylbenzene	0 522 U	0.522 U	1 04 U	1 04	1 04
Vinyl Chloride	0.522 U	0 522 U	1 04 U	1 04	1 04
m- & p-Xylenes	1.04 U	1.04 U	2 09 U	2 09	2 09
o-Xylene	0 522 U	0 522 U	1 04 U	1 04	1.04

U = Not detected at specified reporting limits; If the result is reported by the laboratory as J (estimated result less than the reporting limit) it is presented as U
E = Estimated result, concentration exceeds the calibration range

EMISSION RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX @ CTL M0031
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Run Number: 1
Sample Location: Perennial #1 Landfill Gas Combuster Outlet

Sample Date: 7/19/07
Lab Numbers: 4511 - 4513

Analyte	RUN 1 TOTAL 1A µg/dscm	TOTAL 1B µg/dscm	TOTAL 1C µg/dscm	TOTAL RUN 1 µg/dscm	FIELD BLANK µg/dscm	*TOTAL Reporting Limit µg/dscm*	*TOTAL Detection Limit µg/dscm*
Acetone	10 4 U	10 5 U	16 2	16 2	10 4 U	*31 3*	*18 8*
Benzene	124 6 E	31 5	8.88	165.0 E	1 04 U	*3 13*	*1 35*
Bromobenzene	1.04 U	1.05 U	1 04 U	3 13 U	1 04 U	*3 13*	*1 72*
Bromochloromethene	2 60 U	2 62 U	2 61 U	7 83 U	2 61 U	*7 83*	*1 72*
Bromodichloromethane	1 04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3 13*	*1 38*
Bromoform	2.60 U	2 62 U	2 61 U	7 83 U	2 61 U	*7.83*	*2 04*
Bromomethane	5.19 U	5 24 U	5 22 U	15.7 U	5 22 U	*15 7*	*2 44*
2-Butanone (MEK)	10 4 U	10.5 U	10 4 U	31 3 U	10 4 U	*31.3*	*10 0*
n-Butylbenzene	1 04 U	1.05 U	1 04 U	3 13 U	1 04 U	*3 13*	*2 41*
sec-Butylbenzene	1 04 U	1.05 U	1 04 U	3 13 U	1 04 U	*3 13*	*3 01*
tert-Butylbenzene	1 04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3.13*	*2 70*
Carbon Disulfide	1 04 U	1 05 U	1 46	1 46	1 04 U	*3.13*	*1 32*
Carbon Tetrachloride	1 04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3.13*	*1 06*
Chlorobenzene	1 04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3.13*	*1 35*
Chlorodibromomethane	2 60 U	2.62 U	2 61 U	7 83 U	2 61 U	*7.83*	*1 19*
Chloroethane	5 19 U	5 24 U	5 22 U	15 7 U	5 22 U	*15 7*	*1 22*
Chloroform	1.04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3 13*	*1 44*
Chloromethane	5 19 U	3 04	5 22 U	3 04	5 22 U	*15 7*	*1 88*
2-Chlorotoluene	1 04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3 13*	*1 68*
4-Chlorotoluene	1 04 U	1 05 U	1.04 U	3.13 U	1 04 U	*3 13*	*1 79*
1,2 Dibromo-3-chloropropane	5.19 U	5 24 U	5 22 U	15 7 U	5 22 U	*15 7*	*5 01*
1,2-Dibromoethane	2 60 U	2 62 U	2 61 U	7 83 U	2 61 U	*7 83*	*1 22*
Dibromomethane	2 60 U	2.62 U	2 61 U	7 83 U	2 61 U	*7 83*	*2 00*
1,2-Dichlorobenzene	1 04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3 13*	*1 85*
1,3-Dichlorobenzene	1.04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3 13*	*2 00*
1,4-Dichlorobenzene	1.04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3.13*	*2 32*
Dichlorodifluoromethane	1 40	1 57	1 83	4 80	2 61 U	*7 83*	*1 63*
1,1-Dichloroethane	1 04 U	1.05 U	1 04 U	3 13 U	1 04 U	*3 13*	*1 06*
1,2-Dichloroethane	1 04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3 13*	*1 50*
cis-1,3-Dichloroethene	1 04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3.13*	*1 57*
trans-1,3-Dichloroethene	1 04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3 13*	*1 19*
1,1-Dichloroethene	1 04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3 13*	*1 79*
1,2-Dichloropropane	1 04 U	1.05 U	1 04 U	3 13 U	1 04 U	*3 13*	*1 41*
1 3-Dichloropropane	1.04 U	1 05 U	1 04 U	3.13 U	1 04 U	*3 13*	*2 22*
2,2-Dichloropropane	1 04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3 13*	*1 06*
cis-1,3-Dichloropropene	1 04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3 13*	*1 22*
trans-1,3-Dichloropropene	1 04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3.13*	*1 22*
1,1-Dichloropropene	1 04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3 13*	*1 32*
Ethylbenzene	1 04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3 13*	*1 00*
Hexachlorobutadiene	2.60 U	2 62 U	2 61 U	7 83 U	2 61 U	*7 83*	*1 28*
2-Hexanone	10 4 U	10 5 U	10 4 U	31 3 U	10 4 U	*31 3*	*5 64*
Isopropylbenzene	1 04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3.13*	*1 82*
p-Isopropyltoluene	1 04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3 13*	*2 66*
Methylene Chloride	2 60 U	3 25	9.87	13 1	2 61 U	*7 83*	*3 76*
4-Methyl-2-Pentanone (MIBK)	10 4 U	10 5 U	10 4 U	31 3 U	10 4 U	*31.3*	*9 08*
Naphalene	1 30	2 62 U	2 61 U	1 30	2 61 U	*7 83*	*2 07*
n-Propylbenzene	1 04 U	1.05 U	1 04 U	3 13 U	1 04 U	*3.13*	*1 69*
Styrene	0 831	1 05 U	1 04 U	0 83	1 04 U	*3 13*	*1 50*
1,1,1,2-Tetrachloroethane	1 04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3 13*	*1 44*
1,1,2 2-Tetrachloroethane	2 60 U	2 62 U	2 61 U	7 83 U	2 61 U	*7 83*	*2 10*
Tetrachloroethene	1 04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3 13*	*1 38*
Toluene	3 43	1 31	1 09 U	4 74	1 09 U	*3 26*	*0 846*
1,2 3-Trichlorobenzene	2.60 U	2 62 U	2 61 U	7 83 U	2 61 U	*7 83*	*1 75*
1,2 4-Trichlorobenzene	2 60 U	2 62 U	2 61 U	7 83 U	2 61 U	*7 83*	*2 07*
1,1,1-Trichloroethene	2 60 U	2 62 U	2 61 U	7 83 U	2 61 U	*7 83*	*1 80*
1,1,2-Trichloroethane	2 60 U	2 62 U	2 61 U	7 83 U	2 61 U	*7 83*	*1 75*
Trichloroethene	1 04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3 13*	*3 10*
Trichlorofluoromethane	5 19 U	3 98	63 6	87 5	5 22 U	*15 7*	*2 51*
1 2,3-Trichloropropene	2.39	2 62 U	2 61 U	2 39	2 61 U	*7 83*	*3 10*
1 2,4-Trimethylbenzene	1 04 U	1 05 U	1 04 U	3.13 U	1 04 U	*3 13*	*1 97*
1,3,5-Trimethylbenzene	1 04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3 13*	*2 32*
Vinyl Chloride	1 04 U	1 05 U	1.04 U	3 13 U	1 04 U	*3 13*	*1 00*
m- & p-Xylenes	2 08 U	2 10 U	2 09 U	6 26 U	2 09 U	*6.26*	*2 25*
o-Xylene	1.04 U	1 05 U	1 04 U	3 13 U	1 04 U	*3.13*	*1 66*

U = Not detected at specified reporting limits

EMISSION RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name	8752-001\PX @ CTL M0031	Sample Date	7/20/07
Client	Parametrix @ City of Tacoma Landfill		
Location	Tacoma, Washington	Lab Numbers	4514 - 4516
Run Number	2		
Sample Location	Perennial #1 Landfill Gas Combuster Outlet		

Analyte	RUN 2 TOTAL 2A µg/dscm	RUN 2 TOTAL 2B µg/dscm	RUN 2 TOTAL 2C µg/dscm	RUN 2 TOTAL RUN 2 µg/dscm	FIELD BLANK µg/dscm	*TOTAL Reporting Limit* µg/dscm	*TOTAL Detection Limit* µg/dscm
Acetone	10 2 U	10 4 U	10.2 U	30 8 U	10 3 U	*30 8*	*18 5*
Benzene	1 02 U	40 0	8 14	48 1	1 03 U	*3 08*	*1 32*
Bromobenzene	1 02 U	1 04 U	1.02 U	3 08 U	1 03 U	*3 08*	*1 89*
Bromochloromethane	2 56 U	2 60 U	2.54 U	7.70 U	2 57 U	*7 70*	*1 69*
Bromodichloromethane	1 02 U	1 04 U	1.02 U	3 08 U	1 03 U	*3 08*	*1 36*
Bromoform	2 56 U	2.60 U	2 54 U	7 70 U	2 57 U	*7 70*	*2 00*
Bromomethane	5 12 U	5 19 U	5 09 U	15 4 U	5 13 U	*15 4*	*2 40*
2-Butanone (MEK)	10 2 U	10 4 U	10 2 U	30 8 U	10 3 U	*30 8*	*9 86*
n-Butylbenzene	1.02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*2 37*
sec-Butylbenzene	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*2 96*
tert-Butylbenzene	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*2 74*
Carbon Disulfide	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 29*
Carbon Tetrachloride	1 02 U	1.04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 05*
Chlorobenzene	1 02 U	1 04 U	1.02 U	3 08 U	1 03 U	*3 08*	*1 32*
Chlorodibromomethane	2.56 U	2.60 U	2 54 U	7 70 U	2 57 U	*7 70*	*1 17*
Chloroethane	5 12 U	5 19 U	5.09 U	15 4 U	5 13 U	*15.4*	*1 20*
Chloroform	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 42*
Chloromethane	3 28	5 19 U	5 09 U	3 28	5 13 U	*15 4*	*1 85*
2-Chlorotoluene	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 66*
4-Chlorotoluene	1 02 U	1.04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 76*
1,2 Dibromo-3-chloropropane	5 12 U	5 19 U	5 09 U	15 4 U	5 13 U	*15 4*	*4 93*
1,2-Dibromoethane	2.56 U	2 60 U	2 54 U	7 70 U	2 57 U	*7 70*	*1 20*
Dibromomethane	2 56 U	2 60 U	2.54 U	7 70 U	2 57 U	*7 70*	*1 97*
1,2-Dichlorobenzene	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 62*
1,3-Dichlorobenzene	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 97*
1,4-Dichlorobenzene	1 02 U	1.04 U	1 02 U	3 08 U	1 03 U	*3 08*	*2 28*
Dichlorodifluoromethane	3 18	1 82	1 53	6 52	2 57 U	*7.70*	*1.60*
1,1-Dichloroethane	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 05*
1,2-Dichloroethane	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 48*
cis-1,3-Dichloroethene	1 02 U	1.04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 54*
trans-1,3-Dichloroethene	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3.08*	*1 17*
1,1-Dichloroethene	1 02 U	1.04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 76*
1,2-Dichloropropane	1 02 U	1.04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 39*
1,3-Dichloropropane	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*2 19*
2,2-Dichloropropane	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 05*
cis-1,3-Dichloropropene	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 20*
trans-1,3-Dichloropropene	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 20*
1,1-Dichloropropene	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 29*
Ethylbenzene	1 02 U	1.04 U	1 02 U	3 08 U	1 03 U	*3 08*	*0 986*
Hexachlorobutadiene	2 56 U	2 60 U	2 54 U	7 70 U	2 57 U	*7 70*	*1 26*
2-Hexanone	10 2 U	10.4 U	10 2 U	30 8 U	10 3 U	*30 8*	*5 55*
Isopropylbenzene	1.02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 79*
p-Isopropyltoluene	1 02 U	1.04 U	1 02 U	3 08 U	1 03 U	*3 08*	*2 62*
Methylene Chloride	61 5	2 60 U	3 15	64 8	2 57 U	*7 70*	*3 70*
4-Methyl-2-Pentanone (MIBK)	10.2 U	10 4 U	10 2 U	30.8 U	10 3 U	*30 8*	*8 93*
Naphalene	2 56 U	2 60 U	2 54 U	7 70 U	2 57 U	*7 70*	*2 03*
n-Propylbenzene	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 66*
Styrene	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 51*
1,1,1,2-Tetrachloroethane	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 42*
1,1,2,2-Tetrachloroethane	2 56 U	2 60 U	2 54 U	7 70 U	2 57 U	*7 70*	*2 08*
Tetrachloroethene	1.02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 36*
Toluene	1 07 U	1.97	0 610	2 58	1 07 U	*3 20*	*0 632*
1,2,3-Trichlorobenzene	2 56 U	2 60 U	2 54 U	7 70 U	2 57 U	*7 70*	*1 73*
1,2,4-Trichlorobenzene	2 56 U	2 60 U	2 54 U	7 70 U	2 57 U	*7 70*	*2 03*
1,1,1-Trichloroethane	2 56 U	2 60 U	2 54 U	7 70 U	2 57 U	*7.70*	*1 57*
1,1,2-Trichloroethane	2 56 U	2 60 U	2 54 U	7 70 U	2 57 U	*7 70*	*1 73*
Trichloroethene	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*3 05*
Trichlorofluoromethene	5 12 U	5 19 U	5 09 U	15 4 U	5 13 U	*15 4*	*2 46*
1,2,3-Trichloropropane	2.56 U	2 60 U	2 54 U	7 70 U	2 57 U	*7 70*	*3 05*
1,2,4-Trimethylbenzene	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 94*
1,3,5-Trimethylbenzene	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*2 28*
Vinyl Chloride	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*0 986*
m- & p-Xylenes	2 05 U	2 08 U	2 03 U	6 16 U	2 05 U	*6 16*	*2 22*
o-Xylene	1 02 U	1 04 U	1 02 U	3 08 U	1 03 U	*3 08*	*1 63*

U = Not detected at specified reporting limits

EMISSION RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name	8752-001\PX @ CTL M0031	Sample Date:	7/20/07
Client	Parametrix @ City of Tacoma Landfill		
Location	Tacoma, Washington	Lab Numbers:	4517 - 4519
Run Number.	3		
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet		

	RUN 3						
Analyte	TOTAL 3A µg/dscm	TOTAL 3B µg/dscm	TOTAL 3C µg/dscm	TOTAL RUN 3 µg/dscm	FIELD BLANK µg/dscm	*TOTAL Reporting Limit* µg/dscm	*TOTAL Detection Limit* µg/dscm
Acetone	10 0 U	10 5 U	10 3 U	30.8 U	10 3 U	*30 8*	*18 5*
Benzene	44 6	19 4	51.1	115.1	1 03 U	*3 08*	*1 33*
Bromobenzene	1 00 U	1 05 U	1.03 U	3 08 U	1 03 U	*3 08*	*1 70*
Bromochloromethane	2 51 U	2 62 U	2.58 U	7 71 U	2 57 U	*7 71*	*1 70*
Bromodichloromethane	1 00 U	1 05 U	1.03 U	3 08 U	1 03 U	*3 08*	*1.36*
Bromoform	2.51 U	2 62 U	2 58 U	7 71 U	2 57 U	*7.71*	*2.00*
Bromomethane	5 02 U	5 25 U	5.16 U	15.4 U	5 14 U	*15 4*	*2 41*
2-Butanone (MEK)	10 0 U	10 5 U	10 3 U	30.8 U	10.3 U	*30 8*	*9 87*
n-Butylbenzene	1 00 U	1.05 U	1 03 U	3 08 U	1 03 U	*3.08*	*2 37*
sec-Butylbenzene	1 00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*2 96*
tert-Butylbenzene	1.00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3.08*	*2 74*
Carbon Disulfide	1 00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*1 30*
Carbon Tetrachloride	1 00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*1 05*
Chlorobenzene	1 00 U	1.05 U	1 03 U	3 08 U	1 03 U	*3 08*	*1 33*
Chlorodibromomethane	2.51 U	2 62 U	2 58 U	7 71 U	2.57 U	*7 71*	*1 17*
Chloroethane	5.02 U	5 25 U	5 16 U	15 4 U	5 14 U	*15.4*	*1.20*
Chloroform	1 00 U	1.05 U	1 03 U	3 08 U	1 03 U	*3 08*	*1 42*
Chloromethane	5 02 U	2 68	5 16 U	2.68	5.14 U	*15 4*	*1.85*
2-Chlorotoluene	1 00 U	1.05 U	1 03 U	3 08 U	1 03 U	*3 08*	*1 67*
4-Chlorotoluene	1.00 U	1.05 U	1 03 U	3 08 U	1 03 U	*3 08*	*1 76*
1,2 Dibromo-3-chloropropene	5 02 U	5.25 U	5 16 U	15 4 U	5 14 U	*15 4*	*4 93*
1,2-Dibromoethane	2.51 U	2.62 U	2 58 U	7 71 U	2 57 U	*7 71*	*1 20*
Dibromomethane	2 51 U	2.62 U	2 58 U	7 71 U	2 57 U	*7.71*	*1 97*
1,2-Dichlorobenzene	1 00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*1 82*
1,3-Dichlorobenzene	1 00 U	1.05 U	1 03 U	3 08 U	1 03 U	*3 08*	*1 97*
1,4-Dichlorobenzene	1 00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*2 28*
Dichlorodifluoromethane	1 66	1 31	2 58 U	2 97	2 57 U	*7 71*	*1 60*
1,1-Dichloroethane	1 00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*1 05*
1,2-Dichloroethane	1 00 U	1 05 U	1.03 U	3 08 U	1 03 U	*3 08*	*1 48*
cis-1,3-Dichloroethene	1 00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*1 54*
trans-1,3-Dichloroethene	1 00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*1 17*
1,1-Dichloroethene	1 00 U	1 05 U	1.03 U	3 08 U	1 03 U	*3 08*	*1.76*
1,2-Dichloropropane	1 00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*1.39*
1,3-Dichloropropane	1 00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*2 19*
2,2-Dichloropropane	1 00 U	1 05 U	1.03 U	3 08 U	1 03 U	*3 08*	*1 05*
cis-1,3-Dichloropropene	1.00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*1 20*
trans-1,3-Dichloropropene	1 00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*1 20*
1 1-Dichloropropene	1 00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*1 30*
Ethylbenzene	1 00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*0 987*
Hexachlorobutadiene	2 51 U	2 62 U	2 58 U	7 71 U	2 57 U	*7.71*	*1 26*
2-Hexanone	10 0 U	10 5 U	10 3 U	30 8 U	10 3 U	*30.8*	*5 55*
Isopropylbenzene	1 00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*1.79*
p-Isopropyltoluene	1.00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*2 62*
Methylene Chloride	2 51 U	2 62 U	2 58 U	7 71 U	2 57 U	*7 71*	*3 70*
4-Methyl-2-Pentanone (MiBK)	10 0 U	10 5 U	10 3 U	30 8 U	10 3 U	*30 8*	*8 94*
Naphalene	2 51 U	2 62 U	2 58 U	7 71 U	2 57 U	*7 71*	*2 04*
n-Propylbenzene	1.00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 06*	*1 67*
Styrene	1 00 U	1.05 U	1 03 U	3 08 U	1 03 U	*3 08*	*1 51*
1,1,1,2-Tetrachloroethane	1 00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*1 42*
1,1,2,2-Tetrachloroethene	2 51 U	2 62 U	2 58 U	7 71 U	2 57 U	*7.71*	*2 07*
Tetrachloroethene	1 00 U	1.05 U	1 03 U	3 08 U	1 03 U	*3 08*	*1 36*
Toluene	1 15	0 734	1 14	3 02	1 07 U	*3 21*	*0 833*
1,2,3-Trichlorobenzene	2 51 U	2.62 U	2 58 U	7 71 U	2 57 U	*7 71*	*1 73*
1 2,4-Trichlorobenzene	2 51 U	2 62 U	2 58 U	7 71 U	2 57 U	*7 71*	*2 04*
1,1,1-Trichloroethane	2 51 U	2 62 U	2 58 U	7 71 U	2 57 U	*7 71*	*1 57*
1,1,2-Trichloroethane	2 51 U	2 62 U	2 58 U	7 71 U	2 57 U	*7 71*	*1 73*
Trichloroethane	1 00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*3 05*
Trichlorofluoromethane	4 36	5 25 U	5 16 U	4 36	5 14 U	*15 4*	*2 47*
1,2,3-Trichloropropane	2 51 U	2 62 U	2.58 U	7 71 U	2 57 U	*7 71*	*3 05*
1,2,4-Trimethylbenzene	1 00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*1 94*
1,3,5-Trimethylbenzene	1 00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*2.28*
Vinyl Chloride	1 00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*0 987*
m- & p-Xylenes	2 01 U	2 10 U	2 06 U	6 17 U	2 06 U	*6 17*	*2 22*
o-Xylene	1 00 U	1 05 U	1 03 U	3 08 U	1 03 U	*3 08*	*1 63*

U = Not detected at specified reporting limits

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/19/07
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	1510 - 1610
Location:	Tacoma, Washington	Lab Number:	4511
Run Number:	1A	Volume Sampled:	0.0193 dscm
Sample Locaoun:	Perenniel #1 Landfill Gas Combuster Outlet	Airflow:	9792.7 dscf/min

	RUN 1A			*Reporting Limit*	*MDL*
Analyte	Tenax Tube 1A µg/dscm	Anasorb Tube 1A µg/dscm	TOTAL 1A µg/dscm	*TOTAL 1A* µg/dscm	*TOTAL 1A* µg/dscm
Acetone	5.19 U	5.19 U	10.4 U	10.4	6.23
Benzene	124.6 E	0.52 U	124.6 E	1.04	0.447
Bromobenzene	0.52 U	0.52 U	1.04 U	1.04	0.571
Bromochloromethane	1.30 U	1.30 U	2.60 U	2.60	0.571
Bromodichloromethane	0.52 U	0.52 U	1.04 U	1.04	0.457
Bromoform	1.30 U	1.30 U	2.60 U	2.60	0.675
Bromomethane	2.60 U	2.60 U	5.19 U	5.19	0.810
2-Butanone (MEK)	5.19 U	5.19 U	10.4 U	10.4	3.324
n-Butylbenzene	0.52 U	0.52 U	1.04 U	1.04	0.800
sec-Butylbenzene	0.52 U	0.52 U	1.04 U	1.04	0.997
tert-Butylbenzene	0.52 U	0.52 U	1.04 U	1.04	0.924
Carbon Disulfide	0.52 U	0.52 U	1.04 U	1.04	0.436
Carbon Tetrachloride	0.52 U	0.52 U	1.04 U	1.04	0.353
Chlorobenzene	0.52 U	0.52 U	1.04 U	1.04	0.447
Chlorodibromomethane	1.30 U	1.30 U	2.60 U	2.60	0.395
Chloroethane	2.60 U	2.60 U	5.19 U	5.19	0.405
Chloroform	0.52 U	0.52 U	1.04 U	1.04	0.476
Chloromethane	2.60 U	2.60 U	5.19 U	5.19	0.623
2-Chlorotoluene	0.52 U	0.52 U	1.04 U	1.04	0.561
4-Chlorotoluene	0.52 U	0.52 U	1.04 U	1.04	0.592
1,2 Dibromo-3-chloropropane	2.60 U	2.60 U	5.19 U	5.19	1.66
1,2-Dibromoethane	1.30 U	1.30 U	2.60 U	2.60	0.405
Dibromomethane	1.30 U	1.30 U	2.60 U	2.60	0.665
1,2-Dichlorobenzene	0.52 U	0.52 U	1.04 U	1.04	0.613
1,3-Dichlorobenzene	0.52 U	0.52 U	1.04 U	1.04	0.665
1,4-Dichlorobenzene	0.52 U	0.52 U	1.04 U	1.04	0.769
Dichlorodifluoromethane	1.30 U	1.40	1.40	2.60	0.540
1,1-Dichloroethane	0.52 U	0.52 U	1.04 U	1.04	0.353
1,2-Dichloroethane	0.52 U	0.52 U	1.04 U	1.04	0.499
cis-1,3-Dichloroethene	0.52 U	0.52 U	1.04 U	1.04	0.519
trans-1,3-Dichloroethene	0.52 U	0.52 U	1.04 U	1.04	0.395
1,1-Dichloroethene	0.52 U	0.52 U	1.04 U	1.04	0.592
1,2-Dichloropropane	0.52 U	0.52 U	1.04 U	1.04	0.467
1,3-Dichloropropane	0.52 U	0.52 U	1.04 U	1.04	0.738
2,2-Dichloropropane	0.52 U	0.52 U	1.04 U	1.04	0.353
cis-1,3-Dichloropropene	0.52 U	0.52 U	1.04 U	1.04	0.405
trans-1,3-Dichloropropene	0.52 U	0.52 U	1.04 U	1.04	0.405
1,1-Dichloropropene	0.52 U	0.52 U	1.04 U	1.04	0.436
Ethylbenzene	0.52 U	0.52 U	1.04 U	1.04	0.332
Hexachlorobutadiene	1.30 U	1.30 U	2.60 U	2.60	0.426
2-Hexanone	5.19 U	5.19 U	10.4 U	10.4	1.87
Isopropylbenzene	0.52 U	0.52 U	1.04 U	1.04	0.602
p-Isopropyltoluene	0.52 U	0.52 U	1.04 U	1.04	0.883
Methylene Chloride	1.30 U	1.30 U	2.60 U	2.60	1.25
4-Methyl-2-Pentanone (MIBK)	5.19 U	5.19 U	10.4 U	10.4	3.01
Naphalene	1.30	1.30 U	1.30	2.60	0.686
n-Propylbenzene	0.52 U	0.52 U	1.04 U	1.04	0.561
Styrene	0.831	0.52 U	0.831	1.04	0.509
1,1,1,2-Tetrachloroethane	0.52 U	0.52 U	1.04 U	1.04	0.478
1,1,2,2-Tetrachloroethane	1.30 U	1.30 U	2.60 U	2.60	0.696
Tetrachloroethene	0.52 U	0.52 U	1.04 U	1.04	0.457
Toluene	3.43	0.54 U	3.43	1.08	0.280
1,2,3-Trichlorobenzene	1.30 U	1.30 U	2.60 U	2.60	0.582
1,2,4-Trichlorobenzene	1.30 U	1.30 U	2.60 U	2.60	0.666
1,1,1-Trichloroethane	1.30 U	1.30 U	2.60 U	2.60	0.530
1,1,2-Trichloroethane	1.30 U	1.30 U	2.60 U	2.60	0.582
Trichloroethene	0.52 U	0.52 U	1.04 U	1.04	1.03
Trichlorofluoromethene	2.60 U	2.60 U	5.19 U	5.19	0.631
1,2,3-Trichloropropane	2.39	1.30 U	2.39	2.60	1.03
1,2,4-Trimethylbenzene	0.52 U	0.52 U	1.04 U	1.04	0.654
1,3,5-Trimethylbenzene	0.52 U	0.52 U	1.04 U	1.04	0.769
Vinyl Chloride	0.52 U	0.52 U	1.04 U	1.04	0.332
m- & p-Xylenes	1.04 U	1.04 U	2.08 U	2.08	0.748
o-Xylene	0.52 U	0.52 U	1.04 U	1.04	0.551

U = Not detected at specified reporting limits. If the result is reported by the laboratory as J (estimated result less than the reporting limit) it is presented as U
E = Estimated result, concentration exceeds the calibration range

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/19/07
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	1620 - 1700
Location:	Tacoma, Washington	Leb Number:	4512
Run Number:	1B	Volume Sampled:	0 0191 dscm
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet	Airflow:	9792 7 dscf/min

	RUN 1B			*Reporting Limit*	*MDL*
	Tenex Tube	Anasorb Tube	TOTAL	*TOTAL*	*TOTAL*
	1B	1B	1B	1B	1B
Analyte	µg/dscm	µg/dscm	µg/dscm	µg/dscm	µg/dscm
Acetone	5.24 U	5.24 U	10.5 U	10 5	6.29
Benzene	31.5	0.524 U	31 5	1.05	0.451
Bromobenzene	0.524 U	0.524 U	1 05 U	1 05	0.577
Bromochloromethane	1.31 U	1.31 U	2.62 U	2 62	0.577
Bromodichloromethane	0.524 U	0.524 U	1.05 U	1 05	0.461
Bromoform	1.31 U	1.31 U	2.62 U	2.62	0.681
Bromomethane	2.62 U	2.62 U	5.24 U	5 24	0.818
2-Butanone (MEK)	5.24 U	5.24 U	10.5 U	10.5	3.35
n-Butylbenzene	0.524 U	0.524 U	1 05 U	1.05	0 807
sec-Butylbenzene	0 524 U	0.524 U	1 05 U	1.05	1.006
tert-Butylbenzene	0 524 U	0.524 U	1 05 U	1.05	0.933
Carbon Disulfide	0.524 U	0.524 U	1.05 U	1 05	0.440
Carbon Tetrachloride	0.524 U	0 524 U	1.05 U	1 05	0.356
Chlorobenzene	0.524 U	0.524 U	1.05 U	1 05	0.451
Chlorodibromomethane	1.31 U	1 31 U	2 62 U	2 62	0.398
Chloroethane	2.62 U	2.62 U	5 24 U	5 24	0.409
Chloroform	0.524 U	0.524 U	1 05 U	1.05	0.462
Chloromethane	2.62 U	3.04	3 04	5 24	0 629
2-Chlorotoluene	0.524 U	0 524 U	1 05 U	1 05	0.566
4-Chlorotoluene	0.524 U	0.524 U	1 05 U	1.05	0.596
1,2 Dibromo-3-chloropropane	2 62 U	2.62 U	5 24 U	5.24	1 68
1,2-Dibromoethene	1.31 U	1.31 U	2.62 U	2.62	0.409
Dibromomethane	1.31 U	1.31 U	2.62 U	2.62	0.671
1,2-Dichlorobenzene	0.524 U	0.524 U	1.05 U	1 05	0.819
1,3-Dichlorobenzene	0.524 U	0.524 U	1 05 U	1 05	0.671
1,4-Dichlorobenzene	0.524 U	0.524 U	1 05 U	1 05	0.776
Dichlorodifluoromethane	1.31 U	1.57	1.57	2.62	0.545
1,1-Dichloroethane	0.524 U	0.524 U	1 05 U	1.05	0 356
1,2-Dichloroethane	0.524 U	0.524 U	1 05 U	1.05	0 503
cis-1,3-Dichloroethene	0.524 U	0.524 U	1 05 U	1.05	0 524
trans-1,3-Dichloroethene	0.524 U	0.524 U	1 05 U	1.05	0.398
1,1-Dichloroethene	0.524 U	0.524 U	1 05 U	1 05	0.596
1,2-Dichloropropane	0 524 U	0.524 U	1.05 U	1.05	0 472
1,3-Dichloropropane	0.524 U	0.524 U	1 05 U	1 05	0.744
2,2-Dichloropropane	0.524 U	0.524 U	1.05 U	1.05	0.356
cis-1,3-Dichloropropene	0.524 U	0.524 U	1.05 U	1.05	0.409
trans-1,3-Dichloropropene	0.524 U	0.524 U	1 05 U	1 05	0.409
1,1-Dichloropropene	0.524 U	0.524 U	1 05 U	1 05	0.440
Ethylbenzene	0.524 U	0.524 U	1 05 U	1.05	0.335
Hexachlorobutadiene	1.31 U	1 31 U	2 62 U	2 62	0.430
2-Hexanone	5.24 U	5 24 U	10.5 U	10.5	1 89
Isopropylbenzene	0.524 U	0.524 U	1 05 U	1.05	0.608
p-Isopropyltoluene	0.524 U	0.524 U	1 05 U	1 05	0.891
Methylene Chloride	3.25	1 31 U	3.25	2.62	1 26
4-Methyl-2-Pentenone (MiBK)	5 24 U	5.24 U	10 5 U	10 5	3 04
Nephelene	1 31 U	1.31 U	2 62 U	2 62	0.892
n-Propylbenzene	0.524 U	0.524 U	1 05 U	1 05	0.566
Styrene	0.524 U	0.524 U	1.05 U	1.05	0.514
1,1,1,2-Tetrachloroethene	0.524 U	0.524 U	1 05 U	1.05	0.482
1,1,2,2-Tetrachloroethane	1.31 U	1 31 U	2 62 U	2 62	0.702
Tetrachloroethene	0.524 U	0 524 U	1 05 U	1 05	0.461
Toluene	1 31	0 545 U	1.31	1 09	0 283
1,2,3-Trichlorobenzene	1.31 U	1.31 U	2.62 U	2 62	0.587
1,2,4-Trichlorobenzene	1 31 U	1.31 U	2 62 U	2 62	0 692
1,1,1-Trichloroethane	1 31 U	1.31 U	2 62 U	2 62	0 535
1,1,2-Trichloroethane	1.31 U	1.31 U	2 62 U	2 62	0 587
Trichloroethene	0.524 U	0.524 U	1 05 U	1 05	1 04
Trichlorofluoromethane	2.62 U	3 96	3 96	5.24	0.839
1,2,3-Trichloropropane	1.31 U	1 31 U	2 62 U	2.62	1 94
1,2,4-Trimethylbenzene	0.524 U	0.524 U	1 05 U	1.05	0.680
1,3,5-Trimethylbenzene	0.524 U	0.524 U	1 05 U	1 05	0.776
Vinyl Chloride	0.524 U	0 524 U	1 05 U	1 05	0.335
m- & p-Xylenes	1.05 U	1.05 U	2 10 U	2 10	0.755
o-Xylene	0 524 U	0.524 U	1 05 U	1 05	0.558

U = Not detected at specified reporting limits. If the result is reported by the laboratory as J (estimated result less than the reporting limit) it is presented as U
E = Estimated result, concentration exceeds the calibration range

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/19/07
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	1719 - 1759
Location:	Tacoma, Washington	Lab Number:	4513
Run Number:	1C	Volume Sampled:	0 0191 dscm
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet	Airflow:	9792 7 dscf/min

Analyte	RUN 1C Tenax Tube 1C µg/dscm	RUN 1C Anasorb Tube 1C µg/dscm	RUN 1C TOTAL 1C µg/dscm	*Reporting Limit TOTAL* 1C µg/dscm	*MDL TOTAL* 1C µg/dscm
Acetone	16 2	5 22 U	16.2	10 4	6 27
Benzene	8.88	0.522 U	8 88	1 04	0.449
Bromobenzene	0.522 U	0.522 U	1 04 U	1 04	0.574
Bromochloromethane	1 31 U	1 31 U	2 61 U	2 61	0 574
Bromodichloromethane	0.522 U	0 522 U	1 04 U	1 04	0.460
Bromoform	1 31 U	1.31 U	2 61 U	2 61	0 679
Bromomethane	2.61 U	2 61 U	5 22 U	5.22	0.815
2-Butanone (MEK)	5.22 U	5.22 U	10.4 U	10.4	3.34
n-Butylbenzene	0 522 U	0.522 U	1 04 U	1.04	0 804
sec-Butylbenzene	0.522 U	0.522 U	1 04 U	1 04	1.003
tert-Butylbenzene	0.522 U	0.522 U	1 04 U	1.04	0.930
Carbon Disulfide	1.46	0.522 U	1 46	1.04	0.439
Carbon Tetrachloride	0.522 U	0.522 U	1 04 U	1.04	0.355
Chlorobenzene	0.522 U	0.522 U	1 04 U	1.04	0.449
Chlorodibromomethane	1.31 U	1.31 U	2 61 U	2 61	0.397
Chloroethane	2.61 U	2.61 U	5 22 U	5.22	0 407
Chloroform	0 522 U	0 522 U	1 04 U	1.04	0 480
Chloromethane	2 61 U	2 61 U	5.22 U	5 22	0 627
2-Chlorotoluene	0.522 U	0.522 U	1 04 U	1 04	0.564
4-Chlorotoluene	0.522 U	0.522 U	1 04 U	1 04	0.595
1,2 Dibromo-3-chloropropane	2.61 U	2.61 U	5 22 U	5.22	1.67
1,2-Dibromoethane	1.31 U	1.31 U	2 61 U	2 61	0.407
Dibromomethane	1.31 U	1.31 U	2 61 U	2.61	0.668
1,2-Dichlorobenzene	0.522 U	0.522 U	1 04 U	1 04	0.616
1,3-Dichlorobenzene	0.522 U	0 522 U	1.04 U	1.04	0 668
1,4-Dichlorobenzene	0.522 U	0.522 U	1 04 U	1.04	0 773
Dichlorodifluoromethane	1 83	1.31 U	1.83	2 61	0 543
1,1-Dichloroethane	0.522 U	0.522 U	1 04 U	1 04	0.355
1,2-Dichloroethane	0 522 U	0.522 U	1.04 U	1 04	0.501
cis-1,3-Dichloroethene	0.522 U	0.522 U	1 04 U	1 04	0 522
trans-1,3-Dichloroethene	0.522 U	0.522 U	1 04 U	1 04	0 397
1,1-Dichloroethene	0.522 U	0 522 U	1 04 U	1.04	0 595
1,2-Dichloropropane	0.522 U	0 522 U	1 04 U	1 04	0.470
1,3-Dichloropropane	0.522 U	0 522 U	1 04 U	1.04	0 742
2,2-Dichloropropane	0.522 U	0 522 U	1 04 U	1.04	0 355
cis-1,3-Dichloropropene	0.522 U	0 522 U	1 04 U	1.04	0 407
trans-1,3-Dichloropropene	0 522 U	0 522 U	1 04 U	1 04	0 407
1,1-Dichloropropene	0 522 U	0 522 U	1 04 U	1 04	0 439
Ethylbenzene	0 522 U	0.522 U	1 04 U	1 04	0 334
Hexachlorobutadiene	1.31 U	1.31 U	2 61 U	2 61	0 428
2-Hexanone	5 22 U	5.22 U	10 4 U	10 4	1.88
Isopropylbenzene	0 522 U	0 522 U	1 04 U	1 04	0.606
p-Isopropyltoluene	0 522 U	0.522 U	1 04 U	1 04	0.888
Methylene Chloride	9.87	1 31 U	9 87	2.61	1 25
4-Methyl-2-Pentanone (MiBK)	5.22 U	5 22 U	10 4 U	10 4	3.03
Naphalene	1 31 U	1 31 U	2 61 U	2.61	0 689
n-Propylbenzene	0.522 U	0.522 U	1 04 U	1 04	0 564
Styrene	0.522 U	0 522 U	1 04 U	1.04	0.512
1,1,1,2-Tetrachloroethane	0 522 U	0 522 U	1 04 U	1 04	0 480
1,1,2,2-Tetrachloroethane	1.31 U	1.31 U	2 61 U	2 61	0.700
Tetrachloroethene	0.522 U	0 522 U	1 04 U	1 04	0.460
Toluene	0.543 U	0 543 U	1 09 U	1 09	0.282
1,2,3-Trichlorobenzene	1.31 U	1.31 U	2 61 U	2 61	0.585
1,2,4-Trichlorobenzene	1 31 U	1.31 U	2 61 U	2 61	0.689
1,1,1-Trichloroethane	1 31 U	1 31 U	2 61 U	2 61	0 533
1,1,2-Trichloroethane	1 31 U	1 31 U	2 61 U	2 61	0.585
Trichloroethene	0.522 U	0.522 U	1 04 U	1 04	1 03
Trichlorofluoromethane	83.8	2 61 U	83 6	5 22	0 836
1,2,3-Trichloropropane	1.31 U	1 31 U	2 61 U	2 61	1 03
1,2,4-Trimethylbenzene	0.522 U	0 522 U	1 04 U	1 04	0.658
1,3,5-Trimethylbenzene	0.522 U	0 522 U	1 04 U	1 04	0 773
Vinyl Chloride	0 522 U	0 522 U	1 04 U	1 04	0.334
m- & p-Xylenes	1.04 U	1 04 U	2.09 U	2 09	0 752
o-Xylene	0.522 U	0 522 U	1.04 U	1 04	0 554

U = Not detected at specified reporting limits. If the result is reported by the laboratory as J (estimated result less than the raporting limit) it is presented as U.
E = Estimated result, concentration exceeds the calibration range

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name	8752-001VPX @ CTL M0031	Sample Date	7/19/07
Client.	Parametrix @ City of Tacoma Landfill		
Location.	Tacoma, Washington		
Run Number	1FB	Volume Sampled·	0 0192 dscm
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet		

Analyte	Run 1 - Field Blank Tenax Tube FB µg/dscm	Anasorb Tube FB µg/dscm	TOTAL FB µg/dscm	*Reporting Limit TOTAL* FB µg/dscm	*MDL TOTAL* FB µg/dscm
Acetone	5.22 U	5 22 U	10 4 U	10 4	10.4
Benzene	0.522 U	0 522 U	1 04 U	1 04	1 04
Bromobenzene	0.522 U	0 522 U	1.04 U	1 04	1.04
Bromochloromethane	1 30 U	1 30 U	2 61 U	2 61	2.61
Bromodichloromethane	0 522 U	0 522 U	1 04 U	1 04	1.04
Bromoform	1.30 U	1 30 U	2 61 U	2 61	2.61
Bromomethane	2 61 U	2 61 U	5.22 U	5 22	5.22
2-Butanone (MEK)	5.22 U	5.22 U	10 4 U	10 4	10.4
n-Butylbenzene	0 522 U	0 522 U	1 04 U	1 04	1 04
sec-Butylbenzene	0 522 U	0 522 U	1.04 U	1 04	1 04
tert-Butylbenzene	0 522 U	0 522 U	1 04 U	1 04	1 04
Carbon Disulfide	0 522 U	0.522 U	1 04 U	1 04	1.04
Carbon Tetrachloride	0 522 U	0 522 U	1 04 U	1 04	1.04
Chlorobenzene	0 522 U	0 522 U	1 04 U	1 04	1 04
Chlorodibromomethane	1 30 U	1 30 U	2 61 U	2 61	2.61
Chloroethane	2.61 U	2 61 U	5 22 U	5 22	5 22
Chloroform	0.522 U	0 522 U	1 04 U	1 04	1 04
Chloromethane	2 61 U	2 61 U	5 22 U	5 22	5 22
2-Chlorotoluene	0 522 U	0 522 U	1 04 U	1 04	1.04
4-Chlorotoluene	0 522 U	0 522 U	1 04 U	1 04	1 04
1,2 Dibromo-3-chloropropane	2 61 U	2 61 U	5 22 U	5.22	5.22
1,2-Dibromoethane	1 30 U	1 30 U	2 61 U	2 61	2 61
Dibromomethane	1.30 U	1 30 U	2 61 U	2 61	2 61
1,2-Dichlorobenzene	0 522 U	0 522 U	1 04 U	1 04	1 04
1,3-Dichlorobenzene	0 522 U	0 522 U	1 04 U	1 04	1 04
1,4-Dichlorobenzene	0 522 U	0 522 U	1 04 U	1 04	1 04
Dichlorodifluoromethane	1.30 U	1 30 U	2 61 U	2 61	2 61
1,1-Dichloroethane	0 522 U	0 522 U	1 04 U	1 04	1 04
1,2-Dichloroethane	0 522 U	0 522 U	1 04 U	1 04	1 04
cis-1,3-Dichloroethene	0 522 U	0 522 U	1 04 U	1 04	1 04
trans-1,3-Dichloroethene	0 522 U	0 522 U	1 04 U	1 04	1 04
1,1-Dichloroethene	0 522 U	0 522 U	1 04 U	1 04	1 04
1,2-Dichloropropane	0 522 U	0 522 U	1 04 U	1 04	1 04
1,3-Dichloropropane	0 522 U	0 522 U	1 04 U	1 04	1 04
2,2-Dichloropropane	0 522 U	0 522 U	1 04 U	1 04	1 04
cis-1,3-Dichloropropene	0 522 U	0 522 U	1 04 U	1 04	1 04
trans-1,3-Dichloropropene	0 522 U	0 522 U	1 04 U	1 04	1 04
1,1-Dichloropropene	0 522 U	0 522 U	1 04 U	1 04	1 04
Ethylbenzene	0 522 U	0 522 U	1 04 U	1 04	1.04
Hexachlorobutadiene	1 30 U	1.30 U	2 61 U	2 61	2.61
2-Hexanone	5 22 U	5 22 U	10 4 U	10 4	10 4
Isopropylbenzene	0 522 U	0 522 U	1 04 U	1 04	1 04
p-Isopropyltoluene	0 522 U	0 522 U	1 04 U	1 04	1.04
Methylene Chloride	1 30 U	1 30 U	2 61 U	2 61	2 61
4-Methyl-2-Pentanone (MiBK)	5 22 U	5.22 U	10 4 U	10 4	10 4
Naphelene	1 30 U	1 30 U	2 61 U	2 61	2 61
n-Propylbenzene	0 522 U	0 522 U	1 04 U	1 04	1 04
Styrene	0 522 U	0 522 U	1 04 U	1 04	1 04
1 1,1,2-Tetrachloroethane	0 522 U	0 522 U	1 04 U	1 04	1 04
1,1,2,2-Tetrachloroethane	1 30 U	1 30 U	2 61 U	2 61	2 61
Tetrechloroethane	0 522 U	0 522 U	1 04 U	1 04	1 04
Toluene	0 543 U	0 543 U	1 09 U	1 09	1 09
1,2,3-Trichlorobenzene	1 30 U	1 30 U	2 61 U	2 61	2 61
1 2,4-Trichlorobenzene	1 30 U	1 30 U	2 61 U	2 61	2 61
1,1,1-Trichloroethane	1 30 U	1.30 U	2 61 U	2 61	2 61
1,1,2-Trichloroethane	1 30 U	1 30 U	2 61 U	2 61	2 61
Trichloroethene	0 522 U	0 522 U	1 04 U	1 04	1 04
Trichlorofluoromethane	2 61 U	2 61 U	5 22 U	5 22	5 22
1,2,3-Trichloropropane	1 30 U	1 30 U	2 61 U	2 61	2 61
1,2,4-Trimethylbenzene	0 522 U	0 522 U	1 04 U	1 04	1 04
1,3,5-Trimethylbenzene	0 522 U	0 522 U	1 04 U	1 04	1 04
Vinyl Chloride	0 522 U	0 522 U	1 04 U	1 04	1 04
m- & p-Xylenes	1 04 U	1 04 U	2 09 U	2 09	2 09
o-Xylene	0 522 U	0 522 U	1 04 U	1 04	1 04

U = Not detected at specified reporting limits; If the result is reported by the laboratory as J (estimated result less than the reporting limit) it is presented as U
E = Estimated result, concentration exceeds the calibration range.

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	6752-001VPX @ CTL M0031	Sample Date:	7/20/07
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	831 - 911
Location:	Tacoma, Washington	Lab Number:	4514
Run Number:	2A	Volume Sampled:	0.0195 dscm
Sample Location:	Perennial #1 Landfill Gas Combustor Outlet	Airflow:	10933 dscf/min

Analyte	RUN 2A Tenax Tube 2A µg/dscm	RUN 2A Anasorb Tube 2A µg/dscm	RUN 2A TOTAL 2A µg/dscm	Reporting Limit TOTAL 2A µg/dscm	MDL TOTAL 2A µg/dscm
Acetone	5.12 U	5.12 U	10.2 U	10.2	6.15
Benzene	0.512 U	0.512 U	1.02 U	1.02	0.441
Bromobenzene	0.512 U	0.512 U	1.02 U	1.02	0.564
Bromochloromethane	1.28 U	1.28 U	2.56 U	2.56	0.564
Bromodichloromethane	0.512 U	0.512 U	1.02 U	1.02	0.451
Bromoform	1.28 U	1.28 U	2.56 U	2.56	0.666
Bromomethane	2.56 U	2.56 U	5.12 U	5.12	0.799
2-Butanone (MEK)	5.12 U	5.12 U	10.2 U	10.2	3.28
n-Butylbenzene	0.512 U	0.512 U	1.02 U	1.02	0.789
sec-Butylbenzene	0.512 U	0.512 U	1.02 U	1.02	0.984
tert-Butylbenzene	0.512 U	0.512 U	1.02 U	1.02	0.912
Carbon Disulfide	0.512 U	0.512 U	1.02 U	1.02	0.430
Carbon Tetrachloride	0.512 U	0.512 U	1.02 U	1.02	0.348
Chlorobenzene	0.512 U	0.512 U	1.02 U	1.02	0.441
Chlorodibromomethane	1.28 U	1.28 U	2.56 U	2.56	0.388
Chloroethane	2.56 U	2.56 U	5.12 U	5.12	0.400
Chloroform	0.512 U	0.512 U	1.02 U	1.02	0.471
Chloromethane	2.56 U	3.28	3.28	5.12	0.615
2-Chlorotoluene	0.512 U	0.512 U	1.02 U	1.02	0.553
4-Chlorotoluene	0.512 U	0.512 U	1.02 U	1.02	0.584
1,2 Dibromo-3-chloropropane	2.56 U	2.56 U	5.12 U	5.12	1.64
1,2-Dibromoethane	1.28 U	1.28 U	2.56 U	2.56	0.400
Dibromomethane	1.28 U	1.28 U	2.56 U	2.56	0.656
1,2-Dichlorobenzene	0.512 U	0.512 U	1.02 U	1.02	0.605
1,3-Dichlorobenzene	0.512 U	0.512 U	1.02 U	1.02	0.656
1,4-Dichlorobenzene	0.512 U	0.512 U	1.02 U	1.02	0.758
Dichlorodifluoromethane	1.28 U	3.18	3.18	2.56	0.533
1,1-Dichloroethane	0.512 U	0.512 U	1.02 U	1.02	0.348
1,2-Dichloroethane	0.512 U	0.512 U	1.02 U	1.02	0.492
cis-1,3-Dichloroethene	0.512 U	0.512 U	1.02 U	1.02	0.512
trans-1,3-Dichloroethene	0.512 U	0.512 U	1.02 U	1.02	0.389
1,1-Dichloroethene	0.512 U	0.512 U	1.02 U	1.02	0.584
1,2-Dichloropropene	0.512 U	0.512 U	1.02 U	1.02	0.461
1,3-Dichloropropane	0.512 U	0.512 U	1.02 U	1.02	0.728
2,2-Dichloropropene	0.512 U	0.512 U	1.02 U	1.02	0.348
cis-1,3-Dichloropropene	0.512 U	0.512 U	1.02 U	1.02	0.400
trans-1,3-Dichloropropene	0.512 U	0.512 U	1.02 U	1.02	0.400
1,1-Dichloropropene	0.512 U	0.512 U	1.02 U	1.02	0.430
Ethylbenzene	0.512 U	0.512 U	1.02 U	1.02	0.328
Hexachlorobutadiene	1.28 U	1.28 U	2.56 U	2.56	0.420
2-Hexanone	5.12 U	5.12 U	10.2 U	10.2	1.84
Isopropylbenzene	0.512 U	0.512 U	1.02 U	1.02	0.594
p-Isopropyltoluene	0.512 U	0.512 U	1.02 U	1.02	0.871
Methylene Chloride	61.5	1.28 U	61.5	2.56	1.23
4-Methyl-2-Pentanone (MIBK)	5.12 U	5.12 U	10.2 U	10.2	2.97
Nephalene	1.28 U	1.28 U	2.56 U	2.56	0.676
n-Propylbenzene	0.512 U	0.512 U	1.02 U	1.02	0.553
Styrene	0.512 U	0.512 U	1.02 U	1.02	0.502
1,1,1,2-Tetrachloroethane	0.512 U	0.512 U	1.02 U	1.02	0.471
1,1,2,2-Tetrachloroethane	1.28 U	1.28 U	2.56 U	2.56	0.687
Tetrachloroethene	0.512 U	0.512 U	1.02 U	1.02	0.451
Toluene	0.533 U	0.533 U	1.07 U	1.07	0.277
1,2,3-Trichlorobenzene	1.28 U	1.28 U	2.56 U	2.56	0.574
1,2,4-Trichlorobenzene	1.28 U	1.28 U	2.56 U	2.56	0.676
1,1,1-Trichloroethane	1.28 U	1.28 U	2.56 U	2.56	0.523
1,1,2-Trichloroethane	1.28 U	1.28 U	2.56 U	2.56	0.574
Trichloroethene	0.512 U	0.512 U	1.02 U	1.02	1.01
Trichlorofluoromethane	2.56 U	2.56 U	5.12 U	5.12	0.820
1,2,3-Trichloropropane	1.28 U	1.28 U	2.56 U	2.56	1.01
1,2,4-Trimethylbenzene	0.512 U	0.512 U	1.02 U	1.02	0.646
1,3,5-Trimethylbenzene	0.512 U	0.512 U	1.02 U	1.02	0.758
Vinyl Chloride	0.512 U	0.512 U	1.02 U	1.02	0.326
m- & p-Xylenes	1.02 U	1.02 U	2.05 U	2.05	0.738
o-Xylene	0.512 U	0.512 U	1.02 U	1.02	0.543

U = Not detected at specified reporting limits. If the result is reported by the laboratory as J (estimated result less than the reporting limit) it is presented as U
E = Estimated result: concentration exceeds the calibration range

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/20/07
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	926 - 1006
Location:	Tacoma, Washington	Lab Number:	4515
Run Number:	2B	Volume Sampled:	0.0193 dscm
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet	Airflow	10933 dscf/min

Analyte	RUN 2B Tenax Tube 2B µg/dscm	RUN 2B Anasorb Tube 2B µg/dscm	RUN 2B TOTAL 2B µg/dscm	*Reporting Limit TOTAL* 2B µg/dscm	*MDL TOTAL* 2B µg/dscm
Acetone	5.19 U	5.19 U	10.4 U	10.4	6.23
Benzene	40.0	0.519 U	40.0	1.04	0.447
Bromobenzene	0.519 U	0.519 U	1.04 U	1.04	0.571
Bromochloromethane	1.30 U	1.30 U	2.60 U	2.60	0.571
Bromodichloromethane	0.519 U	0.519 U	1.04 U	1.04	0.457
Bromoform	1.30 U	1.30 U	2.60 U	2.60	0.675
Bromomethane	2.60 U	2.60 U	5.19 U	5.19	0.810
2-Butanone (MEK)	5.19 U	5.19 U	10.4 U	10.4	3.32
n-Butylbenzene	0.519 U	0.519 U	1.04 U	1.04	0.600
sec-Butylbenzene	0.519 U	0.519 U	1.04 U	1.04	0.997
tert-Butylbenzene	0.519 U	0.519 U	1.04 U	1.04	0.924
Carbon Disulfide	0.519 U	0.519 U	1.04 U	1.04	0.436
Carbon Tetrachloride	0.519 U	0.519 U	1.04 U	1.04	0.353
Chlorobenzene	0.519 U	0.519 U	1.04 U	1.04	0.447
Chlorodibromomethane	1.30 U	1.30 U	2.60 U	2.60	0.395
Chloroethane	2.60 U	2.60 U	5.19 U	5.19	0.405
Chloroform	0.519 U	0.519 U	1.04 U	1.04	0.478
Chloromethane	2.60 U	2.60 U	5.19 U	5.19	0.623
2-Chlorotoluene	0.519 U	0.519 U	1.04 U	1.04	0.561
4-Chlorotoluene	0.519 U	0.519 U	1.04 U	1.04	0.592
1,2 Dibromo-3-chloropropane	2.60 U	2.60 U	5.19 U	5.19	1.66
1,2-Dibromoethane	1.30 U	1.30 U	2.60 U	2.60	0.405
Dibromomethane	1.30 U	1.30 U	2.60 U	2.60	0.685
1,2-Dichlorobenzene	0.519 U	0.519 U	1.04 U	1.04	0.613
1,3-Dichlorobenzene	0.519 U	0.519 U	1.04 U	1.04	0.665
1,4-Dichlorobenzene	0.519 U	0.519 U	1.04 U	1.04	0.789
Dichlorodifluoromethane	1.30 U	1.82	1.82	2.60	0.540
1,1-Dichloroethane	0.519 U	0.519 U	1.04 U	1.04	0.353
1,2-Dichloroethene	0.519 U	0.519 U	1.04 U	1.04	0.499
cis-1,3-Dichloroethene	0.519 U	0.519 U	1.04 U	1.04	0.519
trans-1,3-Dichloroethene	0.519 U	0.519 U	1.04 U	1.04	0.395
1,1-Dichloroethene	0.519 U	0.519 U	1.04 U	1.04	0.592
1,2-Dichloropropane	0.519 U	0.519 U	1.04 U	1.04	0.467
1,3-Dichloropropane	0.519 U	0.519 U	1.04 U	1.04	0.737
2,2-Dichloropropane	0.519 U	0.519 U	1.04 U	1.04	0.353
cis-1,3-Dichloropropene	0.519 U	0.519 U	1.04 U	1.04	0.405
trans-1,3-Dichloropropene	0.519 U	0.519 U	1.04 U	1.04	0.405
1,1-Dichloropropene	0.519 U	0.519 U	1.04 U	1.04	0.436
Ethylbenzene	0.519 U	0.519 U	1.04 U	1.04	0.332
Hexachlorobutadiene	1.30 U	1.30 U	2.60 U	2.60	0.426
2-Hexanone	5.19 U	5.19 U	10.4 U	10.4	1.87
Isopropylbenzene	0.519 U	0.519 U	1.04 U	1.04	0.802
p-Isopropyltoluene	0.519 U	0.519 U	1.04 U	1.04	0.883
Methylene Chloride	1.30 U	1.30 U	2.60 U	2.60	1.25
4-Methyl-2-Pentanone (MIBK)	5.19 U	5.19 U	10.4 U	10.4	3.01
Naphalene	1.30 U	1.30 U	2.60 U	2.60	0.686
n-Propylbenzene	0.519 U	0.519 U	1.04 U	1.04	0.581
Styrene	0.519 U	0.519 U	1.04 U	1.04	0.509
1,1,1,2-Tetrachloroethane	0.519 U	0.519 U	1.04 U	1.04	0.478
1,1,2,2-Tetrachloroethane	1.30 U	1.30 U	2.60 U	2.60	0.696
Tetrachloroethene	0.519 U	0.519 U	1.04 U	1.04	0.457
Toluene	1.97	0.540 U	1.97	1.08	0.280
1,2,3-Trichlorobenzene	1.30 U	1.30 U	2.60 U	2.60	0.582
1,2,4-Trichlorobenzene	1.30 U	1.30 U	2.60 U	2.60	0.686
1,1,1-Trichloroethene	1.30 U	1.30 U	2.60 U	2.60	0.530
1,1,2-Trichloroethene	1.30 U	1.30 U	2.60 U	2.60	0.582
Trichloroethene	0.519 U	0.519 U	1.04 U	1.04	1.03
Trichlorofluoromethane	2.60 U	2.60 U	5.19 U	5.19	0.831
1,2,3-Trichloropropane	1.30 U	1.30 U	2.60 U	2.60	1.03
1,2,4-Trimethylbenzene	0.519 U	0.519 U	1.04 U	1.04	0.654
1,3,5-Trimethylbenzene	0.519 U	0.519 U	1.04 U	1.04	0.759
Vinyl Chloride	0.519 U	0.519 U	1.04 U	1.04	0.332
m- & p-Xylenes	1.04 U	1.04 U	2.08 U	2.08	0.748
o-Xylene	0.519 U	0.519 U	1.04 U	1.04	0.550

U = Not detected at specified reporting limits; If the result is reported by the laboratory as J (estimated result less than the reporting limit) it is presented as U
E = Estimated result, concentration exceeds the calibration range

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HDEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/20/07
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	1028 - 1108
Location:	Tacoma, Washington	Lab Number:	4516
Run Number:	2C	Volume Sampled:	0 0197 dscm
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet	Airflow:	10933 dscf/min

Analyte	RUN 2C Tenax Tube 2C µg/dscm	RUN 2C Anasorb Tube 2C µg/dscm	RUN 2C TOTAL 2C µg/dscm	*Reporting Limit TOTAL* 2C µg/dscm	*MDL TOTAL* 2C µg/dscm
Acetone	5.09 U	5.09 U	10.2 U	10.2	6 10
Benzene	8.14	0.509 U	8 14	1.02	0.438
Bromobenzene	0 509 U	0.509 U	1 02 U	1 02	0.560
Bromochloromethene	1.27 U	1.27 U	2.54 U	2 54	0.560
Bromodichloromethane	0 509 U	0.509 U	1.02 U	1.02	0 448
Bromoform	1.27 U	1.27 U	2.54 U	2.54	0 661
Bromomethane	2.54 U	2 54 U	5.09 U	5.09	0.794
2-Bulanone (MEK)	5.09 U	5.09 U	10.2 U	10.2	3 28
n-Butylbenzene	0.509 U	0.509 U	1.02 U	1.02	0.783
sec-Butylbenzene	0.509 U	0.509 U	1 02 U	1.02	0.977
tert-Butylbenzene	0.509 U	0.509 U	1.02 U	1.02	0.906
Carbon Disulfide	0.509 U	0.509 U	1 02 U	1.02	0.427
Carbon Tetrachloride	0 509 U	0.509 U	1 02 U	1.02	0.346
Chlorobenzene	0.509 U	0.509 U	1.02 U	1 02	0.438
Chlorodibromomethane	1.27 U	1.27 U	2.54 U	2 54	0.387
Chloroethane	2 54 U	2.54 U	5 09 U	5 09	0 397
Chloroform	0.509 U	0.509 U	1 02 U	1.02	0.468
Chloromethane	2 54 U	2.54 U	5 09 U	5 09	0 610
2-Chlorotoluene	0.509 U	0.509 U	1.02 U	1.02	0.549
4-Chlorotoluene	0.509 U	0 509 U	1.02 U	1 02	0.580
1,2 Dibromo-3-chloropropane	2 54 U	2 54 U	5 09 U	5 09	1 63
1,2-Dibromoethane	1.27 U	1 27 U	2 54 U	2 54	0 397
Dibromomethane	1 27 U	1.27 U	2 54 U	2 54	0 651
1,2-Dichlorobenzene	0.509 U	0.509 U	1.02 U	1 02	0.600
1,3-Dichlorobenzene	0.509 U	0.509 U	1.02 U	1 02	0 651
1,4-Dichlorobenzene	0.509 U	0.509 U	1.02 U	1 02	0 753
Dichlorodifluoromethane	1.27 U	1.53	1.53	2 54	0 529
1,1-Dichloroethane	0.509 U	0.509 U	1 02 U	1 02	0 346
1,2-Dichloroethane	0.509 U	0.509 U	1.02 U	1.02	0 488
cis-1,3-Dichloroethene	0.509 U	0.509 U	1 02 U	1.02	0 509
trans-1,3-Dichloroethene	0.509 U	0.509 U	1 02 U	1.02	0.387
1,1-Dichloroethene	0 509 U	0.509 U	1 02 U	1 02	0 560
1,2-Dichloropropane	0.509 U	0.509 U	1 02 U	1 02	0 456
1,3-Dichloropropane	0.509 U	0.509 U	1 02 U	1 02	0 722
2,2-Dichloropropane	0.509 U	0.509 U	1.02 U	1 02	0 346
cis-1,3-Dichloropropene	0.509 U	0.509 U	1.02 U	1 02	0 397
trans-1,3-Dichloropropene	0 509 U	0.509 U	1.02 U	1 02	0.397
1,1-Dichloropropene	0.509 U	0.509 U	1 02 U	1 02	0 427
Ethylbenzene	0 509 U	0.509 U	1 02 U	1.02	0 326
Hexachlorobutadiene	1.27 U	1.27 U	2 54 U	2.54	0 417
2-Hexanone	5.09 U	5.09 U	10.2 U	10 2	1 83
Isopropylbenzene	0 509 U	0.509 U	1 02 U	1 02	0 590
p-Isopropyltoluene	0.509 U	0.509 U	1 02 U	1.02	0 865
Methylene Chloride	3.15	1.27 U	3.15	2.54	1 22
4-Methyl-2-Pentanone (MIBK)	5.09 U	5.09 U	10.2 U	10 2	2 95
Naphalene	1.27 U	1.27 U	2.54 U	2 54	0.672
n-Propylbenzene	0.509 U	0.509 U	1.02 U	1 02	0.549
Styrene	0.509 U	0 509 U	1.02 U	1 02	0.499
1,1,1,2-Tetrachloroethane	0.509 U	0.509 U	1 02 U	1 02	0.468
1,1,2,2-Tetrachloroethane	1.27 U	1.27 U	2.54 U	2 54	0 682
Tetrachloroethene	0.509 U	0.509 U	1.02 U	1 02	0.448
Toluene	0.610	0.529 U	0.610	1 06	0.275
1,2,3-Trichlorobenzene	1.27 U	1.27 U	2.54 U	2.54	0.570
1,2,4-Trichlorobenzene	1.27 U	1.27 U	2.54 U	2 54	0.672
1,1,1-Trichloroethane	1 27 U	1.27 U	2.54 U	2.54	0.519
1,1,2-Trichloroethene	1 27 U	1.27 U	2 54 U	2.54	0.570
Trichloroethene	0 509 U	0.509 U	1 02 U	1.02	1.01
Trichlorofluoromethane	2.54 U	2.54 U	5 09 U	5.09	0 814
1,2,3-Trichloropropane	1.27 U	1.27 U	2 54 U	2.54	1 01
1,2,4-Trimethylbenzene	0.509 U	0.509 U	1 02 U	1.02	0 641
1,3,5-Trimethylbenzene	0.509 U	0.509 U	1 02 U	1 02	0 753
Vinyl Chloride	0.509 U	0.509 U	1 02 U	1.02	0 326
m- & p-Xylenes	1.02 U	1.02 U	2 03 U	2.03	0 733
o-Xylene	0.509 U	0.509 U	1 02 U	1 02	0 539

U = Not detected at specified reporting limits; If the result is reported by the laboratory as J (estimated result less than the reporting limit) it is presented as U
E = Estimated result, concentration exceeds the calibration range

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name	8752-001\PX @ CTL M0031	Sample Date	7/20/07
Client	Parametrix @ City of Tacoma Landfill		
Location	Tacoma, Washington		
Run Number.	2FB	Volume Sampled	0.019 dscm
Sample Location	Perennial #1 Landfill Gas Combuster Outlet		

Analyte	Run 2 - Field Blank Tenax Tube FB µg/dscm	Anasorb Tube FB µg/dscm	TOTAL FB µg/dscm	*Reporting Limit TOTAL* FB µg/dscm	*MDL TOTAL* FB µg/dscm
Acetone	5.13 U	5.13 U	10.3 U	10.3	10.3
Benzene	0.513 U	0.513 U	1.03 U	1.03	1.03
Bromobenzene	0.513 U	0.513 U	1.03 U	1.03	1.03
Bromochloromethane	1.28 U	1.28 U	2.57 U	2.57	2.57
Bromodichloromethane	0.513 U	0.513 U	1.03 U	1.03	1.03
Bromoform	1.28 U	1.28 U	2.57 U	2.57	2.57
Bromomethane	2.57 U	2.57 U	5.13 U	5.13	5.13
2-Butanone (MEK)	5.13 U	5.13 U	10.3 U	10.3	10.3
n-Butylbenzene	0.513 U	0.513 U	1.03 U	1.03	1.03
sec-Butylbenzene	0.513 U	0.513 U	1.03 U	1.03	1.03
tert-Butylbenzene	0.513 U	0.513 U	1.03 U	1.03	1.03
Carbon Disulfide	0.513 U	0.513 U	1.03 U	1.03	1.03
Carbon Tetrachloride	0.513 U	0.513 U	1.03 U	1.03	1.03
Chlorobenzene	0.513 U	0.513 U	1.03 U	1.03	1.03
Chlorodibromomethane	1.28 U	1.28 U	2.57 U	2.57	2.57
Chloroethane	2.57 U	2.57 U	5.13 U	5.13	5.13
Chloroform	0.513 U	0.513 U	1.03 U	1.03	1.03
Chloromethane	2.57 U	2.57 U	5.13 U	5.13	5.13
2-Chlorotoluene	0.513 U	0.513 U	1.03 U	1.03	1.03
4-Chlorotoluene	0.513 U	0.513 U	1.03 U	1.03	1.03
1,2 Dibromo-3-chloropropane	2.57 U	2.57 U	5.13 U	5.13	5.13
1,2-Dibromoethane	1.28 U	1.28 U	2.57 U	2.57	2.57
Dibromomethane	1.28 U	1.28 U	2.57 U	2.57	2.57
1,2-Dichlorobenzene	0.513 U	0.513 U	1.03 U	1.03	1.03
1,3-Dichlorobenzene	0.513 U	0.513 U	1.03 U	1.03	1.03
1,4-Dichlorobenzene	0.513 U	0.513 U	1.03 U	1.03	1.03
Dichlorodifluoromethane	1.28 U	1.28 U	2.57 U	2.57	2.57
1,1-Dichloroethane	0.513 U	0.513 U	1.03 U	1.03	1.03
1,2-Dichloroethane	0.513 U	0.513 U	1.03 U	1.03	1.03
cis-1,3-Dichloroethene	0.513 U	0.513 U	1.03 U	1.03	1.03
trans-1,3-Dichloroethene	0.513 U	0.513 U	1.03 U	1.03	1.03
1,1-Dichloroethene	0.513 U	0.513 U	1.03 U	1.03	1.03
1,2-Dichloropropane	0.513 U	0.513 U	1.03 U	1.03	1.03
1,3-Dichloropropane	0.513 U	0.513 U	1.03 U	1.03	1.03
2,2-Dichloropropane	0.513 U	0.513 U	1.03 U	1.03	1.03
cis-1,3-Dichloropropene	0.513 U	0.513 U	1.03 U	1.03	1.03
trans-1,3-Dichloropropene	0.513 U	0.513 U	1.03 U	1.03	1.03
1,1-Dichloropropene	0.513 U	0.513 U	1.03 U	1.03	1.03
Ethylbenzene	0.513 U	0.513 U	1.03 U	1.03	1.03
Hexachlorobutadiene	1.28 U	1.28 U	2.57 U	2.57	2.57
2-Hexanone	5.13 U	5.13 U	10.3 U	10.3	10.3
Isopropylbenzene	0.513 U	0.513 U	1.03 U	1.03	1.03
p-Isopropyltoluene	0.513 U	0.513 U	1.03 U	1.03	1.03
Methylene Chloride	1.28 U	1.28 U	2.57 U	2.57	2.57
4-Methyl-2-Pentanone (MIBK)	5.13 U	5.13 U	10.3 U	10.3	10.3
Naphalene	1.28 U	1.28 U	2.57 U	2.57	2.57
n-Propylbenzene	0.513 U	0.513 U	1.03 U	1.03	1.03
Styrene	0.513 U	0.513 U	1.03 U	1.03	1.03
1,1,1,2-Tetrachloroethane	0.513 U	0.513 U	1.03 U	1.03	1.03
1,1,2,2-Tetrachloroethane	1.28 U	1.28 U	2.57 U	2.57	2.57
Tetrachloroethene	0.513 U	0.513 U	1.03 U	1.03	1.03
Toluene	0.534 U	0.534 U	1.07 U	1.07	1.07
1,2,3-Trichlorobenzene	1.28 U	1.28 U	2.57 U	2.57	2.57
1,2,4-Trichlorobenzene	1.28 U	1.28 U	2.57 U	2.57	2.57
1,1,1-Trichloroethane	1.28 U	1.28 U	2.57 U	2.57	2.57
1,1,2-Trichloroethane	1.28 U	1.28 U	2.57 U	2.57	2.57
Trichloroethene	0.513 U	0.513 U	1.03 U	1.03	1.03
Trichlorofluoromethane	2.57 U	2.57 U	5.13 U	5.13	5.13
1,2,3-Trichloropropane	1.28 U	1.28 U	2.57 U	2.57	2.57
1,2,4-Trimethylbenzene	0.513 U	0.513 U	1.03 U	1.03	1.03
1,3,5-Trimethylbenzene	0.513 U	0.513 U	1.03 U	1.03	1.03
Vinyl Chloride	0.513 U	0.513 U	1.03 U	1.03	1.03
m- & p-Xylenes	1.03 U	1.03 U	2.05 U	2.05	2.05
o-Xylene	0.513 U	0.513 U	1.03 U	1.03	1.03

U = Not detected at specified reporting limits; If the result is reported by the laboratory as J (estimated result less than the reporting limit) it is presented as U.
E = Estimated result, concentration exceeds the calibration range.

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/20/07
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	1138 - 1218
Location:	Tacoma, Washington	Lab Number:	4517
Run Number:	3A	Volume Sampled:	0.0199 dscm
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet	Airflow:	10551 dscf/min

Analyte	RUN 3A Tenax Tube 3A µg/dscm	RUN 3A Anasorb Tube 3A µg/dscm	RUN 3A TOTAL 3A µg/dscm	Reporting Limit TOTAL 3A µg/dscm	MDL TOTAL 3A µg/dscm
Acetone	5.02 U	5.02 U	10 0 U	10.0	6 02
Benzene	44.8	0.502 U	44 6	1.00	0.431
Bromobenzene	0.502 U	0.502 U	1 00 U	1 00	0.552
Bromochloromethane	1 25 U	1.25 U	2 51 U	2.51	0 552
Bromodichloromethane	0.502 U	0.502 U	1 00 U	1 00	0.441
Bromoform	1.25 U	1.25 U	2 51 U	2.51	0 652
Bromomethane	2.51 U	2.51 U	5 02 U	5 02	0.782
2-Butanone (MEK)	5.02 U	5 02 U	10.0 U	10.0	3 21
n-Butylbenzene	0.502 U	0.502 U	1.00 U	1 00	0.772
sec-Butylbenzene	0.502 U	0 502 U	1 00 U	1 00	0.963
tert-Butylbenzene	0.502 U	0.502 U	1.00 U	1 00	0.893
Carbon Disulfide	0.502 U	0.502 U	1.00 U	1 00	0.421
Carbon Tetrachloride	0.502 U	0.502 U	1 00 U	1.00	0.341
Chlorobenzene	0.502 U	0 502 U	1 00 U	1.00	0.431
Chlorodibromomethane	1.25 U	1.25 U	2 51 U	2.51	0.381
Chloroethane	2.51 U	2 51 U	5.02 U	5.02	0.391
Chloroform	0.502 U	0.502 U	1 00 U	1.00	0.461
Chloromethane	2.51 U	2.51 U	5 02 U	5.02	0 602
2-Chlorotoluene	0.502 U	0.502 U	1 00 U	1.00	0 542
4-Chlorotoluene	0.502 U	0.502 U	1 00 U	1.00	0.572
1,2 Dibromo-3-chloropropane	2.51 U	2.51 U	5 02 U	5.02	1 61
1,2-Dibromoethane	1.25 U	1.25 U	2 51 U	2.51	0.391
Dibromomethane	1.25 U	1.25 U	2 51 U	2.51	0.642
1,2-Dichlorobenzene	0.502 U	0.502 U	1 00 U	1.00	0.592
1,3-Dichlorobenzene	0.502 U	0.502 U	1.00 U	1.00	0 642
1,4-Dichlorobenzene	0.502 U	0.502 U	1 00 U	1 00	0.742
Dichlorodifluoromethane	1.25 U	1.66	1 66	2.51	0 522
1,1-Dichloroethane	0 502 U	0.502 U	1.00 U	1 00	0 341
1,2-Dichloroethane	0.502 U	0.502 U	1 00 U	1.00	0.482
cis-1,3-Dichloroethene	0.502 U	0 502 U	1.00 U	1.00	0.502
trans-1,3-Dichloroethene	0.502 U	0.502 U	1.00 U	1.00	0 381
1,1-Dichloroethene	0.502 U	0.502 U	1 00 U	1.00	0 572
1,2-Dichloropropane	0 502 U	0.502 U	1.00 U	1 00	0 451
1,3-Dichloropropane	0 502 U	0.502 U	1.00 U	1 00	0 712
2,2-Dichloropropane	0 502 U	0.502 U	1 00 U	1.00	0.341
cis-1,3-Dichloropropene	0 502 U	0 502 U	1.00 U	1 00	0.391
trans-1,3-Dichloropropene	0 502 U	0.502 U	1.00 U	1 00	0 391
1,1-Dichloropropene	0 502 U	0.502 U	1.00 U	1 00	0 421
Ethylbenzene	0 502 U	0.502 U	1.00 U	1 00	0 321
Hexechlorobutadiene	1.25 U	1 25 U	2.51 U	2.51	0 411
2-Hexanone	5.02 U	5 02 U	10.0 U	10.0	1 806
Isopropylbenzene	0.502 U	0 502 U	1.00 U	1.00	0.582
p-Isopropyltoluene	0.502 U	0 502 U	1.00 U	1 00	0.853
Methylene Chloride	1.25 U	1 25 U	2 51 U	2.51	1 20
4-Methyl-2-Pentanone (MIBK)	5 02 U	5.02 U	10.0 U	10.0	2.91
Naphelene	1.25 U	1 25 U	2 51 U	2.51	0.662
n-Propylbenzene	0.502 U	0.502 U	1.00 U	1 00	0.542
Styrene	0.502 U	0.502 U	1 00 U	1 00	0.492
1,1,1,2-Tetrachloroethane	0.502 U	0.502 U	1 00 U	1 00	0 461
1,1,2,2-Tetrachloroethane	1.25 U	1.25 U	2 51 U	2 51	0 672
Tetrachloroethene	0.502 U	0.502 U	1 00 U	1.00	0 441
Toluene	1.15	0.522 U	1 15	1.04	0 271
1,2,3-Trichlorobenzene	1 25 U	1.25 U	2.51 U	2.51	0 562
1,2,4-Trichlorobenzene	1.25 U	1.25 U	2 51 U	2 51	0 662
1,1,1-Trichloroethane	1.25 U	1 25 U	2.51 U	2 51	0.512
1,1,2-Trichloroethane	1.25 U	1.25 U	2 51 U	2 51	0 562
Trichloroethene	0.502 U	0.502 U	1 00 U	1 00	0 993
Trichlorofluoromethane	2.51 U	4.36	4 36	5.02	0.803
1,2,3-Trichloropropane	1.25 U	1.25 U	2.51 U	2 51	0.993
1,2,4-Trimethylbenzene	0.502 U	0.502 U	1.00 U	1 00	0.632
1,3,5-Trimethylbenzene	0.502 U	0.502 U	1 00 U	1 00	0 742
Vinyl Chloride	0.502 U	0.502 U	1 00 U	1 00	0.321
m- & p-Xylenes	1.00 U	1 00 U	2 01 U	2 01	0.722
o-Xylene	0.502 U	0.502 U	1 00 U	1.00	0.532

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EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/20/07
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	1232 - 1312
Location:	Tacoma, Washington	Lab Number:	4518
Run Number:	3B	Volume Sampled:	0.0191 dscm
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet	Airflow:	10551 dscf/min

Analyte	RUN 3B Tenax Tube 3B µg/dscm	Anasorb Tube 3B µg/dscm	TOTAL 3B µg/dscm	*Reporting Limit TOTAL* 3B µg/dscm	*MDL TOTAL* 3B µg/dscm
Acetone	5.25 U	5.25 U	10.5 U	10.5	6.29
Benzene	19.4	0.525 U	19.4	1.05	0.451
Bromobenzene	0.525 U	0.525 U	1.05 U	1.05	0.577
Bromochloromethane	1.31 U	1.31 U	2.62 U	2.62	0.577
Bromodichloromethane	0.525 U	0.525 U	1.05 U	1.05	0.462
Bromoform	1.31 U	1.31 U	2.62 U	2.62	0.682
Bromomethane	2.62 U	2.62 U	5.25 U	5.25	0.818
2-Butanone (MEK)	5.25 U	5.25 U	10.5 U	10.5	3.36
n-Butylbenzene	0.525 U	0.525 U	1.05 U	1.05	0.808
sec-Butylbenzene	0.525 U	0.525 U	1.05 U	1.05	1.01
tert-Butylbenzene	0.525 U	0.525 U	1.05 U	1.05	0.834
Carbon Disulfide	0.525 U	0.525 U	1.05 U	1.05	0.441
Carbon Tetrachloride	0.525 U	0.525 U	1.05 U	1.05	0.357
Chlorobenzene	0.525 U	0.525 U	1.05 U	1.05	0.451
Chlorodibromomethane	1.31 U	1.31 U	2.62 U	2.62	0.399
Chloroethane	2.62 U	2.62 U	5.25 U	5.25	0.409
Chloroform	0.525 U	0.525 U	1.05 U	1.05	0.483
Chloromethane	2.62 U	2.68	2.68	5.25	0.629
2-Chlorotoluene	0.525 U	0.525 U	1.05 U	1.05	0.568
4-Chlorotoluene	0.525 U	0.525 U	1.05 U	1.05	0.598
1,2 Dibromo-3-chloropropane	2.62 U	2.62 U	5.25 U	5.25	1.68
1,2-Dibromoethene	1.31 U	1.31 U	2.62 U	2.62	0.409
Dibromomethane	1.31 U	1.31 U	2.62 U	2.62	0.671
1,2-Dichlorobenzene	0.525 U	0.525 U	1.05 U	1.05	0.819
1,3-Dichlorobenzene	0.525 U	0.525 U	1.05 U	1.05	0.671
1,4-Dichlorobenzene	0.525 U	0.525 U	1.05 U	1.05	0.776
Dichlorodifluoromethane	1.31 U	1.31	1.31	2.62	0.546
1,1-Dichloroethane	0.525 U	0.525 U	1.05 U	1.05	0.357
1,2-Dichloroethane	0.525 U	0.525 U	1.05 U	1.05	0.504
cis-1,3-Dichloroethene	0.525 U	0.525 U	1.05 U	1.05	0.525
trans-1,3-Dichloroethene	0.525 U	0.525 U	1.05 U	1.05	0.399
1,1-Dichloroethene	0.525 U	0.525 U	1.05 U	1.05	0.598
1,2-Dichloropropane	0.525 U	0.525 U	1.05 U	1.05	0.472
1,3-Dichloropropane	0.525 U	0.525 U	1.05 U	1.05	0.745
2,2-Dichloropropane	0.525 U	0.525 U	1.05 U	1.05	0.357
cis-1,3-Dichloropropene	0.525 U	0.525 U	1.05 U	1.05	0.409
trans-1,3-Dichloropropene	0.525 U	0.525 U	1.05 U	1.05	0.409
1,1-Dichloropropane	0.525 U	0.525 U	1.05 U	1.05	0.441
Ethylbenzene	0.525 U	0.525 U	1.05 U	1.05	0.336
Hexachlorobutadiene	1.31 U	1.31 U	2.62 U	2.62	0.430
2-Hexanone	5.25 U	5.25 U	10.5 U	10.5	1.69
Isopropylbenzene	0.525 U	0.525 U	1.05 U	1.05	0.808
p-Isopropyltoluene	0.525 U	0.525 U	1.05 U	1.05	0.892
Methylene Chloride	1.31 U	1.31 U	2.82 U	2.62	1.26
4-Methyl-2-Pentanone (MIBK)	5.25 U	5.25 U	10.5 U	10.5	3.04
Nephalene	1.31 U	1.31 U	2.62 U	2.62	0.692
n-Propylbenzene	0.525 U	0.525 U	1.05 U	1.05	0.566
Styrene	0.525 U	0.525 U	1.05 U	1.05	0.514
1,1,1,2-Tetrachloroethane	0.525 U	0.526 U	1.05 U	1.05	0.483
1,1,2,2-Tetrachloroethane	1.31 U	1.31 U	2.62 U	2.82	0.703
Tetrachloroethene	0.525 U	0.525 U	1.05 U	1.05	0.462
Toluene	0.734	0.548 U	0.734	1.09	0.283
1,2,3-Trichlorobenzene	1.31 U	1.31 U	2.62 U	2.62	0.587
1,2,4-Trichlorobenzene	1.31 U	1.31 U	2.62 U	2.62	0.692
1,1,1-Trichloroethane	1.31 U	1.31 U	2.82 U	2.62	0.535
1,1,2-Trichloroethane	1.31 U	1.31 U	2.82 U	2.62	0.587
Trichloroethene	0.525 U	0.525 U	1.05 U	1.05	1.04
Trichlorofluoromethane	2.62 U	2.62 U	5.25 U	5.25	0.839
1,2,3-Trichloropropane	1.31 U	1.31 U	2.62 U	2.62	1.04
1,2,4-Trimethylbenzene	0.525 U	0.525 U	1.05 U	1.05	0.661
1,3,5-Trimethylbenzene	0.525 U	0.525 U	1.05 U	1.05	0.776
Vinyl Chloride	0.525 U	0.525 U	1.05 U	1.05	0.336
m- & p-Xylenes	1.05 U	1.05 U	2.10 U	2.10	0.755
o-Xylene	0.525 U	0.525 U	1.05 U	1.05	0.556

U = Not detected at specified reporting limits; if the result is reported by the laboratory as J (estimated result less than the reporting limit) it is presented as U
E = Estimated result, concentration exceeds the calibration range.

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/20/07
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	1325 - 1405
Location:	Tacoma, Washington	Lab Number:	4519
Run Number:	3C	Volume Sampled:	0 0194 dscm
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet	Airflow:	10551 dscf/min

Analyte	RUN 3C Tenax Tube 3C µg/dscm	RUN 3C Anasorb Tube 3C µg/dscm	RUN 3C TOTAL 3C µg/dscm	*Reporting Limit TOTAL* 3C µg/dscm	*MDL TOTAL* 3C µg/dscm
Acetone	5 16 U	5 16 U	10.3 U	10.3	6 19
Benzene	51.1	0.516 U	51.1	1.03	0 444
Bromobenzene	0.516 U	0.516 U	1.03 U	1.03	0.568
Bromochloromethane	1.29 U	1.29 U	2 58 U	2.58	0.568
Bromodichloromethane	0.516 U	0.516 U	1 03 U	1.03	0.454
Bromoform	1.29 U	1.29 U	2 58 U	2.58	0.671
Bromomethane	2.58 U	2.58 U	5.16 U	5.16	0.805
2-Butanone (MEK)	5 16 U	5.16 U	10 3 U	10.3	3.30
n-Butylbenzene	0.516 U	0 516 U	1 03 U	1.03	0.795
sec-Butylbenzene	0.516 U	0.516 U	1.03 U	1.03	0.991
tert-Butylbenzene	0 516 U	0.516 U	1.03 U	1 03	0.916
Carbon Disulfide	0.516 U	0 516 U	1.03 U	1 03	0.433
Carbon Tetrachloride	0.516 U	0.516 U	1.03 U	1 03	0.351
Chlorobenzene	0.516 U	0.516 U	1.03 U	1 03	0.444
Chlorodibromomethane	1.29 U	1 29 U	2 58 U	2 58	0.392
Chloroethane	2.58 U	2 58 U	5 16 U	5.16	0.402
Chloroform	0.516 U	0.516 U	1 03 U	1.03	0.475
Chloromethane	2.58 U	2 58 U	5.16 U	5.16	0.619
2-Chlorotoluene	0.516 U	0.516 U	1.03 U	1 03	0.557
4-Chlorotoluene	0.516 U	0.516 U	1 03 U	1.03	0.588
1,2 Dibromo-3-chloropropane	2.58 U	2.58 U	5 16 U	5.16	1.65
1,2-Dibromoethane	1.29 U	1.29 U	2.58 U	2 58	0.402
Dibromomethane	1.29 U	1.29 U	2.58 U	2 58	0.660
1,2-Dichlorobenzene	0.516 U	0.516 U	1 03 U	1 03	0.809
1,3-Dichlorobenzene	0.516 U	0.516 U	1 03 U	1 03	0 660
1,4-Dichlorobenzene	0.516 U	0.516 U	1 03 U	1 03	0.764
Dichlorodifluoromethane	1.29 U	1.29 U	2 58 U	2.58	0.537
1,1-Dichloroethane	0 516 U	0 516 U	1.03 U	1 03	0.351
1,2-Dichloroethane	0 516 U	0.516 U	1 03 U	1 03	0.495
cis-1,3-Dichloroethene	0 516 U	0.516 U	1 03 U	1 03	0.516
trans-1,3-Dichloroethene	0 516 U	0 516 U	1 03 U	1.03	0.392
1,1-Dichloroethene	0 516 U	0.516 U	1 03 U	1 03	0 588
1,2-Dichloropropane	0 516 U	0 516 U	1 03 U	1 03	0.464
1,3-Dichloropropane	0 516 U	0 516 U	1.03 U	1 03	0.733
2,2-Dichloropropane	0.516 U	0 516 U	1 03 U	1.03	0 351
cis-1,3-Dichloropropene	0.516 U	0.516 U	1 03 U	1 03	0.402
trans-1,3-Dichloropropene	0 516 U	0.516 U	1 03 U	1 03	0.402
1,1-Dichloropropene	0 516 U	0.516 U	1 03 U	1 03	0 433
Ethylbenzene	0 516 U	0.516 U	1 03 U	1 03	0.330
Hexachlorobutadiene	1 29 U	1.29 U	2 58 U	2 58	0.423
2-Hexanone	5 16 U	5.16 U	10.3 U	10.3	1 86
Isopropylbenzene	0.516 U	0.516 U	1 03 U	1 03	0.599
p-Isopropyltoluene	0 516 U	0 516 U	1 03 U	1 03	0.877
Methylene Chloride	1.29 U	1.29 U	2 58 U	2.58	1 24
4-Methyl-2-Pentanone (MIBK)	5.16 U	5.16 U	10.3 U	10.3	2 99
Naphalene	1 29 U	1.29 U	2 58 U	2 58	0 681
n-Propylbenzene	0.516 U	0.516 U	1.03 U	1 03	0.557
Styrene	0.516 U	0 516 U	1.03 U	1.03	0.506
1,1,1,2-Tetrachloroethane	0 516 U	0.516 U	1 03 U	1 03	0 475
1,1,2,2-Tetrachloroethane	1 29 U	1.29 U	2.58 U	2 58	0 691
Tetrachloroethene	0 516 U	0.516 U	1.03 U	1.03	0.454
Toluene	1.14	0 537 U	1.14	1 07	0.279
1,2,3-Trichlorobenzene	1.29 U	1.29 U	2 58 U	2.58	0.578
1,2,4-Trichlorobenzene	1.29 U	1.29 U	2 56 U	2 58	0 681
1,1,1-Trichloroethane	1.29 U	1.29 U	2.58 U	2 58	0 526
1,1,2-Trichloroethane	1.29 U	1.29 U	2 58 U	2 58	0 578
Trichloroethene	0.516 U	0 516 U	1 03 U	1 03	1 02
Trichlorofluoromethane	2.58 U	2 58 U	5 16 U	5.16	0 826
1,2,3-Trichloropropane	1.29 U	1.29 U	2 58 U	2 58	1.02
1,2,4-Trimethylbenzene	0.516 U	0.516 U	1 03 U	1 03	0 650
1,3,5-Trimethylbenzene	0 516 U	0 516 U	1 03 U	1.03	0.764
Vinyl Chloride	0 516 U	0.516 U	1 03 U	1.03	0.330
m- & p-Xylenes	1 03 U	1.03 U	2 06 U	2.06	0.743
o-Xylene	0.516 U	0 516 U	1.03 U	1.03	0.547

U = Not detected at specified reporting limits, If the result is reported by the laboratory as J (estimated result less than the reporting limit) it is presented as U
E = Estimated result, concentration exceeds the calibration range

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date.	7/20/07
Client.	Parametrix @ City of Tacoma Landfill		
Location.	Tacoma, Washington		
Run Number.	3FB	Volume Sampled:	0.019 dscm
Sample Location.	Perennial #1 Landfill Gas Combuster Outlet		

	Run 3 - Field Blank			*Reporting Limit*	*MDL*
Analyte	Tenax Tube FB µg/dscm	Anasorb Tube FB µg/dscm	TOTAL FB µg/dscm	*TOTAL FB µg/dscm*	*TOTAL FB µg/dscm*
Acetone	5.14 U	5.14 U	10.3 U	10.3	10.3
Benzene	0.514 U	0.514 U	1.03 U	1.03	1.03
Bromobenzene	0.514 U	0.514 U	1.03 U	1.03	1.03
Bromochloromethane	1.28 U	1.28 U	2.57 U	2.57	2.57
Bromodichloromethane	0.514 U	0.514 U	1.03 U	1.03	1.03
Bromoform	1.28 U	1.28 U	2.57 U	2.57	2.57
Bromomethane	2.57 U	2.57 U	5.14 U	5.14	5.14
2-Butanone (MEK)	5.14 U	5.14 U	10.3 U	10.3	10.3
n-Butylbenzene	0.514 U	0.514 U	1.03 U	1.03	1.03
sec-Butylbenzene	0.514 U	0.514 U	1.03 U	1.03	1.03
tert-Butylbenzene	0.514 U	0.514 U	1.03 U	1.03	1.03
Carbon Disulfide	0.514 U	0.514 U	1.03 U	1.03	1.03
Carbon Tetrachloride	0.514 U	0.514 U	1.03 U	1.03	1.03
Chlorobenzene	0.514 U	0.514 U	1.03 U	1.03	1.03
Chlorodibromomethane	1.28 U	1.28 U	2.57 U	2.57	2.57
Chloroethane	2.57 U	2.569 U	5.14 U	5.14	5.14
Chloroform	0.514 U	0.514 U	1.03 U	1.03	1.03
Chloromethane	2.57 U	2.57 U	5.14 U	5.14	5.14
2-Chlorotoluene	0.514 U	0.514 U	1.03 U	1.03	1.03
4-Chlorotoluene	0.514 U	0.514 U	1.03 U	1.03	1.03
1,2 Dibromo-3-chloropropane	2.57 U	2.57 U	5.14 U	5.14	5.14
1,2-Dibromoethane	1.28 U	1.28 U	2.57 U	2.57	2.57
Dibromomethane	1.28 U	1.28 U	2.57 U	2.57	2.57
1,2-Dichlorobenzene	0.514 U	0.514 U	1.03 U	1.03	1.03
1,3-Dichlorobenzene	0.514 U	0.514 U	1.03 U	1.03	1.03
1,4-Dichlorobenzene	0.514 U	0.514 U	1.03 U	1.03	1.03
Dichlorodifluoromethane	1.28 U	1.28 U	2.57 U	2.57	2.57
1,1-Dichloroethane	0.514 U	0.514 U	1.03 U	1.03	1.03
1,2-Dichloroethane	0.514 U	0.514 U	1.03 U	1.03	1.03
cis-1,3-Dichloroethene	0.514 U	0.514 U	1.03 U	1.03	1.03
trans-1,3-Dichloroethene	0.514 U	0.514 U	1.03 U	1.03	1.03
1,1-Dichloroethene	0.514 U	0.514 U	1.03 U	1.03	1.03
1,2-Dichloropropane	0.514 U	0.514 U	1.03 U	1.03	1.03
1,3-Dichloropropane	0.514 U	0.514 U	1.03 U	1.03	1.03
2,2-Dichloropropane	0.514 U	0.514 U	1.03 U	1.03	1.03
cis-1,3-Dichloropropene	0.514 U	0.514 U	1.03 U	1.03	1.03
trans-1,3-Dichloropropene	0.514 U	0.514 U	1.03 U	1.03	1.03
1,1-Dichloropropene	0.514 U	0.514 U	1.03 U	1.03	1.03
Ethylbenzene	0.514 U	0.514 U	1.03 U	1.03	1.03
Hexachlorobutadiene	1.28 U	1.28 U	2.57 U	2.57	2.57
2-Hexanone	5.14 U	5.14 U	10.3 U	10.3	10.3
Isopropylbenzene	0.514 U	0.514 U	1.03 U	1.03	1.03
p-Isopropyltoluene	0.514 U	0.514 U	1.03 U	1.03	1.03
Methylene Chloride	1.28 U	1.28 U	2.57 U	2.57	2.57
4-Methyl-2-Pentanone (MIBK)	5.14 U	5.14 U	10.3 U	10.3	10.3
Naphalene	1.28 U	1.28 U	2.57 U	2.57	2.57
n-Propylbenzene	0.514 U	0.514 U	1.03 U	1.03	1.03
Styrene	0.514 U	0.514 U	1.03 U	1.03	1.03
1,1,1,2-Tetrachloroethane	0.514 U	0.514 U	1.03 U	1.03	1.03
1,1,2,2-Tetrachloroethane	1.28 U	1.28 U	2.57 U	2.57	2.57
Tetrachloroethene	0.514 U	0.514 U	1.03 U	1.03	1.03
Toluene	0.534 U	0.534 U	1.07 U	1.07	1.07
1,2,3-Trichlorobenzene	1.28 U	1.28 U	2.57 U	2.57	2.57
1,2,4-Trichlorobenzene	1.28 U	1.28 U	2.57 U	2.57	2.57
1,1,1-Trichloroethane	1.28 U	1.28 U	2.57 U	2.57	2.57
1,1,2-Trichloroethane	1.28 U	1.28 U	2.57 U	2.57	2.57
Trichloroethene	0.514 U	0.514 U	1.03 U	1.03	1.03
Trichlorofluoromethane	2.57 U	2.57 U	5.14 U	5.14	5.14
1,2,3-Trichloropropane	1.28 U	1.28 U	2.57 U	2.57	2.57
1,2,4-Trimethylbenzene	0.514 U	0.514 U	1.03 U	1.03	1.03
1,3,5-Trimethylbenzene	0.514 U	0.514 U	1.03 U	1.03	1.03
Vinyl Chloride	0.514 U	0.514 U	1.03 U	1.03	1.03
m- & p-Xylenes	1.03 U	1.03 U	2.06 U	2.06	2.06
o-Xylene	0.514 U	0.514 U	1.03 U	1.03	1.03

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E = Estimated result; concentration exceeds the calibration range.

EMISSION RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX @ CTL M0031
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Run Number: 1
Sample Location: Perennial #1 Landfill Gas Combustor Outlet

Sample Date: 7/19/07
Lab Numbers: 4511 - 4513

Analyte	RUN 1 TOTAL 1A µg	RUN 1 TOTAL 1B µg	RUN 1 TOTAL 1C µg	RUN 1 TOTAL RUN 1 µg	FIELD BLANK µg	*TOTAL Reporting Limit* µg	*TOTAL Detection Limit* µg
Acetone	0.20 U	0.20 U	0.31	0.31	*0.20 U*	*0.600*	*0.360*
Benzene	2.400 E	0.600	0.170	3.170 E	*0.020 U*	*0.060*	*0.026*
Bromobenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.033*
Bromochloromethane	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.033*
Bromodichloromethane	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.026*
Bromoform	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.039*
Bromomethane	0.100 U	0.100 U	0.100 U	0.300 U	*0.100 U*	*0.300*	*0.047*
2-Butanone (MEK)	0.200 U	0.200 U	0.200 U	0.600 U	*0.200 U*	*0.600*	*0.192*
n-Butylbenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.046*
sec-Butylbenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.058*
tert-Butylbenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.053*
Carbon Disulfide	0.020 U	0.020 U	0.028	0.028	*0.020 U*	*0.060*	*0.025*
Carbon Tetrachloride	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.020*
Chlorobenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.026*
Chlorodibromomethane	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.023*
Chloroethane	0.100 U	0.100 U	0.100 U	0.300 U	*0.100 U*	*0.300*	*0.023*
Chloroform	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.028*
Chloromethane	0.100 U	0.058	0.100 U	0.058	*0.100 U*	*0.300*	*0.036*
2-Chlorotoluene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.032*
4-Chlorotoluene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.034*
1,2 Dibromo-3-chloropropane	0.100 U	0.100 U	0.100 U	0.300 U	*0.100 U*	*0.300*	*0.096*
1,2-Dibromoethane	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.023*
Dibromomethane	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.038*
1,2-Dichlorobenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.035*
1,3-Dichlorobenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.038*
1,4-Dichlorobenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.044*
Dichlorodifluoromethane	0.027	0.030	0.035	0.092	*0.050 U*	*0.150*	*0.031*
1,1-Dichloroethane	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.020*
1,2-Dichloroethane	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.029*
cis-1,3-Dichloroethene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.030*
trans-1,3-Dichloroethene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.023*
1,1-Dichloroethane	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.034*
1,2-Dichloropropane	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.027*
1,3-Dichloropropane	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.043*
2,2-Dichloropropane	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.020*
cis-1,3-Dichloropropene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.023*
trans-1,3-Dichloropropene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.023*
1,1-Dichloropropene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.025*
Ethylbenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.019*
Hexachlorobutadiene	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.025*
2-Hexanone	0.200 U	0.200 U	0.200 U	0.600 U	*0.200 U*	*0.600*	*0.108*
Isopropylbenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.035*
p-Isopropyltoluene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.051*
Methylene Chloride	0.050 U	0.062	0.189	0.251	*0.050 U*	*0.150*	*0.072*
4-Methyl-2-Pentanone (MIBK)	0.200 U	0.200 U	0.200 U	0.600 U	*0.200 U*	*0.600*	*0.174*
Naphalene	0.025	0.050 U	0.050 U	0.025	*0.050 U*	*0.150*	*0.040*
n-Propylbenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.032*
Styrene	0.016	0.020 U	0.020 U	0.016	*0.020 U*	*0.060*	*0.029*
1,1,1,2-Tetrachloroethane	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.028*
1,1,2,2-Tetrachloroethane	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.040*
Tetrachloroethene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.026*
Toluene	0.066	0.025	0.021 U	0.091	*0.021 U*	*0.062*	*0.016*
1,2,3-Trichlorobenzene	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.034*
1,2,4-Trichlorobenzene	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.040*
1,1,1-Trichloroethane	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.031*
1,1,2-Trichloroethane	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.034*
Trichloroethene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.059*
Trichlorofluoromethane	0.100 U	0.076	1.600	1.676	*0.100 U*	*0.300*	*0.048*
1,2,3-Trichloropropane	0.046	0.050 U	0.050 U	0.046	*0.050 U*	*0.150*	*0.059*
1,2,4-Trimethylbenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.038*
1,3,5-Trimethylbenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.044*
Vinyl Chloride	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.019*
m- & p-Xylenes	0.040 U	0.040 U	0.040 U	0.120 U	*0.040 U*	*0.120*	*0.043*
o-Xylene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.032*

U = Not detected at specified reporting limits

EMISSION RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HDEFLER CONSULTING GROUP

File Name: 8752-001\PX @ CTL M0031
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Run Number: 2
Sample Location: Perennial #1 Landfill Gas Combuster Outlet

Sample Date: 7/20/07
Lab Numbers: 4514 - 4516

	RUN 2						
Analyte	TOTAL 2A µg	TOTAL 2B µg	TOTAL 2C µg	TOTAL RUN 2 µg	FIELD BLANK µg	*TOTAL Reporting Limit* µg	*TOTAL Detection Limit* µg
Acetone	0.20 U	0.20 U	0.20 U	0.60 U	*0.20 U*	*0.600*	*0.360*
Benzene	0.020 U	0.770	0.160	0.930	*0.020 U*	*0.060*	*0.026*
Bromobenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.033*
Bromochloromethane	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.033*
Bromodichloromethane	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.026*
Bromoform	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.039*
Bromomethane	0.100 U	0.100 U	0.100 U	0.300 U	*0.100 U*	*0.300*	*0.047*
2-Butanone (MEK)	0.200 U	0.200 U	0.200 U	0.600 U	*0.200 U*	*0.600*	*0.192*
n-Butylbenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.046*
sec-Butylbenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.058*
tert-Butylbenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.053*
Carbon Disulfide	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.025*
Carbon Tetrachloride	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.020*
Chlorobenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.026*
Chlorodibromomethane	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.023*
Chloroethane	0.100 U	0.100 U	0.100 U	0.300 U	*0.100 U*	*0.300*	*0.023*
Chloroform	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.028*
Chloromethane	0.064	0.100 U	0.100 U	0.064	*0.100 U*	*0.300*	*0.036*
2-Chlorotoluene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.032*
4-Chlorotoluene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.034*
1,2 Dibromo-3-chloropropane	0.100 U	0.100 U	0.100 U	0.300 U	*0.100 U*	*0.300*	*0.096*
1,2-Dibromoethane	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.023*
Dibromomethane	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.038*
1,2-Dichlorobenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.035*
1,3-Dichlorobenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.036*
1,4-Dichlorobenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.044*
Dichlorodifluoromethane	0.062	0.035	0.030	0.127	*0.050 U*	*0.150*	*0.031*
1,1-Dichloroethane	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.020*
1,2-Dichloroethane	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.029*
cis-1,3-Dichloroethene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.030*
trans-1,3-Dichloroethene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.023*
1,1-Dichloroethene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.034*
1,2-Dichloropropane	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.027*
1,3-Dichloropropane	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.043*
2,2-Dichloropropane	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.020*
cis-1,3-Dichloropropene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.023*
trans-1,3-Dichloropropene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.023*
1,1-Dichloropropene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.025*
Ethylbenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.019*
Hexachlorobutadiene	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.025*
2-Hexanone	0.200 U	0.200 U	0.200 U	0.600 U	*0.200 U*	*0.600*	*0.108*
Isopropylbenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.035*
p-Isopropyltoluene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.051*
Methylene Chloride	1.200	0.050 U	0.062	1.262	*0.050 U*	*0.150*	*0.072*
4-Methyl-2-Pentanone (MIBK)	0.200 U	0.200 U	0.200 U	0.600 U	*0.200 U*	*0.600*	*0.174*
Naphalene	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.040*
n-Propylbenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.032*
Styrene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.029*
1,1,1,2-Tetrachloroethane	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.028*
1,1,2,2-Tetrachloroethane	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.040*
Tetrachloroethene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.026*
Toluene	0.021 U	0.038	0.012	0.050	*0.021 U*	*0.062*	*0.016*
1,2,3-Trichlorobenzene	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.034*
1,2,4-Trichlorobenzene	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.040*
1,1,1-Trichloroethane	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.031*
1,1,2-Trichloroethane	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.034*
Trichloroethene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.059*
Trichlorofluoromethane	0.100 U	0.100 U	0.100 U	0.300 U	*0.100 U*	*0.300*	*0.048*
1,2,3-Trichloropropane	0.050 U	0.050 U	0.050 U	0.150 U	*0.050 U*	*0.150*	*0.059*
1,2,4-Trimethylbenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.038*
1,3,5-Trimethylbenzene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.044*
Vinyl Chloride	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.019*
m- & p-Xylenes	0.040 U	0.040 U	0.040 U	0.120 U	*0.040 U*	*0.120*	*0.043*
o-Xylene	0.020 U	0.020 U	0.020 U	0.060 U	*0.020 U*	*0.060*	*0.032*

U = Not detected at specified reporting limits

EMISSION RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX @ CTL M0031
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Run Number: 3
Sample Location: Perennial #1 Landfill Gas Combuster Outlet

Sample Date: 7/20/07
Lab Numbers: 4517 - 4519

Analyte	RUN 3 TOTAL 3A µg	RUN 3 TOTAL 3B µg	RUN 3 TOTAL 3C µg	RUN 3 TOTAL RUN 3 µg	FIELD BLANK µg	*TOTAL Reporting Limit µg*	*TOTAL Detection Limit µg*
Acetone	0.20 U	0 20 U	0 20 U	0 60 U	*0 20 U*	*0 600*	*0 360*
Benzene	0 890	0 370	0.990	2.250	*0 020 U*	*0 060*	*0 026*
Bromobenzene	0 020 U	0 020 U	0 020 U	0.060 U	*0 020 U*	*0,060*	*0 033*
Bromochloromethane	0,050 U	0 050 U	0 050 U	0 150 U	*0 050 U*	*0 150*	*0 033*
Bromodichloromethane	0 020 U	0 020 U	0.020 U	0 060 U	*0 020 U*	*0 060*	*0 026*
Bromoform	0 050 U	0 050 U	0.050 U	0 150 U	*0 050 U*	*0,150*	*0 039*
Bromomethane	0.100 U	0.100 U	0 100 U	0 300 U	*0,100 U*	*0,300*	*0 047*
2-Butanone (MEK)	0,200 U	0,200 U	0 200 U	0 600 U	*0 200 U*	*0 600*	*0 192*
n-Butylbenzene	0.020 U	0.020 U	0 020 U	0 060 U	*0,020 U*	*0,060*	*0 046*
sec-Butylbenzene	0 020 U	0 020 U	0 020 U	0 060 U	*0 020 U*	*0 060*	*0 056*
tert-Butylbenzene	0 020 U	0,020 U	0.020 U	0 060 U	*0 020 U*	*0,060*	*0,053*
Carbon Disulfide	0 020 U	0.020 U	0 020 U	0 060 U	*0 020 U*	*0,060*	*0 025*
Carbon Tetrachloride	0,020 U	0,020 U	0 020 U	0 060 U	*0 020 U*	*0,060*	*0 020*
Chlorobenzene	0 020 U	0,020 U	0 020 U	0 060 U	*0,020 U*	*0 060*	*0 026*
Chlorodibromomethane	0,050 U	0,050 U	0 050 U	0,150 U	*0 050 U*	*0,150*	*0 023*
Chloroethane	0 100 U	0,100 U	0 100 U	0,300 U	*0 100 U*	*0 300*	*0 023*
Chloroform	0 020 U	0,020 U	0,020 U	0 060 U	*0 020 U*	*0,060*	*0 026*
Chloromethane	0 100 U	0,051	0 100 U	0 051	*0 100 U*	*0 300*	*0 036*
2-Chlorotoluene	0 020 U	0,020 U	0 020 U	0,060 U	*0 020 U*	*0 060*	*0 032*
4-Chlorotoluene	0,020 U	0 020 U	*0 020* U	0 060 U	*0 020 U*	*0,060*	*0 034*
1,2 Dibromo-3-chloropropane	0 100 U	0 100 U	0 100 U	0 300 U	*0,100 U*	*0 300*	*0 096*
1,2-Dibromoethane	0,050 U	0 050 U	0,050 U	0,150 U	*0,050 U*	*0,150*	*0,023*
Dibromomethane	0 050 U	0 050 U	0 050 U	0 150 U	*0 050 U*	*0 150*	*0 038*
1,2-Dichlorobenzene	0 020 U	0 020 U	0,020 U	0 060 U	*0 020 U*	*0,060*	*0,035*
1,3-Dichlorobenzene	0 020 U	0 020 U	0,020 U	0 060 U	*0 020 U*	*0,060*	*0 038*
1,4-Dichlorobenzene	0,020 U	0,020 U	0 020 U	0 060 U	*0,020 U*	*0,060*	*0 044*
Dichlorodifluoromethane	0 033	0 025	0 050 U	*0 058*	*0 050 U*	*0,150*	*0 031*
1,1-Dichloroethane	0,020 U	0,020 U	0,020 U	0 060 U	*0 020 U*	*0,060*	*0 020*
1,2-Dichloroethane	0 020 U	0,020 U	0 020 U	0 060 U	*0 020 U*	*0 060*	*0 029*
cis-1,3-Dichloroethene	0,020 U	0,020 U	0 020 U	0,060 U	*0 020 U*	*0 060*	*0 030*
trans-1,3-Dichloroethene	0 020 U	0,020 U	0 020 U	0 060 U	*0 020 U*	*0 060*	*0 023*
1,1-Dichloroethene	0,020 U	0 020 U	0 020 U	0 060 U	*0 020 U*	*0 060*	*0 034*
1,2-Dichloropropane	*0 020* U	0,020 U	0 020 U	0 060 U	*0 020 U*	*0,060*	*0 027*
1,3-Dichloropropane	0,020 U	0,020 U	0,020 U	0,060 U	*0 020 U*	*0,060*	*0 043*
2,2-Dichloropropane	0 020 U	0 020 U	0 020 U	0 060 U	*0 020 U*	*0 060*	*0 020*
cis-1,3-Dichloropropene	0 020 U	0 020 U	0 020 U	0 060 U	*0 020 U*	*0,060*	*0 023*
trans-1,3-Dichloropropene	0 020 U	0,020 U	0,020 U	0 060 U	*0 020 U*	*0,060*	*0 023*
1,1-Dichloropropene	0 020 U	0 020 U	0,020 U	0 060 U	*0,020 U*	*0,060*	*0 025*
Ethylbenzene	*0 020* U	0 020 U	0,020 U	0 060 U	*0 020 U*	*0,060*	*0 019*
Hexachlorobutadiene	0 050 U	0,050 U	0 050 U	0 150 U	*0 050 U*	*0,150*	*0 025*
2-Hexanone	0 200 U	0 200 U	*0,200* U	0 600 U	*0,200 U*	*0 600*	*0 108*
Isopropylbenzene	0 020 U	0,020 U	0 020 U	0 060 U	*0 020 U*	*0,060*	*0 035*
p-Isopropyltoluene	0 020 U	0 020 U	0,020 U	0 060 U	*0 020 U*	*0 060*	*0 051*
Methylene Chloride	0 050 U	0 050 U	0,050 U	0 150 U	*0 050 U*	*0 150*	*0 072*
4-Methyl-2-Pentanone (MIBK)	0,200 U	0 200 U	0 200 U	0 600 U	*0 200 U*	*0 600*	*0 174*
Naphalene	0 050 U	0,050 U	0,050 U	0 150 U	*0 050 U*	*0,150*	*0 040*
n-Propylbenzene	0 020 U	*0 020* U	0 020 U	*0 060* U	*0 020 U*	*0,060*	*0 032*
Styrene	0 020 U	0,020 U	0,020 U	0 060 U	*0 020 U*	*0,060*	*0 029*
1,1,1,2-Tetrachloroethane	0 020 U	0 020 U	0 020 U	0 060 U	*0 020 U*	*0 060*	*0 026*
1,1,2,2-Tetrachloroethane	0 050 U	0 050 U	0 050 U	0 150 U	*0 050 U*	*0 150*	*0 040*
Tetrachloroethene	0 020 U	0 020 U	0 020 U	0 060 U	*0 020 U*	*0,060*	*0 026*
Toluene	0 023	*0 014*	0 022	0,059	*0 021 U*	*0 062*	*0 016*
1,2,3-Trichlorobenzene	0 050 U	0 050 U	0 050 U	0 150 U	*0 050 U*	*0,150*	*0 034*
1,2,4-Trichlorobenzene	0,050 U	0,050 U	0 050 U	0 150 U	*0 050 U*	*0,150*	*0 040*
1,1,1-Trichloroethane	0,050 U	0 050 U	0 050 U	0 150 U	*0,050 U*	*0,150*	*0 031*
1,1,2-Trichloroethane	0 050 U	0 050 U	0 050 U	0 150 U	*0 050 U*	*0 150*	*0 034*
Trichloroethene	0,020 U	0,020 U	0 020 U	0 060 U	*0 020 U*	*0,060*	*0 059*
Trichlorofluoromethane	0,087	0 100 U	0 100 U	0,087	*0 100 U*	*0 300*	*0 046*
1,2,3-Trichloropropane	0 050 U	0,050 U	0 050 U	0 150 U	*0,050 U*	*0 150*	*0 059*
1,2,4-Trimethylbenzene	0 020 U	0,020 U	0 020 U	0 060 U	*0 020 U*	*0,060*	*0 036*
1,3,5-Trimethylbenzene	0 020 U	0 020 U	0 020 U	0 060 U	*0 020 U*	*0 060*	*0 044*
Vinyl Chloride	0 020 U	0 020 U	0 020 U	0 060 U	*0 020 U*	*0 060*	*0 019*
m- & p-Xylenes	0 040 U	0 040 U	0 040 U	0 120 U	*0 040 U*	*0,120*	*0 043*
o-Xylene	0 020 U	0 020 U	0,020 U	0 060 U	*0 020 U*	*0 060*	*0 032*

U = Not detected at specified reporting limits

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/19/07
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	1510 - 1610
Location:	Tacoma, Washington	Lab Number:	4511
Run Number:	1A		
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet		

Analyte	RUN 1A Tenax Tube 1A µg	RUN 1A Anasorb Tube 1A µg	RUN 1A TOTAL 1A µg	*Reporting Limit TOTAL 1A µg*	*MDL TOTAL 1A µg*
Acetone	0.100 U	0.100 U	0.200 U	*0.200*	*0.120*
Benzene	2.40 E	0.010 U	2.40 E	*0.020*	*0.009*
Bromobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
Bromochloromethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.011*
Bromodichloromethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Bromoform	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
Bromomethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.016*
2-Butanone (MEK)	0.100 U	0.100 U	0.200 U	*0.200*	*0.064*
n-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.015*
sec-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.019*
tert-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.018*
Carbon Disulfide	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
Carbon Tetrachloride	0.010 U	0.010 U	0.020 U	*0.020*	*0.007*
Chlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Chlorodibromomethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.008*
Chloroethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.008*
Chloroform	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Chloromethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.012*
2-Chlorotoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
4-Chlorotoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
1,2 Dibromo-3-chloropropene	0.050 U	0.050 U	0.100 U	*0.100*	*0.032*
1,2-Dibromoethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.008*
Dibromomethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
1,2-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.012*
1,3-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.013*
1,4-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.015*
Dichlorodifluoromethane	0.025 U	0.027	0.027	*0.050*	*0.010*
1,1-Dichloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.007*
1,2-Dichloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.010*
cis-1,3-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.010*
trans-1,3-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
1,1-Dichloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
1,2-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
1,3-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.014*
2,2-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.007*
cis-1,3-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
trans-1,3-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
1,1-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
Ethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.006*
Hexachlorobutadiene	0.025 U	0.025 U	0.050 U	*0.050*	*0.008*
2-Hexanone	0.100 U	0.100 U	0.200 U	*0.200*	*0.036*
Isopropylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.012*
p-Isopropyltoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.017*
Methylene Chloride	0.025 U	0.025 U	0.050 U	*0.050*	*0.024*
4-Methyl-2-Pentanone (MiBK)	0.100 U	0.100 U	0.200 U	*0.200*	*0.058*
Naphalene	0.025	0.025 U	0.025	*0.050*	*0.013*
n-Propylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
Styrene	0.016	0.010 U	0.016	*0.020*	*0.010*
1,1,1,2-Tetrachloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
1,1,2,2-Tetrachloroethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
Tetrachloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Toluene	0.066	0.010 U	0.066	*0.021*	*0.005*
1,2,3-Trichlorobenzene	0.025 U	0.025 U	0.050 U	*0.050*	*0.011*
1,2,4-Trichlorobenzene	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
1,1,1-Trichloroethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.010*
1,1,2-Trichloroethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.011*
Trichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Trichlorofluoromethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.016*
1,2,3-Trichloropropane	0.046	0.025 U	0.046	*0.050*	*0.020*
1,2,4-Trimethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.013*
1,3,5-Trimethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.015*
Vinyl Chloride	0.010 U	0.010 U	0.020 U	*0.020*	*0.006*
m- & p-Xylenes	0.020 U	0.020 U	0.040 U	*0.040*	*0.014*
o-Xylene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*

U = Not detected at specified reporting limits. If the result is reported by the laboratory as J (estimated result less than the reporting limit) it is presented as U.
E = Estimated result, concentration exceeds the calibration range.

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001VPX @ CTL M0031	Sample Date:	7/19/07
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	1620 - 1700
Location:	Tacoma, Washington	Lab Number:	4512
Run Number:	1B		
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet		

Analyte	RUN 1B Tenax Tube 1B µg	Anasorb Tube 1B µg	TOTAL 1B µg	*Reporting Limit TOTAL 1B µg*	*MDL TOTAL 1B µg*
Acetone	0.100 U	0.100 U	0.200 U	*0.200*	*0.120*
Benzene	0.600	0.010 U	0.600	*0.020*	*0.009*
Bromobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
Bromochloromethane	0.026 U	0.025 U	0.050 U	*0.050*	*0.011*
Bromodichloromethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Bromoform	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
Bromomethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.016*
2-Butanone (MEK)	0.100 U	0.100 U	0.200 U	*0.200*	*0.064*
n-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.015*
sec-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.019*
tert-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.016*
Carbon Disulfide	0.010 U	0.010 U	0.020 U	*0.020*	*0.006*
Carbon Tetrachloride	0.010 U	0.010 U	0.020 U	*0.020*	*0.007*
Chlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Chlorodibromomethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.008*
Chloroethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.008*
Chloroform	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Chloromethane	0.050 U	0.058	0.058	*0.100*	*0.012*
2-Chlorotoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
4-Chlorotoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
1,2 Dibromo-3-chloropropane	0.050 U	0.050 U	0.100 U	*0.100*	*0.032*
1,2-Dibromoethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.008*
Dibromomethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
1,2-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.012*
1,3-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.013*
1,4-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.015*
Dichlorodifluoromethane	0.025 U	0.030	0.030	*0.050*	*0.010*
1,1-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.007*
1,2-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.010*
cis-1,3-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.010*
trans-1,3-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
1,1-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
1,2-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
1,3-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.014*
2,2-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.007*
cis-1,3-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
trans-1,3-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
1,1-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
Ethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.006*
Hexachlorobutadiene	0.025 U	0.025 U	0.050 U	*0.050*	*0.008*
2-Hexanone	0.100 U	0.100 U	0.200 U	*0.200*	*0.036*
Isopropylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.012*
p-Isopropyltoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.017*
Methylene Chloride	0.062	0.025 U	0.062	*0.050*	*0.024*
4-Methyl-2-Pentanone (MIBK)	0.100 U	0.100 U	0.200 U	*0.200*	*0.058*
Naphalene	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
n-Propylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
Styrene	0.010 U	0.010 U	0.020 U	*0.020*	*0.010*
1,1,1,2-Tetrachloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
1,1,2,2-Tetrachloroethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
Tetrachloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Toluene	0.025	0.010 U	0.025	*0.021*	*0.005*
1,2,3-Trichlorobenzene	0.025 U	0.025 U	0.050 U	*0.050*	*0.011*
1,2,4-Trichlorobenzene	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
1,1,1-Trichloroethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.010*
1,1,2-Trichloroethene	0.025 U	0.025 U	0.050 U	*0.050*	*0.011*
Trichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Trichlorofluoromethane	0.050 U	0.076	0.076	*0.100*	*0.018*
1,2,3-Trichloropropane	0.025 U	0.025 U	0.050 U	*0.050*	*0.020*
1,2,4-Trimethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.013*
1,3,5-Trimethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.015*
Vinyl Chloride	0.010 U	0.010 U	0.020 U	*0.020*	*0.006*
m- & p-Xylenes	0.020 U	0.020 U	0.040 U	*0.040*	*0.014*
o-Xylene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*

U = Not detected at specified reporting limits. If the result is reported by the laboratory as J (estimated result less than the reporting limit) it is presented as U
E = Estimated result; concentration exceeds the calibration range

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/19/07
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	1719 - 1759
Location:	Tacoma, Washington	Lab Number:	4513
Run Number:	1C		
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet		

Analyte	RUN 1C Tenax Tube 1C µg	RUN 1C Anasorb Tube 1C µg	RUN 1C TOTAL 1C µg	*Reporting Limit TOTAL 1C µg*	*MDL TOTAL 1C µg*
Acetone	0.310	0.100 U	0.310	*0.200*	*0.120*
Benzene	0.170	0.010 U	0.170	*0.020*	*0.009*
Bromobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
Bromochloromethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.011*
Bromodichloromethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Bromoform	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
Bromomethene	0.050 U	0.050 U	0.100 U	*0.100*	*0.016*
2-Butanone (MEK)	0.100 U	0.100 U	0.200 U	*0.200*	*0.064*
n-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.015*
sec-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.019*
tert-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.018*
Carbon Disulfide	0.028	0.010 U	0.028	*0.020*	*0.008*
Carbon Tetrachloride	0.010 U	0.010 U	0.020 U	*0.020*	*0.007*
Chlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Chlorodibromomethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.008*
Chloroethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.008*
Chloroform	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Chloromethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.012*
2-Chlorotoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
4-Chlorotoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
1,2 Dibromo-3-chloropropane	0.050 U	0.050 U	0.100 U	*0.100*	*0.032*
1,2-Dibromoethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.008*
Dibromomethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
1,2-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.012*
1,3-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.013*
1,4-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.015*
Dichlorodifluoromethane	0.035	0.025 U	0.035	*0.050*	*0.010*
1,1-Dichloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.007*
1,2-Dichloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.010*
cis-1,3-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.010*
trans-1,3-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
1,1-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
1,2-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
1,3-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.014*
2,2-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.007*
cis-1,3-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
trans-1,3-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
1,1-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
Ethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.006*
Hexachlorobutadiene	0.025 U	0.025 U	0.050 U	*0.050*	*0.008*
2-Hexanone	0.100 U	0.100 U	0.200 U	*0.200*	*0.036*
Isopropylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.012*
p-Isopropyltoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.017*
Methylene Chloride	0.189	0.025 U	0.189	*0.050*	*0.024*
4-Methyl-2-Pentanone (MIBK)	0.100 U	0.100 U	0.200 U	*0.200*	*0.058*
Naphalene	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
n-Propylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
Styrene	0.010 U	0.010 U	0.020 U	*0.020*	*0.010*
1,1,1,2-Tetrachloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
1,1,2,2-Tetrachloroethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
Tetrachloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Toluene	0.010 U	0.010 U	0.021 U	*0.021*	*0.005*
1,2,3-Trichlorobenzene	0.025 U	0.025 U	0.050 U	*0.050*	*0.011*
1,2,4-Trichlorobenzene	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
1,1,1-Trichloroethene	0.025 U	0.025 U	0.050 U	*0.050*	*0.010*
1,1,2-Trichloroethene	0.025 U	0.025 U	0.050 U	*0.050*	*0.011*
Trichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Trichlorofluoromethane	1.600	0.050 U	1.600	*0.100*	*0.016*
1,2,3-Trichloropropane	0.025 U	0.025 U	0.050 U	*0.050*	*0.020*
1,2,4-Trimethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.013*
1,3,5-Trimethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.015*
Vinyl Chloride	0.010 U	0.010 U	0.020 U	*0.020*	*0.006*
m- & p-Xylenes	0.020 U	0.020 U	0.040 U	*0.040*	*0.014*
o-Xylene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*

U = Not detected at specified reporting limits; If the result is reported by the laboratory as J (estimated result less than the reporting limit) it is presented as U
E = Estimated result, concentration exceeds the calibration range.

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX @ CTL M0031 Sample Date: 7/19/07
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Run Number: 1FB
Sample Location: Perennial #1 Landfill Gas Combuster Outlet

Analyte	Run 1 - Field Blank Tenax Tube FB µg	Anasorb Tube FB µg	TOTAL FB µg	*Reporting Limit* TOTAL FB *µg*	*MDL* TOTAL FB *µg*
Acetone	0.100 U	0.100 U	0.200 U	*0.200*	*0.200*
Benzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Bromobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Bromochloromethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
Bromodichloromethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Bromoform	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
Bromomethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.100*
2-Butanone (MEK)	0.100 U	0.100 U	0.200 U	*0.200*	*0.200*
n-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
sec-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
tert-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Carbon Disulfide	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Carbon Tetrachloride	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Chlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Chlorodibromomethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
Chloroethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.100*
Chloroform	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Chloromethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.100*
2-Chlorotoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
4-Chlorotoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,2 Dibromo-3-chloropropane	0.050 U	0.050 U	0.100 U	*0.100*	*0.100*
1,2-Dibromoethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
Dibromomethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
1,2-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,3-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,4-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Dichlorodifluoromethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
1,1-Dichloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,2-Dichloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
cis-1,3-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
trans-1,3-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,1-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,2-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,3-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
2,2-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
cis-1,3-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
trans-1,3-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,1-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Ethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Hexachlorobutadiene	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
2-Hexanone	0.100 U	0.100 U	0.200 U	*0.200*	*0.200*
Isopropylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
p-Isopropyltoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Methylene Chloride	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
4-Methyl-2-Pentanone (MIBK)	0.100 U	0.100 U	0.200 U	*0.200*	*0.200*
Naphalene	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
n-Propylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Styrene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,1,1,2-Tetrachloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,1,2,2-Tetrachloroethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
Tetrachloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Toluene	0.010 U	0.010 U	0.021 U	*0.021*	*0.021*
1,2,3-Trichlorobenzene	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
1,2,4-Trichlorobenzene	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
1,1,1-Trichloroethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
1,1,2-Trichloroethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
Trichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Trichlorofluoromethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.100*
1,2,3-Trichloropropane	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
1,2,4-Trimethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,3,5-Trimethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Vinyl Chloride	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
m- & p-Xylenes	0.020 U	0.020 U	0.040 U	*0.040*	*0.040*
o-Xylene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*

U = Not detected at specified reporting limits. If the result is reported by the laboratory as J (estimated result less than the reporting limit) it is presented as U
E = Estimated result concentration exceeds the calibration range

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0001	Sample Date:	7/20/07
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	831 - 911
Location:	Tacoma, Washington	Lab Number:	4514
Run Number:	2A		
Sample Location:	Perenniel #1 Landfill Gas Combuster Outlet		

	RUN 2A			Reporting Limit	MDL
	Tenax Tube 2A	Anasorb Tube 2A	TOTAL 2A	TOTAL 2A	TOTAL 2A
Analyte	µg	µg	µg	µg	µg
Acetone	0.100 U	0.100 U	0.200 U	0.200	0.120
Benzene	0.010 U	0.010 U	0.020 U	0.020	0.009
Bromobenzene	0.010 U	0.010 U	0.020 U	0.020	0.011
Bromochloromethane	0.025 U	0.025 U	0.050 U	0.050	0.011
Bromodichloromethane	0.010 U	0.010 U	0.020 U	0.020	0.009
Bromoform	0.025 U	0.025 U	0.050 U	0.050	0.013
Bromomethane	0.050 U	0.050 U	0.100 U	0.100	0.016
2-Butanone (MEK)	0.100 U	0.100 U	0.200 U	0.200	0.064
n-Butylbenzene	0.010 U	0.010 U	0.020 U	0.020	0.015
sec-Butylbenzene	0.010 U	0.010 U	0.020 U	0.020	0.019
tert-Butylbenzene	0.010 U	0.010 U	0.020 U	0.020	0.018
Carbon Disulfide	0.010 U	0.010 U	0.020 U	0.020	0.008
Carbon Tetrachloride	0.010 U	0.010 U	0.020 U	0.020	0.007
Chlorobenzene	0.010 U	0.010 U	0.020 U	0.020	0.009
Chlorodibromomethane	0.025 U	0.025 U	0.050 U	0.050	0.008
Chloroethane	0.050 U	0.050 U	0.100 U	0.100	0.008
Chloroform	0.010 U	0.010 U	0.020 U	0.020	0.009
Chloromethane	0.050 U	0.064	0.064	0.100	0.012
2-Chlorotoluene	0.010 U	0.010 U	0.020 U	0.020	0.011
4-Chlorotoluene	0.010 U	0.010 U	0.020 U	0.020	0.011
1,2 Dibromo-3-chloropropane	0.050 U	0.050 U	0.100 U	0.100	0.032
1,2-Dibromoethane	0.025 U	0.025 U	0.050 U	0.050	0.008
Dibromomethane	0.025 U	0.025 U	0.050 U	0.050	0.013
1,2-Dichlorobenzene	0.010 U	0.010 U	0.020 U	0.020	0.012
1,3-Dichlorobenzene	0.010 U	0.010 U	0.020 U	0.020	0.013
1,4-Dichlorobenzene	0.010 U	0.010 U	0.020 U	0.020	0.015
Dichlorodifluoromethane	0.025 U	0.062	0.062	0.050	0.010
1,1-Dichloroethane	0.010 U	0.010 U	0.020 U	0.020	0.007
1,2-Dichloroethene	0.010 U	0.010 U	0.020 U	0.020	0.010
cis-1,3-Dichloroethene	0.010 U	0.010 U	0.020 U	0.020	0.010
trans-1,3-Dichloroethene	0.010 U	0.010 U	0.020 U	0.020	0.008
1,1-Dichloroethene	0.010 U	0.010 U	0.020 U	0.020	0.011
1,2-Dichloropropane	0.010 U	0.010 U	0.020 U	0.020	0.009
1,3-Dichloropropane	0.010 U	0.010 U	0.020 U	0.020	0.014
2,2-Dichloropropane	0.010 U	0.010 U	0.020 U	0.020	0.007
cis-1,3-Dichloropropene	0.010 U	0.010 U	0.020 U	0.020	0.008
trans-1,3-Dichloropropene	0.010 U	0.010 U	0.020 U	0.020	0.008
1,1-Dichloropropene	0.010 U	0.010 U	0.020 U	0.020	0.008
Ethylbenzene	0.010 U	0.010 U	0.020 U	0.020	0.006
Hexachlorobutadiene	0.025 U	0.025 U	0.050 U	0.050	0.008
2-Hexanone	0.100 U	0.100 U	0.200 U	0.200	0.036
Isopropylbenzene	0.010 U	0.010 U	0.020 U	0.020	0.012
p-Isopropyltoluene	0.010 U	0.010 U	0.020 U	0.020	0.017
Methylene Chloride	1.20	0.025 U	1.20	0.050	0.024
4-Methyl-2-Pentanone (MiBK)	0.100 U	0.100 U	0.200 U	0.200	0.058
Naphalene	0.025 U	0.025 U	0.050 U	0.050	0.013
n-Propylbenzene	0.010 U	0.010 U	0.020 U	0.020	0.011
Styrene	0.010 U	0.010 U	0.020 U	0.020	0.010
1,1,1,2-Tetrachloroethane	0.010 U	0.010 U	0.020 U	0.020	0.009
1,1,2,2-Tetrachloroethene	0.025 U	0.025 U	0.050 U	0.050	0.013
Tetrachloroethene	0.010 U	0.010 U	0.020 U	0.020	0.009
Toluene	0.010 U	0.010 U	0.021 U	0.021	0.005
1,2,3-Trichlorobenzene	0.025 U	0.025 U	0.050 U	0.050	0.011
1,2,4-Trichlorobenzene	0.025 U	0.025 U	0.050 U	0.050	0.013
1,1,1-Trichloroethane	0.025 U	0.025 U	0.050 U	0.050	0.010
1,1,2-Trichloroethane	0.025 U	0.025 U	0.050 U	0.050	0.011
Trichloroethene	0.010 U	0.010 U	0.020 U	0.020	0.020
Trichlorofluoromethane	0.050 U	0.050 U	0.100 U	0.100	0.016
1,2,3-Trichloropropane	0.025 U	0.025 U	0.050 U	0.050	0.020
1,2,4-Trimethylbenzene	0.010 U	0.010 U	0.020 U	0.020	0.013
1,3,5-Trimethylbenzene	0.010 U	0.010 U	0.020 U	0.020	0.015
Vinyl Chloride	0.010 U	0.010 U	0.020 U	0.020	0.006
m- & p-Xylenes	0.020 U	0.020 U	0.040 U	0.040	0.014
o-Xylene	0.010 U	0.010 U	0.020 U	0.020	0.011

U = Not detected at specified reporting limits. If the result is reported by the laboratory as J (estimated result less than the reporting limit) it is presented as U
E = Estimated result, concentration exceeds the calibration range.

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/20/07
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	926 - 1006
Location:	Tacoma, Washington	Lab Number:	4515
Run Number	2B		
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet		

	RUN 2B			*Reporting Limit*	*MDL*
	Tenax Tube 2B	Anasorb Tube 2B	TOTAL 2B	*TOTAL 2B*	*TOTAL 2B*
Analyte	µg	µg	µg	*µg*	*µg*
Acetone	0.100 U	0.100 U	0.200 U	*0.200*	*0.120*
Benzene	0.770	0.010 U	0.770	*0.020*	*0.009*
Bromobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
Bromochloromethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.011*
Bromodichloromethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Bromoform	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
Bromomethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.016*
2-Butanone (MEK)	0.100 U	0.100 U	0.200 U	*0.200*	*0.064*
n-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.015*
sec-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.019*
tert-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.018*
Carbon Disulfide	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
Carbon Tetrachloride	0.010 U	0.010 U	0.020 U	*0.020*	*0.007*
Chlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Chlorodibromomethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.008*
Chloroethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.008*
Chloroform	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Chloromethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.012*
2-Chlorotoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
4-Chlorotoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
1,2 Dibromo-3-chloropropane	0.050 U	0.050 U	0.100 U	*0.100*	*0.032*
1,2-Dibromoethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.008*
Dibromomethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
1,2-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.012*
1,3-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.013*
1,4-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.015*
Dichlorodifluoromethane	0.025 U	0.035	0.035	*0.050*	*0.010*
1,1-Dichloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.007*
1,2-Dichloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.010*
cis-1,3-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.010*
trans-1,3-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
1,1-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
1,2-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
1,3-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.014*
2,2-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.007*
cis-1,3-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
trans-1,3-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
1,1-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
Ethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.006*
Hexachlorobutadiene	0.025 U	0.025 U	0.050 U	*0.050*	*0.008*
2-Hexanone	0.100 U	0.100 U	0.200 U	*0.200*	*0.036*
Isopropylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.012*
p-Isopropyltoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.017*
Methylene Chloride	0.025 U	0.025 U	0.050 U	*0.050*	*0.024*
4-Methyl-2-Pentanone (MIBK)	0.100 U	0.100 U	0.200 U	*0.200*	*0.058*
Naphalene	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
n-Propylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
Styrene	0.010 U	0.010 U	0.020 U	*0.020*	*0.010*
1,1,1,2-Tetrachloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
1,1,2,2-Tetrachloroethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
Tetrachloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Toluene	0.038	0.010 U	0.038	*0.021*	*0.005*
1,2,3-Trichlorobenzene	0.025 U	0.025 U	0.050 U	*0.050*	*0.011*
1,2,4-Trichlorobenzene	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
1,1,1-Trichloroethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.010*
1,1,2-Trichloroethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.011*
Trichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Trichlorofluoromethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.016*
1,2,3-Trichloropropane	0.025 U	0.025 U	0.050 U	*0.050*	*0.020*
1,2,4-Trimethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.013*
1,3,5-Trimethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.015*
Vinyl Chloride	0.010 U	0.010 U	0.020 U	*0.020*	*0.006*
m- & p-Xylenes	0.020 U	0.020 U	0.040 U	*0.040*	*0.014*
o-Xylene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*

U = Not detected at specified reporting limits. If the result is reported by the laboratory as J (estimated result less than the reporting limit) it is presented as U.
E = Estimated result, concentration exceeds the calibration range.

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/20/07
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	1028 - 1108
Location:	Tacoma, Washington	Lab Number:	4516
Run Number:	2C		
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet		

Analyte	RUN 2C Tenax Tube 2C µg	RUN 2C Anasorb Tube 2C µg	RUN 2C TOTAL 2C µg	*Reporting Limit TOTAL 2C µg*	*MDL TOTAL 2C µg*
Acetone	0.100 U	0.100 U	0.200 U	*0.200*	*0.120*
Benzene	0.160	0.010 U	0.160	*0.020*	*0.009*
Bromobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
Bromochloromethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.011*
Bromodichloromethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Bromoform	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
Bromomethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.016*
2-Butanone (MEK)	0.100 U	0.100 U	0.200 U	*0.200*	*0.064*
n-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.015*
sec-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.019*
tert-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.018*
Carbon Disulfide	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
Carbon Tetrachloride	0.010 U	0.010 U	0.020 U	*0.020*	*0.007*
Chlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Chlorodibromomethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.008*
Chloroethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.008*
Chloroform	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Chloromethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.012*
2-Chlorotoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
4-Chlorotoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
1,2 Dibromo-3-chloropropane	0.050 U	0.050 U	0.100 U	*0.100*	*0.032*
1,2-Dibromoethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.008*
Dibromomethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
1,2-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.012*
1,3-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.013*
1,4-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.015*
Dichlorodifluoromethane	0.025 U	0.030	0.030	*0.050*	*0.010*
1,1-Dichloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.007*
1,2-Dichloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.010*
cis-1,3-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.010*
trans-1,3-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
1,1-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
1,2-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
1,3-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.014*
2,2-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.007*
cis-1,3-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
trans-1,3-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
1,1-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
Ethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.006*
Hexachlorobutadiene	0.025 U	0.025 U	0.050 U	*0.050*	*0.008*
2-Hexanone	0.100 U	0.100 U	0.200 U	*0.200*	*0.036*
Isopropylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.012*
p-Isopropyltoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.017*
Methylene Chloride	0.062	0.025 U	0.062	*0.050*	*0.024*
4-Methyl-2-Pentanone (MIBK)	0.100 U	0.100 U	0.200 U	*0.200*	*0.058*
Naphelene	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
n-Propylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
Styrene	0.010 U	0.010 U	0.020 U	*0.020*	*0.010*
1,1,1,2-Tetrachloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
1,1,2,2-Tetrachloroethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
Tetrachloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Toluene	0.012	0.010 U	0.012	*0.021*	*0.005*
1,2,3-Trichlorobenzene	0.025 U	0.025 U	0.050 U	*0.050*	*0.011*
1,2,4-Trichlorobenzene	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
1,1,1-Trichloroethene	0.025 U	0.025 U	0.050 U	*0.050*	*0.010*
1,1,2-Trichloroethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.011*
Trichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Trichlorofluoromethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.016*
1,2,3-Trichloropropene	0.025 U	0.025 U	0.050 U	*0.050*	*0.020*
1,2,4-Trimethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.013*
1,3,5-Trimethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.015*
Vinyl Chloride	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
m- & p-Xylenes	0.020 U	0.020 U	0.040 U	*0.040*	*0.014*
o-Xylene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*

U = Not detected at specified reporting limits; If the result is reported by the laboratory as J (estimated result less than the reporting limit) it is presented as U.
E = Estimated result, concentration exceeds the calibration range

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/20/07
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	1138 - 1218
Location:	Tacoma, Washington	Lab Number	4517
Run Number:	3A		
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet		

Analyte	RUN 3A Tenax Tube 3A µg	RUN 3A Anasorb Tube 3A µg	RUN 3A TOTAL 3A µg	Reporting Limit TOTAL 3A µg	MDL TOTAL 3A µg
Acetone	0.100 U	0.100 U	0.200 U	0.200	0.120
Benzene	0.890	0 010 U	0 890	0.020	0.009
Bromobenzene	0.010 U	0.010 U	0.020 U	0.020	0.011
Bromochloromethene	0 025 U	0 025 U	0 050 U	0.050	0.011
Bromodichloromethane	0.010 U	0.010 U	0.020 U	0.020	0.009
Bromoform	0.025 U	0 025 U	0.050 U	0.050	0.013
Bromomethane	0.050 U	0.050 U	0.100 U	0.100	0.016
2-Butanone (MEK)	0.100 U	0.100 U	0.200 U	0.200	0.064
n-Butylbenzene	0.010 U	0.010 U	0 020 U	0.020	0.015
sec-Butylbenzene	0.010 U	0.010 U	0 020 U	0.020	0.019
tert-Butylbenzene	0.010 U	0.010 U	0.020 U	0.020	0.018
Carbon Disulfide	0.010 U	0.010 U	0.020 U	0.020	0.008
Carbon Tetrachloride	0.010 U	0.010 U	0.020 U	0 020	0 007
Chlorobenzene	0.010 U	0.010 U	0.020 U	0.020	0.009
Chlorodibromomethane	0.025 U	0.025 U	0.050 U	0.050	0.008
Chloroethane	0 050 U	0.050 U	0.100 U	0.100	0.008
Chloroform	0.010 U	0.010 U	0 020 U	0 020	0.009
Chloromethene	0.050 U	0.050 U	0.100 U	0 100	0.012
2-Chlorotoluene	0.010 U	0.010 U	0.020 U	0 020	0 011
4-Chlorotoluene	0.010 U	0.010 U	0 020 U	0 020	0.011
1,2 Dibromo-3-chloropropane	0.050 U	0.050 U	0 100 U	0.100	0.032
1,2-Dibromoethane	0.025 U	0.025 U	0.050 U	0 050	0.008
Dibromomethane	0.025 U	0.025 U	0.050 U	0.050	0.013
1,2-Dichlorobenzene	0.010 U	0.010 U	0.020 U	0 020	0 012
1,3-Dichlorobenzene	0.010 U	0.010 U	0.020 U	0.020	0.013
1,4-Dichlorobenzene	0.010 U	0 010 U	0.020 U	0.020	0.015
Dichlorodifluoromethene	0.025 U	0.033	0.033	0 050	0.010
1,1-Dichloroethane	0.010 U	0.010 U	0.020 U	0 020	0.007
1,2-Dichloroethane	0.010 U	0.010 U	0.020 U	0 020	0.010
cis-1,3-Dichloroethene	0.010 U	0.010 U	0.020 U	0.020	0.010
trans-1,3-Dichloroethane	0.010 U	0 010 U	0.020 U	0.020	0.008
1,1-Dichloroethene	0.010 U	0.010 U	0.020 U	0 020	0 011
1,2-Dichloropropane	0.010 U	0.010 U	0.020 U	0 020	0.009
1,3-Dichloropropane	0.010 U	0.010 U	0.020 U	0 020	0.014
2,2-Dichloropropane	0.010 U	0.010 U	0 020 U	0 020	0.007
cis-1,3-Dichloropropene	0.010 U	0.010 U	0.020 U	0 020	0.008
trans-1,3-Dichloropropene	0.010 U	0.010 U	0 020 U	0.020	0.008
1,1-Dichloropropene	0 010 U	0.010 U	0 020 U	0.020	0.008
Ethylbenzene	0 010 U	0.010 U	0.020 U	0.020	0.006
Hexachlorobutadiene	0 025 U	0.025 U	0.050 U	0.050	0.008
2-Hexanone	0.100 U	0.100 U	0.200 U	0 200	0.036
Isopropylbenzene	0.010 U	0.010 U	0 020 U	0 020	0.012
p-Isopropyltoluene	0 010 U	0.010 U	0.020 U	0 020	0.017
Methylene Chlonde	0 025 U	0 025 U	0 050 U	0.050	0.024
4-Methyl-2-Pentanone (MiBK)	0 100 U	0 100 U	0.200 U	0.200	0 058
Naphalene	0.025 U	0 025 U	0.050 U	0 050	0.013
n-Propylbenzene	0.010 U	0.010 U	0.020 U	0.020	0.011
Styrene	0 010 U	0.010 U	0.020 U	0.020	0.010
1,1,1,2-Tetrachloroethane	0.010 U	0 010 U	0.020 U	0 020	0 009
1,1,2,2-Tetrachloroethane	0.025 U	0 025 U	0.050 U	0 050	0 013
Tetrachloroethane	0.010 U	0 010 U	0 020 U	0 020	0 009
Toluene	0.023	0.010 U	0 023	0 021	0.005
1,2,3-Trichlorobenzene	0.025 U	0.025 U	0 050 U	0.050	0 011
1,2,4-Trichlorobenzene	0 025 U	0 025 U	0 050 U	0 050	0 013
1,1,1-Trichloroethane	0 025 U	0.025 U	0.050 U	0 050	0 010
1,1,2-Trichloroethane	0.025 U	0.025 U	0.050 U	0 050	0.011
Trichloroethene	0.010 U	0.010 U	0.020 U	0 020	0.020
Trichlorofluoromethane	0.050 U	0 087	0.087	0.100	0.016
1,2,3-Trichloropropane	0.025 U	0.025 U	0 050 U	0.050	0.020
1,2,4-Trimethylbenzene	0.010 U	0.010 U	0.020 U	0.020	0 013
1,3,5-Trimethylbenzene	0.010 U	0.010 U	0 020 U	0.020	0.015
Vinyl Chlonde	0.010 U	0.010 U	0.020 U	0.020	0.006
m- & p-Xylenes	0.020 U	0.020 U	0 040 U	0.040	0.014
o-Xylene	0.010 U	0 010 U	0 020 U	0.020	0.011

U = Not detected at specified reporting limits. If the result is reported by the laboratory as J (estimated result less than the reporting limit) it is presented as U
E = Estimated result, concentration exceeds the calibration range.

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/20/07
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	1232 - 1312
Location:	Tacoma, Washington	Lab Number:	4518
Run Number:	3B		
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet		

	RUN 3B			*Reporting Limit*	*MDL*
	Tenax Tube 3B	Anasorb Tube 3B	TOTAL 3B	*TOTAL 3B*	*TOTAL 3B*
Analyte	µg	µg	µg	*µg*	*µg*
Acetone	0.100 U	0.100 U	0.200 U	*0.200*	*0.120*
Benzene	0.370	0.010 U	0.370	*0.020*	*0.009*
Bromobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
Bromochloromethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.011*
Bromodichloromethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Bromoform	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
Bromomethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.018*
2-Butanone (MEK)	0.100 U	0.100 U	0.200 U	*0.200*	*0.064*
n-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.015*
sec-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.019*
tert-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.018*
Carbon Disulfide	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
Carbon Tetrachloride	0.010 U	0.010 U	0.020 U	*0.020*	*0.007*
Chlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Chlorodibromomethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.008*
Chloroethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.008*
Chloroform	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Chloromethane	0.050 U	0.051	0.051	*0.100*	*0.012*
2-Chlorotoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
4-Chlorotoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
1,2 Dibromo-3-chloropropane	0.050 U	0.050 U	0.100 U	*0.100*	*0.032*
1,2-Dibromoethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.008*
Dibromomethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
1,2-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.012*
1,3-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.013*
1,4-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.015*
Dichlorodifluoromethane	0.025 U	0.025	0.025	*0.050*	*0.010*
1,1-Dichloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.007*
1,2-Dichloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.010*
cis-1,3-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.010*
trans-1,3-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
1,1-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
1,2-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
1,3-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.014*
2,2-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.007*
cis-1,3-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
trans-1,3-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
1,1-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.008*
Ethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.006*
Hexachlorobutadiene	0.025 U	0.025 U	0.050 U	*0.050*	*0.008*
2-Hexanone	0.100 U	0.100 U	0.200 U	*0.200*	*0.036*
Isopropylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.012*
p-Isopropyltoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.017*
Methylene Chloride	0.025 U	0.025 U	0.050 U	*0.050*	*0.024*
4-Methyl-2-Pentanone (MIBK)	0.100 U	0.100 U	0.200 U	*0.200*	*0.058*
Naphalene	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
n-Propylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
Styrene	0.010 U	0.010 U	0.020 U	*0.020*	*0.010*
1,1,1,2-Tetrachloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
1,1,2,2-Tetrachloroethene	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
Tetrachloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Toluene	0.014	0.010 U	0.014	*0.021*	*0.005*
1,2,3-Trichlorobenzene	0.025 U	0.025 U	0.050 U	*0.050*	*0.011*
1,2,4-Trichlorobenzene	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
1,1,1-Trichloroethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.010*
1,1,2-Trichloroethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.011*
Trichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Trichlorofluoromethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.016*
1,2,3-Trichloropropane	0.025 U	0.025 U	0.050 U	*0.050*	*0.020*
1,2,4-Trimethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.013*
1,3,5-Trimethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.015*
Vinyl Chloride	0.010 U	0.010 U	0.020 U	*0.020*	*0.006*
m- & p-Xylenes	0.020 U	0.020 U	0.040 U	*0.040*	*0.014*
o-Xylene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*

U = Not detected at specified reporting limits; if the result is reported by the laboratory as J (estimated result less than the reporting limit) it is presented as U
E = Estimated result; concentration exceeds the calibration range

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/20/07
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	1325 - 1405
Location:	Tacoma, Washington	Lab Number:	4519
Run Number:	3C		
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet		

Analyte	RUN 3C Tenax Tube 3C µg	RUN 3C Anasorb Tube 3C µg	RUN 3C TOTAL 3C µg	*Reporting Limit TOTAL 3C µg*	*MDL TOTAL 3C µg*
Acetone	0.100 U	0.100 U	0.200 U	*0.200*	*0.120*
Benzene	0.990	0 010 U	0.990	*0.020*	*0.009*
Bromobenzene	0.010 U	0 010 U	0.020 U	*0.020*	*0.011*
Bromochloromethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.011*
Bromodichloromethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Bromoform	0.025 U	0.025 U	0.050 U	*0.050*	*0.013*
Bromomethane	0.050 U	0.050 U	0.100 U	*0 100*	*0.016*
2-Butanone (MEK)	0.100 U	0.100 U	0.200 U	*0 200*	*0 064*
n-Butylbenzene	0.010 U	0.010 U	0.020 U	*0 020*	*0.015*
sec-Butylbenzene	0.010 U	0.010 U	0.020 U	*0 020*	*0.019*
tert-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.018*
Carbon Disulfide	0.010 U	0.010 U	0 020 U	*0.020*	*0.008*
Carbon Tetrachloride	0.010 U	0.010 U	0.020 U	*0.020*	*0.007*
Chlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Chlorodibromomethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.008*
Chloroethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.008*
Chloroform	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
Chloromethane	0 050 U	0.050 U	0 100 U	*0.100*	*0.012*
2-Chlorotoluene	0.010 U	0.010 U	0 020 U	*0 020*	*0.011*
4-Chlorotoluene	0.010 U	0.010 U	0 020 U	*0 020*	*0.011*
1,2 Dibromo-3-chloropropene	0.050 U	0.050 U	0 100 U	*0 100*	*0.032*
1,2-Dibromoethane	0.025 U	0.025 U	0 050 U	*0 050*	*0.008*
Dibromomethane	0 025 U	0.025 U	0.050 U	*0.050*	*0.013*
1,2-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0 020*	*0.012*
1,3-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.013*
1,4-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0 015*
Dichlorodifluoromethane	0.025 U	0 025 U	0.050 U	*0.050*	*0 010*
1,1-Dichloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0 007*
1,2-Dichloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0 010*
cis-1,3-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0 010*
trans-1,3-Dichloroethene	0 010 U	0.010 U	0 020 U	*0.020*	*0.008*
1,1-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.011*
1,2-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.009*
1,3-Dichloropropane	0.010 U	0.010 U	0 020 U	*0.020*	*0.014*
2,2-Dichloropropene	0.010 U	0.010 U	0 020 U	*0.020*	*0.007*
cis-1,3-Dichloropropene	0 010 U	0.010 U	0 020 U	*0.020*	*0.008*
trans-1,3-Dichloropropene	0 010 U	0 010 U	0 020 U	*0.020*	*0.008*
1,1-Dichloropropene	0.010 U	0.010 U	0 020 U	*0.020*	*0.008*
Ethylbenzene	0 010 U	0.010 U	0.020 U	*0.020*	*0.006*
Hexachlorobutadiene	0.025 U	0.025 U	0.050 U	*0.050*	*0.008*
2-Hexanone	0.100 U	0.100 U	0.200 U	*0.200*	*0.036*
Isopropylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.012*
p-Isopropyltoluene	0 010 U	0 010 U	0.020 U	*0.020*	*0.017*
Methylene Chloride	0.025 U	0.025 U	0 050 U	*0.050*	*0 024*
4-Methyl-2-Pentanone (MiBK)	0 100 U	0.100 U	0.200 U	*0 200*	*0 058*
Naphalene	0.025 U	0.025 U	0.050 U	*0 050*	*0.013*
n-Propylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0 011*
Styrene	0.010 U	0.010 U	0.020 U	*0 020*	*0 010*
1,1,1,2-Tetrachloroethane	0 010 U	0 010 U	0 020 U	*0 020*	*0 009*
1,1,2,2-Tetrachloroethane	0.025 U	0 025 U	0.050 U	*0.050*	*0 013*
Tetrachloroethene	0 010 U	0.010 U	0.020 U	*0.020*	*0 009*
Toluene	0.022	0 010 U	0 022	*0.021*	*0 005*
1,2,3-Trichlorobenzene	0.025 U	0 025 U	0.050 U	*0.050*	*0 011*
1,2,4-Trichlorobenzene	0 025 U	0 025 U	0.050 U	*0.050*	*0.013*
1,1,1-Trichloroethene	0 025 U	0 025 U	0.050 U	*0.050*	*0.010*
1,1,2-Trichloroethene	0.025 U	0 025 U	0.050 U	*0 050*	*0 011*
Trichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Trichlorofluoromethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.016*
1,2,3-Trichloropropane	0.025 U	0 025 U	0.050 U	*0.050*	*0.020*
1,2,4-Trimethylbenzene	0 010 U	0.010 U	0.020 U	*0.020*	*0.013*
1,3,5-Trimethylbenzene	0 010 U	0.010 U	0.020 U	*0 020*	*0.015*
Vinyl Chloride	0.010 U	0.010 U	0.020 U	*0 020*	*0.006*
m- & p-Xylenes	0 020 U	0 020 U	0.040 U	*0 040*	*0.014*
o-Xylene	0 010 U	0.010 U	0.020 U	*0 020*	*0.011*

U = Not detected at specified reporting limits. If the result is reported by the laboratory as J (estimated result less than the reporting limit) it is presented as U
E = Estimated result, concentration exceeds the calibration range

EMISSIONS RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX @ CTL M0031 Sample Date: 7/20/07
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Run Number: 3FB
Sample Location: Perennial #1 Landfill Gas Combuster Outlet

Analyte	Run 3 - Field Blank Tenax Tube FB µg	Anasorb Tube FB µg	TOTAL FB µg	*Reporting Limit TOTAL FB µg*	*MDL TOTAL FB µg*
Acetone	0.100 U	0.100 U	0.200 U	*0.200*	*0.200*
Benzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Bromobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Bromochloromethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
Bromodichloromethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Bromoform	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
Bromomethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.100*
2-Butanone (MEK)	0.100 U	0.100 U	0.200 U	*0.200*	*0.200*
n-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
sec-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
tert-Butylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Carbon Disulfide	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Carbon Tetrachloride	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Chlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Chlorodibromomethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
Chloroethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.100*
Chloroform	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Chloromethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.100*
2-Chlorotoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
4-Chlorotoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,2 Dibromo-3-chloropropane	0.050 U	0.050 U	0.100 U	*0.100*	*0.100*
1,2-Dibromoethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
Dibromomethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
1,2-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,3-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,4-Dichlorobenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Dichlorodifluoromethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
1,1-Dichloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,2-Dichloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
cis-1,3-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
trans-1,3-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,1-Dichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,2-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,3-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
2,2-Dichloropropane	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
cis-1,3-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
trans-1,3-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,1-Dichloropropene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Ethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Hexachlorobutadiene	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
2-Hexanone	0.100 U	0.100 U	0.200 U	*0.200*	*0.200*
Isopropylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
p-Isopropyltoluene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Methylene Chloride	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
4-Methyl-2-Pentanone (MIBK)	0.100 U	0.100 U	0.200 U	*0.200*	*0.200*
Naphtalene	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
n-Propylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Styrene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,1,1,2-Tetrachloroethane	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,1,2,2-Tetrachloroethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
Tetrachloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Toluene	0.010 U	0.010 U	0.021 U	*0.021*	*0.021*
1,2,3-Trichlorobenzene	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
1,2,4-Trichlorobenzene	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
1,1,1-Trichloroethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
1,1,2-Trichloroethane	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
Trichloroethene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Trichlorofluoromethane	0.050 U	0.050 U	0.100 U	*0.100*	*0.100*
1,2,3-Trichloropropane	0.025 U	0.025 U	0.050 U	*0.050*	*0.050*
1,2,4-Trimethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
1,3,5-Trimethylbenzene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
Vinyl Chloride	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*
m- & p-Xylenes	0.020 U	0.020 U	0.040 U	*0.040*	*0.040*
o-Xylene	0.010 U	0.010 U	0.020 U	*0.020*	*0.020*

U = Not detected at specified reporting limits; If the result is reported by the laboratory as J (estimated result less than the reporting limit) it is presented as U.
E = Estimated result, concentration exceeds the calibration range.

DATA INPUT PAGE
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001VPX @ CTL M0031	Sample Date:	7/19/07	Sample Volume:	0 0103 dscm
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	1510 - 1610	Airflow:	9792.7 dscfm
Location:	Tacoma, Washington	Lab Numbers:	4511		
Run Number:	1A				
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet				

	RUN 1A - RESULTS		RUN 1A - REPORTING LIMIT (RL)			RUN 1A - MINIMUM DETECTION LIMIT (MDL)		
	Tenax Tube 1A µg	Anasorb Tube 1A µg	Tenax 1A µg	Anasorb 1A µg	TOTAL 1A µg	Tenax 1A µg	Anasorb 1A µg	TOTAL 1A µg
Acetone	0.077 J	0	0.10	0.10	0.20	0.060	0.060	0.120
Benzene	2.4 E	0	0.010	0.010	0.020	0.0043	0.0043	0.0086
Bromobenzene	0	0	0.010	0.010	0.020	0.0055	0.0055	0.0110
Bromochloromethane	0	0	0 025	0 025	0 050	0.0055	0.0055	0.0110
Bromodichloromethane	0	0	0 010	0.010	0.020	0.0044	0.0044	0 0088
Bromoform	0	0	0.025	0.025	0.050	0.0065	0 0065	0 0130
Bromomethane	0	0	0.050	0 050	0.100	0.0078	0 0078	0 0156
2-Butanone (MEK)	0	0	0.10	0.10	0 20	0.032	0.032	0.064
n-Butylbenzene	0	0	0.010	0.010	0.020	0.0077	0.0077	0.0154
sec-Butylbenzene	0	0	0.010	0.010	0.020	0.0096	0 0096	0.0192
tert-Butylbenzene	0	0	0.010	0.010	0.020	0.0089	0 0089	0.0176
Carbon Disulfide	0.0042 J	0	0.010	0 010	0.020	0.0042	0 0042	0.0084
Carbon Tetrachloride	0	0	0 010	0.010	0.020	0.0034	0 0034	0 0068
Chlorobenzene	0	0	0.010	0.010	0.020	0.0043	0 0043	0.0066
Chlorodibromomethane	0	0	0.025	0.025	0.050	0.0038	0 0038	0.0076
Chloroethane	0	0	0.050	0.050	0.100	0 0039	0 0039	0.0078
Chloroform	0	0	0.010	0.010	0.020	0.0046	0 0046	0 0092
Chloromethane	0	0.048 J	0.050	0.050	0.100	0.0060	0.0060	0.0120
2-Chlorotoluene	0	0	0.010	0.010	0 020	0.0054	0 0054	0 0108
4-Chlorotoluene	0	0	0 010	0.010	0 020	0.0057	0.0057	0.0114
1,2 Dibromo-3-chloropropane	0	0	0.050	0.050	0 100	0.016	0.016	0.032
1,2-Dibromoethane	0	0	0.025	0.025	0.050	0.0039	0.0039	0.0078
Dibromomethane	0	0	0.025	0.025	0.050	0 0064	0.0064	0.0128
1,2-Dichlorobenzene	0	0	0.010	0.010	0.020	0 0059	0 0059	0 0118
1,3-Dichlorobenzene	0	0	0.010	0.010	0.020	0 0064	0 0064	0 0128
1,4-Dichlorobenzene	0	0	0.010	0 010	0 020	0 0074	0 0074	0 0148
Dichlorodifluoromethane	0	0.027	0.025	0.025	0.050	0.0052	0.0052	0.0104
1,1-Dichloroethane	0	0	0.010	0.010	0.020	0.0034	0 0034	0 0068
1,2-Dichloroethane	0	0	0.010	0 010	0.020	0.0048	0.0048	0 0098
cis-1,3-Dichloroethene	0	0	0 010	0.010	0 020	0.0050	0 0050	0.0100
trans-1,3-Dichloroethene	0	0	0.010	0.010	0.020	0 0038	0 0038	0.0078
1,1-Dichloroethene	0	0	0.010	0.010	0.020	0.0057	0 0057	0 0114
1,2-Dichloropropane	0	0	0.010	0.010	0.020	0.0045	0 0045	0 0090
1,3-Dichloropropane	0	0	0.010	0.010	0.020	0.0071	0 0071	0 0142
2,2-Dichloropropane	0	0	0.010	0.010	0.020	0 0034	0 0034	0 0068
cis-1,3-Dichloropropene	0	0	0 010	0.010	0.020	0.0039	0 0039	0.0078
trans-1,3-Dichloropropene	0	0	0 010	0.010	0 020	0.0039	0.0039	0 0078
1,1-Dichloropropene	0	0	0 010	0.010	0 020	0.0042	0.0042	0 0084
Ethylbenzene	0.0049 J	0	0.010	0.010	0.020	0.0032	0 0032	0.0064
Hexachlorobutadiene	0	0	0 025	0.025	0 050	0.0041	0 0041	0 0082
2-Hexanone	0	0	0.10	0.10	0.20	0.018	0 018	0.036
Isopropylbenzene	0	0	0.010	0.010	0 020	0.0058	0 0058	0.0116
p-Isopropyltoluene	0	0	0 010	0.010	0.020	0 0085	0 0085	0.0170
Methylene Chloride	0	0	0 025	0.025	0.050	0.012	0 012	0 024
4-Methyl-2-Pentanone (MIBK)	0	0	0.10	0.10	0.20	0.029	0 029	0 058
Naphalene	0.025	0	0.025	0 025	0.050	0.0066	0 0066	0.0132
n-Propylbenzene	0	0	0 010	0.010	0 020	0 0054	0 0054	0 0108
Styrene	0.016	0	0.010	0.010	0.020	0.0049	0 0049	0.0098
1,1,1,2-Tetrachloroethane	0	0	0.010	0 010	0.020	0.0046	0.0045	0 0092
1,1,2,2-Tetrachloroethane	0	0	0.025	0.025	0.050	0.0067	0 0067	0 0134
Tetrachloroethene	0	0	0.010	0.010	0.020	0.0044	0 0044	0 0088
Toluene	0.066	0.0039 J	0.010	0.010	0.021	0.0027	0.0027	0.0054
1,2,3-Trichlorobenzene	0	0	0.025	0 025	0.050	0.0058	0 0056	0 0112
1,2,4-Trichlorobenzene	0	0	0.025	0.025	0 050	0.0066	0 0066	0 0132
1,1,1-Trichloroethane	0	0	0 025	0.025	0.050	0.0051	0.0051	0.0102
1,1,2-Trichloroethane	0	0	0.025	0.025	0.050	0.0056	0 0056	0 0112
Trichloroethene	0	0	0.010	0.010	0.020	0.0099	0.0099	0 0198
Trichlorofluoromethane	0.0085 J	0	0.050	0.050	0.100	0.0080	0 0080	0.0160
1,2,3-Trichloropropane	0.046	0	0.025	0.025	0.060	0.0099	0 0099	0.0198
1,2,4-Trimethylbenzene	0	0	0 010	0.010	0 020	0.0063	0.0063	0.0126
1,3,5-Trimethylbenzene	0	0	0.010	0.010	0 020	0.0074	0 0074	0 0148
Vinyl Chloride	0	0	0.010	0.010	0 020	0.0032	0 0032	0.0064
m- & p-Xylenes	0	0	0 020	0.020	0 040	0.0072	0 0072	0.0144
o-Xylene	0	0	0.010	0.010	0 020	0 0053	0 0053	0 0106

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VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/18/07	Sample Volume:	0 0191 dscm
Client:	Perametrix @ City of Tacoma Landfill	Sample Time:	1820 - 1700	Airflow:	9792 7 dscfm
Location:	Tacoma, Washington	Lab Numbers:	4512		
Run Number:	1B				
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet				

	RUN 1B - RESULTS		RUN 1B - REPORTING LIMIT (RL)			RUN 1B - MINIMUM DETECTION LIMIT (MDL)		
	Tenax Tube 1B µg	Anasorb Tube 1B µg	Tenax 1B µg	Anasorb 1B µg	TOTAL 1B µg	Tenax 1B µg	Anasorb 1B µg	TOTAL 1B µg
Acetone	0	0	0.10	0.10	0 20	0.060	0.060	0.120
Benzene	0.6	0	0.010	0.010	0.020	0.0043	0.0043	0.0086
Bromobenzene	0	0	0.010	0 010	0.020	0.0055	0.0055	0.0110
Bromochloromethane	0	0	0.025	0.025	0.050	0.0055	0.0055	0.0110
Bromodichloromethane	0	0	0 010	0.010	0.020	0.0044	0 0044	0.0088
Bromoform	0	0	0.025	0.025	0 050	0.0065	0 0065	0.0130
Bromomethane	0	0	0.050	0 050	0 100	0.0078	0.0078	0.0156
2-Butanone (MEK)	0	0	0.10	0.10	0 20	0.032	0.032	0.064
n-Butylbenzene	0	0	0.010	0.010	0.020	0.0077	0 0077	0.0154
sec-Butylbenzene	0	0	0.010	0.010	0.020	0.0096	0 0096	0.0192
tert-Butylbenzene	0	0	0.010	0.010	0.020	0.0089	0.0089	0.0178
Carbon Disulfide	0	0	0.010	0.010	0 020	0.0042	0.0042	0.0084
Carbon Tetrachloride	0	0	0.010	0.010	0.020	0.0034	0.0034	0.0068
Chlorobenzene	0	0	0.010	0.010	0.020	0.0043	0.0043	0.0086
Chlorodibromomethane	0	0	0.025	0.025	0 050	0.0038	0.0038	0.0076
Chloroethane	0	0	0.050	0.050	0 100	0.0039	0.0039	0.0078
Chloroform	0	0	0.010	0.010	0 020	0.0048	0 0048	0.0092
Chloromethane	0	0.058	0 050	0.050	0.100	0.0060	0.0060	0.0120
2-Chlorotoluene	0	0	0.010	0.010	0.020	0 0054	0 0054	0.0108
4-Chlorotoluene	0	0	0.010	0.010	0 020	0 0057	0.0057	0.0114
1,2 Dibromo-3-chloropropane	0	0	0.050	0.050	0.100	0.016	0 016	0.032
1,2-Dibromoethane	0	0	0.025	0.025	0.050	0.0039	0 0039	0.0078
Dibromomethane	0	0	0.025	0.025	0 050	0.0064	0 0064	0 0128
1,2-Dichlorobenzene	0	0	0.010	0.010	0 020	0.0059	0 0059	0.0118
1,3-Dichlorobenzene	0	0	0.010	0.010	0 020	0 0064	0.0064	0.0128
1,4-Dichlorobenzene	0	0	0.010	0.010	0.020	0 0074	0.0074	0.0148
Dichlorodifluoromethane	0	0.03	0.025	0.025	0.050	0.0052	0.0052	0.0104
1,1-Dichloroethane	0	0	0.010	0.010	0.020	0.0034	0.0034	0.0068
1,2-Dichloroethane	0	0	0.010	0.010	0.020	0.0048	0.0048	0.0096
cis-1,3-Dichloroethene	0	0	0.010	0.010	0.020	0 0050	0 0050	0.0100
trans-1,3-Dichloroethene	0	0	0.010	0.010	0.020	0.0038	0 0038	0.0076
1,1-Dichloroethene	0	0	0.010	0.010	0.020	0.0057	0 0057	0.0114
1,2-Dichloropropane	0	0	0.010	0.010	0.020	0.0045	0.0045	0.0090
1,3-Dichloropropane	0	0	0.010	0.010	0.020	0.0071	0.0071	0.0142
2,2-Dichloropropene	0	0	0.010	0.010	0.020	0 0034	0.0034	0.0068
cis-1,3-Dichloropropene	0	0	0 010	0.010	0.020	0 0039	0.0039	0.0078
trans-1,3-Dichloropropene	0	0	0.010	0.010	0 020	0.0039	0.0039	0.0078
1,1-Dichloropropane	0	0	0.010	0.010	0.020	0.0042	0.0042	0 0084
Ethylbenzene	0	0	0.010	0.010	0.020	0.0032	0.0032	0 0064
Hexachlorobutadiene	0	0	0.025	0 025	0 050	0 0041	0 0041	0.0082
2-Hexanone	0	0	0.10	0.10	0.20	0.018	0.018	0.036
Isopropylbenzene	0	0	0.010	0.010	0 020	0.0058	0.0058	0.0116
p-Isopropyltoluene	0	0	0.010	0.010	0.020	0.0085	0.0085	0.0170
Methylene Chloride	0.062	0.015 J	0.025	0.025	0.050	0.012	0.012	0.024
4-Methyl-2-Pentanone (MIBK)	0	0	0.10	0.10	0.200	0.029	0.029	0 058
Naphalene	0.0086 J	0	0.025	0.025	0.050	0.0066	0.0066	0.0132
n-Propylbenzene	0	0	0.010	0.010	0.020	0 0054	0.0054	0.0108
Styrene	0.0053 J	0	0.010	0 010	0.020	0.0049	0.0049	0.0098
1,1,1,2-Tetrachloroethane	0	0	0.010	0 010	0.020	0.0046	0.0046	0.0092
1,1,2,2-Tetrachloroethane	0	0	0.025	0.025	0.050	0 0067	0.0067	0.0134
Tetrachloroethene	0	0	0.010	0.010	0.020	0 0044	0 0044	0.0088
Toluene	0.025	0.0037 J	0.010	0.010	0.021	0.0027	0.0027	0.0054
1,2,3-Trichlorobenzene	0	0	0.025	0 025	0.050	0.0056	0.0056	0.0112
1,2,4-Trichlorobenzene	0	0	0 025	0.025	0.050	0.0066	0 0066	0.0132
1,1,1-Trichloroethane	0	0	0.025	0.025	0.050	0.0051	0.0051	0.0102
1,1,2-Trichloroethane	0	0	0.025	0.025	0.050	0.0056	0 0056	0.0112
Trichloroethene	0	0	0.010	0.010	0.020	0.0099	0 0099	0.0198
Trichlorofluoromethene	0	0.076	0.050	0.050	0.100	0.0080	0.0080	0.0160
1,2,3-Trichloropropene	0	0	0.025	0.025	0.050	0.0099	0 0099	0.0198
1,2,4-Trimethylbenzene	0	0	0.010	0.010	0 020	0.0063	0 0063	0.0128
1,3,5-Trimethylbenzene	0	0	0.010	0.010	0 020	0.0074	0.0074	0.0146
Vinyl Chloride	0	0	0.010	0.010	0 020	0.0032	0.0032	0.0064
m- & p-Xylenes	0	0	0.020	0 020	0.040	0.0072	0 0072	0.0144
o-Xylene	0	0	0.010	0.010	0.020	0 0053	0 0053	0.0106

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VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/19/07	Sample Volume:	0.0191 dscm
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	1719 - 1759	Airflow:	979.2 dscfm
Location:	Tacoma, Washington	Lab Numbers:	4513		
Run Number:	1C				
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet				

	RUN 1C - RESULTS			RUN 1C - REPORTING LIMIT (RL)			RUN 1C - MINIMUM DETECTION LIMIT (MDL)		
	Tenax Tube 1C µg	Anasorb Tube 1C µg		Tenax 1C µg	Anasorb 1C µg	TOTAL 1C µg	Tenax 1C µg	Anasorb 1C µg	TOTAL 1C µg
Acetone	0.31	0		0.10	0.10	0.20	0.060	0.060	0.120
Benzene	0.17	0		0.010	0.010	0.020	0.0043	0.0043	0.0086
Bromobenzene	0	0		0.010	0.010	0.020	0.0055	0.0055	0.0110
Bromochloromethane	0	0		0.025	0.025	0.050	0.0055	0.0055	0.0110
Bromodichloromethane	0	0		0.010	0.010	0.020	0.0044	0.0044	0.0088
Bromoform	0	0		0.025	0.025	0.050	0.0065	0.0065	0.0130
Bromomethane	0	0		0.050	0.050	0.100	0.0078	0.0078	0.0156
2-Butanone (MEK)	0	0		0.10	0.10	0.20	0.032	0.032	0.064
n-Butylbenzene	0	0		0.010	0.010	0.020	0.0077	0.0077	0.0154
sec-Butylbenzene	0	0		0.010	0.010	0.020	0.0096	0.0096	0.0192
tert-Butylbenzene	0	0		0.010	0.010	0.020	0.0089	0.0089	0.0178
Carbon Disulfide	0.026	0		0.010	0.010	0.020	0.0042	0.0042	0.0084
Carbon Tetrachloride	0	0		0.010	0.010	0.020	0.0034	0.0034	0.0068
Chlorobenzene	0	0		0.010	0.010	0.020	0.0043	0.0043	0.0086
Chlorodibromomethane	0	0		0.025	0.025	0.050	0.0038	0.0038	0.0076
Chloroethane	0	0		0.050	0.050	0.100	0.0039	0.0039	0.0078
Chloroform	0	0		0.010	0.010	0.020	0.0046	0.0046	0.0092
Chloromethane	0	0.023	J	0.050	0.050	0.100	0.0060	0.0060	0.0120
2-Chlorotoluene	0	0		0.010	0.010	0.020	0.0054	0.0054	0.0108
4-Chlorotoluene	0	0		0.010	0.010	0.020	0.0057	0.0057	0.0114
1,2 Dibromo-3-chloropropane	0	0		0.050	0.050	0.100	0.016	0.016	0.032
1,2-Dibromoethane	0	0		0.025	0.025	0.050	0.0039	0.0039	0.0078
Dibromomethane	0	0		0.025	0.025	0.050	0.0064	0.0064	0.0128
1,2-Dichlorobenzene	0	0		0.010	0.010	0.020	0.0059	0.0059	0.0118
1,3-Dichlorobenzene	0	0		0.010	0.010	0.020	0.0064	0.0064	0.0128
1,4-Dichlorobenzene	0	0		0.010	0.010	0.020	0.0074	0.0074	0.0148
Dichlorodifluoromethane	0.035	0.024	J	0.025	0.025	0.050	0.0052	0.0052	0.0104
1,1-Dichloroethene	0	0		0.010	0.010	0.020	0.0034	0.0034	0.0068
1,2-Dichloroethane	0	0		0.010	0.010	0.020	0.0048	0.0048	0.0096
cis-1,3-Dichloroethene	0	0		0.010	0.010	0.020	0.0050	0.0050	0.0100
trans-1,3-Dichloroethene	0	0		0.010	0.010	0.020	0.0038	0.0038	0.0078
1,1-Dichloroethene	0	0		0.010	0.010	0.020	0.0057	0.0057	0.0114
1,2-Dichloropropane	0	0		0.010	0.010	0.020	0.0045	0.0045	0.0090
1,3-Dichloropropane	0	0		0.010	0.010	0.020	0.0071	0.0071	0.0142
2,2-Dichloropropane	0	0		0.010	0.010	0.020	0.0034	0.0034	0.0068
cis-1,3-Dichloropropene	0	0		0.010	0.010	0.020	0.0039	0.0039	0.0078
trans-1,3-Dichloropropene	0	0		0.010	0.010	0.020	0.0039	0.0039	0.0078
1,1-Dichloropropene	0	0		0.010	0.010	0.020	0.0042	0.0042	0.0084
Ethylbenzene	0	0		0.010	0.010	0.020	0.0032	0.0032	0.0064
Hexachlorobutadiene	0	0		0.025	0.025	0.050	0.0041	0.0041	0.0082
2-Hexanone	0	0		0.10	0.10	0.20	0.018	0.018	0.036
Isopropylbenzene	0	0		0.010	0.010	0.020	0.0058	0.0058	0.0116
p-Isopropyltoluene	0	0		0.010	0.010	0.020	0.0085	0.0085	0.0170
Methylene Chloride	0.189	0.016	J	0.025	0.025	0.050	0.012	0.012	0.024
4-Methyl-2-Pentanone (MIBK)	0	0		0.10	0.10	0.20	0.029	0.029	0.058
Naphalene	0	0		0.025	0.025	0.050	0.0066	0.0066	0.0132
n-Propylbenzene	0	0		0.010	0.010	0.020	0.0054	0.0054	0.0108
Styrene	0	0		0.010	0.010	0.020	0.0049	0.0049	0.0098
1,1,1,2-Tetrachloroethane	0	0		0.010	0.010	0.020	0.0046	0.0046	0.0092
1,1,2,2-Tetrachloroethane	0	0		0.025	0.025	0.050	0.0067	0.0067	0.0134
Tetrachloroethene	0	0		0.010	0.010	0.020	0.0044	0.0044	0.0088
Toluene	0.0096	J 0		0.010	0.010	0.021	0.0027	0.0027	0.0054
1,2,3-Trichlorobenzene	0	0		0.025	0.025	0.050	0.0058	0.0056	0.0112
1,2,4-Trichlorobenzene	0	0		0.025	0.025	0.050	0.0066	0.0066	0.0132
1,1,1-Trichloroethane	0	0		0.025	0.025	0.050	0.0051	0.0051	0.0102
1,1,2-Trichloroethane	0	0		0.025	0.025	0.050	0.0056	0.0056	0.0112
Trichloroethene	0	0		0.010	0.010	0.020	0.0099	0.0099	0.0198
Trichlorofluoromethane	1.6	0		0.050	0.050	0.100	0.0080	0.0080	0.0160
1,2,3-Trichloropropene	0	0		0.025	0.025	0.050	0.0099	0.0099	0.0198
1,2,4-Trimethylbenzene	0	0		0.010	0.010	0.020	0.0063	0.0063	0.0126
1,3,5-Trimethylbenzene	0	0		0.010	0.010	0.020	0.0074	0.0074	0.0146
Vinyl Chloride	0	0		0.010	0.010	0.020	0.0032	0.0032	0.0064
m- & p-Xylenes	0	0		0.020	0.020	0.040	0.0072	0.0072	0.0144
o-Xylene	0	0		0.010	0.010	0.020	0.0053	0.0053	0.0106

DATA INPUT PAGE
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX @ CTL M0031 Sample Date: 7/19/07 Sample Volume: 0.0192 dscm
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Run Number: 1FB
Sample Location: Perennial #1 Landfill Gas Combuster Outlet

	RUN 1 - FB - RESULTS		RUN 1 - FB - REPORTING LIMIT			RUN 1 - FB - MDL		
	Tenax Tube FB µg	Anasorb Tube FB µg	Reporting Limit Tenax FB µg	Reporting Limit Anasorb FB µg	Reporting Limit TOTAL FB µg	MDL Tenax FB µg	MDL Anasorb FB µg	MDL TOTAL FB µg
Acetone	0	0	0.10	0.10	0.20	0.060	0.060	0.120
Benzene	0	0	0.010	0.010	0.020	0.0043	0.0043	0.0086
Bromobenzene	0	0	0.010	0.010	0.020	0.0055	0.0055	0.0110
Bromochloromethane	0	0	0.025	0.025	0.050	0.0055	0.0055	0.0110
Bromodichloromethane	0	0	0.010	0.010	0.020	0.0044	0.0044	0.0088
Bromoform	0	0	0.025	0.025	0.050	0.0065	0.0065	0.0130
Bromomethane	0	0	0.050	0.050	0.100	0.0078	0.0078	0.0156
2-Butanone (MEK)	0	0	0.10	0.10	0.200	0.032	0.032	0.064
n-Butylbenzene	0	0	0.010	0.010	0.020	0.0077	0.0077	0.0154
sec-Butylbenzene	0	0	0.010	0.010	0.020	0.0096	0.0096	0.0192
tert-Butylbenzene	0	0	0.010	0.010	0.020	0.0088	0.0089	0.0178
Carbon Disulfide	0	0	0.010	0.010	0.020	0.0042	0.0042	0.0084
Carbon Tetrachloride	0	0	0.010	0.010	0.020	0.0034	0.0034	0.0068
Chlorobenzene	0	0	0.010	0.010	0.020	0.0043	0.0043	0.0086
Chlorodibromomethane	0	0	0.025	0.025	0.050	0.0038	0.0038	0.0078
Chloroethane	0	0	0.050	0.050	0.100	0.0039	0.0039	0.0078
Chloroform	0	0	0.010	0.010	0.020	0.0048	0.0046	0.0092
Chloromethane	0	0.0077 J	0.050	0.050	0.100	0.0060	0.0060	0.0120
2-Chlorotoluene	0	0	0.010	0.010	0.020	0.0054	0.0054	0.0108
4-Chlorotoluene	0	0	0.010	0.010	0.020	0.0057	0.0057	0.0114
1,2 Dibromo-3-chloropropane	0	0	0.050	0.050	0.100	0.016	0.016	0.032
1,2-Dibromoethane	0	0	0.025	0.025	0.050	0.0039	0.0039	0.0078
Dibromomethane	0	0	0.025	0.025	0.050	0.0064	0.0064	0.0128
1,2-Dichlorobenzene	0	0	0.010	0.010	0.020	0.0059	0.0059	0.0118
1,3-Dichlorobenzene	0	0	0.010	0.010	0.020	0.0064	0.0064	0.0128
1,4-Dichlorobenzene	0	0	0.010	0.010	0.020	0.0074	0.0074	0.0148
Dichlorodifluoromethane	0	0	0.025	0.025	0.050	0.0052	0.0052	0.0104
1,1-Dichloroethane	0	0	0.010	0.010	0.020	0.0034	0.0034	0.0068
1,2-Dichloroethane	0	0	0.010	0.010	0.020	0.0048	0.0048	0.0096
cis-1,3-Dichloroethene	0	0	0.010	0.010	0.020	0.0050	0.0050	0.0100
trans-1,3-Dichloroethene	0	0	0.010	0.010	0.020	0.0038	0.0038	0.0076
1,1-Dichloroethene	0	0	0.010	0.010	0.020	0.0057	0.0057	0.0114
1,2-Dichloropropane	0	0	0.010	0.010	0.020	0.0045	0.0045	0.0090
1,3-Dichloropropane	0	0	0.010	0.010	0.020	0.0071	0.0071	0.0142
2,2-Dichloropropane	0	0	0.010	0.010	0.020	0.0034	0.0034	0.0068
cis-1,3-Dichloropropene	0	0	0.010	0.010	0.020	0.0039	0.0039	0.0078
trans-1,3-Dichloropropene	0	0	0.010	0.010	0.020	0.0039	0.0039	0.0078
1,1-Dichloropropene	0	0	0.010	0.010	0.020	0.0042	0.0042	0.0084
Ethylbenzene	0	0	0.010	0.010	0.020	0.0032	0.0032	0.0064
Hexachlorobutadiene	0	0	0.025	0.025	0.050	0.0041	0.0041	0.0082
2-Hexanone	0	0	0.10	0.10	0.200	0.018	0.018	0.036
Isopropylbenzene	0	0	0.010	0.010	0.020	0.0058	0.0058	0.0116
p-Isopropyltoluene	0	0	0.010	0.010	0.020	0.0085	0.0085	0.0170
Methylene Chloride	0	0	0.025	0.025	0.050	0.012	0.012	0.024
4-Methyl-2-Pentanone (MIBK)	0	0	0.10	0.10	0.200	0.029	0.029	0.058
Naphalene	0	0	0.025	0.025	0.050	0.0066	0.0066	0.0132
n-Propylbenzene	0	0	0.010	0.010	0.020	0.0054	0.0054	0.0108
Styrene	0	0	0.010	0.010	0.020	0.0049	0.0049	0.0098
1,1,1,2-Tetrachloroethane	0	0	0.010	0.010	0.020	0.0046	0.0046	0.0092
1,1,2,2-Tetrachloroethene	0	0	0.025	0.025	0.050	0.0067	0.0067	0.0134
Tetrachloroethene	0	0	0.010	0.010	0.020	0.0044	0.0044	0.0088
Toluene	0	0	0.010	0.010	0.021	0.0027	0.0027	0.0054
1,2,3-Trichlorobenzene	0	0	0.025	0.025	0.050	0.0056	0.0056	0.0112
1,2,4-Trichlorobenzene	0	0	0.025	0.025	0.050	0.0066	0.0066	0.0132
1,1,1-Trichloroethane	0	0	0.025	0.025	0.050	0.0051	0.0051	0.0102
1,1,2-Trichloroethane	0	0	0.025	0.025	0.050	0.0056	0.0056	0.0112
Trichloroethene	0	0	0.010	0.010	0.020	0.0099	0.0099	0.0198
Trichlorofluoromethane	0	0	0.050	0.050	0.100	0.0080	0.0080	0.0160
1,2,3-Trichloropropane	0	0	0.025	0.025	0.050	0.0099	0.0099	0.0198
1,2,4-Trimethylbenzene	0	0	0.010	0.010	0.020	0.0063	0.0063	0.0126
1,3,5-Trimethylbenzene	0	0	0.010	0.010	0.020	0.0074	0.0074	0.0148
Vinyl Chloride	0	0	0.010	0.010	0.020	0.0032	0.0032	0.0064
m- & p-Xylenes	0	0	0.020	0.020	0.040	0.0072	0.0072	0.0144
o-Xylene	0	0	0.010	0.010	0.020	0.0053	0.0053	0.0106

DATA INPUT PAGE
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/20/07	Sample Volume:	0 0195 dscm
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	831 - 911	Airflow:	10933 dscfm
Location:	Tacoma, Washington	Lab Numbers:	4514		
Run Number:	2A				
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet				

	RUN 2A - RESULTS		RUN 2A - REPORTING LIMIT (RL)			RUN 2A - MINIMUM DETECTION LIMIT (MDL)		
	Tenax Tube 2A µg	Anasorb Tube 2A µg	Tenax 2A µg	Anasorb 2A µg	TOTAL 2A µg	Tenax 2A µg	Anasorb 2A µg	TOTAL 2A µg
Acetone	0	0	0.10	0 10	0 20	0.060	0 060	0 120
Benzene	0	0	0.010	0.010	0.020	0.0043	0.0043	0.0086
Bromobenzene	0	0	0.010	0.010	0.020	0.0055	0.0055	0.0110
Bromochloromethane	0	0	0.025	0.025	0.050	0.0055	0 0055	0.0110
Bromodichloromethane	0	0	0.010	0.010	0.020	0.0044	0 0044	0.0088
Bromoform	0	0	0 025	0 025	0 050	0.0065	0.0065	0.0130
Bromomethane	0	0	0.050	0.050	0.100	0.0078	0.0078	0.0156
2-Butanone (MEK)	0	0	0.10	0.10	0.200	0.032	0.032	0.064
n-Butylbenzene	0	0	0.010	0.010	0.020	0.0077	0.0077	0.0154
sec-Butylbenzene	0	0	0.010	0.010	0.020	0.0096	0.0096	0.0192
tert-Butylbenzene	0	0	0.010	0.010	0.020	0.0089	0.0089	0.0178
Carbon Disulfide	0	0	0 010	0.010	0.020	0.0042	0 0042	0.0084
Carbon Tetrachloride	0	0	0.010	0.010	0.020	0.0034	0 0034	0 0068
Chlorobenzene	0	0	0.010	0.010	0.020	0.0043	0 0043	0.0088
Chlorodibromomethane	0	0	0.025	0 025	0.050	0.0038	0.0038	0.0078
Chloroethane	0	0	0 050	0 050	0 100	0.0039	0.0039	0.0078
Chloroform	0	0	0 010	0 010	0 020	0.0046	0 0046	0.0092
Chloromethane	0	0.064	0.050	0.050	0.100	0.0060	0.0060	-0.0120
2-Chlorotoluene	0	0	0.010	0.010	0.020	0.0054	0 0054	0.0108
4-Chlorotoluene	0	0	0.010	0 010	0.020	0.0057	0.0057	0.0114
1,2 Oibromo-3-chloropropane	0	0	0.050	0 050	0 100	0 018	0.016	0 032
1,2-Dibromoethane	0	0	0.025	0.025	0.050	0 0039	0.0039	0 0078
Dibromomethane	0	0	0.025	0.025	0.050	0.0064	0.0064	0.0128
1,2-Oichlorobenzene	0	0	0.010	0.010	0 020	0.0059	0.0059	0.0118
1,3-Dichlorobenzene	0	0	0.010	0.010	0.020	0.0064	0 0064	0.0128
1,4-Dichlorobenzene	0	0	0.010	0 010	0.020	0.0074	0 0074	0 0148
Dichlorodifluoromethane	0.0072 J	0.062	0.025	0.025	0.050	0.0052	0.0052	0.0104
1,1-Dichloroethane	0	0	0.010	0.010	0.020	0.0034	0.0034	0.0068
1,2-Dichloroethane	0	0	0.010	0 010	0.020	0.0048	0.0048	0.0096
cis-1,3-Dichloroethene	0	0	0.010	0.010	0 020	0.0050	0 0050	0 0100
trans-1,3-Dichloroethene	0	0	0.010	0.010	0 020	0.0038	0.0038	0 0076
1,1-Dichloroethene	0	0	0.010	0.010	0.020	0.0057	0.0057	0.0114
1,2-Dichloropropane	0	0	0.010	0.010	0.020	0 0045	0.0045	0 0090
1,3-Dichloropropene	0	0	0.010	0 010	0 020	0 0071	0 0071	0 0142
2,2-Dichloropropene	0	0	0 010	0 010	0.020	0.0034	0.0034	0 0068
cis-1,3-Dichloropropene	0	0	0.010	0.010	0 020	0.0039	0.0039	0 0078
trans-1,3-Dichloropropene	0	0	0.010	0.010	0.020	0.0039	0.0039	0 0078
1,1-Dichloropropene	0	0	0.010	0 010	0.020	0.0042	0 0042	0.0084
Ethylbenzene	0	0	0.010	0 010	0 020	0.0032	0 0032	0.0064
Hexachlorobutadiene	0	0	0.025	0.025	0 050	0.0041	0.0041	0 0082
2-Hexanone	0	0	0.10	0.10	0 200	0.018	0 018	0 038
Isopropylbenzene	0	0	0.010	0.010	0.020	0.0058	0.0058	0 0116
p-Isopropyltoluene	0	0	0 010	0.010	0.020	0.0085	0.0085	0 0170
Methylene Chloride	1.2	0.020 J	0.025	0.025	0.050	0.012	0.012	0.024
4-Methyl-2-Pentanone (MIBK)	0	0	0.10	0.10	0.200	0.029	0.029	0.058
Naphalene	0	0	0 025	0.025	0.050	0.0066	0.0066	0 0132
n-Propylbenzene	0	0	0.010	0.010	0 020	0.0054	0 0054	0.0108
Styrene	0	0	0.010	0.010	0.020	0.0049	0.0049	0.0098
1,1,1,2-Tetrachloroethane	0	0	0.010	0.010	0 020	0.0046	0.0046	0.0092
1,1,2,2-Tetrachloroethane	0	0	0.025	0 025	0.050	0.0067	0.0067	0.0134
Tetrachloroethene	0	0	0.010	0.010	0.020	0.0044	0 0044	0.0088
Toluene	0.0028 J	0.0070 J	0.010	0.010	0.021	0.0027	0.0027	0.0054
1,2,3-Trichlorobenzene	0	0	0.025	0.025	0.050	0.0056	0 0056	0.0112
1,2,4-Trichlorobenzene	0	0	0.025	0.025	0.050	0.0066	0 0066	0.0132
1,1,1-Trichloroethane	0	0	0.025	0.025	0 050	0.0051	0.0051	0 0102
1,1,2-Trichloroethane	0	0	0.025	0.025	0 050	0 0056	0.0056	0 0112
Trichloroethene	0	0	0.010	0.010	0.020	0.0099	0.0099	0 0198
Trichlorofluoromethane	0	0.020 J	0 050	0.050	0.100	0.0080	0.0080	0.0160
1,2,3-Trichloropropane	0	0	0.025	0 025	0.050	0.0099	0 0099	0.0198
1,2,4-Trimethylbenzene	0	0	0.010	0 010	0.020	0 0063	0.0063	0 0126
1,3,5-Trimethylbenzene	0	0	0.010	0.010	0.020	0 0074	0 0074	0.0148
Vinyl Chloride	0	0	0.010	0.010	0 020	0.0032	0.0032	0.0064
m- & p-Xylenes	0	0	0.020	0 020	0 040	0.0072	0.0072	0 0144
o-Xylene	0	0	0.010	0.010	0 020	0 0053	0.0053	0 0106

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VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/20/07	Sample Volume:	0 0193 dscm
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	926 - 1006	Airflow:	10933 dscfm
Location:	Tacoma, Washington	Lab Numbers:	4515		
Run Number:	2B				
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet				

	RUN 2B - RESULTS			RUN 2B - REPORTING LIMIT (RL)			RUN 2B - MINIMUM DETECTION LIMIT (MDL)		
	Tenax Tube 2B µg		Anasorb Tube 2B µg	Tenax 2B µg	Anasorb 2B µg	TOTAL 2B µg	Tenax 2B µg	Anasorb 2B µg	TOTAL 2B µg
Acetone	0		0	0.10	0.10	0 20	0.060	0.060	0.120
Benzene	0.77		0	0.010	0.010	0.020	0.0043	0.0043	0.0086
Bromobenzene	0		0	0.010	0 010	0 020	0.0055	0.0055	0 0110
Bromochloromethane	0		0	0.025	0.025	0.050	0.0055	0.0055	0.0110
Bromodichloromethane	0		0	0.010	0.010	0.020	0.0044	0.0044	0.0088
Bromoform	0		0	0.025	0.025	0 050	0 0065	0.0065	0.0130
Bromomethene	0		0	0 050	0.050	0 100	0 0078	0.0078	0.0156
2-Butanone (MEK)	0		0	0.10	0.10	0 200	0.032	0.032	0.064
n-Butylbenzene	0		0	0.010	0.010	0.020	0.0077	0.0077	0.0154
sec-Butylbenzene	0		0	0 010	0.010	0.020	0.0096	0 0098	0.0192
tert-Butylbenzene	0		0	0 010	0.010	0.020	0.0089	0.0089	0.0178
Carbon Disulfide	0		0	0 010	0.010	0 020	0 0042	0.0042	0 0084
Carbon Tetrachloride	0		0	0.010	0 010	0 020	0 0034	0.0034	0 0068
Chlorobenzene	0		0	0.010	0.010	0.020	0 0043	0.0043	0.0086
Chlorodibromomethane	0		0	0.025	0.025	0 050	0.0038	0.0038	0.0076
Chloroethane	0		0	0.050	0.050	0.100	0 0039	0.0039	0.0078
Chloroform	0		0	0.010	0.010	0 020	0.0046	0.0046	0.0092
Chloromethane	0		0.044 J	0.050	0.050	0.100	0.0060	0.0060	0.0120
2-Chlorotoluene	0		0	0.010	0.010	0 020	0.0054	0 0054	0.0108
4-Chlorotoluene	0		0	0.010	0.010	0 020	0.006	0 006	0.011
1,2 Dibromo-3-chloropropane	0		0	0.050	0 050	0 100	0.016	0 016	0.032
1,2-Dibromoethane	0		0	0.025	0.025	0.050	0 0039	0.0039	0.0078
Dibromomethane	0		0	0.025	0.025	0.050	0 0064	0.0064	0.0126
1,2-Dichlorobenzene	0		0	0.010	0.010	0.020	0.0059	0.0059	0.0118
1,3-Dichlorobenzene	0		0	0.010	0.010	0.020	0.0064	0.0064	0 0126
1,4-Dichlorobenzene	0		0	0.010	0.010	0.020	0.0074	0.0074	0.0148
Dichlorodifluoromethane	0		0.035	0.025	0.025	0.050	0.0052	0.0052	0.0104
1,1-Dichloroethane	0		0	0.010	0.010	0.020	0.0034	0.0034	0 0068
1,2-Dichloroethane	0		0	0.010	0 010	0.020	0 0048	0.0048	0 0096
cis-1,3-Dichloroethene	0		0	0.010	0 010	0.020	0.0050	0.0050	0 0100
trans-1,3-Dichloroethene	0		0	0.010	0.010	0.020	0.0038	0.0038	0 0076
1,1-Dichloroethene	0		0	0 010	0.010	0.020	0.0057	0.0057	0.0114
1,2-Dichloropropane	0		0	0.010	0.010	0.020	0.0045	0.0045	0.0090
1,3-Dichloropropane	0		0	0.010	0.010	0 020	0.0071	0.0071	0.0142
2,2-Dichloropropane	0		0	0.010	0.010	0 020	0 0034	0 0034	0.0068
cis-1,3-Dichloropropene	0		0	0.010	0.010	0 020	0 0039	0.0039	0.0078
trans-1,3-Dichloropropene	0		0	0.010	0.010	0.020	0 0039	0.0039	0.0078
1,1-Dichloropropene	0		0	0.010	0 010	0.020	0.0042	0.0042	0 0084
Ethylbenzene	0.0035 J		0	0.010	0.010	0.020	0.0032	0 0032	0.0064
Hexachlorobutadiene	0		0	0.025	0 025	0.050	0.0041	0 0041	0.0082
2-Hexanone	0		0	0.10	0.10	0.200	0.018	0 018	0.036
Isopropylbenzene	0		0	0.010	0.010	0.020	0 0058	0.0058	0.0116
p-Isopropyltoluene	0		0	0.010	0.010	0.020	0 0085	0 0065	0.0170
Methylene Chloride	0.017 J		0	0.025	0 025	0.050	0.012	0 012	0.024
4-Methyl-2-Pentanone (MIBK)	0		0	0.10	0.10	0 200	0.029	0.029	0 058
Naphalene	0		0	0.025	0.025	0.050	0.0066	0 0066	0.0132
n-Propylbenzene	0		0	0.010	0.010	0.020	0 0054	0 0054	0.0108
Styrene	0		0	0.010	0.010	0.020	0.0049	0 0049	0.0098
1,1,1,2-Tetrachloroethane	0		0	0.010	0.010	0.020	0.0046	0 0046	0.0092
1,1,2,2-Tetrachloroethane	0		0	0.025	0 025	0.050	0 0067	0 0067	0 0134
Tetrachloroethene	0.0058 J		0	0.010	0.010	0.020	0.0044	0 0044	0.0088
Toluene	0.038		0.0064 J	0.010	0.010	0.021	0.0027	0.0027	0.0054
1,2,3-Trichlorobenzene	0		0	0.025	0.025	0.050	0.0056	0 0056	0 0112
1,2,4-Trichlorobenzene	0		0	0.025	0.025	0 050	0.0066	0.0066	0 0132
1,1,1-Trichloroethane	0		0	0.025	0 025	0.050	0.0051	0.0051	0.0102
1,1,2-Trichloroethane	0		0	0.025	0 025	0 050	0.0056	0.0056	0.0112
Trichloroethene	0		0	0.010	0 010	0 020	0.0099	0.0099	0.0198
Trichlorofluoromethane	0.013 J		0	0.050	0.050	0.100	0.0080	0.0080	0.0160
1,2,3-Trichloropropane	0		0	0.025	0 025	0.050	0.0099	0.0099	0.0198
1,2,4-Trimethylbenzene	0		0	0 010	0.010	0.020	0.0063	0 0063	0.0128
1,3,5-Trimethylbenzene	0		0	0.010	0.010	0 020	0.0074	0 0074	0.0148
Vinyl Chloride	0		0	0.010	0.010	0 020	0 0032	0 0032	0.0064
m- & p-Xylenes	0.0093 J		0	0.020	0.020	0.040	0.0072	0.0072	0.0144
o-Xylene	0		0	0.010	0.010	0 020	0.0053	0 0053	0.0106

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VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/20/07	Sample Volume:	0.0197 dscm
Client.	Parametrix @ City of Tacoma Landfill	Sample Time:	1028 - 1108	Airflow.	10933 dscfm
Location.	Tacoma, Washington	Lab Numbers:	4518		
Run Number.	2C				
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet				

	RUN 2C - RESULTS			RUN 2C - REPORTING LIMIT (RL)			RUN 2C - MINIMUM DETECTION LIMIT (MDL)		
	Tenax Tube 2C µg	Anasorb Tube 2C µg		Tenax 2C µg	Anasorb 2C µg	TOTAL 2C µg	Tenax 2C µg	Anasorb 2C µg	TOTAL 2C µg
Acetone	0	0		0.10	0.10	0.20	0.060	0.060	0.120
Benzene	0.16	0		0.010	0.010	0.020	0.0043	0.0043	0.0086
Bromobenzene	0	0		0.010	0.010	0.020	0.0055	0.0055	0.0110
Bromochloromethane	0	0		0.025	0.025	0.050	0.0055	0.0055	0.0110
Bromodichloromethane	0	0		0.010	0.010	0.020	0.0044	0.0044	0.0088
Bromoform	0	0		0.025	0.025	0.050	0.0065	0.0065	0.0130
Bromomethane	0	0		0.050	0.050	0.100	0.0078	0.0078	0.0156
2-Butanone (MEK)	0	0		0.10	0.10	0.200	0.032	0.032	0.064
n-Butylbenzene	0	0		0.010	0.010	0.020	0.0077	0.0077	0.0154
sec-Butylbenzene	0	0		0.010	0.010	0.020	0.0096	0.0096	0.0192
tert-Butylbenzene	0	0		0.010	0.010	0.020	0.0089	0.0089	0.0178
Carbon Disulfide	0	0		0.010	0.010	0.020	0.0042	0.0042	0.0084
Carbon Tetrachloride	0	0		0.010	0.010	0.020	0.0034	0.0034	0.0068
Chlorobenzene	0	0		0.010	0.010	0.020	0.0043	0.0043	0.0086
Chlorodibromomethane	0	0		0.025	0.025	0.050	0.0038	0.0038	0.0076
Chloroethane	0	0		0.050	0.050	0.100	0.0039	0.0039	0.0078
Chloroform	0	0		0.010	0.010	0.020	0.0046	0.0046	0.0092
Chloromethane	0	0.045	J	0.050	0.050	0.100	0.0060	0.0060	0.0120
2-Chlorotoluene	0	0		0.010	0.010	0.020	0.0054	0.0054	0.0108
4-Chlorotoluene	0	0		0.010	0.010	0.020	0.0057	0.0057	0.0114
1,2 Dibromo-3-chloropropane	0	0		0.050	0.050	0.100	0.016	0.016	0.032
1,2-Dibromoethane	0	0		0.025	0.025	0.050	0.0039	0.0039	0.0078
Dibromomethane	0	0		0.025	0.025	0.050	0.0064	0.0064	0.0128
1,2-Dichlorobenzene	0	0		0.010	0.010	0.020	0.0059	0.0059	0.0118
1,3-Dichlorobenzene	0	0		0.010	0.010	0.020	0.0064	0.0064	0.0128
1,4-Dichlorobenzene	0	0		0.010	0.010	0.020	0.0074	0.0074	0.0148
Dichlorodifluoromethane	0	0.030		0.025	0.025	0.050	0.0052	0.0052	0.0104
1,1-Dichloroethane	0	0		0.010	0.010	0.020	0.0034	0.0034	0.0068
1,2-Dichloroethane	0	0		0.010	0.010	0.020	0.0048	0.0048	0.0096
cis-1,3-Dichloroethene	0	0		0.010	0.010	0.020	0.0050	0.0050	0.0100
trans-1,3-Dichloroethene	0	0		0.010	0.010	0.020	0.0038	0.0038	0.0076
1,1-Dichloroethene	0	0		0.010	0.010	0.020	0.0057	0.0057	0.0114
1,2-Dichloropropene	0	0		0.010	0.010	0.020	0.0045	0.0045	0.0090
1,3-Dichloropropane	0	0		0.010	0.010	0.020	0.0071	0.0071	0.0142
2,2-Dichloropropane	0	0		0.010	0.010	0.020	0.0034	0.0034	0.0068
cis-1,3-Dichloropropene	0	0		0.010	0.010	0.020	0.0039	0.0039	0.0078
trans-1,3-Dichloropropene	0	0		0.010	0.010	0.020	0.0039	0.0039	0.0078
1,1-Dichloropropene	0	0		0.010	0.010	0.020	0.0042	0.0042	0.0084
Ethylbenzene	0	0		0.010	0.010	0.020	0.0032	0.0032	0.0064
Hexachlorobutadiene	0	0		0.025	0.025	0.050	0.0041	0.0041	0.0082
2-Hexanone	0	0		0.10	0.10	0.200	0.018	0.018	0.036
Isopropylbenzene	0	0		0.010	0.010	0.020	0.0058	0.0058	0.0116
p-Isopropyltoluene	0	0		0.010	0.010	0.020	0.0085	0.0085	0.0170
Methylene Chloride	0.062	0		0.025	0.025	0.050	0.012	0.012	0.024
4-Methyl-2-Pentanone (MiBK)	0	0		0.10	0.10	0.200	0.029	0.029	0.058
Naphalene	0	0		0.025	0.025	0.050	0.0066	0.0066	0.0132
n-Propylbenzene	0	0		0.010	0.010	0.020	0.0054	0.0054	0.0108
Styrene	0	0		0.010	0.010	0.020	0.0049	0.0049	0.0098
1,1 1,2-Tetrachloroethane	0	0		0.010	0.010	0.020	0.0046	0.0046	0.0092
1,1,2,2-Tetrachloroethane	0	0		0.025	0.025	0.050	0.0067	0.0067	0.0134
Tetrachloroethene	0	0		0.010	0.010	0.020	0.0044	0.0044	0.0088
Toluene	0.012	0.0052	J	0.010	0.010	0.021	0.0027	0.0027	0.0054
1,2,3-Trichlorobenzene	0	0		0.025	0.025	0.050	0.0056	0.0056	0.0112
1,2,4-Trichlorobenzene	0	0		0.025	0.025	0.050	0.0066	0.0066	0.0132
1,1,1-Trichloroethane	0	0		0.025	0.025	0.050	0.0051	0.0051	0.0102
1,1,2-Trichloroethane	0	0		0.025	0.025	0.050	0.0056	0.0056	0.0112
Trichloroethene	0	0		0.010	0.010	0.020	0.0099	0.0099	0.0198
Trichlorofluoromethane	0.0087	J 0.020	J	0.050	0.050	0.100	0.0080	0.0080	0.0160
1,2,3-Trichloropropane	0	0		0.025	0.025	0.050	0.0099	0.0099	0.0198
1,2,4-Trimethylbenzene	0	0		0.010	0.010	0.020	0.0063	0.0063	0.0126
1,3,5-Trimethylbenzene	0	0		0.010	0.010	0.020	0.0074	0.0074	0.0148
Vinyl Chloride	0	0		0.010	0.010	0.020	0.0032	0.0032	0.0064
m- & p-Xylenes	0	0		0.020	0.020	0.040	0.0072	0.0072	0.0144
o-Xylene	0	0		0.010	0.010	0.020	0.0053	0.0053	0.0106

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VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/20/07	Sample Volume:	0.0199 dscm
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	1138 - 1218	Airflow:	10551 dscfm
Location:	Tacoma, Washington	Lab Numbers:	4517		
Run Number	3A				
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet				

	RUN 3A - RESULTS		RUN 3A - REPORTING LIMIT (RL)			RUN 3A - MINIMUM DETECTION LIMIT (MDL)		
	Tenax Tube 3A µg	Anasorb Tube 3A µg	Tenax 3A µg	Anasorb 3A µg	TOTAL 3A µg	Tenax 3A µg	Anasorb 3A µg	TOTAL 3A µg
Acetone	0	0	0.10	0.10	0.20	0.060	0.060	0.120
Benzene	0.89	0	0.010	0.010	0.020	0.0043	0.0043	0.0086
Bromobenzene	0	0	0.010	0.010	0.020	0.0055	0.0055	0.0110
Bromochloromethane	0	0	0.025	0.025	0.050	0.0055	0.0055	0.0110
Bromodichloromethane	0	0	0.010	0.010	0.020	0.0044	0.0044	0.0088
Bromoform	0	0	0.025	0.025	0.050	0.0065	0.0065	0.0130
Bromomethane	0	0	0.050	0.050	0.100	0.0078	0.0078	0.0156
2-Butanone (MEK)	0	0	0.10	0.10	0.200	0.032	0.032	0.064
n-Butylbenzene	0	0	0.010	0.010	0.020	0.0077	0.0077	0.0154
sec-Butylbenzene	0	0	0.010	0.010	0.020	0.0096	0.0096	0.0192
tert-Butylbenzene	0	0	0.010	0.010	0.020	0.0089	0.0089	0.0176
Carbon Disulfide	0	0	0.010	0.010	0.020	0.0042	0.0042	0.0084
Carbon Tetrachloride	0	0	0.010	0.010	0.020	0.0034	0.0034	0.0068
Chlorobenzene	0	0	0.010	0.010	0.020	0.0043	0.0043	0.0086
Chlorodibromomethane	0	0	0.025	0.025	0.050	0.0038	0.0038	0.0076
Chloroethane	0	0	0.050	0.050	0.100	0.0039	0.0039	0.0078
Chloroform	0	0	0.010	0.010	0.020	0.0046	0.0046	0.0092
Chloromethane	0	0.030 J	0.050	0.050	0.100	0.0060	0.0060	0.0120
2-Chlorotoluene	0	0	0.010	0.010	0.020	0.0054	0.0054	0.0108
4-Chlorotoluene	0	0	0.010	0.010	0.020	0.0057	0.0057	0.0114
1,2 Dibromo-3-chloropropene	0	0	0.050	0.050	0.100	0.016	0.016	0.032
1,2-Dibromoethane	0	0	0.025	0.025	0.050	0.0039	0.0039	0.0078
Dibromomethane	0	0	0.025	0.025	0.050	0.0064	0.0064	0.0128
1,2-Dichlorobenzene	0	0	0.010	0.010	0.020	0.0059	0.0059	0.0118
1,3-Dichlorobenzene	0	0	0.010	0.010	0.020	0.0064	0.0064	0.0128
1,4-Dichlorobenzene	0	0	0.010	0.010	0.020	0.0074	0.0074	0.0148
Dichlorodifluoromethane	0	0.033	0.025	0.025	0.050	0.0052	0.0052	0.0104
1,1-Dichloroethane	0	0	0.010	0.010	0.020	0.0034	0.0034	0.0068
1,2-Dichloroethane	0	0	0.010	0.010	0.020	0.0048	0.0048	0.0096
cis-1,3-Dichloroethene	0	0	0.010	0.010	0.020	0.0050	0.0050	0.0100
trans-1,3-Dichloroethene	0	0	0.010	0.010	0.020	0.0038	0.0038	0.0076
1,1-Dichloroethene	0	0	0.010	0.010	0.020	0.0057	0.0057	0.0114
1,2-Dichloropropane	0	0	0.010	0.010	0.020	0.0045	0.0045	0.0090
1,3-Dichloropropane	0	0	0.010	0.010	0.020	0.0071	0.0071	0.0142
2,2-Dichloropropane	0	0	0.010	0.010	0.020	0.0034	0.0034	0.0068
cis-1,3-Dichloropropene	0	0	0.010	0.010	0.020	0.0039	0.0039	0.0078
trans-1,3-Dichloropropene	0	0	0.010	0.010	0.020	0.0039	0.0039	0.0078
1,1-Dichloropropene	0	0	0.010	0.010	0.020	0.0042	0.0042	0.0084
Ethylbenzene	0	0	0.010	0.010	0.020	0.0032	0.0032	0.0064
Hexachlorobutadiene	0	0	0.025	0.025	0.050	0.0041	0.0041	0.0082
2-Hexanone	0	0	0.10	0.10	0.200	0.018	0.018	0.036
Isopropylbenzene	0	0	0.010	0.010	0.020	0.0058	0.0058	0.0116
p-Isopropyltoluene	0	0	0.010	0.010	0.020	0.0085	0.0085	0.0170
Methylene Chloride	0.021 J	0.018 J	0.025	0.025	0.050	0.012	0.012	0.024
4-Methyl-2-Pentanone (MIBK)	0	0	0.10	0.10	0.200	0.029	0.029	0.058
Naphalene	0	0	0.025	0.025	0.050	0.0066	0.0066	0.0132
n-Propylbenzene	0	0	0.010	0.010	0.020	0.0054	0.0054	0.0108
Styrene	0	0	0.010	0.010	0.020	0.0049	0.0049	0.0098
1,1,1,2-Tetrachloroethane	0	0	0.010	0.010	0.020	0.0046	0.0046	0.0092
1,1,2,2-Tetrachloroethane	0	0	0.025	0.025	0.050	0.0067	0.0067	0.0134
Tetrachloroethene	0	0	0.010	0.010	0.020	0.0044	0.0044	0.0088
Toluene	0.023	0.0067 J	0.010	0.010	0.021	0.0027	0.0027	0.0054
1,2,3-Trichlorobenzene	0	0	0.025	0.025	0.050	0.0056	0.0056	0.0112
1,2,4-Trichlorobenzene	0	0	0.025	0.025	0.050	0.0066	0.0066	0.0132
1,1,1-Trichloroethane	0	0	0.025	0.025	0.050	0.0051	0.0051	0.0102
1,1,2-Trichloroethane	0	0	0.025	0.025	0.050	0.0056	0.0056	0.0112
Trichloroethene	0	0	0.010	0.010	0.020	0.0099	0.0099	0.0198
Trichlorofluoromethane	0	0.087	0.050	0.050	0.100	0.0080	0.0080	0.0160
1,2,3-Trichloropropane	0	0	0.025	0.025	0.050	0.0099	0.0099	0.0198
1,2,4-Trimethylbenzene	0	0	0.010	0.010	0.020	0.0063	0.0063	0.0126
1,3,5-Trimethylbenzene	0	0	0.010	0.010	0.020	0.0074	0.0074	0.0148
Vinyl Chloride	0	0	0.010	0.010	0.020	0.0032	0.0032	0.0064
m- & p-Xylenes	0	0	0.020	0.020	0.040	0.0072	0.0072	0.0144
o-Xylene	0	0	0.010	0.010	0.020	0.0053	0.0053	0.0106

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VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/20/07	Sample Volume:	0 0191	dscm
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	1232 - 1312	Airflow:	10551	dscfm
Location:	Tacoma, Washington	Lab Numbers:	4518			
Run Number:	3B					
Sample Location:	Perennial #1 Landfill Gas Combuster Outlet					

	RUN 3B - RESULTS			RUN 3B - REPORTING LIMIT (RL)			RUN 3B - MINIMUM DETECTION LIMIT (MDL)		
	Tenax Tube 3B µg	Anasorb Tube 3B µg		Tenax 3B µg	Anasorb 3B µg	TOTAL 3B µg	Tenax 3B µg	Anasorb 3B µg	TOTAL 3B µg
Acetone	0	0		0.10	0.10	0 20	0.060	0.060	0.120
Benzene	0.37	0		0.010	0.010	0.020	0.0043	0.0043	0.0086
Bromobenzene	0	0		0.010	0 010	0.020	0.0055	0.0055	0.0110
Bromochloromethane	0	0		0.025	0 025	0.050	0.0055	0.0055	0.0110
Bromodichloromethane	0	0		0 010	0.010	0 020	0 0044	0.0044	0.0088
Bromoform	0	0		0.025	0.025	0 050	0.0065	0.0065	0.0130
Bromomethane	0	0		0 050	0 050	0 100	0.0078	0.0078	0.0156
2-Butanone (MEK)	0	0		0.10	0.10	0.200	0.032	0 032	0 064
n-Butylbenzene	0	0		0.010	0 010	0.020	0.0077	0 0077	0 0154
sec-Butylbenzene	0	0		0.010	0 010	0.020	0.0096	0.0096	0.0192
tert-Butylbenzene	0	0		0.010	0.010	0.020	0.0089	0 0089	0.0178
Carbon Disulfide	0	0		0 010	0.010	0.020	0.0042	0 0042	0 0084
Carbon Tetrachloride	0	0		0.010	0.010	0.020	0.0034	0 0034	0 0068
Chlorobenzene	0	0		0.010	0.010	0 020	0.0043	0 0043	0 0086
Chlorodibromomethane	0	0		0.025	0.025	0.050	0.0038	0.0038	0.0076
Chloroethane	0	0		0.050	0.050	0 100	0.0039	0.0039	0.0078
Chloroform	0	0		0.010	0.010	0 020	0.0046	0 0046	0.0092
Chloromethane	0	0.051		0.050	0.050	0.100	0.0060	0.0060	0.0120
2-Chlorotoluene	0	0		0 010	0.010	0.020	0.0054	0 0054	0.0108
4-Chlorotoluene	0	0		0 010	0.010	0 020	0.0057	0 0057	0.0114
1,2 Dibromo-3-chloropropane	0	0		0.050	0.050	0 100	0.016	0 016	0.032
1,2-Dibromoethane	0	0		0.025	0.025	0 050	0.0039	0.0039	0.0078
Dibromomethane	0	0		0.025	0.025	0 050	0.0064	0.0064	0.0128
1,2-Dichlorobenzene	0	0		0.010	0.010	0 020	0.0059	0 0059	0.0118
1,3-Dichlorobenzene	0	0		0 010	0.010	0.020	0.0064	0 0064	0.0128
1,4-Dichlorobenzene	0	0		0.010	0.010	0 020	0.0074	0 0074	0.0148
Dichlorodifluoromethane	0	0.025		0 025	0.025	0.050	0.0052	0.0052	0.0104
1,1-Dichloroethane	0	0		0.010	0.010	0.020	0.0034	0.0034	0.0068
1,2-Dichloroethane	0	0		0.010	0.010	0 020	0.0048	0 0048	0.0096
cis-1,3-Dichloroethene	0	0		0.010	0.010	0 020	0.0050	0 0050	0.0100
trans-1,3-Dichloroethene	0	0		0 010	0.010	0.020	0.0038	0 0038	0.0076
1,1-Dichloroethene	0	0		0.010	0.010	0.020	0.0057	0 0057	0.0114
1,2-Dichloropropane	0	0		0.010	0.010	0.020	0.0045	0 0045	0.0090
1,3-Dichloropropane	0	0		0.010	0.010	0.020	0.0071	0.0071	0.0142
2,2-Dichloropropane	0	0		0.010	0.010	0 020	0.0034	0.0034	0.0068
cis-1,3-Dichloropropene	0	0		0.010	0.010	0 020	0.0039	0.0039	0.0078
trans-1,3-Dichloropropene	0	0		0.010	0.010	0 020	0.0039	0 0039	0.0076
1,1-Dichloropropene	0	0		0.010	0.010	0 020	0.0042	0 0042	0.0084
Ethylbenzene	0	0		0.010	0.010	0 020	0.0032	0.0032	0.0064
Hexachlorobutadiene	0	0		0.025	0.025	0.050	0.0041	0.0041	0.0082
2-Hexanone	0	0		0.10	0 10	0.200	0.018	0.018	0 036
Isopropylbenzene	0	0		0.010	0.010	0.020	0.0058	0.0058	0 0118
p-Isopropyltoluene	0	0		0.010	0 010	0.020	0 0085	0 0085	0 0170
Methylene Chloride	0	0		0.025	0.025	0.050	0.012	0.012	0.024
4-Methyl-2-Pentanone (MIBK)	0	0		0.10	0.10	0.200	0.029	0.029	0.058
Naphalene	0	0		0.025	0.025	0.050	0.0066	0.0066	0 0132
n-Propylbenzene	0	0		0.010	0.010	0.020	0.0054	0.0054	0.0108
Styrene	0	0		0.010	0.010	0.020	0.0049	0.0049	0.0098
1,1,1,2-Tetrachloroethane	0	0		0.010	0.010	0.020	0 0046	0.0046	0.0092
1,1,2,2-Tetrachloroethane	0	0		0.025	0.025	0.050	0.0067	0.0067	0.0134
Tetrachloroethene	0	0		0 010	0.010	0.020	0.0044	0.0044	0.0088
Toluene	0.014	0.0029	J	0.010	0.010	0.021	0.0027	0.0027	0.0054
1,2,3-Trichlorobenzene	0	0		0.025	0.025	0.050	0.0056	0.0056	0.0112
1,2,4-Trichlorobenzene	0	0		0.025	0.025	0.050	0.0066	0.0066	0.0132
1,1,1-Trichloroethane	0	0		0.025	0 025	0.050	0.0051	0 0051	0.0102
1,1,2-Trichloroethane	0	0		0.025	0.025	0 050	0.0056	0 0056	0.0112
Trichloroethene	0	0		0.010	0.010	0.020	0 0099	0 0099	0 0198
Trichlorofluoromethane	0	0.034	J	0.050	0.050	0.100	0 0080	0.0080	0.0160
1,2,3-Trichloropropane	0	0		0.025	0.025	0.050	0 0099	0.0099	0.0198
1,2,4-Trimethylbenzene	0	0		0.010	0.010	0 020	0.0083	0.0063	0.0126
1,3,5-Trimethylbenzene	0	0		0.010	0 010	0 020	0.0074	0.0074	0 0148
Vinyl Chloride	0	0		0.010	0.010	0.020	0.0032	0.0032	0 0064
m- & p-Xylenes	0	0		0.020	0.020	0 040	0.0072	0.0072	0 0144
o-Xylene	0	0		0.010	0.010	0 020	0 0053	0.0053	0.0106

DATA INPUT PAGE
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031	Sample Date:	7/20/07	Sample Volume:	0.0194 dscm
Client:	Parametrix @ City of Tacoma Landfill	Sample Time:	1325 - 1405	Airflow:	10551 dscfm
Location:	Tacoma, Washington	Lab Numbers:	4519		
Run Number:	3C				
Sample Location:	Perennial #1 Landfill Gas Combustor Outlet				

	RUN 3C - RESULTS			RUN 3C - REPORTING LIMIT (RL)			RUN 3C - MINIMUM DETECTION LIMIT (MDL)		
	Tenax Tube 3C µg	Anasorb Tube 3C µg		Tenax 3C µg	Anasorb 3C µg	TOTAL 3C µg	Tenax 3C µg	Anasorb 3C µg	TOTAL 3C µg
Acetone	0	0		0.10	0.10	0.20	0.060	0.060	0.120
Benzene	0.99	0		0.010	0.010	0.020	0.0043	0.0043	0.0086
Bromobenzene	0	0		0.010	0.010	0.020	0.0055	0.0055	0.0110
Bromochloromethane	0	0		0.025	0.025	0.050	0.0055	0.0055	0.0110
Bromodichloromethane	0	0		0.010	0.010	0.020	0.0044	0.0044	0.0088
Bromoform	0	0		0.025	0.025	0.050	0.0065	0.0065	0.0130
Bromomethane	0	0		0.050	0.050	0.100	0.0078	0.0078	0.0156
2-Butanone (MEK)	0	0		0.10	0.10	0.200	0.032	0.032	0.064
n-Butylbenzene	0	0		0.010	0.010	0.020	0.0077	0.0077	0.0154
sec-Butylbenzene	0	0		0.010	0.010	0.020	0.0096	0.0096	0.0192
tert-Butylbenzene	0	0		0.010	0.010	0.020	0.0089	0.0089	0.0178
Carbon Disulfide	0	0		0.010	0.010	0.020	0.0042	0.0042	0.0084
Carbon Tetrachloride	0	0		0.010	0.010	0.020	0.0034	0.0034	0.0068
Chlorobenzene	0	0		0.010	0.010	0.020	0.0043	0.0043	0.0086
Chlorodibromomethane	0	0		0.025	0.025	0.050	0.0038	0.0038	0.0076
Chloroethane	0	0		0.050	0.050	0.100	0.0038	0.0039	0.0078
Chloroform	0	0		0.010	0.010	0.020	0.0046	0.0046	0.0092
Chloromethane	0	0.034	J	0.050	0.050	0.100	0.0060	0.0060	0.0120
2-Chlorotoluene	0	0		0.010	0.010	0.020	0.0054	0.0054	0.0108
4-Chlorotoluene	0	0		0.010	0.010	0.020	0.0057	0.0057	0.0114
1,2 Dibromo-3-chloropropane	0	0		0.050	0.050	0.100	0.016	0.016	0.032
1,2-Dibromoethane	0	0		0.025	0.025	0.050	0.0039	0.0039	0.0078
Dibromomethane	0	0		0.025	0.025	0.050	0.0064	0.0064	0.0128
1,2-Dichlorobenzene	0	0		0.010	0.010	0.020	0.0059	0.0059	0.0118
1,3-Dichlorobenzene	0	0		0.010	0.010	0.020	0.0064	0.0064	0.0128
1,4-Dichlorobenzene	0	0		0.010	0.010	0.020	0.0074	0.0074	0.0148
Dichlorodifluoromethane	0	0.019	J	0.025	0.025	0.050	0.0052	0.0052	0.0104
1,1-Dichloroethane	0	0		0.010	0.010	0.020	0.0034	0.0034	0.0068
1,2-Dichloroethane	0	0		0.010	0.010	0.020	0.0048	0.0048	0.0096
cis-1,3-Dichloroethene	0	0		0.010	0.010	0.020	0.0050	0.0050	0.0100
trans-1,3-Dichloroethene	0	0		0.010	0.010	0.020	0.0038	0.0038	0.0078
1,1-Dichloroethene	0	0		0.010	0.010	0.020	0.0057	0.0057	0.0114
1,2-Dichloropropane	0	0		0.010	0.010	0.020	0.0045	0.0045	0.0090
1,3-Dichloropropane	0	0		0.010	0.010	0.020	0.0071	0.0071	0.0142
2,2-Dichloropropane	0	0		0.010	0.010	0.020	0.0034	0.0034	0.0068
cis-1,3-Dichloropropene	0	0		0.010	0.010	0.020	0.0039	0.0039	0.0078
trans-1,3-Dichloropropene	0	0		0.010	0.010	0.020	0.0039	0.0038	0.0078
1,1-Dichloropropene	0	0		0.010	0.010	0.020	0.0042	0.0042	0.0084
Ethylbenzene	0	0		0.010	0.010	0.020	0.0032	0.0032	0.0064
Hexachlorobutadiene	0	0		0.025	0.025	0.050	0.0041	0.0041	0.0082
2-Hexanone	0	0		0.10	0.10	0.200	0.018	0.018	0.036
Isopropylbenzene	0	0		0.010	0.010	0.020	0.0058	0.0058	0.0116
p-Isopropyltoluene	0	0		0.010	0.010	0.020	0.0085	0.0085	0.0170
Methylene Chloride	0	0		0.025	0.025	0.050	0.012	0.012	0.024
4-Methyl-2-Pentanone (MIBK)	0	0		0.10	0.10	0.200	0.029	0.029	0.058
Naphalene	0	0		0.025	0.025	0.050	0.0066	0.0066	0.0132
n-Propylbenzene	0	0		0.010	0.010	0.020	0.0054	0.0054	0.0108
Styrene	0	0		0.010	0.010	0.020	0.0049	0.0049	0.0098
1,1,1,2-Tetrachloroethane	0	0		0.010	0.010	0.020	0.0046	0.0046	0.0092
1,1,2,2-Tetrachloroethene	0	0		0.025	0.025	0.050	0.0067	0.0067	0.0134
Tetrachloroethene	0	0		0.010	0.010	0.020	0.0044	0.0044	0.0088
Toluene	0.022	0		0.010	0.010	0.021	0.0027	0.0027	0.0054
1,2,3-Trichlorobenzene	0	0		0.025	0.025	0.050	0.0058	0.0056	0.0112
1,2,4-Trichlorobenzene	0	0		0.025	0.025	0.050	0.0066	0.0066	0.0132
1,1,1-Trichloroethane	0	0		0.025	0.025	0.050	0.0051	0.0051	0.0102
1,1,2-Trichloroethene	0	0		0.025	0.025	0.050	0.0056	0.0056	0.0112
Trichloroethene	0	0		0.010	0.010	0.020	0.0099	0.0099	0.0198
Trichlorofluoromethane	0	0.013	J	0.050	0.050	0.100	0.0080	0.0080	0.0160
1,2,3-Trichloropropane	0	0		0.025	0.025	0.050	0.0099	0.0099	0.0198
1,2,4-Trimethylbenzene	0	0		0.010	0.010	0.020	0.0063	0.0063	0.0126
1,3,5-Trimethylbenzene	0	0		0.010	0.010	0.020	0.0074	0.0074	0.0148
Vinyl Chloride	0	0		0.010	0.010	0.020	0.0032	0.0032	0.0064
m- & p-Xylenes	0	0		0.020	0.020	0.040	0.0072	0.0072	0.0144
o-Xylene	0	0		0.010	0.010	0.020	0.0053	0.0053	0.0106

DATA INPUT PAGE
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name	8752-001\PX @ CTL M0031	Sample Date	7/20/07
Client	Parametrix @ City of Tacoma Landfill	Sample Volume	0 0195 dscm
Location	Tacoma, Washington		
Run Number	3FB		
Sample Location	Perennial #1 Landfill Gas Combuster Outlet		

	RUN 3 - FB - RESULTS			RUN 3 - FB - REPORTING LIMIT			RUN 3 - FB - MDL		
	Tenax Tube FB µg	Anasorb Tube FB µg	TOTAL FB µg	Reporting Limit Tenax FB µg	Reporting Limit Anasorb FB µg	Reporting Limit TOTAL FB µg	MDL Tenax FB µg	MDL Anasorb FB µg	MDL TOTAL FB µg
Acetone	0	0	0 000	0 10	0 10	0 20	0.060	0 060	0 120
Benzene	0	0	0 000	0 010	0 010	0 020	0 0043	0 0043	0,0086
Bromobenzene	0	0	0 000	0 010	0 010	0.020	0 0055	0 0055	0 0110
Bromochloromethane	0	0	0.000	0 025	0 025	0 050	0 0055	0 0055	0 0110
Bromodichloromethene	0	0	0 000	0 010	0.010	0 020	0 0044	0 0044	0 0088
Bromoform	0	0	0 000	0 025	0 025	0 050	0 0065	0 0065	0 0130
Bromomethane	0	0	0.000	0 050	0 050	0 100	0 0078	0.0078	0 0156
2-Butanone (MEK)	0	0	0 000	0 10	0 10	0 200	0 032	0 032	0 064
n-Butylbenzene	0	0	0 000	0 010	0.010	0 020	0.0077	0 0077	0 0154
sec-Butylbenzene	0	0	0 000	0 010	0 010	0 020	0 0096	0 0096	0 0192
tert-Butylbenzene	0	0	0 000	0.010	0 010	0 020	0 0089	0 0089	0 0178
Carbon Disulfide	0	0	0 000	0 010	0 010	0 020	0 0042	0 0042	0 0084
Carbon Tetrachloride	0	0	0 000	0 010	0 010	0 020	0 0034	0 0034	0 0068
Chlorobenzene	0	0	0 000	0 010	0.010	0 020	0.0043	0 0043	0 0086
Chlorodibromomethane	0	0	0 000	0 025	0 025	0 050	0 0038	0 0038	0.0076
Chloroethane	0	0	0 000	0 050	0.050	0 100	0 0039	0 0039	0.0078
Chloroform	0	0	0.000	0 010	0 010	0 020	0 0046	0 0046	0.0092
Chloromethane	0	**0.0094 J**	0 0094	0 050	**0.050**	**0,100**	0 0060	**0.0060**	**0.0120**
2-Chlorotoluene	0	0	0 000	0 010	0 010	0 020	0 0054	0 0054	0 0108
4-Chlorotoluene	0	0	0.000	0 010	0 010	0 020	0 0057	0 0057	0 0114
1,2 Dibromo-3-chloropropane	0	0	0.000	0.050	0 050	0 100	0 016	0 016	0 032
1,2-Dibromoethane	0	0	0 000	0 025	0 025	0 050	0.0039	0 0039	0 0078
Dibromomethane	0	0	0.000	0 025	0 025	0 050	0 0064	0 0064	0 0128
1,2-Dichlorobenzene	0	0	0 000	0 010	0.010	0 020	0 0059	0.0059	0 0118
1,3-Dichlorobenzene	0	0	0 000	0.010	0 010	0 020	0 0064	0 0064	0 0128
1,4-Dichlorobenzene	0	0	0 000	0.010	0 010	0 020	0 0074	0 0074	0 0148
Dichlorodifluoromethane	0	0	0 000	0.025	0.025	0 050	0 0052	0 0052	0 0104
1,1-Dichloroethene	0	0	0 000	0 010	0.010	0 020	0 0034	0 0034	0 0068
1,2-Dichloroethane	0	0	0 000	0 010	0.010	0 020	0 0048	0 0048	0 0096
cis-1,3-Dichloroethene	0	0	0 000	0 010	0.010	0 020	0 0050	0 0050	0 0100
trans-1,3-Dichloroethene	0	0	0 000	0 010	0 010	0 020	0 0038	0 0038	0 0076
1,1-Dichloroethene	0	0	0 000	0 010	0 010	0 020	0 0057	0 0057	0 0114
1 2-Dichloropropane	0	0	0 000	0 010	0 010	0 020	0 0045	0 0045	0 0090
1,3-Dichloropropane	0	0	0 000	0 010	0 010	0 020	0 0071	0 0071	0 0142
2,2-Dichloropropane	0	0	0 000	0 010	0 010	0 020	0 0034	0 0034	0 0068
cis-1,3-Dichloropropene	0	0	0 000	0.010	0 010	0 020	0 0039	0 0039	0 0078
trans-1,3-Dichloropropene	0	0	0 000	0 010	0 010	0 020	0 0039	0 0039	0 0078
1,1-Dichloropropene	0	0	0 000	0 010	0.010	0 020	0 0042	0 0042	0 0084
Ethylbenzene	0	0	0.000	0.010	0 010	0 020	0.0032	0 0032	0 0064
Hexachlorobutadiene	0	0	0.000	0 025	0 025	0 050	0 0041	0 0041	0 0082
2-Hexanone	0	0	0 000	0.10	0 10	0 200	0.018	0 018	0 036
Isopropylbenzene	0	0	0 000	0 010	0 010	0 020	0 0058	0 0058	0 0116
p-Isopropyltoluene	0	0	0 000	0.010	0 010	0 020	0 0085	0 0085	0 0170
Methylene Chloride	0	0	0 000	0 025	0 025	0 050	0 012	0 012	0 024
4-Methyl-2-Pentanone (MiBK)	0	0	0 000	0 10	0 10	0 200	0 029	0 029	0 058
Naphalene	0	0	0 000	0 025	0 025	0 050	0 0066	0 0066	0 0132
n-Propylbenzene	0	0	0 000	0 010	0 010	0 020	0 0054	0 0054	0 0108
Styrene	0	0	0.000	0 010	0 010	0.020	0 0049	0 0049	0 0098
1,1,1,2-Tetrachloroethane	0	0	0.000	0.010	0 010	0 020	0 0046	0 0046	0 0092
1,1,2,2-Tetrachloroethane	0	0	0 000	0 025	0 025	0 050	0 0067	0 0067	0 0134
Tetrachloroethene	0	0	0 000	0 010	0 010	0 020	0 0044	0 0044	0 0088
Toluene	0	0	0 000	0 010	0 010	0 021	0.0027	0 0027	0 0054
1 2,3-Trichlorobenzene	0	0	0 000	0 025	0 025	0 050	0 0056	0 0056	0.0112
1,2,4-Trichlorobenzene	0	0	0 000	0 025	0.025	0 050	0 0066	0 0066	0 0132
1,1,1-Trichloroethane	0	0	0 000	0.025	0,025	0 050	0 0051	0 0051	0 0102
1,1,2-Trichloroethane	0	0	0 000	0 025	0.025	0 050	0 0056	0 0056	0 0112
Trichloroethene	0	0	0 000	0.010	0 010	0 020	0 0099	0 0099	0 0198
Trichlorofluoromethene	0	0	0 000	0 050	0 050	0 100	0 0080	0 0080	0 0160
1,2,3-Trichloropropane	0	0	0 000	0.025	0 025	0 050	0 0099	0 0099	0 0198
1,2,4-Trimethylbenzene	0	0	0 000	0 010	0 010	0 020	0 0063	0 0063	0.0126
1,3,5-Trimethylbenzene	0	0	0 000	0 010	0 010	0 020	0 0074	0 0074	0 0148
Vinyl Chloride	0	0	0 000	0.010	0 010	0 020	0 0032	0 0032	0 0064
m- & p-Xylenes	0	0	0 000	0 020	0.020	0 040	0 0072	0 0072	0 0144
o-Xylene	0	0	0 000	0 010	0 010	0 020	0 0053	0 0053	0 0106

APPENDIX B

Laboratory Analysis Results

Atmospheric Analysis & Consulting, Inc.

CLIENT	: AMTEST Air Quality
PROJECT NAME	: Parametrix @ City of Tacoma Landfill
PROJECT NO.	: 8752-001
AAC PROJECT NO.	: 070784
REPORT DATE	: 08/09/2007

On July 25, 2007, Atmospheric Analysis & Consulting, Inc. received four (4) Summa Canisters for non-methane organic compounds analysis by EPA 25C and Fix Gases by EPA 3C. Upon receipt the samples were assigned unique Laboratory ID numbers as follows:

Client ID	Lab No.	Initial Pressure
R-1; #1 Perennial Gas Combustor Inlet	070784-27273	716.4
R-2; #1 Perennial Gas Combustor Inlet	070784-27274	781.4
R-3A; #1 Perennial Gas Combustor Inlet	070784-27275	745.0
R-3B; #1 Perennial Gas Combustor Inlet	070784-27276	792.2

EPA 25C Analysis - Up to a 1 mL aliquot of samples is injected into the GC/FID/TCA for analysis in triplicate following EPA 25C as specified in the SOW.

EPA 3C Analysis - An aliquot of the gaseous sample is injected into the GC/TCD for analysis following EPA 3C as specified in the SOW.

No problems were encountered during receiving, preparation, and/ or analysis of this sample. The test results included in this report meet all requirements of the NELAC Standards and/or AAC SOP# AACI- EPA 25C.

I certify that this data is technically accurate, complete, and in compliance with the terms and conditions of the contract. Release of the data contained in this hardcopy data package and its electronic data deliverable submitted on diskette has been authorized by the Laboratory Director or his designee, as verified by the following signature.

If you have any questions or require further explanation of data results, please contact the undersigned.

Sucha S. Parmar, PhD
Technical Director

This report consists of 7 pages.

Laboratory Analysis Report

Client:	**: AMTEST Air Quality**	**Sampling Date**	**: 07/19-20/2007**
Project No.	**: 070784**	**Receiving Date**	**: 07/25/2007**
Matrix	**: air**	**Analysis Date**	**: 07/30/2007**
Units	**: %**	**Report Date**	**: 08/09/2007**

EPA Method 3C

Detection Limit: 0.1 %			Analyte				
Client ID	**AAC ID**	**Hydrogen**	**Oxygen**	**Nitrogen**	**CO**	**Methane**	**CO2**
R-1; #1 Perennial Gas Combustor Inlet	070784-27273	<PQL	3.4	49.5	<PQL	24.7	22.3
R-2; #1 Perennial Gas Combustor Inlet	070784-27274	<PQL	3.1	48.7	<PQL	25.4	22.7
R-3A; #1 Perennial Gas Combustor Inlet	070784-27275	<PQL	3.3	49.0	<PQL	25.1	22.6
R-3B; #1 Perennial Gas Combustor Inlet	070784-27276	<PQL	3.3	48.8	<PQL	25.2	22.7

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Dr. Sucha Parmar
Technical Director

1534 Eastman Avenue • Suite A • Ventura, California 93003 (805) 650-1642 • FAX (805) 650-1644

Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

Client	: **AMTEST Air Quality**	**Sampling Date**	: **07/19-20/2007**
Project No.	: **070784**	**Receiving Date**	: **07/25/2007**
Matrix	: **air**	**Analysis Date**	: **07/28-30/2007**
Units	: **ppmv**	**Report Date**	: **08/09/2007**

EPA Method 25C

Detection Limit:		1.0 ppmv
Client Sample ID	**AAC ID**	**NMHC****
R-1; #1 Perennial Gas Combustor Inlet	070784-27273	738
R-2; #1 Perennial Gas Combustor Inlet	070784-27274	756
R-3A; #1 Perennial Gas Combustor Inlet	070784-27275	446
R-3B; #1 Perennial Gas Combustor Inlet	070784-27276	462

****Non-Methane Hydrocarbons as Methane**

Sucha Parmar, Ph.D.
Technical Director

1534 Eastman Avenue • Suite A • Ventura, California 93003 (805) 650-1642 • FAX (805) 650-1644

Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

Analysis Date: 8/1/2007
Analyst: TT
Units: ppmv

Instrument ID: FID#4
Calibration Date: 6/14/2007

I - Opening Calibration Verification Standard - Method 25C

Analyte	xCF	dCF	%RPD*
CO	3218	3327	3.3
CH4	3185	3301	3.6
CO2	3232	3294	1.9
Propane	9268	9321	0.6

II - Method Blank - Method 25C

AAC ID	Analyte	Sample Result
MB	NMEHC	ND

III - Laboratory Control Spike & Duplicate - Method 25C

AAC ID	Analyte	Spike Added	LCS Result	LCSD Result	LCS % Rec **	LCSD % Rec **	% RPD***
LCS/LCSD	NMEHC	50.0	51.0	47.6	102.1	95.2	7.0

IV - Closing Calibration Verification Standard - Method 25C

Analyte	xCF	dCF	%RPD*
CO	3218	3435	6.5
CH4	3185	3431	7.4
CO2	3232	3363	4.0
Propane	9268	9902	6.6

xCF - Average Calibration Factor from Initial Calibration Curve

dCF - Daily Calibration Factor

* Must be <15%

** Must be 90-110 %

*** Must be <20%

Dr. Sucha Parmar
Technical Director

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

Analysis Date: 7/28/2007
Analyst: TT
Units: ppmv

Instrument ID: FID#4
Calibration Date: 6/14/2007

I - Opening Calibration Verification Standard - Method 25C

Analyte	xCF	dCF	%RPD*
CO	3218	3500	8.4
CH4	3185	3415	7.0
CO2	3232	3488	7.6
Propane	9268	9798	5.6

II - Method Blank - Method 25C

AAC ID	Analyte	Sample Result
MB	NMEHC	ND

III - Laboratory Control Spike & Duplicate - Method 25C

AAC ID	Analyte	Spike Added	LCS Result	LCSD Result	LCS % Rec **	LCSD % Rec **	% RPD***
LCS/LCSD	NMEHC	50.0	46.3	46.5	92.6	92.9	0.4

IV - Closing Calibration Verification Standard - Method 25C

Analyte	xCF	dCF	%RPD*
CO	3218	3270	1.6
CH4	3185	3293	3.3
CO2	3232	3513	8.4
Propane	9268	9491	2.4

xCF - Average Calibration Factor from Initial Calibration Curve

dCF - Daily Calibration Factor

* Must be <15%

** Must be 90-110 %

*** Must be <20%

Dr. Sucha Parmar
Technical Director

1534 Eastman Avenue • Suite A • Ventura, California 93003 (805) 650-1642 • FAX (805) 650-1644

Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

Date Analyzed: 7/30/2007
Analyst: TT

Instrument ID: TCD#1
Units: %

I - Method Blank-EPA Method 3C

AAC ID	Analyte	MB Concentration
Method Blank	Hydrogen	ND
	Oxygen	ND
	Nitrogen	ND
	CO	ND
	Methane	ND
	CO2	ND

II-Laboratory Control Spike & Duplicate - EPA Method 3C

AAC ID	Analyte	Spike Added	LCS Result	LCSD Result	LCS % Rec *	LCSD % Rec *	% RPD***
Lab Control Standards	Hydrogen	20.0	21.5	21.8	108	109	1.1
	Nitrogen	20.0	21.2	21.3	106	107	0.8
	CO	20.0	20.1	20.2	100	101	0.8
	Methane	20.0	19.5	19.6	97	98	0.7
	CO2	20.0	20.0	20.1	100	101	0.6

III - Duplicate Analysis - EPA Method 3C

AAC ID	Analyte	Sample Concentration	Duplicate Concentration	Mean	% RPD***
070783-27271	Hydrogen	0.0	0.0	0.0	0.0
	Oxygen	0.0	0.0	0.0	0.0
	Nitrogen	51.3	50.4	50.8	1.8
	CO	0.0	0.0	0.0	0.0
	Methane	0.0	0.0	0.0	0.0
	CO2	6.7	6.7	6.7	1.0

IV-Matrix Spike & Duplicate- EPA Method 3C

AAC ID	Analyte	Sample Concentration	Spike Added	MS Result	MSD Result	MS % Rec **	MSD % Rec **	% RPD***
070783-27271	Hydrogen	0.0	10.0	9.5	9.8	95	98	3.0
	Nitrogen	25.4	10.0	37.1	37.4	117	120	2.2
	CO	0.0	10.0	9.9	10.1	99	101	2.0
	Methane	0.0	10.0	9.7	9.9	96	98	2.0
	CO2	3.3	10.0	13.2	13.5	99	101	2.4

** Must be 85-115%*
*** Must be 75-125%*
**** Must be < 25%*

Dr. Sucha Punnar
Technical Director

1534 Eastman Avenue • Suite A • Ventura, California 93003 (805) 650-1642 • FAX (805) 650-1644

Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

Date Analyzed: 7/30/2007 **Instrument ID: TCD#1**

Analyst: TT **Calibration Date: 09/27/06**

Opening Calibration Verification Standard

Analyte	xLR**	LR	%RPD*
Hydrogen	2128	2288	7.3
Oxygen* **	58037	57800	0.4
Nitrogen	62209	65054	4.5
Carbon Monoxide	69067	69111	0.1
Methane	59891	58275	2.7
Carbon Dioxide	93158	93121	0.0

Closing Calibration Verification Standard

Analyte	xLR**	LR	%RPD*
Hydrogen	2128	2253	5.7
Nitrogen	62209	65037	4.4
Carbon Monoxide	69067	68630	0.6
Methane	59891	58505	2.3
Carbon Dioxide	93158	92523	0.7

* Must be <15%

** Linear Response Factor from Initial Calibration Curve

*** Oxygen from Lab Air

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AMTEST AIR QUALITY, LLC

Analysis Lab: AAC

070741

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME
8752-001	Parametrix @ City of Tacoma Landfill - Perennial Stack

SAMPLERS: (*Signature*)

KEF, RDR, KJR, TWG

LAB #	DATE	TIME	COMP.	GRAB	LOCATION/DESCRIPTION	NUMBER OF CONTAINERS	% Fixed Gases by M3C (GC-TCD) (CO_2, O_2, CH_4, N_2, CO)	Total NMOC by Method 25C (GC-FID)	Speciated VOCs by Method TO-14A (GC-MS)			
4507	7/19/07	1510-1810		X	R-1; #1 Perennial Gas Combustor Inlet	1	X	X	X			27273
4508	7/20/07	0831-1031		X	R-2; #1 Perennial Gas Combustor Inlet	1	X	X	X			27274
4509	7/20/07	1138-1338		X	R-3A; #1 Perennial Gas Combustor Inlet	1	X	X	X			27275
4510	7/20/07	1138-1338		X	R-3B; #1 Perennial Gas Combustor Inlet	1	X	X	X			27276

Client Name
AM TEST-AIR QUALITY, A Division of Hoefler Group
Client Address
30545 SE 84th St., #5 / PO Box 525 / Preston, WA 98050
Client Phone/Fax
425-222-7746 / 425-222-7849 (fax)
Contact Person
Matt Caron
P.O. Number
8752-001

Please provide NMOC results in ppmv as CH_4.

Please provide speciated VOCs in $\mu g/m^3$.

Relinquished by: (*Signature*)	Date/Time	Received by: (*Signature*)	Relinquished by: (*Signature*)	Date/Time	Received by: (*Signature*)
	7-24-07 1030	Thien Tran 7/25/07 930			
Relinquished by: (*Signature*)	Date/Time	Received for Laboratory by:	Date/Time	Remarks	

Am Test Inc.
14603 N.E. 87th St.
Redmond, WA 98052
(425) 885-1664

AM TEST LABORATORIES

Professional Analytical Services

Aug 13 2007
Am Test Air Quality
PO Box 525
Preston, WA 98050-0525
Attention: Matt Caron

Dear Matt Caron:

Enclosed please find the analytical data for your Rendering Scrubber project.

The following is a cross correlation of client and laboratory identifications for your convenience.

CLIENT ID	MATRIX	AMTEST ID	TEST
4504 R-1 #1 Perennial Gas Combustor	Impinger	07-A009319	Impinger Metals
4505 R-2 #1 Perennial Gas Combustor	Impinger	07-A009320	Impinger Metals
4506 R-3 #1 Perennial Gas Combustor	Impinger	07-A009321	Impinger Metals
Blank 0.1 n H2So4	Impinger	07-A009322	Impinger Metals

Your samples were received on Monday, July 23, 2007. At the time of receipt, the samples were logged in and properly maintained prior to the subsequent analysis.

The analytical procedures used at AmTest are well documented and are typically derived from the protocols of the EPA, USDA, FDA or the Army Corps of Engineers.

Following the analytical data you will find the Quality Control (QC) results.

Please note that the detection limits that are listed in the body of the report refer to the Method Detection Limits (MDL's), as opposed to Practical Quantitation Limits (PQL's).

If you should have any questions pertaining to the data package, please feel free to contact me.

Sincerely,

Kathy Fugiel
President

PO Number: 8752-001

BACT = Bacteriological
CONV = Conventionals
MET = Metals
ORG = Organics
NUT=Nutrients
DEM=Demand
MIN=Minerals

AMTEST AIR QUALITY, LLC

Analysis Lab: AmTest

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME
8752-001	**Rendering Scrubber Exhaust** Parametrix @ City of Tacoma Landfill - Perennial Stack

SAMPLERS: (*Signature*)

KEF, RDR, KJR, TWG

Client Name: **AM TEST-AIR QUALITY, A Division of Hoefler Group**

Client Address: **30545 SE 84th St, #5 / PO Box 525 / Preston, WA 98050**

Client Phone/Fax: **425-222-7746 / 425-222-7849 (fax)**

Contact Person: **Matt Caron** MC

P.O. Number: 8752-001

LAB #	DATE	TIME	COMP.	GRAB	LOCATION/DESCRIPTION	NUMBER OF CONTAINERS	Hydrogen chloride by IC per M26A	Hydrogen fluoride by IC per M26A			Volume (ml)	
4504	7/19/07	1510-1745		X	R-1; #1 Perennial Gas Combustor	1	X	X			475	Please provide results in ug per sample. 9319
4505	7/20/07	0831-1042		X	R-2; #1 Perennial Gas Combustor	1	X	X			459	20
4506	7/20/07	1138-1351		X	R-3; #1 Perennial Gas Combustor	1	X	X			460	21
Blank					Blank 0.1 N H2SO4	1	X	X			400	22

Relinquished by: (*Signature*)	Date/Time	Received by: (*Signature*)	Relinquished by: (*Signature*)	Date/Time	Received by: (*Signature*)
[signature]	7-23-07 1430				
[signature]	7/23/07 1510	[signature]			

Relinquished by: (*Signature*)	Date/Time	Received for Laboratory by:	Date/Time	Remarks

Am Test Inc.
14603 N.E. 87th St.
Redmond, WA 98052
(425) 885-1664
www.amtestlab.com

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AM TEST LABORATORIES

Professional Analytical Services

ANALYSIS REPORT

Am Test Air Quality
PO Box 525
Preston, WA 98050-0525
Attention: Matt Caron
Project Name: Rendering Scrubber
PO Number: 8752-001
All results reported on an as received basis.

Date Received: 07/23/07
Date Reported: 8/13/07

AMTEST Identification Number 07-A009319
Client Identification 4504 R-1 #1 Perennial Gas Combustor
Sampling Date

Impinger

PARAMETER	RESULT	UNITS	Q	MDL	METHOD	ANALYST	DATE
Chloride	2200	ug		24.	300.0	MO	07/26/07
Fluoride	1700	ug		24.	340.2	MO	07/26/07
Water Volume	475.	mls				KF	08/08/07

AMTEST Identification Number 07-A009320
Client Identification 4505 R-2 #1 Perennial Gas Combustor
Sampling Date

Impinger

PARAMETER	RESULT	UNITS	Q	MDL	METHOD	ANALYST	DATE
Chloride	1800	ug		23.	300.0	MO	07/26/07
Fluoride	1300	ug		23.	340.2	MO	07/26/07
Water Volume	459.	mls				KF	08/08/07

AMTEST Identification Number 07-A009321
Client Identification 4506 R-3 #1 Perennial Gas Combustor
Sampling Date

Impinger

PARAMETER	RESULT	UNITS	Q	MDL	METHOD	ANALYST	DATE
Chloride	2100	ug		23.	300.0	MO	07/26/07
Fluoride	1200	ug		23.	340.2	MO	07/26/07
Water Volume	460.	mls				KF	08/08/07

AMTEST Identification Number 07-A009322
Client Identification Blank 0.1 n H2So4
Sampling Date

Impinger

PARAMETER	RESULT	UNITS	Q	MDL	METHOD	ANALYST	DATE
Chloride	< 20	ug		20.	300.0	MO	07/26/07
Fluoride	< 20	ug		20.	340.2	MO	07/26/07
Water Volume	400.	mls				KF	08/08/07

Kathy Fugiel
President

Atmospheric Analysis & Consulting, Inc.

CLIENT : AMTEST
PROJECT NAME : Parametrix @ City of Tacoma Landfill
PROJECT NUMBER : 8752-001
AAC PROJECT NO. : 070784
REPORT DATE : 07/31/07

On July 25, 2007, Atmospheric Analysis & Consulting, Inc. received four (4) Six-Liter Summa Canisters for Volatile Organic Compounds analysis by EPA method TO-15. Upon receipt the samples were assigned unique Laboratory ID numbers as follows:

Client ID	Lab ID	Initial Pressure
R-1; #1 Perennial Gas Combustor Inlet	070784-27273	716.4
R-2; #1 Perennial Gas Combustor Inlet	070784-27274	781.4
R-3B; #1 Perennial Gas Combustor Inlet	070784-27275	745.0
R-3B; #1 Perennial Gas Combustor Inlet	070784-27276	792.2

An initial reading of the canister's vacuum was taken and recorded. Subsequently, the canisters were brought to positive pressure using UHP-He and the final pressure was also recorded.

TO-15 Analysis - Up to a 500 ml aliquot of samples is concentrated, put through a water and CO2 management system, cryofocused and injected into the GC/MS (full scan mode) for analysis following EPA Method TO-15 as specified in the SOW.

No problems were encountered during receiving, preparation and/ or analysis of these samples. The test results included in this report meet all requirements of the NELAC Standards and/or AAC SOP# AACI-TO-15. Estimated uncertainty of the test results will be provided upon request.

I certify that this data is technically accurate, complete and in compliance with the terms and conditions of the contract. The Laboratory Director or his designee, as verified by the following signature, has authorized the release of the data contained in this hardcopy data package.

If you have any questions or require further explanation of data results, please contact the undersigned.

Sucha S. Parmar, PhD
Technical Director

This report consists of 24 pages.

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Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : AMTEST
PROJECT NO : 070784
MATRIX : AIR
UNITS : PPB (v/v)

DATE RECEIVED : 07/25/07
DATE REPORTED : 07/31/07

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID	R-1; #1 Perennial Gas Combustor Inlet			Sample Reporting Limit (RLxDF's)	R-2; #1 Perennial Gas Combustor Inlet			Sample Reporting Limit (RLxDF's)	Method Reporting Limit
AAC ID	070784-27273				070784-27274				
Date Sampled	7/19/2007				7/20/2007				
Date Analyzed	7/27/2007				7/27/2007				
Can Dilution Factor	1.40				1.29				
	Result	Qualifier	Dil. Fac.		Result	Qualifier	Dil. Fac.		
Chlorodifluoromethane	530		200	280	583		200	257	1.0
Propylene	2650		200	280	2880		200	257	1.0
Dichlorodifluoromethane	ND	U	200	280	ND	U	200	257	1.0
Chloromethane	ND	U	200	280	ND	U	200	257	1.0
1,2-Dichloro-1,1,2,2-Tetrafluoroethane	ND	U	200	280	ND	U	200	257	1.0
Vinyl Chloride	388		200	280	460		200	257	1.0
Methanol	ND	U	200	1399	ND	U	200	1285	5.0
1,3-Butadiene	ND	U	200	280	ND	U	200	257	1.0
Bromomethane	ND	U	200	280	ND	U	200	257	1.0
Chloroethane	ND	U	200	280	ND	U	200	257	1.0
Dichlorofluoromethane	ND	U	200	280	ND	U	200	257	1.0
Ethanol	ND	U	200	560	ND	U	200	514	2.0
Vinyl Bromide	ND	U	200	280	ND	U	200	257	1.0
Acetone	669		200	560	ND	U	200	514	2.0
Trichlorofluoromethane	ND	U	200	280	ND	U	200	257	1.0
Isopropyl Alcohol	ND	U	200	560	ND	U	200	514	2.0
Acrylonitrile	ND	U	200	280	ND	U	200	257	1.0
1,1-Dichloroethylene	ND	U	200	280	ND	U	200	257	1.0
Methylene Chloride	ND	U	200	280	ND	U	200	257	1.0
Allyl Chloride (Chloroprene)	ND	U	200	280	ND	U	200	257	1.0
Carbon Disulfide	ND	U	200	280	ND	U	200	257	1.0
1,1,2-Trichloro-1,2,2-Trifluoroethane	ND	U	200	280	ND	U	200	257	1.0
t-1,2-Dichloroethylene	ND	U	200	280	ND	U	200	257	1.0
1,1-Dichloroethane	ND	U	200	280	ND	U	200	257	1.0
MTBE	ND	U	200	280	ND	U	200	257	1.0
Vinyl Acetate	ND	U	200	280	ND	U	200	257	1.0
2-Butanone (MEK)	ND	U	200	280	ND	U	200	257	1.0
cis-1,2- Dichloroethene	ND	U	200	280	ND	U	200	257	1.0
Hexane	881		200	280	787		200	257	1.0
Chloroform	ND	U	200	280	ND	U	200	257	1.0
Ethyl Acetate	ND	U	200	280	ND	U	200	257	1.0
Tetrahydrofuran	343		200	280	347		200	257	1.0
1,2-Dichloroethane	ND	U	200	280	ND	U	200	257	1.0
1,1,1-Trichloroethane	ND	U	200	280	ND	U	200	257	1.0

Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : AMTEST
PROJECT NO : 070784
MATRIX : AIR
UNITS : PPB (v/v)

DATE RECEIVED : 07/25/07
DATE REPORTED : 07/31/07

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID	R-1; #1 Perennial Gas Combustor Inlet			Sample Reporting Limit (RLxDF's)	R-2; #1 Perennial Gas Combustor Inlet			Sample Reporting Limit (RLxDF's)	Method Reporting Limit
AAC ID	070784-27273				070784-27274				
Date Sampled	7/19/2007				7/20/2007				
Date Analyzed	7/27/2007				7/27/2007				
Can Dilution Factor	1.40				1.29				
	Result	Qualifier	Dil. Fac.		Result	Qualifier	Dil. Fac.		
Benzene	434		200	280	418		200	257	1.0
Carbon Tetrachloride	ND	U	200	280	ND	U	200	257	1.0
Cyclohexane	506		200	280	438		200	257	1.0
1,2-Dichloropropane	ND	U	200	280	ND	U	200	257	1.0
Bromodichloromethane	ND	U	200	280	ND	U	200	257	1.0
1,4-Dioxane	ND	U	200	280	ND	U	200	257	1.0
Trichloroethene	ND	U	200	280	ND	U	200	257	1.0
2,2,4-Trimethylpentane	ND	U	200	280	ND	U	200	257	1.0
Heptane	1060		200	280	948		200	257	1.0
cis-1,3-Dichloropropene	ND	U	200	280	ND	U	200	257	1.0
4-Methyl-2-Pentanone (MiBK)	ND	U	200	280	ND	U	200	257	1.0
t-1,3-Dichloropropene	ND	U	200	280	ND	U	200	257	1.0
1,1,2-Trichloroethane	ND	U	200	280	ND	U	200	257	1.0
Toluene	1690		200	280	1700		200	257	1.0
2-Hexanone	ND	U	200	280	ND	U	200	257	1.0
Dibromochloromethane	ND	U	200	280	ND	U	200	257	1.0
1,2-Dibromoethane	ND	U	200	280	ND	U	200	257	1.0
Tetrachloroethylene	ND	U	200	280	ND	U	200	257	1.0
Chlorobenzene	ND	U	200	280	ND	U	200	257	1.0
Ethylbenzene	3900		200	280	4040		200	257	1.0
m- & p-Xylenes	3400		200	560	3510		200	514	2.0
Bromoform	ND	U	200	840	ND	U	200	771	3.0
Styrene	ND	U	200	280	ND	U	200	257	1.0
1,1,2,2-Tetrachloroethane	ND	U	200	280	ND	U	200	257	1.0
o-Xylene	867		200	280	872		200	257	1.0
4-Ethyltoluene	ND	U	200	280	ND	U	200	257	1.0
1,3,5-Trimethylbenzene	290		200	280	280		200	257	1.0
1,2,4-Trimethylbenzene	820		200	280	777		200	257	1.0
Benzyl Chloride	ND	U	200	1399	ND	U	200	1285	5.0
1,3-Dichlorobenzene	ND	U	200	280	ND	U	200	257	1.0
1,4-Dichlorobenzene	ND	U	200	280	ND	U	200	257	1.0
1,2-Dichlorobenzene	ND	U	200	280	ND	U	200	257	1.0
1,2,4-Trichlorobenzene	ND	U	200	280	ND	U	200	257	1.0
Hexachlorobutadiene	ND	U	200	280	ND	U	200	257	1.0
BFB-Surrogate Std. % Recovery	106%				106%				70-130%

J- Analyte was detected. However the analyte concentration is an estimated value, which is between the Method Detection Limit (MDL) and the Reporting Limit (RL).
E - Estimated value, result outside linear range of instrument.
U - Compound was analyzed for, but was not detected.
!! - Estimated

Sucha S. Parmar, PhD
Technical Director

Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : AMTEST
PROJECT NO : 070784
MATRIX : AIR
UNITS : ug/m3

DATE RECEIVED : 07/25/07
DATE REPORTED : 07/31/07

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID	R-1; #1 Perennial Gas Combustor Inlet			Sample Reporting Limit (RLxDF's)	R-2; #1 Perennial Gas Combustor Inlet			Sample Reporting Limit (RLxDF's)	Method Reporting Limit
AAC ID	070784-27273				070784-27274				
Date Sampled	7/19/2007				7/20/2007				
Date Analyzed	7/27/2007				7/27/2007				
Can Dilution Factor	1.40				1.29				
	Result	Qualifier	Dil. Fac.		Result	Qualifier	Dil. Fac.		
Chlorodifluoromethane	1870		200	990	2060		200	909	3.5
Propylene	4560		200	482	4950		200	442	1.7
Dichlorodifluoromethane	ND	U	200	1178	ND	U	200	1082	4.2
Chloromethane	ND	U	200	578	ND	U	200	531	2.1
1,2-Dichloro-1,1,2,2-Tetrafluoroethane	ND	U	200	1957	ND	U	200	1797	7.0
Vinyl Chloride	991		200	715	1180		200	657	2.6
Methanol	ND	U	200	1834	ND	U	200	1684	6.6
1,3-Butadiene	ND	U	200	619	ND	U	200	569	2.2
Bromomethane	ND	U	200	1087	ND	U	200	998	3.9
Chloroethane	ND	U	200	738	ND	U	200	678	2.6
Dichlorofluoromethane	ND	U	200	1178	ND	U	200	1082	4.2
Ethanol	ND	U	200	1055	ND	U	200	969	3.8
Vinyl Bromide	ND	U	200	1224	ND	U	200	1124	4.4
Acetone	1590		200	1330	ND	U	200	1221	4.8
Trichlorofluoromethane	ND	U	200	1460	ND	U	200	1340	5.2
Isopropyl Alcohol	ND	U	200	1376	ND	U	200	1264	4.9
Acrylonitrile	ND	U	200	607	ND	U	200	558	2.2
1,1-Dichloroethylene	ND	U	200	1099	ND	U	200	1009	3.9
Methylene Chloride	ND	U	200	973	ND	U	200	894	3.5
Allyl Chloride (Chloroprene)	ND	U	200	876	ND	U	200	805	3.1
Carbon Disulfide	ND	U	200	872	ND	U	200	800	3.1
1,1,2-Trichloro-1,2,2-Trifluoroethane	ND	U	200	2145	ND	U	200	1970	7.7
t-1,2-Dichloroethylene	ND	U	200	1110	ND	U	200	1019	4.0
1,1-Dichloroethane	ND	U	200	1122	ND	U	200	1030	4.0
MTBE	ND	U	200	1009	ND	U	200	927	3.6
Vinyl Acetate	ND	U	200	986	ND	U	200	905	3.5
2-Butanone (MEK)	ND	U	200	825	ND	U	200	758	2.9
cis-1,2- Dichloroethene	ND	U	200	1099	ND	U	200	1009	3.9
Hexane	3100		200	987	2770		200	906	3.5
Chloroform	ND	U	200	1368	ND	U	200	1256	4.9
Ethyl Acetate	ND	U	200	1009	ND	U	200	926	3.6
Tetrahydrofuran	1010		200	825	1020		200	758	2.9
1,2-Dichloroethane	ND	U	200	1122	ND	U	200	1030	4.0
1,1,1-Trichloroethane	ND	U	200	1528	ND	U	200	1403	5.5

Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : AMTEST
PROJECT NO : 070784
MATRIX : AIR
UNITS : ug/m3

DATE RECEIVED : 07/25/07
DATE REPORTED : 07/31/07

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID	R-1; #1 Perennial Gas Combustor Inlet			Sample Reporting Limit (RLxDF's)	R-2; #1 Perennial Gas Combustor Inlet			Sample Reporting Limit (RLxDF's)	Method Reporting Limit
AAC ID	070784-27273				070784-27274				
Date Sampled	7/19/2007				7/20/2007				
Date Analyzed	7/27/2007				7/27/2007				
Can Dilution Factor	1.40				1.29				
	Result	Qualifier	Dil. Fac.		Result	Qualifier	Dil. Fac.		
Benzene	1380		200	893	1330		200	820	3.2
Carbon Tetrachloride	ND	U	200	1763	ND	U	200	1619	6.3
Cyclohexane	1740		200	963	1510		200	885	3.4
1,2-Dichloropropane	ND	U	200	1294	ND	U	200	1188	4.6
Bromodichloromethane	ND	U	200	1875	ND	U	200	1722	6.7
1,4-Dioxane	ND	U	200	1009	ND	U	200	926	3.6
Trichloroethene	ND	U	200	1500	ND	U	200	1377	5.4
2,2,4-Trimethylpentane	ND	U	200	1308	ND	U	200	1201	4.7
Heptane	4340		200	1147	3890		200	1053	4.1
cis-1,3-Dichloropropene	ND	U	200	1248	ND	U	200	1146	4.5
4-Methyl-2-Pentanone (MiBK)	ND	U	200	1147	ND	U	200	1053	4.1
t-1,3-Dichloropropene	ND	U	200	1248	ND	U	200	1146	4.5
1,1,2-Trichloroethane	ND	U	200	1522	ND	U	200	1398	5.4
Toluene	6370		200	1053	6380		200	967	3.8
2-Hexanone	ND	U	200	1147	ND	U	200	1053	4.1
Dibromochloromethane	ND	U	200	2384	ND	U	200	2190	8.5
1,2-Dibromoethane	ND	U	200	2118	ND	U	200	1945	7.6
Tetrachloroethylene	ND	U	200	1900	ND	U	200	1745	6.8
Chlorobenzene	ND	U	200	1288	ND	U	200	1183	4.6
Ethylbenzene	16900		200	1213	17500		200	1114	4.3
m- & p-Xylenes	14700		200	2427	15200		200	2229	8.7
Bromoform	ND	U	200	8680	ND	U	200	7971	31.0
Styrene	ND	U	200	1192	ND	U	200	1095	4.3
1,1,2,2-Tetrachloroethane	ND	U	200	1923	ND	U	200	1766	6.9
o-Xylene	3760		200	1213	3780		200	1114	4.3
4-Ethyltoluene	ND	U	200	1376	ND	U	200	1264	4.9
1,3,5-Trimethylbenzene	1420		200	1374	1370		200	1262	4.9
1,2,4-Trimethylbenzene	4030		200	1374	3810		200	1262	4.9
Benzyl Chloride	ND	U	200	7245	ND	U	200	6654	25.9
1,3-Dichlorobenzene	ND	U	200	1683	ND	U	200	1545	6.0
1,4-Dichlorobenzene	ND	U	200	1683	ND	U	200	1545	6.0
1,2-Dichlorobenzene	ND	U	200	1683	ND	U	200	1545	6.0
1,2,4-Trichlorobenzene	ND	U	200	2077	ND	U	200	1908	7.4
Hexachlorobutadiene	ND	U	200	2985	ND	U	200	2741	10.7
BFB-Surrogate Std. % Recovery	106%				106%				70-130%

J- Analyte was detected. However the analyte concentration is an estimated value, which is between the Method Detection Limit (MDL) and the Reporting Limit (RL).
E - Estimated value, result outside linear range of instrument.
U - Compound was analyzed for, but was not detected.
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Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : AMTEST
PROJECT NO : 070784
MATRIX : AIR
UNITS : PPB (v/v)

DATE RECEIVED : 07/25/07
DATE REPORTED : 07/31/07

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID	R-3A; #1 Perennial Gas Combustor Inlet			Sample Reporting Limit (RLxDF's)	R-3B; #1 Perennial Gas Combustor Inlet			Sample Reporting Limit (RLxDF's)	Method Reporting Limit
AAC ID	070784-27275				070784-27276				
Date Sampled	7/20/2007				7/20/2007				
Date Analyzed	7/30/2007				7/30/2007				
Can Dilution Factor	1.34				1.27				
	Result	Qualifier	Dil. Fac.		Result	Qualifier	Dil. Fac.		
Chlorodifluoromethane	585		200	269	536		200	254	1.0
Propylene	2870		200	269	2640		200	254	1.0
Dichlorodifluoromethane	ND	U	200	269	ND	U	200	254	1.0
Chloromethane	ND	U	200	269	ND	U	200	254	1.0
1,2-Dichloro-1,1,2,2-Tetrafluoroethane	ND	U	200	269	ND	U	200	254	1.0
Vinyl Chloride	453		200	269	419		200	254	1.0
Methanol	ND	U	200	1343	ND	U	200	1269	5.0
1,3-Butadiene	ND	U	200	269	ND	U	200	254	1.0
Bromomethane	ND	U	200	269	ND	U	200	254	1.0
Chloroethane	ND	U	200	269	ND	U	200	254	1.0
Dichlorofluoromethane	ND	U	200	269	ND	U	200	254	1.0
Ethanol	ND	U	200	537	ND	U	200	508	2.0
Vinyl Bromide	ND	U	200	269	ND	U	200	254	1.0
Acetone	ND	U	200	537	ND	U	200	508	2.0
Trichlorofluoromethane	ND	U	200	269	ND	U	200	254	1.0
Isopropyl Alcohol	ND	U	200	537	ND	U	200	508	2.0
Acrylonitrile	ND	U	200	269	ND	U	200	254	1.0
1,1-Dichloroethylene	ND	U	200	269	ND	U	200	254	1.0
Methylene Chloride	ND	U	200	269	ND	U	200	254	1.0
Allyl Chloride (Chloroprene)	ND	U	200	269	ND	U	200	254	1.0
Carbon Disulfide	ND	U	200	269	ND	U	200	254	1.0
1,1,2-Trichloro-1,2,2-Trifluoroethane	ND	U	200	269	ND	U	200	254	1.0
t-1,2-Dichloroethylene	ND	U	200	269	ND	U	200	254	1.0
1,1-Dichloroethane	ND	U	200	269	ND	U	200	254	1.0
MTBE	ND	U	200	269	ND	U	200	254	1.0
Vinyl Acetate	ND	U	200	269	ND	U	200	254	1.0
2-Butanone (MEK)	ND	U	200	269	ND	U	200	254	1.0
cis-1,2- Dichloroethene	ND	U	200	269	ND	U	200	254	1.0
Hexane	764		200	269	709		200	254	1.0
Chloroform	ND	U	200	269	ND	U	200	254	1.0
Ethyl Acetate	ND	U	200	269	ND	U	200	254	1.0
Tetrahydrofuran	346		200	269	312		200	254	1.0
1,2-Dichloroethane	ND	U	200	269	ND	U	200	254	1.0
1,1,1-Trichloroethane	ND	U	200	269	ND	U	200	254	1.0

Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : AMTEST
PROJECT NO : 070784
MATRIX : AIR
UNITS : PPB (v/v)

DATE RECEIVED : 07/25/07
DATE REPORTED : 07/31/07

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID	R-3A; #1 Perennial Gas Combustor Inlet			Sample Reporting Limit (RLxDF's)	R-3B; #1 Perennial Gas Combustor Inlet			Sample Reporting Limit (RLxDF's)	Method Reporting Limit
AAC ID	070784-27275				070784-27276				
Date Sampled	7/20/2007				7/20/2007				
Date Analyzed	7/30/2007				7/30/2007				
Can Dilution Factor	1.34				1.27				
	Result	Qualifier	Dil. Fac.		Result	Qualifier	Dil. Fac.		
Benzene	427		200	269	384		200	254	1.0
Carbon Tetrachloride	ND	U	200	269	ND	U	200	254	1.0
Cyclohexane	438		200	269	385		200	254	1.0
1,2-Dichloropropane	ND	U	200	269	ND	U	200	254	1.0
Bromodichloromethane	ND	U	200	269	ND	U	200	254	1.0
1,4-Dioxane	ND	U	200	269	ND	U	200	254	1.0
Trichloroethene	ND	U	200	269	ND	U	200	254	1.0
2,2,4-Trimethylpentane	ND	U	200	269	ND	U	200	254	1.0
Heptane	950		200	269	840		200	254	1.0
cis-1,3-Dichloropropene	ND	U	200	269	ND	U	200	254	1.0
4-Methyl-2-Pentanone (MiBK)	ND	U	200	269	ND	U	200	254	1.0
t-1,3-Dichloropropene	ND	U	200	269	ND	U	200	254	1.0
1,1,2-Trichloroethane	ND	U	200	269	ND	U	200	254	1.0
Toluene	1720		200	269	1530		200	254	1.0
2-Hexanone	ND	U	200	269	ND	U	200	254	1.0
Dibromochloromethane	ND	U	200	269	ND	U	200	254	1.0
1,2-Dibromoethane	ND	U	200	269	ND	U	200	254	1.0
Tetrachloroethylene	ND	U	200	269	ND	U	200	254	1.0
Chlorobenzene	ND	U	200	269	ND	U	200	254	1.0
Ethylbenzene	4200		200	269	3600		200	254	1.0
m- & p-Xylenes	3630		200	537	3090		200	508	2.0
Bromoform	ND	U	200	806	ND	U	200	762	3.0
Styrene	ND	U	200	269	ND	U	200	254	1.0
1,1,2,2-Tetrachloroethane	ND	U	200	269	ND	U	200	254	1.0
o-Xylene	894		200	269	765		200	254	1.0
4-Ethyltoluene	ND	U	200	269	ND	U	200	254	1.0
1,3,5-Trimethylbenzene	302		200	269	ND	U	200	254	1.0
1,2,4-Trimethylbenzene	846		200	269	687		200	254	1.0
Benzyl Chloride	ND	U	200	1343	ND	U	200	1269	5.0
1,3-Dichlorobenzene	ND	U	200	269	ND	U	200	254	1.0
1,4-Dichlorobenzene	ND	U	200	269	ND	U	200	254	1.0
1,2-Dichlorobenzene	ND	U	200	269	ND	U	200	254	1.0
1,2,4-Trichlorobenzene	ND	U	200	269	ND	U	200	254	1.0
Hexachlorobutadiene	ND	U	200	269	ND	U	200	254	1.0
BFB-Surrogate Std. % Recovery	107%				106%				70-130%

J- Analyte was detected. However the analyte concentration is an estimated value, which is between the Method Detection Limit (MDL) and the Reporting Limit (RL).
E - Estimated value, result outside linear range of instrument.
U - Compound was analyzed for, but was not detected.
B - Estimated

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Laboratory Analysis Report

CLIENT : AMTEST
PROJECT NO : 070784
MATRIX : AIR
UNITS : ug/m3

DATE RECEIVED : 07/25/07
DATE REPORTED : 07/31/07

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID	R-3A; #1 Perennial Gas Combustor Inlet			Sample Reporting Limit (RLxDF's)	R-3B; #1 Perennial Gas Combustor Inlet			Sample Reporting Limit (RLxDF's)	Method Reporting Limit
AAC ID	070784-27275				070784-27276				
Date Sampled	7/20/2007				7/20/2007				
Date Analyzed	7/30/2007				7/30/2007				
Can Dilution Factor	1.34				1.27				
	Result	Qualifier	Dil. Fac.		Result	Qualifier	Dil. Fac.		
Chlorodifluoromethane	2070		200	950	1900		200	898	3.5
Propylene	4930		200	462	4540		200	437	1.7
Dichlorodifluoromethane	ND	U	200	1131	ND	U	200	1069	4.2
Chloromethane	ND	U	200	555	ND	U	200	524	2.1
1,2-Dichloro-1,1,2,2-Tetrafluoroethane	ND	U	200	1877	ND	U	200	1775	7.0
Vinyl Chloride	1160		200	687	1070		200	649	2.6
Methanol	ND	U	200	1760	ND	U	200	1663	6.6
1,3-Butadiene	ND	U	200	594	ND	U	200	562	2.2
Bromomethane	ND	U	200	1043	ND	U	200	986	3.9
Chloroethane	ND	U	200	709	ND	U	200	670	2.6
Dichlorofluoromethane	ND	U	200	1131	ND	U	200	1069	4.2
Ethanol	ND	U	200	1012	ND	U	200	957	3.8
Vinyl Bromide	ND	U	200	1175	ND	U	200	1111	4.4
Acetone	ND	U	200	1276	ND	U	200	1206	4.8
Trichlorofluoromethane	ND	U	200	1401	ND	U	200	1324	5.2
Isopropyl Alcohol	ND	U	200	1320	ND	U	200	1248	4.9
Acrylonitrile	ND	U	200	583	ND	U	200	551	2.2
1,1-Dichloroethylene	ND	U	200	1055	ND	U	200	997	3.9
Methylene Chloride	ND	U	200	934	ND	U	200	883	3.5
Allyl Chloride (Chloroprene)	ND	U	200	841	ND	U	200	795	3.1
Carbon Disulfide	ND	U	200	836	ND	U	200	791	3.1
1,1,2-Trichloro-1,2,2-Trifluoroethane	ND	U	200	2058	ND	U	200	1946	7.7
t-1,2-Dichloroethylene	ND	U	200	1065	ND	U	200	1007	4.0
1,1-Dichloroethane	ND	U	200	1077	ND	U	200	1018	4.0
MTBE	ND	U	200	968	ND	U	200	915	3.6
Vinyl Acetate	ND	U	200	946	ND	U	200	894	3.5
2-Butanone (MEK)	ND	U	200	792	ND	U	200	749	2.9
cis-1,2- Dichloroethene	ND	U	200	1055	ND	U	200	997	3.9
Hexane	2690		200	947	2500		200	895	3.5
Chloroform	ND	U	200	1313	ND	U	200	1241	4.9
Ethyl Acetate	ND	U	200	968	ND	U	200	915	3.6
Tetrahydrofuran	1020		200	792	920		200	749	2.9
1,2-Dichloroethane	ND	U	200	1077	ND	U	200	1018	4.0
1,1,1-Trichloroethane	ND	U	200	1466	ND	U	200	1386	5.5

Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : AMTEST
PROJECT NO : 070784
MATRIX : AIR
UNITS : ug/m3

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VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID	R-3A; #1 Perennial Gas Combustor Inlet			Sample Reporting Limit (RLxDF's)	R-3B; #1 Perennial Gas Combustor Inlet			Sample Reporting Limit (RLxDF's)	Method Reporting Limit
AAC ID	070784-27275				070784-27276				
Date Sampled	7/20/2007				7/20/2007				
Date Analyzed	7/30/2007				7/30/2007				
Can Dilution Factor	1.34				1.27				
	Result	Qualifier	Dil. Fac.		Result	Qualifier	Dil. Fac.		
Benzene	1360		200	857	1230		200	810	3.2
Carbon Tetrachloride	ND	U	200	1692	ND	U	200	1599	6.3
Cyclohexane	1510		200	924	1330		200	874	3.4
1,2-Dichloropropane	ND	U	200	1241	ND	U	200	1173	4.6
Bromodichloromethane	ND	U	200	1800	ND	U	200	1701	6.7
1,4-Dioxane	ND	U	200	968	ND	U	200	915	3.6
Trichloroethene	ND	U	200	1439	ND	U	200	1360	5.4
2,2,4-Trimethylpentane	ND	U	200	1255	ND	U	200	1186	4.7
Heptane	3890		200	1101	3440		200	1041	4.1
cis-1,3-Dichloropropene	ND	U	200	1197	ND	U	200	1132	4.5
4-Methyl-2-Pentanone (MiBK)	ND	U	200	1100	ND	U	200	1040	4.1
t-1,3-Dichloropropene	ND	U	200	1197	ND	U	200	1132	4.5
1,1,2-Trichloroethane	ND	U	200	1461	ND	U	200	1381	5.4
Toluene	6480		200	1011	5740		200	955	3.8
2-Hexanone	ND	U	200	1100	ND	U	200	1040	4.1
Dibromochloromethane	ND	U	200	2288	ND	U	200	2163	8.5
1,2-Dibromoethane	ND	U	200	2032	ND	U	200	1921	7.6
Tetrachloroethylene	ND	U	200	1823	ND	U	200	1724	6.8
Chlorobenzene	ND	U	200	1236	ND	U	200	1168	4.6
Ethylbenzene	18200		200	1164	15600		200	1101	4.3
m- & p-Xylenes	15700		200	2329	13400		200	2201	8.7
Bromoform	ND	U	200	8329	ND	U	200	7873	31.0
Styrene	ND	U	200	1144	ND	U	200	1081	4.3
1,1,2,2-Tetrachloroethane	ND	U	200	1845	ND	U	200	1744	6.9
o-Xylene	3870		200	1164	3320		200	1101	4.3
4-Ethyltoluene	ND	U	200	1320	ND	U	200	1248	4.9
1,3,5-Trimethylbenzene	1480		200	1318	ND	U	200	1246	4.9
1,2,4-Trimethylbenzene	4150		200	1318	3370		200	1246	4.9
Benzyl Chloride	ND	U	200	6953	ND	U	200	6572	25.9
1,3-Dichlorobenzene	ND	U	200	1615	ND	U	200	1526	6.0
1,4-Dichlorobenzene	ND	U	200	1615	ND	U	200	1526	6.0
1,2-Dichlorobenzene	ND	U	200	1615	ND	U	200	1526	6.0
1,2,4-Trichlorobenzene	ND	U	200	1993	ND	U	200	1884	7.4
Hexachlorobutadiene	ND	U	200	2864	ND	U	200	2708	10.7
BFB-Surrogate Std. % Recovery	107%				106%				70-130%

J - Analyte was detected. However the analyte concentration is an estimated value, which is between the Method Detection Limit (MDL) and the Reporting Limit (RL).
E - Estimated value, result outside linear range of instrument.
U - Compound was analyzed for, but was not detected.
II - Estimated

Sucha S. Parmar, PhD
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Atmospheric Analysis & Consulting, Inc.

ANALYSIS DATE : 07/27/07
ANALYST : JJG
INSTRUMENT ID : GC/MS-03
STD ID : PS052107-02

VOLATILE ORGANIC COMPOUNDS BY EPA METHOD TO-15
Continuing Calibration Verification of the 07/24/07 Calibration

Compounds	*Conc*	*Daily Conc*	*%REC*
4-BFB (surrogate standard)***	10	10.16	102
Chlorodifluoromethane*	10	10.20	102
Propylene*	10	9.86	99
DiClDIFMethane*	10	10.42	104
CHLOROMETHANE*	10	10.02	100
1,2 DiCl-1,1,2,2-TetraFEthane*	10	10.57	106
VINYL CHLORIDE*	10	10.06	101
Methanol*	10	9.48	95
1,3-Butadiene*	10	9.86	99
BROMOMETHANE*	10	10.30	103
CHLOROETHANE*	10	10.65	107
Dichlorofluoromethane*	10	11.08	111
Ethanol*	10	10.25	103
Vinyl Bromide*	10	10.70	107
Acetone*	10	9.97	100
TRICHLOROFLUOROMETHANE*	10	11.29	113
Isopropanol*	10	10.59	106
Acrylonitrile*	10	10.69	107
1,1 DICHLOROETHENE*	10	11.30	113
METHYLENE CHLORIDE*	10	11.22	112
Allyl CHLORIDE*	10	11.39	114
Carbon disulfide*	10	11.34	113
1,1,2-TRICHLORO-1,2,2-TRIFLUO	10	11.72	117
trans-1,2- DICHLOROETHYLENE*	10	10.51	105
1,1- DICHLOROETHANE*	10	10.50	105
MTBE*	10	10.76	108
Vinyl Acetate*	10	10.74	107
MEK*	10	10.29	103
cis-1,2- DICHLOROETHYLENE*	10	10.44	104
Hexane*	10	10.85	109
CHLOROFORM*	10	10.73	107
Ethyl Acetate*	10	10.48	105
Tetrahydrofuran*	10	10.24	102
1,2-DICHLOROETHANE*	10	10.38	104
1,1,1-TRICHLOROETHANE*	10	10.58	106

Atmospheric Analysis & Consulting, Inc.

ANALYSIS DATE : 07/27/07 INSTRUMENT ID : GC/MS-03
ANALYST : JJG STD ID : PS052107-02

VOLATILE ORGANIC COMPOUNDS BY EPA METHOD TO-15

Continuing Calibration Verification of the 07/24/07 Calibration

Compounds	*Conc*	*Daily Conc*	*%REC*
BENZENE**	10	11.31	113
CARBON TETRACHLORIDE**	10	11.37	114
Cyclohexane**	10	11.43	114
1,2-DICHLOROPROPANE**	10	11.27	113
Bromodichloromethane**	10	11.03	110
1,4-Dioxane**	10	10.29	103
TRICHLOROETHENE**	10	10.62	106
2,2,4-Trimethylpentane**	10	10.60	106
Heptane**	10	11.40	114
cis- 1,3 DICHLOROPROPENE**	10	12.00	120
MiBK**	10	11.84	118
trans 1,3 DICHLOROPROPENE**	10	11.58	116
1,1,2-TRICHLOROETHANE**	10	11.50	115
TOLUENE**	10	11.44	114
2-Hexanone**	10	11.32	113
Dibromochloromethane**	10	11.74	117
1,2 DIBROMOETHANE**	10	11.54	115
TETRACHLOROETHYLENE**	10	11.13	111
CHLOROBENZENE***	10	11.38	114
ETHYLBENZENE***	10	11.63	116
m-, & p- XYLENES***	20	20.80	104
Bromoform***	10	10.57	106
STYRENE***	10	11.36	114
1,1, 2,2- TETRACHLORETHANE**	10	10.56	106
o- XYLENE***	10	10.44	104
Ethyltoluene***	10	11.80	118
1,3,5- TRIMETHYLBENZENE***	10	11.85	119
1,2,4- TRIMETHYLBENZENE***	10	11.77	118
Benzyl Chloride***	10	10.20	102
1,3- DICHLOROBENZENE***	10	11.29	113
1,4- DICHLOROBENZENE***	10	11.31	113
1,2-DICHLOROBENZENE***	10	11.22	112
1,2,4-TRICHLOROBENZENE***	10	9.87	99
HEXACHLOROBUTADIENE***	10	10.64	106

* Internal std calculation IS1 : Bromochloromethane

** Internal std calculation IS2 : 1,4-Difluorobenzene

*** Internal std calculation IS3 : Chlorobenzene-d5

%REC should be 70-130%

!! Compound failed criteria and results should be considered estimated.

Sucha S. Parmar, PhD
Technical Director

Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

CLIENT ID	: Laboratory Control Spike	**DATE ANALYZED**	: 07/27/07
AAC ID	: LCS/LCSD	**DATE REPORTED**	: 07/27/07
MEDIA	: Air	**UNITS**	: ppbv

TO-15 Laboratory Control Spike Recovery

Compound	Sample Conc.	Spike Added	Spike Res	Dup Spike Res	Spike % Rec *	Spike Dup % Rec *	RPD** %
1,1-DICHLOROETHYLENE	0.0	10.00	11.30	11.43	113	114	1.1
METHYLENE CHLORIDE	0.0	10.00	11.22	11.36	112	114	1.2
BENZENE	0.0	10.00	11.31	11.48	113	115	1.5
TRICHLOROETHENE	0.0	10.00	10.62	10.74	106	107	1.1
TOLUENE	0.0	10.00	11.44	11.57	114	116	1.1
TETRACHLOROETHYLENE	0.0	10.00	11.13	11.19	111	112	0.5
CHLOROBENZENE	0.0	10.00	11.38	11.48	114	115	0.9
ETHYLBENZENE	0.0	10.00	11.63	11.81	116	118	1.5
m-, & p- XYLENES	0.0	20.00	20.80	21.04	104	105	1.1
o- XYLENE	0.0	10.00	10.44	10.54	104	105	1.0

* Must be 70-130%

** Must be < 25%

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Atmospheric Analysis & Consulting, Inc.

Method Blank Analysis Report

MATRIX	: AIR	ANALYSIS DATE	: 07/27/07
UNITS	: ppbv	REPORT DATE	: 07/27/07

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID / *AAC ID*	Method Blank MB 072707	RL
Chlorodifluoromethane*	<RL	1.0
Propylene*	<RL	1.0
DiClDIFMethane*	<RL	1.0
CHLOROMETHANE*	<RL	1.0
1,2 DiCl-1,1,2,2-TetraFEthane*	<RL	1.0
VINYL CHLORIDE*	<RL	1.0
Methanol*	<RL	5.0
1,3-Butadiene*	<RL	1.0
BROMOMETHANE*	<RL	1.0
CHLOROETHANE*	<RL	1.0
Dichlorofluoromethane	<RL	1.0
Ethanol*	<RL	2.0
Vinyl Bromide*	<RL	1.0
Acetone*	<RL	2.0
TRICHLOROFLUOROMETHANE*	<RL	1.0
Isopropyl Alcohol*	<RL	2.0
Acrylonitrile*	<RL	1.0
1,1 DICHLOROETHENE*	<RL	1.0
METHYLENE CHLORIDE*	<RL	1.0
Allyl CHLORIDE*	<RL	1.0
Carbon disulfide*	<RL	1.0
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE*	<RL	1.0
trans-1,2- DICHLOROETHYLENE*	<RL	1.0
1,1- DICHLOROETHANE*	<RL	1.0
MTBE*	<RL	1.0
Vinyl Acetate*	<RL	1.0
MEK*	<RL	1.0
cis-1,2- DICHLOROETHYLENE*	<RL	1.0
Hexane*	<RL	1.0
CHLOROFORM*	<RL	1.0
Ethyl Acetate*	<RL	1.0
Tetrahydrofuran*	<RL	1.0
1,2-DICHLOROETHANE*	<RL	1.0
1,1,1-TRICHLOROETHANE*	<RL	1.0
BENZENE**	<RL	1.0
CARBON TETRACHLORIDE**	<RL	1.0
Cyclohexane**	<RL	1.0
1,2-DICHLOROPROPANE**	<RL	1.0
Bromodichloromethane**	<RL	1.0
1,4-Dioxane**	<RL	1.0
TRICHLOROETHENE**	<RL	1.0
2,2,4-Trimethylpentane**	<RL	1.0
Heptane**	<RL	1.0

Atmospheric Analysis & Consulting, Inc.

Method Blank Analysis Report

MATRIX	: AIR	ANALYSIS DATE	: 07/27/07
UNITS	: ppbv	REPORT DATE	: 07/27/07

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID / *AAC ID*	Method Blank MB 072707	RL
cis- 1,3 DICHLOROPROPENE**	<RL	1.0
MiBK**	<RL	1.0
trans 1,3 DICHLOROPROPENE**	<RL	1.0
1,1,2-TRICHLOROETHANE**	<RL	1.0
TOLUENE**	<RL	1.0
2-Hexanone**	<RL	1.0
Dibromochloromethane**	<RL	1.0
1,2 DIBROMOETHANE**	<RL	1.0
TETRACHLOROETHYLENE**	<RL	1.0
CHLOROBENZENE***	<RL	1.0
ETHYLBENZENE***	<RL	1.0
m-, & p- XYLENES***	<RL	2.0
Bromoform***	<RL	3.0
STYRENE***	<RL	1.0
1,1, 2,2- TETRACHLORETHANE***	<RL	1.0
o- XYLENE***	<RL	1.0
Ethyltoluene***	<RL	1.0
1,3,5- TRIMETHYLBENZENE***	<RL	1.0
1,2,4- TRIMETHYLBENZENE***	<RL	1.0
Benzyl Chloride***	<RL	5.0
1,3- DICHLOROBENZENE***	<RL	1.0
1,4- DICHLOROBENZENE***	<RL	1.0
1,2-DICHLOROBENZENE***	<RL	1.0
1,2,4 TRICHLOROBENZENE***	<RL	1.0
HEXACHLOROBUTADIENE***	<RL	1.0
System Monitoring Compounds		
BFB-Surrogate Std. % Recovery	100%	--

RL - Reporting Limit

Sucha S. Parmar, PhD
Technical Director

Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

AAC ID	: 070792-27321	DATE ANALYZED	: 07/27/07
MATRIX	: Air	DATE REPORTED	: 07/27/07
		UNITS	: ppbv

TO-15 Duplicate Analysis

Compound	Sample Conc	Duplicate Conc	% RPD
Chlorodifluoromethane*	<RL	<RL	0.0
Propylene*	<RL	<RL	0.0
DiCIDIFMethane*	<RL	<RL	0.0
CHLOROMETHANE*	<RL	<RL	0.0
1,2 DiCl-1,1,2,2-TetraFEthane*	<RL	<RL	0.0
VINYL CHLORIDE*	<RL	<RL	0.0
Methanol*	<RL	<RL	0.0
1,3-Butadiene*	<RL	<RL	0.0
BROMOMETHANE*	<RL	<RL	0.0
CHLOROETHANE*	<RL	<RL	0.0
Dichlorofluoromethane	<RL	<RL	0.0
Ethanol*	<RL	<RL	0.0
Vinyl Bromide*	<RL	<RL	0.0
Acetone*	596	597	0.2
TRICHLOROFLUOROMETHANE*	<RL	<RL	0.0
Isopropyl Alcohol*	<RL	<RL	0.0
Acrylonitrile*	<RL	<RL	0.0
1,1 DICHLOROETHENE*	<RL	<RL	0.0
METHYLENE CHLORIDE*	<RL	<RL	0.0
Allyl CHLORIDE*	<RL	<RL	0.0
Carbon disulfide*	<RL	<RL	0.0
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE*	<RL	<RL	0.0
trans-1,2- DICHLOROETHYLENE*	<RL	<RL	0.0
1,1- DICHLOROETHANE*	<RL	<RL	0.0
MTBE*	<RL	<RL	0.0
Vinyl Acetate*	<RL	<RL	0.0
MEK*	5170	5160	0.2
cis-1,2- DICHLOROETHYLENE*	<RL	<RL	0.0
Hexane*	<RL	<RL	0.0
CHLOROFORM*	<RL	<RL	0.0
Ethyl Acetate*	<RL	<RL	0.0
Tetrahydrofuran*	<RL	<RL	0.0
1,2-DICHLOROETHANE*	<RL	<RL	0.0
1,1,1-TRICHLOROETHANE*	<RL	<RL	0.0
BENZENE**	<RL	<RL	0.0
CARBON TETRACHLORIDE**	<RL	<RL	0.0

Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

AAC ID	: 070792-27321	DATE ANALYZED	: 07/27/07
MATRIX	: Air	DATE REPORTED	: 07/27/07
		UNITS	: ppbv

TO-15 Duplicate Analysis

Compound	Sample Conc	Duplicate Conc	% RPD
Cyclohexane**	<RL	<RL	0.0
1,2-DICHLOROPROPANE**	<RL	<RL	0.0
Bromodichloromethane**	<RL	<RL	0.0
1,4-Dioxane**	<RL	<RL	0.0
TRICHLOROETHENE**	<RL	<RL	0.0
2,2,4-Trimethylpentane**	<RL	<RL	0.0
Heptane**	<RL	<RL	0.0
cis- 1,3 DICHLOROPROPENE**	<RL	<RL	0.0
MiBK**	2530	2560	1.2
trans 1,3 DICHLOROPROPENE**	<RL	<RL	0.0
1,1,2-TRICHLOROETHANE**	<RL	<RL	0.0
TOLUENE**	2720	2720	0.0
2-Hexanone**	<RL	<RL	0.0
Dibromochloromethane**	<RL	<RL	0.0
1,2 DIBROMOETHANE**	<RL	<RL	0.0
TETRACHLOROETHYLENE**	<RL	<RL	0.0
CHLOROBENZENE***	<RL	<RL	0.0
ETHYLBENZENE***	<RL	<RL	0.0
m-, & p- XYLENES***	<RL	<RL	0.0
Bromoform***	<RL	<RL	0.0
STYRENE***	<RL	<RL	0.0
1,1,2,2-TETRACHLORETHANE***	<RL	<RL	0.0
o- XYLENE***	<RL	<RL	0.0
Ethyltoluene***	<RL	<RL	0.0
1,3,5- TRIMETHYLBENZENE***	<RL	<RL	0.0
1,2,4- TRIMETHYLBENZENE***	<RL	<RL	0.0
Benzyl Chloride***	<RL	<RL	0.0
1,3- DICHLOROBENZENE***	<RL	<RL	0.0
1,4- DICHLOROBENZENE***	<RL	<RL	0.0
1,2-DICHLOROBENZENE***	<RL	<RL	0.0
1,2,4 TRICHLOROBENZENE***	<RL	<RL	0.0
Hexachlorobutadiene***	<RL	<RL	0.0
System Monitoring Compounds			
BFB-Surrogate Std. % Recovery	101%	100%	0.7

RL - Reporting Limit

Sucha S. Parmar, PhD
Technical Director

Atmospheric Analysis & Consulting, Inc.

ANALYSIS DATE : 07/30/07
ANALYST : JJG
INSTRUMENT ID : GC/MS-03
STD ID : PS052107-02

VOLATILE ORGANIC COMPOUNDS BY EPA METHOD TO-15
Continuing Calibration Verification of the 07/24/07 Calibration

Compounds	*Conc*	*Daily Conc*	*%REC*
4-BFB (surrogate standard)***	10	10.09	101
Chlorodifluoromethane*	10	10.67	107
Propylene*	10	9.54	95
DiClDIFMethane*	10	10.83	108
CHLOROMETHANE*	10	10.56	106
1,2 DiCl-1,1,2,2-TetraFEthane*	10	11.24	112
VINYL CHLORIDE*	10	10.51	105
Methanol*	10	9.54	95
1,3-Butadiene*	10	10.36	104
BROMOMETHANE*	10	10.94	109
CHLOROETHANE*	10	10.94	109
Dichlorofluoromethane*	10	11.68	117
Ethanol*	10	10.79	108
Vinyl Bromide*	10	11.19	112
Acetone*	10	10.37	104
TRICHLOROFLUOROMETHANE*	10	12.08	121
Isopropanol*	10	11.09	111
Acrylonitrile*	10	11.13	111
1,1 DICHLOROETHENE*	10	12.06	121
METHYLENE CHLORIDE*	10	11.86	119
Allyl CHLORIDE*	10	12.04	120
Carbon disulfide*	10	12.19	122
1,1,2-TRICHLORO-1,2,2-TRIFLUO	10	12.74	127
trans-1,2- DICHLOROETHYLENE*	10	10.64	106
1,1- DICHLOROETHANE*	10	10.51	105
MTBE*	10	10.83	108
Vinyl Acetate*	10	10.80	108
MEK*	10	10.38	104
cis-1,2- DICHLOROETHYLENE*	10	10.53	105
Hexane*	10	10.93	109
CHLOROFORM*	10	10.85	109
Ethyl Acetate*	10	10.95	110
Tetrahydrofuran*	10	10.39	104
1,2-DICHLOROETHANE*	10	10.61	106
1,1,1-TRICHLOROETHANE*	10	10.81	108

Atmospheric Analysis & Consulting, Inc.

ANALYSIS DATE : 07/30/07
ANALYST : JJG
INSTRUMENT ID : GC/MS-03
STD ID : PS052107-02

VOLATILE ORGANIC COMPOUNDS BY EPA METHOD TO-15

Continuing Calibration Verification of the 07/24/07 Calibration

Compounds	*Conc*	*Daily Conc*	*%REC*
BENZENE**	10	11.25	113
CARBON TETRACHLORIDE**	10	11.48	115
Cyclohexane**	10	11.48	115
1,2-DICHLOROPROPANE**	10	11.15	112
Bromodichloromethane**	10	11.70	117
1,4-Dioxane**	10	10.49	105
TRICHLOROETHENE**	10	11.33	113
2,2,4-Trimethylpentane**	10	11.03	110
Heptane**	10	11.46	115
cis- 1,3 DICHLOROPROPENE**	10	12.12	121
MiBK**	10	11.79	118
trans 1,3 DICHLOROPROPENE**	10	11.54	115
1,1,2-TRICHLOROETHANE**	10	11.55	116
TOLUENE**	10	11.45	115
2-Hexanone**	10	11.26	113
Dibromochloromethane**	10	11.93	119
1,2 DIBROMOETHANE**	10	11.60	116
TETRACHLOROETHYLENE**	10	11.34	113
CHLOROBENZENE***	10	11.65	117
ETHYLBENZENE***	10	11.83	118
m-, & p- XYLENES***	20	21.45	107
Bromoform***	10	10.89	109
STYRENE***	10	11.58	116
1,1, 2,2- TETRACHLORETHANE**	10	11.02	110
o- XYLENE***	10	10.84	108
Ethyltoluene***	10	12.13	121
1,3,5- TRIMETHYLBENZENE***	10	12.18	122
1,2,4- TRIMETHYLBENZENE***	10	12.14	121
Benzyl Chloride***	10	10.12	101
1,3- DICHLOROBENZENE***	10	11.69	117
1,4- DICHLOROBENZENE***	10	11.66	117
1,2-DICHLOROBENZENE***	10	11.54	115
1,2,4-TRICHLOROBENZENE***	10	9.98	100
HEXACHLOROBUTADIENE***	10	10.80	108

* Internal std calculation IS1 : Bromochloromethane

** Internal std calculation IS2 : 1,4-Difluorobenzene

*** Internal std calculation IS3 : Chlorobenzene-d5

%REC should be 70-130%

!! Compound failed criteria and results should be considered estimated.

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

CLIENT ID	: Laboratory Control Spike	**DATE ANALYZED**	: 07/30/07
AAC ID	: LCS/LCSD	**DATE REPORTED**	: 07/30/07
MEDIA	: Air	**UNITS**	: ppbv

TO-15 Laboratory Control Spike Recovery

Compound	Sample Conc.	Spike Added	Spike Res	Dup Spike Res	Spike % Rec *	Spike Dup % Rec *	RPD** %
1,1-DICHLOROETHYLENE	0.0	10.00	12.06	12.21	121	122	1.2
METHYLENE CHLORIDE	0.0	10.00	11.86	12.09	119	121	1.9
BENZENE	0.0	10.00	11.25	11.42	112	114	1.5
TRICHLOROETHENE	0.0	10.00	11.33	11.56	113	116	2.0
TOLUENE	0.0	10.00	11.45	11.64	114	116	1.6
TETRACHLOROETHYLENE	0.0	10.00	11.34	11.49	113	115	1.3
CHLOROBENZENE	0.0	10.00	11.65	11.82	116	118	1.4
ETHYLBENZENE	0.0	10.00	11.83	12.04	118	120	1.8
m-, & p- XYLENES	0.0	20.00	21.45	21.80	107	109	1.6
o- XYLENE	0.0	10.00	10.84	11.03	108	110	1.7

* Must be 70-130%

** Must be < 25%

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Atmospheric Analysis & Consulting, Inc.

Method Blank Analysis Report

MATRIX	: AIR	ANALYSIS DATE	: 07/30/07
UNITS	: ppbv	REPORT DATE	: 07/30/07

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID / *AAC ID*	Method Blank MB 073007	RL
Chlorodifluoromethane*	<RL	1.0
Propylene*	<RL	1.0
DiClDIFMethane*	<RL	1.0
CHLOROMETHANE*	<RL	1.0
1,2 DiCl-1,1,2,2-TetraFEthane*	<RL	1.0
VINYL CHLORIDE*	<RL	1.0
Methanol*	<RL	5.0
1,3-Butadiene*	<RL	1.0
BROMOMETHANE*	<RL	1.0
CHLOROETHANE*	<RL	1.0
Dichlorofluoromethane	<RL	1.0
Ethanol*	<RL	2.0
Vinyl Bromide*	<RL	1.0
Acetone*	<RL	2.0
TRICHLOROFLUOROMETHANE*	<RL	1.0
Isopropyl Alcohol*	<RL	2.0
Acrylonitrile*	<RL	1.0
1,1 DICHLOROETHENE*	<RL	1.0
METHYLENE CHLORIDE*	<RL	1.0
Allyl CHLORIDE*	<RL	1.0
Carbon disulfide*	<RL	1.0
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE*	<RL	1.0
trans-1,2- DICHLOROETHYLENE*	<RL	1.0
1,1- DICHLOROETHANE*	<RL	1.0
MTBE*	<RL	1.0
Vinyl Acetate*	<RL	1.0
MEK*	<RL	1.0
cis-1,2- DICHLOROETHYLENE*	<RL	1.0
Hexane*	<RL	1.0
CHLOROFORM*	<RL	1.0
Ethyl Acetate*	<RL	1.0
Tetrahydrofuran*	<RL	1.0
1,2-DICHLOROETHANE*	<RL	1.0
1,1,1-TRICHLOROETHANE*	<RL	1.0
BENZENE**	<RL	1.0
CARBON TETRACHLORIDE**	<RL	1.0
Cyclohexane**	<RL	1.0
1,2-DICHLOROPROPANE**	<RL	1.0
Bromodichloromethane**	<RL	1.0
1,4-Dioxane**	<RL	1.0
TRICHLOROETHENE**	<RL	1.0
2,2,4-Trimethylpentane**	<RL	1.0
Heptane**	<RL	1.0

Atmospheric Analysis & Consulting, Inc.

Method Blank Analysis Report

MATRIX	: AIR	ANALYSIS DATE	: 07/30/07
UNITS	: ppbv	REPORT DATE	: 07/30/07

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID / *AAC ID*	Method Blank MB 073007	RL
cis- 1,3 DICHLOROPROPENE**	<RL	1.0
MiBK**	<RL	1.0
trans 1,3 DICHLOROPROPENE**	<RL	1.0
1,1,2-TRICHLOROETHANE**	<RL	1.0
TOLUENE**	<RL	1.0
2-Hexanone**	<RL	1.0
Dibromochloromethane**	<RL	1.0
1,2 DIBROMOETHANE**	<RL	1.0
TETRACHLOROETHYLENE**	<RL	1.0
CHLOROBENZENE***	<RL	1.0
ETHYLBENZENE***	<RL	1.0
m-, & p- XYLENES***	<RL	2.0
Bromoform***	<RL	3.0
STYRENE***	<RL	1.0
1,1, 2,2- TETRACHLORETHANE***	<RL	1.0
o- XYLENE***	<RL	1.0
Ethyltoluene***	<RL	1.0
1,3,5- TRIMETHYLBENZENE***	<RL	1.0
1,2,4- TRIMETHYLBENZENE***	<RL	1.0
Benzyl Chloride***	<RL	5.0
1,3- DICHLOROBENZENE***	<RL	1.0
1,4- DICHLOROBENZENE***	<RL	1.0
1,2-DICHLOROBENZENE***	<RL	1.0
1,2,4 TRICHLOROBENZENE***	<RL	1.0
HEXACHLOROBUTADIENE***	<RL	1.0
System Monitoring Compounds		
BFB-Surrogate Std. % Recovery	100%	--

RL - Reporting Limit

Sucha S. Parmar, PhD
Technical Director

Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

AAC ID	: 070803-27376	DATE ANALYZED	: 07/30/07
MATRIX	: Air	DATE REPORTED	: 07/30/07
		UNITS	: ppbv

TO-15 Duplicate Analysis

Compound	Sample Conc	Duplicate Conc	% RPD
Chlorodifluoromethane*	1.8	1.8	0.0
Propylene*	<RL	<RL	0.0
DiClDiFMethane*	3.1	3.2	1.6
CHLOROMETHANE*	<RL	<RL	0.0
1,2 DiCl-1,1,2,2-TetraFEthane*	<RL	<RL	0.0
VINYL CHLORIDE*	<RL	<RL	0.0
Methanol*	<RL	<RL	0.0
1,3-Butadiene*	<RL	<RL	0.0
BROMOMETHANE*	<RL	<RL	0.0
CHLOROETHANE*	<RL	<RL	0.0
Dichlorofluoromethane	<RL	<RL	0.0
Ethanol*	<RL	<RL	0.0
Vinyl Bromide*	<RL	<RL	0.0
Acetone*	<RL	<RL	0.0
TRICHLOROFLUOROMETHANE*	<RL	<RL	0.0
Isopropyl Alcohol*	<RL	<RL	0.0
Acrylonitrile*	<RL	<RL	0.0
1,1 DICHLOROETHENE*	15.0	15.1	0.7
METHYLENE CHLORIDE*	<RL	<RL	0.0
Allyl CHLORIDE*	<RL	<RL	0.0
Carbon disulfide*	<RL	<RL	0.0
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE*	<RL	<RL	0.0
trans-1,2- DICHLOROETHYLENE*	<RL	<RL	0.0
1,1- DICHLOROETHANE*	<RL	<RL	0.0
MTBE*	<RL	<RL	0.0
Vinyl Acetate*	<RL	<RL	0.0
MEK*	<RL	<RL	0.0
cis-1,2- DICHLOROETHYLENE*	5.6	5.6	0.9
Hexane*	<RL	<RL	0.0
CHLOROFORM*	2.6	2.6	0.0
Ethyl Acetate*	<RL	<RL	0.0
Tetrahydrofuran*	<RL	<RL	0.0
1,2-DICHLOROETHANE*	<RL	<RL	0.0
1,1,1-TRICHLOROETHANE*	<RL	<RL	0.0
BENZENE**	<RL	<RL	0.0
CARBON TETRACHLORIDE**	<RL	<RL	0.0

Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

AAC ID	: 070803-27376	DATE ANALYZED	: 07/30/07
MATRIX	: Air	DATE REPORTED	: 07/30/07
		UNITS	: ppbv

TO-15 Duplicate Analysis

Compound	Sample Conc	Duplicate Conc	% RPD
Cyclohexane**	<RL	<RL	0.0
1,2-DICHLOROPROPANE**	<RL	<RL	0.0
Bromodichloromethane**	<RL	<RL	0.0
1,4-Dioxane**	<RL	<RL	0.0
TRICHLOROETHENE**	<RL	<RL	0.0
2,2,4-Trimethylpentane**	<RL	<RL	0.0
Heptane**	<RL	<RL	0.0
cis- 1,3 DICHLOROPROPENE**	<RL	<RL	0.0
MiBK**	<RL	<RL	0.0
trans 1,3 DICHLOROPROPENE**	<RL	<RL	0.0
1,1,2-TRICHLOROETHANE**	<RL	<RL	0.0
TOLUENE**	<RL	<RL	0.0
2-Hexanone**	<RL	<RL	0.0
Dibromochloromethane**	<RL	<RL	0.0
1,2 DIBROMOETHANE**	<RL	<RL	0.0
TETRACHLOROETHYLENE**	<RL	<RL	0.0
CHLOROBENZENE***	<RL	<RL	0.0
ETHYLBENZENE***	<RL	<RL	0.0
m-, & p- XYLENES***	<RL	<RL	0.0
Bromoform***	<RL	<RL	0.0
STYRENE***	<RL	<RL	0.0
1,1,2,2-TETRACHLORETHANE***	<RL	<RL	0.0
o- XYLENE***	<RL	<RL	0.0
Ethyltoluene***	<RL	<RL	0.0
1,3,5- TRIMETHYLBENZENE***	<RL	<RL	0.0
1,2,4- TRIMETHYLBENZENE***	<RL	<RL	0.0
Benzyl Chloride***	<RL	<RL	0.0
1,3- DICHLOROBENZENE***	<RL	<RL	0.0
1,4- DICHLOROBENZENE***	<RL	<RL	0.0
1,2-DICHLOROBENZENE***	<RL	<RL	0.0
1,2,4 TRICHLOROBENZENE***	<RL	<RL	0.0
Hexachlorobutadiene***	<RL	<RL	0.0
System Monitoring Compounds			
BFB-Surrogate Std. % Recovery	100%	100%	0.2

RL - Reporting Limit

Sucha S. Parmar, PhD
Technical Director

AMTEST AIR QUALITY, LLC

Analysis Lab: AAC

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME
8752-001	Parametrix @ City of Tacoma Landfill - Perennial Stack

SAMPLERS: (*Signature*)

KEF, RDR, KJR, TWG

LAB #	DATE	TIME	COMP.	GRAB	LOCATION/DESCRIPTION	NUMBER OF CONTAINERS	% Fixed Gases by M3C (GC-TCD) (CO_2, O_2, CH_4, N_2, CO)	Total NMOC by Method 25C (GC-FID)	Speciated VOCs by Method TO-14A (GC-MS)			
4507	7/19/07	1510-1610		X	R-1; #1 Perennial Gas Combustor Inlet	1	X	X	X			Please provide NMOC results in ppmv as CH_4.
4508	7/20/07	0831-1031		X	R-2; #1 Perennial Gas Combustor Inlet	1	X	X	X			Please provide speciated VOCs in $\mu g/m^3$.
4509	7/20/07	1138-1338		X	R-3A; #1 Perennial Gas Combustor Inlet	1	X	X	X			
4510	7/20/07	1138-1338		X	R-3B; #1 Perennial Gas Combustor Inlet	1	X	X	X			

Client Name
AM TEST-AIR QUALITY, A Division of Hoefler Group
Client Address
30545 SE 84th St., #5 / PO Box 525 / Preston, WA 98050
Client Phone/Fax
425-222-7746 / 425-222-7849 (fax)
Contact Person
Matt Caron
P.O. Number
8752-001

Relinquished by: (*Signature*)	Date/Time	Received by: (*Signature*)	Relinquished by: (*Signature*)	Date/Time	Received by: (*Signature*)
	7-24-07 1030	Thien Tran 7/25/07			
Relinquished by: (*Signature*)	Date/Time	Received for Laboratory by:	Date/Time	Remarks	

PROJECT NARRATIVE
H7G260160

The results reported herein are applicable to the samples submitted for analysis only.

This report shall not be reproduced except in full, without the written approval of the laboratory.

The original chain of custody documentation is included with this report.

Sample Receipt

Custody seals were not present.

Quality Control and Data Interpretation

Unless otherwise noted, all holding times and QC criteria were met and the test results shown in this report meet all applicable NELAC requirements.

VOST tubes samples were analyzed for the volatile organic target analytes by purge and trap GCMS using STL Knoxville standard operating procedures KNOX-MS-0011 and KNOX-MS-0015, based on the following methods:

- SW-846 5041A, "Analysis for Desorption of Sorbent Cartridges from Volatile Organic Sampling Train (VOST)"
- SW-846 8260B, "Volatile Organic Compounds by Gas Chromatography/ Mass Spectrometry (GC/MS)"

Samples were received as SW-846 method 0031 trains. Each Tenax tube pair and each Tenax/Anasorb tube is separately prepared by spiking a known amount of surrogate onto the media using a flash vaporization device. Volatile compounds are introduced into the gas chromatograph by thermal desorption of the analytes from the VOST tube using a clamshell oven and a purge and trap device. The components are separated using the chromatograph and detected using a mass spectrometer, which provides both qualitative and quantitative information.

Sample results were calculated using the following equations:

TestAmerica Knoxville (formerly STL Knoxville) maintains the following certifications, approvals and accreditations: Arkansas DEQ Cert. #05-043-0, California DHS ELAP Cert. #2423, Colorado DPHE, Connecticut DPH Cert. #PH-0223, Florida DOH Cert. #E87177, Georgia DNR Cert. #906, Hawaii DOH, Illinois EPA Cert. #000687, Indiana DOH Cert. #C-TN-02, Iowa DNR Cert. #375, Kansas DHE Cert. #E-10349, Kentucky DEP Lab ID #90101, Louisiana DEQ Cert. #03079, Louisiana DOHH Cert. #LA030024, Maryland DHMH Cert. #277, Massachusetts DEP Cert. #M-TN009, Michigan DEQ Lab ID #9933, New Jersey DEP Cert. #TN001, New York DOH Lab #10781, North Carolina DPH Lab ID #21705, North Carolina DEHNR Cert. #64, Ohio EPA VAP Cert. #CL0059, Oklahoma DEQ ID #9415, Pennsylvania DEP Cert. #68-00576, South Carolina DHEC Lab ID #84001001, Tennessee DOH Lab ID #02014, Utah DOH Cert. # QUAN3, Virginia DGS Lab ID #00165, Washington DOE Lab #C120, West Virginia DEP Cert. #345, Wisconsin DNR Lab ID #998044300, Naval Facilities Engineering Service Center and USDA Soil Permit #S-46424. This list of approvals is subject to change and does not imply that laboratory certification is available for all parameters reported in this environmental sample data report.

PROJECT NARRATIVE
H7G260160

VOST Result, ug = $(On\ column\ concentration, ug/L) * (Purge\ Volume, L)$

One surrogate recovery for samples PGC #1 Run 3A Tenax and PGC #1 Run 3B Tenax were outside QC limits. However, reanalysis of the associated samples was not possible since the entire sample was consumed during analysis. Since the recoveries were low, the results for the samples may be biased low.

The concentration of benzene was greater than the calibration range for sample PGC #1 Run 1A Tenax. Reanalysis at a dilution was not possible because the entire sample was consumed during analysis.

Tube 1 of sample PGC #1 Run 1C Tenax was broken upon receipt and wrapped in Teflon tape. The Tenax sample tubes had to be analyzed separately versus in tandem. Sample J3LEP1AA corresponds to tube 1, and sample J3LEP2AA corresponds to tube 2.

SAMPLE SUMMARY

H7G260160

WO #	SAMPLE#	CLIENT SAMPLE ID	SAMPLED DATE	SAMP TIME
J3LD8	001	PGC #1 RUN 1A TENAX	07/19/07	16:10
J3LEJ	002	PGC #1 RUN 1A ANASORB	07/19/07	16:10
J3LEK	003	PGC #1 RUN 1B TENAX	07/19/07	17:00
J3LEL	004	PGC #1 RUN 1B ANASORB	07/19/07	17:00
J3LEP	005	PGC #1 RUN 1C TENAX	07/19/07	17:59
J3LEQ	006	PGC #1 RUN 1C ANASORB	07/19/07	17:59
J3LET	007	PGC #1 RUN 1 FB TENAX	07/19/07	
J3LEV	008	PGC #1 RUN 1 FB ANASORB	07/19/07	
J3LEX	009	PGC #1 RUN 2A TENAX	07/20/07	09:11
J3LE0	010	PGC #1 RUN 2A ANASORB	07/20/07	09:11
J3LE1	011	PGC #1 RUN 2B TENAX	07/20/07	10:06
J3LE3	012	PGC #1 RUN 2B ANASORB	07/20/07	10:06
J3LE5	013	PGC #1 RUN 2C TENAX	07/20/07	11:08
J3LE7	014	PGC #1 RUN 2C ANASORB	07/20/07	11:08
J3LE9	015	PGC #1 RUN 2 FB TENAX	07/20/07	
J3LFD	016	PGC #1 RUN 2 FB ANASORB	07/20/07	
J3LFE	017	PGC #1 RUN 3A TENAX	07/20/07	12:18
J3LFF	018	PGC #1 RUN 3A ANASORB	07/20/07	12:18
J3LFG	019	PGC #1 RUN 3B TENAX	07/20/07	13:12
J3LFH	020	PGC #1 RUN 3B ANASORB	07/20/07	13:12
J3LFK	021	PGC #1 RUN 3C TENAX	07/20/07	14:05
J3LFL	022	PGC #1 RUN 3C ANASORB	07/20/07	14:05
J3LFM	023	PGC #1 RUN 3 FB TENAX	07/20/07	
J3LFP	024	PGC #1 RUN 3 FB ANASORB	07/20/07	
J3LFQ	025	PGC #1 RUN TB TENAX	07/20/07	
J3LFR	026	PGC #1 RUN TB ANASORB	07/20/07	
J3LFT	027	A-5734 MEDIA CHECK TENAX	07/19/07	
J3LFV	028	A-5735 MEDIA CHECK ANASORB	07/19/07	

NOTE(S):

- The analytical results of the samples listed above are presented on the following pages.
- All calculations are performed before rounding to avoid round-off errors in calculated results.
- Results noted as "ND" were not detected at or above the stated limit.
- This report must not be reproduced, except in full, without the written approval of the laboratory.
- Results for the following parameters are never reported on a dry weight basis: color, corrosivity, density, flashpoint, ignitability, layers, odor, paint filter test, pH, porosity pressure, reactivity, redox potential, specific gravity, spot tests, solids, solubility, temperature, viscosity, and weight.

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 1A TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-001 Work Order #...: J3LD81AA Matrix.....: AIR
Date Sampled...: 07/19/07 Date Received..: 07/25/07
Prep Date.....: 07/30/07 Analysis Date..: 07/30/07
Prep Batch #...: 7208163
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	0.077 J	0.10	ug	0.060
Benzene	2.4 E	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	0.0042 J	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	ND	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	ND	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

(Continued on next page)

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 1A TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-001 Work Order #...: J3LD81AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	0.0049 J	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	ND	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	0.025	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	0.016	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	0.066	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	0.0085 J	0.050	ug	0.0080
1,2,3-Trichloropropane	0.046	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	103	(50 - 134)
1,2-Dichloroethane-d4	113	(50 - 134)
Toluene-d8	97	(57 - 127)
Bromofluorobenzene	87	(50 - 125)

NOTE(S):

J Estimated result. Result is less than RL.

E Estimated result. Result concentration exceeds the calibration range.

Hoefler Consulting Group Inc

PGC #1 RUN 1A TENAX

GC/MS Volatiles

Lot-Sample #: H7G260160-001 Work Order #: J3LD81AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT		RETENTION TIME	UNITS
Allene	463-49-0	0.10 NJ	M	1.0129	ug
Bicyclo[1.1.0]butane	157-33-5	0.073 NJ	M	1.1589	ug
Unknown		0.12 NJ	M	1.244	ug
Unknown		0.069 NJ	M	1.4934	ug
Phenylethyne	536-74-3	0.033 NJ	M	9.3898	ug

NOTE(S):

M: Result was measured against nearest internal standard assuming a response factor of 1.

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 1A ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-002 Work Order #...: J3LEJ1AA Matrix.....: AIR
Date Sampled...: 07/19/07 Date Received..: 07/25/07
Prep Date.....: 07/30/07 Analysis Date..: 07/30/07
Prep Batch #...: 7208163
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	ND	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	0.046 J	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	0.027	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 1A ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-002 Work Order #...: J3LEJ1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	ND	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	0.0039 J	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	ND	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	101	(50 - 134)
1,2-Dichloroethane-d4	104	(50 - 134)
Toluene-d8	94	(57 - 127)
Bromofluorobenzene	90	(50 - 125)

NOTE(S):

J Estimated result. Result is less than RL.

Hoefler Consulting Group Inc

PGC #1 RUN 1A ANASORB

GC/MS Volatiles

Lot-Sample #: H7G260160-002 Work Order #: J3LEJ1AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
Unknown		0.032 NJ M	13.144	ug
Unknown		0.037 NJ M	14.494	ug

NOTE(S):

M: Result was measured against nearest internal standard assuming a response factor of 1.

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 1B TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-003 Work Order #...: J3LEK1AA Matrix.....: AIR
Date Sampled...: 07/19/07 Date Received..: 07/25/07
Prep Date.....: 07/30/07 Analysis Date..: 07/30/07
Prep Batch #...: 7208163
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	0.60	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	ND	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	ND	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 1B TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-003 Work Order #...: J3LEK1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	0.062	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	0.0086 J	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	0.0053 J	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	0.025	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	ND	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	108	(50 - 134)
1,2-Dichloroethane-d4	115	(50 - 134)
Toluene-d8	97	(57 - 127)
Bromofluorobenzene	95	(50 - 125)

NOTE(S):

J Estimated result. Result is less than RL.

Hoefler Consulting Group Inc

PGC #1 RUN 1B TENAX

GC/MS Volatiles

Lot-Sample #: H7G260160-003 Work Order #: J3LEK1AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 1B ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-004 Work Order #...: J3LEL1AA Matrix.....: AIR
Date Sampled...: 07/19/07 Date Received..: 07/25/07
Prep Date.....: 07/30/07 Analysis Date..: 07/30/07
Prep Batch #...: 7208163
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	ND	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	0.058	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	0.030	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 1B ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-004 Work Order #...: J3LEL1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	0.015 J	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	0.0037 J	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	0.076	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	107	(50 - 134)
1,2-Dichloroethane-d4	107	(50 - 134)
Toluene-d8	99	(57 - 127)
Bromofluorobenzene	89	(50 - 125)

NOTE(S):

J Estimated result. Result is less than RL.

Hoefler Consulting Group Inc

PGC #1 RUN 1B ANASORB

GC/MS Volatiles

Lot-Sample #: H7G260160-004 Work Order #: J3LEL1AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
Unknown		0.055 NJ M	14.496	ug

NOTE(S):

M: Result was measured against nearest internal standard assuming a response factor of 1.

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 1C TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-005 Work Order #...: J3LEP1AA Matrix.....: AIR
Date Sampled...: 07/19/07 Date Received..: 07/25/07
Prep Date.....: 07/30/07 Analysis Date..: 07/30/07
Prep Batch #...: 7208163
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	0.31	0.10	ug	0.060
Benzene	0.17	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	0.028	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	ND	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	0.035	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 1C TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-005 Work Order #...: J3LEP1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	0.13	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	0.0096 J	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	1.6	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	100	(50 - 134)
1,2-Dichloroethane-d4	102	(50 - 134)
Toluene-d8	96	(57 - 127)
Bromofluorobenzene	81	(50 - 125)

NOTE(S):

J Estimated result. Result is less than RL.

Hoefler Consulting Group Inc

PGC #1 RUN 1C TENAX

GC/MS Volatiles

Lot-Sample #: H7G260160-005 Work Order #: J3LEP1AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT		RETENTION TIME	UNITS
Unknown		0.072 NJ	M	1.1223	ug
Butane, 2-methyl-	78-78-4	0.046 NJ	M	1.4387	ug

NOTE(S):

M: Result was measured against nearest internal standard assuming a response factor of 1.

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 1C TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-005 Work Order #...: J3LEP2AA Matrix.....: AIR
Date Sampled...: 07/19/07 Date Received..: 07/25/07
Prep Date.....: 07/30/07 Analysis Date..: 07/30/07
Prep Batch #...: 7208163
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	ND	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	ND	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	ND	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 1C TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-005 Work Order #...: J3LEP2AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	0.059	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	ND	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	ND	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	101	(50 - 134)
1,2-Dichloroethane-d4	103	(50 - 134)
Toluene-d8	95	(57 - 127)
Bromofluorobenzene	80	(50 - 125)

Hoefler Consulting Group Inc

PGC #1 RUN 1C TENAX

GC/MS Volatiles

Lot-Sample #: H7G260160-005 Work Order #: J3LEP2AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 1C ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-006 Work Order #...: J3LEQ1AA Matrix.....: AIR
Date Sampled...: 07/19/07 Date Received..: 07/25/07
Prep Date.....: 07/30/07 Analysis Date..: 07/30/07
Prep Batch #...: 7208163
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	ND	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	0.023 J	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	0.024 J	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 1C ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-006 Work Order #...: J3LEQ1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	0.016 J	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	ND	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	ND	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	103	(50 - 134)
1,2-Dichloroethane-d4	108	(50 - 134)
Toluene-d8	97	(57 - 127)
Bromofluorobenzene	87	(50 - 125)

NOTE(S):

J Estimated result. Result is less than RL.

Hoefler Consulting Group Inc

PGC #1 RUN 1C ANASORB

GC/MS Volatiles

Lot-Sample #: H7G260160-006 **Work Order #:** J3LEQ1AA **Matrix:** AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 1 FB TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-007 Work Order #...: J3LET1AA Matrix.....: AIR
Date Sampled...: 07/19/07 Date Received..: 07/25/07
Prep Date.....: 07/27/07 Analysis Date..: 07/27/07
Prep Batch #...: 7207287
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	ND	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	ND	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	ND	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 1 FB TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-007 Work Order #...: J3LET1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	ND	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	ND	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	ND	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	95	(50 - 134)
1,2-Dichloroethane-d4	92	(50 - 134)
Toluene-d8	98	(57 - 127)
Bromofluorobenzene	84	(50 - 125)

Hoefler Consulting Group Inc

PGC #1 RUN 1 FB TENAX

GC/MS Volatiles

Lot-Sample #: H7G260160-007 Work Order #: J3LET1AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 1 FB ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-008 Work Order #...: J3LEV1AA Matrix.....: AIR
Date Sampled...: 07/19/07 Date Received..: 07/25/07
Prep Date.....: 07/27/07 Analysis Date..: 07/27/07
Prep Batch #...: 7207287
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	ND	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	0.0077 J	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	ND	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 1 FB ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-008 Work Order #...: J3LEV1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	ND	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	ND	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	ND	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	96	(50 - 134)
1,2-Dichloroethane-d4	95	(50 - 134)
Toluene-d8	93	(57 - 127)
Bromofluorobenzene	79	(50 - 125)

NOTE(S):

J Estimated result. Result is less than RL.

Hoefler Consulting Group Inc

PGC #1 RUN 1 FB ANASORB

GC/MS Volatiles

Lot-Sample #: H7G260160-008 Work Order #: J3LEV1AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 2A TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-009 Work Order #...: J3LEX1AA Matrix.....: AIR
Date Sampled...: 07/20/07 Date Received..: 07/25/07
Prep Date.....: 07/30/07 Analysis Date..: 07/30/07
Prep Batch #...: 7208163
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	ND	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	ND	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	0.0072 J	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 2A TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-009 Work Order #...: J3LEX1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	1.2	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	0.0028 J	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	ND	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	99	(50 - 134)
1,2-Dichloroethane-d4	97	(50 - 134)
Toluene-d8	92	(57 - 127)
Bromofluorobenzene	79	(50 - 125)

NOTE(S):

J Estimated result. Result is less than RL.

Hoefler Consulting Group Inc

PGC #1 RUN 2A TENAX

GC/MS Volatiles

Lot-Sample #: H7G260160-009 **Work Order #:** J3LEX1AA **Matrix:** AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 2A ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-010 Work Order #...: J3LE01AA Matrix.....: AIR
Date Sampled...: 07/20/07 Date Received..: 07/25/07
Prep Date.....: 07/30/07 Analysis Date..: 07/30/07
Prep Batch #...: 7208163
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	ND	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	0.064	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	0.062	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 2A ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-010 Work Order #...: J3LE01AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	0.020 J	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	0.0070 J	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	0.020 J	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	102	(50 - 134)
1,2-Dichloroethane-d4	100	(50 - 134)
Toluene-d8	97	(57 - 127)
Bromofluorobenzene	88	(50 - 125)

NOTE(S):

J Estimated result. Result is less than RL.

Hoefler Consulting Group Inc

PGC #1 RUN 2A ANASORB

GC/MS Volatiles

Lot-Sample #: H7G260160-010 Work Order #: J3LE01AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 2B TENAX

GC/MS Volatiles

Lot-Sample #...: R7G260160-011 Work Order #...: J3LE11AA Matrix.....: AIR
Date Sampled...: 07/20/07 Date Received..: 07/25/07
Prep Date.....: 07/30/07 Analysis Date..: 07/30/07
Prep Batch #...: 7208163
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	0.77	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	ND	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	ND	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

(Continued on next page)

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 2B TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-011 Work Order #...: J3LE11AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	0.0035 J	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	0.017 J	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	0.0058 J	0.010	ug	0.0044
Toluene	0.038	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	0.013 J	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	0.0093 J	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	103	(50 - 134)
1,2-Dichloroethane-d4	104	(50 - 134)
Toluene-d8	97	(57 - 127)
Bromofluorobenzene	83	(50 - 125)

NOTE(S):

J Estimated result. Result is less than RL.

Hoefler Consulting Group Inc

PGC #1 RUN 2B TENAX

GC/MS Volatiles

Lot-Sample #: H7G260160-011 Work Order #: J3LE11AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
1,3-Butadiene	106-99-0	0.030 NJ M	1.1614	ug

NOTE(S):

M: Result was measured against nearest internal standard assuming a response factor of 1.

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 2B ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-012 Work Order #...: J3LE31AA Matrix.....: AIR
Date Sampled...: 07/20/07 Date Received..: 07/25/07
Prep Date.....: 07/30/07 Analysis Date..: 07/30/07
Prep Batch #...: 7208163
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	ND	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	0.044 J	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	0.035	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 2B ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-012 Work Order #...: J3LE31AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	ND	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	0.0064 J	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	ND	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	100	(50 - 134)
1,2-Dichloroethane-d4	105	(50 - 134)
Toluene-d8	96	(57 - 127)
Bromofluorobenzene	91	(50 - 125)

NOTE(S):

J Estimated result. Result is less than RL.

Hoefler Consulting Group Inc

PGC #1 RUN 2B ANASORB

GC/MS Volatiles

Lot-Sample #: H7G260160-012 Work Order #: J3LE31AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 2C TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-013 Work Order #...: J3LE51AA Matrix.....: AIR
Date Sampled...: 07/20/07 Date Received..: 07/25/07
Prep Date.....: 07/30/07 Analysis Date..: 07/30/07
Prep Batch #...: 7208163
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	0.16	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	ND	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	ND	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 2C TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-013 Work Order #...: J3LE51AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	0.062	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	0.012	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	0.0087 J	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	107	(50 - 134)
1,2-Dichloroethane-d4	110	(50 - 134)
Toluene-d8	86	(57 - 127)
Bromofluorobenzene	51	(50 - 125)

NOTE(S):

J Estimated result. Result is less than RL.

Hoefler Consulting Group Inc

PGC #1 RUN 2C TENAX

GC/MS Volatiles

Lot-Sample #: B7G260160-013 Work Order #: J3LE51AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 2C ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-014 Work Order #...: J3LE71AA Matrix.....: AIR
Date Sampled...: 07/20/07 Date Received..: 07/25/07
Prep Date.....: 07/30/07 Analysis Date..: 07/30/07
Prep Batch #...: 7208163
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	ND	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	0.045 J	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	0.030	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 2C ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-014 Work Order #...: J3LE71AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	ND	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	0.0052 J	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	0.020 J	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	100	(50 - 134)
1,2-Dichloroethane-d4	103	(50 - 134)
Toluene-d8	97	(57 - 127)
Bromofluorobenzene	90	(50 - 125)

NOTE(S):

J Estimated result. Result is less than RL.

Hoefler Consulting Group Inc

PGC #1 RUN 2C ANASORB

GC/MS Volatiles

Lot-Sample #: H7G260160-014 **Work Order #:** J3LE71AA **Matrix:** AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 2 FB TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-015 Work Order #...: J3LE91AA Matrix.....: AIR
Date Sampled...: 07/20/07 Date Received..: 07/25/07
Prep Date.....: 07/27/07 Analysis Date..: 07/27/07
Prep Batch #...: 7207287
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	ND	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	ND	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	ND	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 2 FB TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-015 Work Order #...: J3LE91AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	ND	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	ND	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	ND	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	100	(50 - 134)
1,2-Dichloroethane-d4	100	(50 - 134)
Toluene-d8	100	(57 - 127)
Bromofluorobenzene	83	(50 - 125)

Hoefler Consulting Group Inc

PGC #1 RUN 2 FB TENAX

GC/MS Volatiles

Lot-Sample #: H7G260160-015 Work Order #: J3LE91AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 2 FB ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-016 Work Order #...: J3LFD1AA Matrix.....: AIR
Date Sampled...: 07/20/07 Date Received..: 07/25/07
Prep Date.....: 07/27/07 Analysis Date..: 07/27/07
Prep Batch #...: 7207287
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	ND	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	0.0079 J	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	ND	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 2 FB ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-016 Work Order #...: J3LFD1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	ND	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	ND	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	ND	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	101	(50 - 134)
1,2-Dichloroethane-d4	98	(50 - 134)
Toluene-d8	93	(57 - 127)
Bromofluorobenzene	84	(50 - 125)

NOTE(S):

J Estimated result. Result is less than RL.

Hoefler Consulting Group Inc

PGC #1 RUN 2 FB ANASORB

GC/MS Volatiles

Lot-Sample #: H7G260160-016 **Work Order #:** J3LFD1AA **Matrix:** AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 3A TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-017 Work Order #...: J3LFE1AA Matrix.....: AIR
Date Sampled...: 07/20/07 Date Received..: 07/25/07
Prep Date.....: 07/30/07 Analysis Date..: 07/30/07
Prep Batch #...: 7208163
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	0.89	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	ND	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	ND	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 3A TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-017 Work Order #...: J3LFE1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	0.021 J	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	0.023	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	ND	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	106	(50 - 134)
1,2-Dichloroethane-d4	111	(50 - 134)
Toluene-d8	87	(57 - 127)
Bromofluorobenzene	47 *	(50 - 125)

NOTE(S):

* Surrogate recovery is outside stated control limits.

J Estimated result. Result is less than RL.

Hoefler Consulting Group Inc

PGC #1 RUN 3A TENAX

GC/MS Volatiles

Lot-Sample #: H7G260160-017 **Work Order #:** J3LFE1AA **Matrix:** AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 3A ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-018 Work Order #...: J3LFF1AA Matrix.....: AIR
Date Sampled...: 07/20/07 Date Received..: 07/25/07
Prep Date.....: 07/30/07 Analysis Date..: 07/30/07
Prep Batch #...: 7208163
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	ND	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	0.030 J	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	0.033	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 3A ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-018 Work Order #...: J3LFF1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	0.018 J	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	0.0067 J	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	0.087	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	103	(50 - 134)
1,2-Dichloroethane-d4	104	(50 - 134)
Toluene-d8	93	(57 - 127)
Bromofluorobenzene	89	(50 - 125)

NOTE(S):

J Estimated result. Result is less than RL.

Hoefler Consulting Group Inc

PGC #1 RUN 3A ANASORB

GC/MS Volatiles

Lot-Sample #: H7G260160-018 **Work Order #:** J3LFF1AA **Matrix:** AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 3B TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-019 Work Order #...: J3LFG1AA Matrix.....: AIR
Date Sampled...: 07/20/07 Date Received..: 07/25/07
Prep Date.....: 07/30/07 Analysis Date..: 07/30/07
Prep Batch #...: 7208163
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	0.37	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	ND	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	ND	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 3B TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-019 Work Order #...: J3LFG1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	ND	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	0.014	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	ND	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	101	(50 - 134)
1,2-Dichloroethane-d4	103	(50 - 134)
Toluene-d8	71	(57 - 127)
Bromofluorobenzene	29 *	(50 - 125)

NOTE(S):

* Surrogate recovery is outside stated control limits.

Hoefler Consulting Group Inc

PGC #1 RUN 3B TENAX

GC/MS Volatiles

Lot-Sample #: H7G260160-019 Work Order #: J3LFG1AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 3B ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-020 Work Order #...: J3LFH1AA Matrix.....: AIR
Date Sampled...: 07/20/07 Date Received..: 07/25/07
Prep Date.....: 07/30/07 Analysis Date..: 07/30/07
Prep Batch #...: 7208163
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	ND	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	0.051	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	0.025	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 3B ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-020 Work Order #...: J3LFH1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	ND	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	0.0029 J	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	0.034 J	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	103	(50 - 134)
1,2-Dichloroethane-d4	106	(50 - 134)
Toluene-d8	92	(57 - 127)
Bromofluorobenzene	89	(50 - 125)

NOTE(S):

J Estimated result. Result is less than RL.

Hoefler Consulting Group Inc

PGC #1 RUN 3B ANASORB

GC/MS Volatiles

Lot-Sample #: H7G260160-020 Work Order #: J3LFH1AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 3C TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-021 Work Order #...: J3LFK1AA Matrix.....: AIR
Date Sampled...: 07/20/07 Date Received..: 07/25/07
Prep Date.....: 07/30/07 Analysis Date..: 07/30/07
Prep Batch #...: 7208163
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	0.99	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	ND	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	ND	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 3C TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-021 Work Order #...: J3LFK1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	ND	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	0.022	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	ND	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	102	(50 - 134)
1,2-Dichloroethane-d4	105	(50 - 134)
Toluene-d8	92	(57 - 127)
Bromofluorobenzene	60	(50 - 125)

Hoefler Consulting Group Inc

PGC #1 RUN 3C TENAX

GC/MS Volatiles

Lot-Sample #: H7G260160-021 Work Order #: J3LFK1AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
Unknown		0.026 NJ M	1.239	ug

NOTE(S):

M: Result was measured against nearest internal standard assuming a response factor of 1.

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 3C ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-022 Work Order #...: J3LFL1AA Matrix.....: AIR
Date Sampled...: 07/20/07 Date Received..: 07/25/07
Prep Date.....: 07/30/07 Analysis Date..: 07/30/07
Prep Batch #...: 7208163
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	ND	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	0.034 J	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	0.019 J	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 3C ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-022 Work Order #...: J3LFL1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	ND	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	ND	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	0.013 J	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	109	(50 - 134)
1,2-Dichloroethane-d4	111	(50 - 134)
Toluene-d8	101	(57 - 127)
Bromofluorobenzene	91	(50 - 125)

NOTE(S):

J Estimated result. Result is less than RL.

Hoefler Consulting Group Inc

PGC #1 RUN 3C ANASORB

GC/MS Volatiles

Lot-Sample #: H7G260160-022 Work Order #: J3LFL1AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 3 FB TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-023 Work Order #...: J3LFM1AA Matrix.....: AIR
Date Sampled...: 07/20/07 Date Received..: 07/25/07
Prep Date.....: 07/27/07 Analysis Date..: 07/27/07
Prep Batch #...: 7207287
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	ND	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	ND	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	ND	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 3 FB TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-023 Work Order #...: J3LFM1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	ND	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	ND	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	ND	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	94	(50 - 134)
1,2-Dichloroethane-d4	92	(50 - 134)
Toluene-d8	94	(57 - 127)
Bromofluorobenzene	85	(50 - 125)

Hoefler Consulting Group Inc

PGC #1 RUN 3 FB TENAX

GC/MS Volatiles

Lot-Sample #: H7G260160-023 **Work Order #:** J3LFM1AA **Matrix:** AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 3 FB ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-024 Work Order #...: J3LFP1AA Matrix.....: AIR
Date Sampled...: 07/20/07 Date Received..: 07/25/07
Prep Date.....: 07/27/07 Analysis Date..: 07/27/07
Prep Batch #...: 7207287
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	ND	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	0.0094 J	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	ND	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN 3 FB ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-024 Work Order #...: J3LFP1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	ND	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	ND	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	ND	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	94	(50 - 134)
1,2-Dichloroethane-d4	93	(50 - 134)
Toluene-d8	93	(57 - 127)
Bromofluorobenzene	77	(50 - 125)

NOTE(S):

J Estimated result. Result is less than RL.

Hoefler Consulting Group Inc

PGC #1 RUN 3 FB ANASORB

GC/MS Volatiles

Lot-Sample #: H7G260160-024 **Work Order #:** J3LFP1AA **Matrix:** AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN TB TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-025 Work Order #...: J3LFQ1AA Matrix.....: AIR
Date Sampled...: 07/20/07 Date Received..: 07/25/07
Prep Date.....: 07/27/07 Analysis Date..: 07/27/07
Prep Batch #...: 7207287
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	ND	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	ND	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	ND	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN TB TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-025 Work Order #...: J3LFQ1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	ND	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	ND	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	ND	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	97	(50 - 134)
1,2-Dichloroethane-d4	94	(50 - 134)
Toluene-d8	101	(57 - 127)
Bromofluorobenzene	87	(50 - 125)

Hoefler Consulting Group Inc

PGC #1 RUN TB TENAX

GC/MS Volatiles

Lot-Sample #: H7G260160-025 Work Order #: J3LFQ1AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN TB ANASORB

GC/MS Volatiles

Lot-Sample #...: B7G260160-026 Work Order #...: J3LFR1AA Matrix.....: AIR
Date Sampled...: 07/20/07 Date Received..: 07/25/07
Prep Date.....: 07/27/07 Analysis Date..: 07/27/07
Prep Batch #...: 7207287
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	ND	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	0.012 J	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	ND	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: PGC #1 RUN TB ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-026 Work Order #...: J3LFR1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	ND	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	ND	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	ND	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	99	(50 - 134)
1,2-Dichloroethane-d4	99	(50 - 134)
Toluene-d8	98	(57 - 127)
Bromofluorobenzene	84	(50 - 125)

NOTE(S):

J Estimated result. Result is less than RL.

Hoefler Consulting Group Inc

PGC #1 RUN TB ANASORB

GC/MS Volatiles

Lot-Sample #: H7G260160-026 Work Order #: J3LFR1AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: A-5734 MEDIA CHECK TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-027 Work Order #...: J3LFT1AA Matrix.....: AIR
Date Sampled...: 07/19/07 Date Received..: 07/25/07
Prep Date.....: 07/27/07 Analysis Date..: 07/27/07
Prep Batch #...: 7207287
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	ND	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	ND	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	ND	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: A-5734 MEDIA CHECK TENAX

GC/MS Volatiles

Lot-Sample #...: H7G260160-027 Work Order #...: J3LFT1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	ND	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	ND	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	ND	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	95	(50 - 134)
1,2-Dichloroethane-d4	95	(50 - 134)
Toluene-d8	98	(57 - 127)
Bromofluorobenzene	90	(50 - 125)

Hoefler Consulting Group Inc

A-5734 MEDIA CHECK TENAX

GC/MS Volatiles

Lot-Sample #: H7G260160-027 Work Order #: J3LFT1AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

Hoefler Consulting Group Inc

Client Sample ID: A-5735 MEDIA CHECK ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-028 Work Order #...: J3LFV1AA Matrix.....: AIR
Date Sampled...: 07/19/07 Date Received..: 07/25/07
Prep Date.....: 07/27/07 Analysis Date..: 07/27/07
Prep Batch #...: 7207287
Dilution Factor: 1 Method.....: SW846 VOST

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	ND	0.10	ug	0.060
Benzene	ND	0.010	ug	0.0043
Bromobenzene	ND	0.010	ug	0.0055
Bromochloromethane	ND	0.025	ug	0.0055
Bromodichloromethane	ND	0.010	ug	0.0044
Bromoform	ND	0.025	ug	0.0065
Bromomethane	ND	0.050	ug	0.0078
2-Butanone	ND	0.10	ug	0.032
n-Butylbenzene	ND	0.010	ug	0.0077
sec-Butylbenzene	ND	0.010	ug	0.0096
tert-Butylbenzene	ND	0.010	ug	0.0089
Carbon disulfide	ND	0.010	ug	0.0042
Carbon tetrachloride	ND	0.010	ug	0.0034
Chlorobenzene	ND	0.010	ug	0.0043
Chlorodibromomethane	ND	0.025	ug	0.0038
Chloroethane	ND	0.050	ug	0.0039
Chloroform	ND	0.010	ug	0.0046
Chloromethane	0.011 J	0.050	ug	0.0060
2-Chlorotoluene	ND	0.010	ug	0.0054
4-Chlorotoluene	ND	0.010	ug	0.0057
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	0.016
1,2-Dibromoethane	ND	0.025	ug	0.0039
Dibromomethane	ND	0.025	ug	0.0064
1,2-Dichlorobenzene	ND	0.010	ug	0.0059
1,3-Dichlorobenzene	ND	0.010	ug	0.0064
1,4-Dichlorobenzene	ND	0.010	ug	0.0074
Dichlorodifluoromethane	ND	0.025	ug	0.0052
1,1-Dichloroethane	ND	0.010	ug	0.0034
1,2-Dichloroethane	ND	0.010	ug	0.0048
cis-1,2-Dichloroethene	ND	0.010	ug	0.0050
trans-1,2-Dichloroethene	ND	0.010	ug	0.0038
1,1-Dichloroethene	ND	0.010	ug	0.0057
1,2-Dichloropropane	ND	0.010	ug	0.0045
1,3-Dichloropropane	ND	0.010	ug	0.0071
2,2-Dichloropropane	ND	0.010	ug	0.0034
cis-1,3-Dichloropropene	ND	0.010	ug	0.0039
trans-1,3-Dichloropropene	ND	0.010	ug	0.0039
1,1-Dichloropropene	ND	0.010	ug	0.0042

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Hoefler Consulting Group Inc

Client Sample ID: A-5735 MEDIA CHECK ANASORB

GC/MS Volatiles

Lot-Sample #...: H7G260160-028 Work Order #...: J3LFV1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Ethylbenzene	ND	0.010	ug	0.0032
Hexachlorobutadiene	ND	0.025	ug	0.0041
2-Hexanone	ND	0.10	ug	0.018
Isopropylbenzene	ND	0.010	ug	0.0058
p-Isopropyltoluene	ND	0.010	ug	0.0085
Methylene chloride	ND	0.025	ug	0.012
4-Methyl-2-pentanone	ND	0.10	ug	0.029
Naphthalene	ND	0.025	ug	0.0066
n-Propylbenzene	ND	0.010	ug	0.0054
Styrene	ND	0.010	ug	0.0049
1,1,1,2-Tetrachloroethane	ND	0.010	ug	0.0046
1,1,2,2-Tetrachloroethane	ND	0.025	ug	0.0067
Tetrachloroethene	ND	0.010	ug	0.0044
Toluene	ND	0.010	ug	0.0027
1,2,3-Trichlorobenzene	ND	0.025	ug	0.0056
1,2,4-Trichloro-benzene	ND	0.025	ug	0.0066
1,1,1-Trichloroethane	ND	0.025	ug	0.0051
1,1,2-Trichloroethane	ND	0.025	ug	0.0056
Trichloroethene	ND	0.010	ug	0.0099
Trichlorofluoromethane	ND	0.050	ug	0.0080
1,2,3-Trichloropropane	ND	0.025	ug	0.0099
1,2,4-Trimethylbenzene	ND	0.010	ug	0.0063
1,3,5-Trimethylbenzene	ND	0.010	ug	0.0074
Vinyl chloride	ND	0.010	ug	0.0032
m-Xylene & p-Xylene	ND	0.020	ug	0.0072
o-Xylene	ND	0.010	ug	0.0053

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	96	(50 - 134)
1,2-Dichloroethane-d4	93	(50 - 134)
Toluene-d8	93	(57 - 127)
Bromofluorobenzene	77	(50 - 125)

NOTE(S):

J Estimated result. Result is less than RL.

Hoefler Consulting Group Inc

A-5735 MEDIA CHECK ANASORB

GC/MS Volatiles

Lot-Sample #: H7G260160-028 Work Order #: J3LFV1AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

METHOD BLANK REPORT

GC/MS Volatiles

Client Lot #...: H7G260160 Work Order #...: J3LKQ1AA Matrix.....: AIR
MB Lot-Sample #: H7G260000-287

Prep Date.....: 07/27/07
Analysis Date..: 07/27/07 Prep Batch #...: 7207287
Dilution Factor: 1

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD
Acetone	ND	0.10	ug	SW846 VOST
Benzene	ND	0.010	ug	SW846 VOST
Bromobenzene	ND	0.010	ug	SW846 VOST
Bromochloromethane	ND	0.025	ug	SW846 VOST
Bromodichloromethane	ND	0.010	ug	SW846 VOST
Bromoform	ND	0.025	ug	SW846 VOST
Bromomethane	ND	0.050	ug	SW846 VOST
2-Butanone	ND	0.10	ug	SW846 VOST
n-Butylbenzene	ND	0.010	ug	SW846 VOST
sec-Butylbenzene	ND	0.010	ug	SW846 VOST
tert-Butylbenzene	ND	0.010	ug	SW846 VOST
Carbon disulfide	ND	0.010	ug	SW846 VOST
Carbon tetrachloride	ND	0.010	ug	SW846 VOST
Chlorobenzene	ND	0.010	ug	SW846 VOST
Chlorodibromomethane	ND	0.025	ug	SW846 VOST
Chloroethane	ND	0.050	ug	SW846 VOST
Chloroform	ND	0.010	ug	SW846 VOST
Chloromethane	ND	0.050	ug	SW846 VOST
2-Chlorotoluene	ND	0.010	ug	SW846 VOST
4-Chlorotoluene	ND	0.010	ug	SW846 VOST
1,2-Dibromo-3-chloro-propane	ND	0.050	ug	SW846 VOST
1,2-Dibromoethane	ND	0.025	ug	SW846 VOST
Dibromomethane	ND	0.025	ug	SW846 VOST
1,2-Dichlorobenzene	ND	0.010	ug	SW846 VOST
1,3-Dichlorobenzene	ND	0.010	ug	SW846 VOST
1,4-Dichlorobenzene	ND	0.010	ug	SW846 VOST
Dichlorodifluoromethane	ND	0.025	ug	SW846 VOST
1,1-Dichloroethane	ND	0.010	ug	SW846 VOST
1,2-Dichloroethane	ND	0.010	ug	SW846 VOST
cis-1,2-Dichloroethene	ND	0.010	ug	SW846 VOST
trans-1,2-Dichloroethene	ND	0.010	ug	SW846 VOST
1,1-Dichloroethene	ND	0.010	ug	SW846 VOST
1,2-Dichloropropane	ND	0.010	ug	SW846 VOST
1,3-Dichloropropane	ND	0.010	ug	SW846 VOST
2,2-Dichloropropane	ND	0.010	ug	SW846 VOST
cis-1,3-Dichloropropene	ND	0.010	ug	SW846 VOST
trans-1,3-Dichloropropene	ND	0.010	ug	SW846 VOST
1,1-Dichloropropene	ND	0.010	ug	SW846 VOST
Ethylbenzene	ND	0.010	ug	SW846 VOST
Hexachlorobutadiene	ND	0.025	ug	SW846 VOST

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METHOD BLANK REPORT

GC/MS Volatiles

Client Lot #...: H7G260160 Work Order #...: J3LKQ1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD
2-Hexanone	ND	0.10	ug	SW846 VOST
Isopropylbenzene	ND	0.010	ug	SW846 VOST
p-Isopropyltoluene	ND	0.010	ug	SW846 VOST
Methylene chloride	ND	0.025	ug	SW846 VOST
4-Methyl-2-pentanone	ND	0.10	ug	SW846 VOST
Naphthalene	ND	0.025	ug	SW846 VOST
n-Propylbenzene	ND	0.010	ug	SW846 VOST
Styrene	ND	0.010	ug	SW846 VOST
1,1,1,2-Tetrachloroethane	ND	0.010	ug	SW846 VOST
1,1,2,2-Tetrachloroethane	ND	0.025	ug	SW846 VOST
Tetrachloroethene	ND	0.010	ug	SW846 VOST
Toluene	ND	0.010	ug	SW846 VOST
1,2,3-Trichlorobenzene	ND	0.025	ug	SW846 VOST
1,2,4-Trichloro-benzene	ND	0.025	ug	SW846 VOST
1,1,1-Trichloroethane	ND	0.025	ug	SW846 VOST
1,1,2-Trichloroethane	ND	0.025	ug	SW846 VOST
Trichloroethene	ND	0.010	ug	SW846 VOST
Trichlorofluoromethane	ND	0.050	ug	SW846 VOST
1,2,3-Trichloropropane	ND	0.025	ug	SW846 VOST
1,2,4-Trimethylbenzene	ND	0.010	ug	SW846 VOST
1,3,5-Trimethylbenzene	ND	0.010	ug	SW846 VOST
Vinyl chloride	ND	0.010	ug	SW846 VOST
m-Xylene & p-Xylene	ND	0.020	ug	SW846 VOST
o-Xylene	ND	0.010	ug	SW846 VOST

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	95	(50 - 134)
1,2-Dichloroethane-d4	92	(50 - 134)
Toluene-d8	97	(57 - 127)
Bromofluorobenzene	81	(50 - 125)

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Hoefler Consulting Group Inc

Method Blank Report

GC/MS Volatiles

Lot-Sample #: H7G260000-287 B Work Order #: J3LKQ1AA Matrix: AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

LABORATORY CONTROL SAMPLE EVALUATION REPORT

GC/MS Volatiles

Client Lot #...: H7G260160 Work Order #...: J3LKQ1AC-LCS Matrix.....: AIR
LCS Lot-Sample#: H7G260000-287 J3LKQ1AD-LCSD
Prep Date.....: 07/27/07 Analysis Date..: 07/27/07
Prep Batch #...: 7207287
Dilution Factor: 1

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	RPD	RPD LIMITS	METHOD
Benzene	87	(69 - 130)			SW846 VOST
	96	(69 - 130)	9.9	(0-25)	SW846 VOST
Chlorobenzene	76	(70 - 116)			SW846 VOST
	86	(70 - 116)	13	(0-25)	SW846 VOST
1,1-Dichloroethene	98	(63 - 150)			SW846 VOST
	93	(63 - 150)	5.5	(0-25)	SW846 VOST
Toluene	90	(64 - 128)			SW846 VOST
	93	(64 - 128)	3.2	(0-25)	SW846 VOST
Trichloroethene	96	(72 - 150)			SW846 VOST
	102	(72 - 150)	5.5	(0-25)	SW846 VOST

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	77	(50 - 134)
	93	(50 - 134)
1,2-Dichloroethane-d4	69	(50 - 134)
	93	(50 - 134)
Toluene-d8	95	(57 - 127)
	99	(57 - 127)
Bromofluorobenzene	79	(50 - 125)
	94	(50 - 125)

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Bold print denotes control parameters

LABORATORY CONTROL SAMPLE DATA REPORT

GC/MS Volatiles

Client Lot #...: H7G260160 Work Order #...: J3LKQ1AC-LCS Matrix.....: AIR
LCS Lot-Sample#: H7G260000-287 J3LKQ1AD-LCSD
Prep Date.....: 07/27/07 Analysis Date..: 07/27/07
Prep Batch #...: 7207287
Dilution Factor: 1

PARAMETER	SPIKE AMOUNT	MEASURED AMOUNT	UNITS	PERCENT RECOVERY	RPD	METHOD
Benzene	0.250	0.218	ug	87		SW846 VOST
	0.250	0.240	ug	96	9.9	SW846 VOST
Chlorobenzene	0.250	0.189	ug	76		SW846 VOST
	0.250	0.215	ug	86	13	SW846 VOST
1,1-Dichloroethene	0.250	0.246	ug	98		SW846 VOST
	0.250	0.233	ug	93	5.5	SW846 VOST
Toluene	0.250	0.226	ug	90		SW846 VOST
	0.250	0.233	ug	93	3.2	SW846 VOST
Trichloroethene	0.250	0.241	ug	96		SW846 VOST
	0.250	0.255	ug	102	5.5	SW846 VOST

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	77	(50 - 134)
	93	(50 - 134)
1,2-Dichloroethane-d4	69	(50 - 134)
	93	(50 - 134)
Toluene-d8	95	(57 - 127)
	99	(57 - 127)
Bromofluorobenzene	79	(50 - 125)
	94	(50 - 125)

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Bold print denotes control parameters

METHOD BLANK REPORT

GC/MS Volatiles

Client Lot #...: H7G260160 Work Order #...: J3N2M1AA Matrix.....: AIR
MB Lot-Sample #: H7G270000-163

Prep Date.....: 07/30/07
Analysis Date..: 07/30/07 Prep Batch #...: 7208163
Dilution Factor: 1

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD
Acetone	ND	0.10	ug	SW846 VOST
Benzene	ND	0.010	ug	SW846 VOST
Bromobenzene	ND	0.010	ug	SW846 VOST
Bromochloromethane	ND	0.025	ug	SW846 VOST
Bromodichloromethane	ND	0.010	ug	SW846 VOST
Bromoform	ND	0.025	ug	SW846 VOST
Bromomethane	ND	0.050	ug	SW846 VOST
2-Butanone	ND	0.10	ug	SW846 VOST
n-Butylbenzene	ND	0.010	ug	SW846 VOST
sec-Butylbenzene	ND	0.010	ug	SW846 VOST
tert-Butylbenzene	ND	0.010	ug	SW846 VOST
Carbon disulfide	ND	0.010	ug	SW846 VOST
Carbon tetrachloride	ND	0.010	ug	SW846 VOST
Chlorobenzene	ND	0.010	ug	SW846 VOST
Chlorodibromomethane	ND	0.025	ug	SW846 VOST
Chloroethane	ND	0.050	ug	SW846 VOST
Chloroform	ND	0.010	ug	SW846 VOST
Chloromethane	ND	0.050	ug	SW846 VOST
2-Chlorotoluene	ND	0.010	ug	SW846 VOST
4-Chlorotoluene	ND	0.010	ug	SW846 VOST
1,2-Dibromo-3-chloropropane	ND	0.050	ug	SW846 VOST
1,2-Dibromoethane	ND	0.025	ug	SW846 VOST
Dibromomethane	ND	0.025	ug	SW846 VOST
1,2-Dichlorobenzene	ND	0.010	ug	SW846 VOST
1,3-Dichlorobenzene	ND	0.010	ug	SW846 VOST
1,4-Dichlorobenzene	ND	0.010	ug	SW846 VOST
Dichlorodifluoromethane	ND	0.025	ug	SW846 VOST
1,1-Dichloroethane	ND	0.010	ug	SW846 VOST
1,2-Dichloroethane	ND	0.010	ug	SW846 VOST
cis-1,2-Dichloroethene	ND	0.010	ug	SW846 VOST
trans-1,2-Dichloroethene	ND	0.010	ug	SW846 VOST
1,1-Dichloroethene	ND	0.010	ug	SW846 VOST
1,2-Dichloropropane	ND	0.010	ug	SW846 VOST
1,3-Dichloropropane	ND	0.010	ug	SW846 VOST
2,2-Dichloropropane	ND	0.010	ug	SW846 VOST
cis-1,3-Dichloropropene	ND	0.010	ug	SW846 VOST
trans-1,3-Dichloropropene	ND	0.010	ug	SW846 VOST
1,1-Dichloropropene	ND	0.010	ug	SW846 VOST
Ethylbenzene	ND	0.010	ug	SW846 VOST
Hexachlorobutadiene	ND	0.025	ug	SW846 VOST

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METHOD BLANK REPORT

GC/MS Volatiles

Client Lot #...: H7G260160 Work Order #...: J3N2M1AA Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD
2-Hexanone	ND	0.10	ug	SW846 VOST
Isopropylbenzene	ND	0.010	ug	SW846 VOST
p-Isopropyltoluene	ND	0.010	ug	SW846 VOST
Methylene chloride	ND	0.025	ug	SW846 VOST
4-Methyl-2-pentanone	ND	0.10	ug	SW846 VOST
Naphthalene	ND	0.025	ug	SW846 VOST
n-Propylbenzene	ND	0.010	ug	SW846 VOST
Styrene	ND	0.010	ug	SW846 VOST
1,1,1,2-Tetrachloroethane	ND	0.010	ug	SW846 VOST
1,1,2,2-Tetrachloroethane	ND	0.025	ug	SW846 VOST
Tetrachloroethene	ND	0.010	ug	SW846 VOST
Toluene	ND	0.010	ug	SW846 VOST
1,2,3-Trichlorobenzene	ND	0.025	ug	SW846 VOST
1,2,4-Trichloro-benzene	ND	0.025	ug	SW846 VOST
1,1,1-Trichloroethane	ND	0.025	ug	SW846 VOST
1,1,2-Trichloroethane	ND	0.025	ug	SW846 VOST
Trichloroethene	ND	0.010	ug	SW846 VOST
Trichlorofluoromethane	ND	0.050	ug	SW846 VOST
1,2,3-Trichloropropane	ND	0.025	ug	SW846 VOST
1,2,4-Trimethylbenzene	ND	0.010	ug	SW846 VOST
1,3,5-Trimethylbenzene	ND	0.010	ug	SW846 VOST
Vinyl chloride	ND	0.010	ug	SW846 VOST
m-Xylene & p-Xylene	ND	0.020	ug	SW846 VOST
o-Xylene	ND	0.010	ug	SW846 VOST

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	100	(50 - 134)
1,2-Dichloroethane-d4	97	(50 - 134)
Toluene-d8	96	(57 - 127)
Bromofluorobenzene	78	(50 - 125)

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Hoefler Consulting Group Inc

Method Blank Report

GC/MS Volatiles

Lot-Sample #: H7G270000-163 B **Work Order #:** J3N2M1AA **Matrix:** AIR

MASS SPECTROMETER/DATA SYSTEM (MSDS) TENTATIVELY IDENTIFIED COMPOUNDS

PARAMETER	CAS #	ESTIMATED RESULT	RETENTION TIME	UNITS
None				ug

LABORATORY CONTROL SAMPLE EVALUATION REPORT

GC/MS Volatiles

Client Lot #...: H7G260160 Work Order #...: J3N2M1AC-LCS Matrix.....: AIR
LCS Lot-Sample#: H7G270000-163 J3N2M1AD-LCSD
Prep Date.....: 07/30/07 Analysis Date..: 07/30/07
Prep Batch #...: 7208163
Dilution Factor: 1

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	RPD	RPD LIMITS	METHOD
Benzene	93	(69 - 130)			SW846 VOST
	95	(69 - 130)	1.9	(0-25)	SW846 VOST
Chlorobenzene	82	(70 - 116)			SW846 VOST
	84	(70 - 116)	2.2	(0-25)	SW846 VOST
1,1-Dichloroethene	101	(63 - 150)			SW846 VOST
	101	(63 - 150)	0.050	(0-25)	SW846 VOST
Toluene	90	(64 - 128)			SW846 VOST
	91	(64 - 128)	1.6	(0-25)	SW846 VOST
Trichloroethene	106	(72 - 150)			SW846 VOST
	113	(72 - 150)	6.6	(0-25)	SW846 VOST

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	95	(50 - 134)
	99	(50 - 134)
1,2-Dichloroethane-d4	91	(50 - 134)
	96	(50 - 134)
Toluene-d8	96	(57 - 127)
	101	(57 - 127)
Bromofluorobenzene	84	(50 - 125)
	88	(50 - 125)

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Bold print denotes control parameters

LABORATORY CONTROL SAMPLE DATA REPORT

GC/MS Volatiles

Client Lot #...: H7G260160 Work Order #...: J3N2M1AC-LCS Matrix.....: AIR
LCS Lot-Sample#: H7G270000-163 J3N2M1AD-LCSD
Prep Date.....: 07/30/07 Analysis Date..: 07/30/07
Prep Batch #...: 7208163
Dilution Factor: 1

PARAMETER	SPIKE AMOUNT	MEASURED AMOUNT	UNITS	PERCENT RECOVERY	RPD	METHOD
Benzene	0.250	0.232	ug	93		SW846 VOST
	0.250	0.237	ug	95	1.9	SW846 VOST
Chlorobenzene	0.250	0.206	ug	82		SW846 VOST
	0.250	0.210	ug	84	2.2	SW846 VOST
1,1-Dichloroethene	0.250	0.253	ug	101		SW846 VOST
	0.250	0.253	ug	101	0.050	SW846 VOST
Toluene	0.250	0.224	ug	90		SW846 VOST
	0.250	0.228	ug	91	1.6	SW846 VOST
Trichloroethene	0.250	0.265	ug	106		SW846 VOST
	0.250	0.283	ug	**113**	6.6	SW846 VOST

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Dibromofluoromethane	95	(50 - 134)
	99	(50 - 134)
1,2-Dichloroethane-d4	91	(50 - 134)
	96	(50 - 134)
Toluene-d8	96	(57 - 127)
	101	(57 - 127)
Bromofluorobenzene	84	(50 - 125)
	88	(50 - 125)

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Bold print denotes control parameters

AMTEST AIR QUALITY, LLC

Analysis Lab: TestAmerica Knoxville

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME
8752-001	Parametrix @ City of Tacoma Landfill - Perennial Stack

SAMPLERS: (*Signature*)

KEF, RDR, KJR, TWG

LAB #	DATE	TIME	COMP.	GRAB	LOCATION/DESCRIPTION	NUMBER OF CONTAINERS	Tenax Tube #1	Tenax Tube #2	Anasorb Tube		
4511	7/19/07	1510-1610		X	R-1A; #1 Perennial Gas Combustor	3	X	X	X		
4512	7/19/07	1620-1700		X	R-1B; #1 Perennial Gas Combustor	3	X	X	X		
4513	7/19/07	1719-1759		X	R-1C; #1 Perennial Gas Combustor	3	X	X	X		
	7/19/07			X	R-1 Field Blank	3	X	X	X		
4514	7/20/07	0831-0911		X	R-2A; #1 Perennial Gas Combustor	3	X	X	X		
4515	7/20/07	0926-1006		X	R-2B; #1 Perennial Gas Combustor	3	X	X	X		
4516	7/20/07	1028-1108		X	R-2C; #1 Perennial Gas Combustor	3	X	X	X		
	7/20/07			X	R-2 Field Blank	3	X	X	X		
4517	7/20/07	1138-1218		X	R-3A; #1 Perennial Gas Combustor	3	X	X	X		
4518	7/20/07	1232-1312		X	R-3B; #1 Perennial Gas Combustor	3	X	X	X		
4519	7/20/07	1325-1405		X	R-3C; #1 Perennial Gas Combustor	3	X	X	X		
	7/20/07			X	R-3 Field Blank	3	X	X	X		
	7/20/07			X	Trip Blank	3	X	X	X		
LB*					Lab Blank*	3	X	X	X		

Client Name	AMTEST AIR QUALITY, A Division of Hoefler Group
Client Address	30545 SE 84th St., #5 / PO Box 525 / Preston, WA 98050
Client Phone/Fax	425-222-7746 / 425-222-7849 (fax)
Contact Person	Matt Caron
P.O. Number	8752-001
Analysis: VOA by EPA SW-846 Method 0031/TO-15	
Please report sample results in µg/sample.	
*Lab Blank retained by laboratory	

Relinquished by: (*Signature*)	Date/Time	Received by: (*Signature*)	Relinquished by: (*Signature*)	Date/Time	Received by: (*Signature*)
	7/24/07 1530				
Relinquished by: (*Signature*)	Date/Time	Received by: (*Signature*)	Relinquished by: (*Signature*)	Date/Time	Received by: (*Signature*)
Relinquished by: (*Signature*)	Date/Time	Received for Laboratory by:	Date/Time	Remarks	

SAP -- Project Design Template

SAP Project #:	LID-8644R
Applicant -- Project Requester:	Ralph Rodriguez
Designed By :	Mike Garrison
Phone Number :	591-5336
Mandatory Data Fields - All Projects:	
Project Title :	LID-8644R
Person Responsible / Project Lead :	Ralph Rodriguez
Start Date :	2/1/2008
End Date :	12/31/2011
Planned Project Cost :	$939,750
Company Code :	City
Department :	Public Works
Section :	Construction
Responsible Cost Center:	661600
SAP Fund :	1060
Grant # :	
General Government Data Fields	
Neighborhood District :	North End & Central
Council District :	#2 & #3
Six-Year Program Category :	LID Participation
SAP Project Mask	LID XXXXX-XX-XX-XX-X-X

Optional Fields	
Map #	
Drawing #	
Overhead Key	12

Capital Facilities Levels	
Level 1	General Government
Level 2	Transportation Facilities
Level 3	Road Systems & Amenities
Level 4	LID Participation Program

Max 7 levels

Complete for each row of information on WBS

WBS Level (1-7)	WBS #	WBS - Description (40 characters maximum)	Z1 or Z2	Plan Elem X	Acct Level (X)	Billable (X)	Settlement	Settlement	List PM's (If Any)	Revenue Cost Element	Revenue Amount
1	LID-8644R	LID - 8644R	Z1	x	x		AUC				
2	LID-8644R-01	Preliminary Engineering	Z2	x	x		LID-8644R				
2	LID-8644R-02	Construction Engineering	Z2	x	x		LID-8644R				
2	LID-8644R-03	Other Costs	Z2	x	x		LID-8644R				
2	LID-8644R-04	Treasury Costs	Z2	x	x		LID-8644R				
2	LID-8644R-05	Contractor Payments	Z2	x	x		LID-8644R				
2	LID-8644R-FS	Funding Sources	Z2								
3	LID-8644R-FS-AD	AD-Adopted Budget	Z2	x							
4	LID-8644R-FS-AD-01	AD-Fund Revenues	Z2	x	x		661600				
4	LID-8644R-FS-AD-02	AD-Contribution from Other Funds	Z2	x	x		661600			8611010	$697,740.00
4	LID-8644R-FS-AD-03	AD-Proceeds from Financing	Z2	x	x		661600				
4	LID-8644R-FS-AD-04	AD-Federal and State Grants	Z2	x	x	x	661600				
4	LID-8644R-FS-AD-05	AD-Interlocal Revenues	Z2	x	x		661600				
4	LID-8644R-FS-AD-06	AD-Property Owner Assessments	Z2	x	x	x	661600			4368110	$136,660.35
4	LID-8644R-FS-AD-07	AD-Other	Z2	x	x		661600				
4	LID-8644R-FS-AD-08	AD-Const Participation; Prop Funds	Z2	x	x		LID-8644R			8311245	$103,350.00
3	LID-8644R-FS-AN	AN-Anticipated Funding	Z2	x							
4	LID-8644R-FS-AN-01	AN-Fund Revenues	Z2	x							
4	LID-8644R-FS-AN-02	AN-Contributions from Other Funds	Z2	x							

APPENDIX C

Example Calculations and Field Data Sheets

EXAMPLE CALCULATION SHEET
EPA METHODS 1, 2, 3, AND 4
PSYCHROMETRIC MOISTURE
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX@CTL-M1-4 INLET
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Site: Perennial #1 Landfill Gas Combuster Inlet
Date: 7/19/07
Lab #: —
Run #: 1A - Method 2

Psychrometric Moisture

Wet Bulb Temperature (T_w) = 78 °F
Dry Bulb Temperature (T_d) = 96 °F
Barometric Pressure (P_{bar}) = 29.7 " Hg
Static Pressure (P_{static}) = 5.80 " H_2O
Stack Pressure (P_s) = 30.13 " Hg $P_s = P_{bar} + (P_{static}/13.6)$ (P_s is also refered to as Absolute Pressure P_a)

SVP = Saturated Vapor Pressure (" Hg)
VP = Vapor Pressure (" Hg)

$$SVP = [\,0.000000000000000177506 * (T_w)^6 + 0.000000000321411 * (T_w)^5 + 0.0000000034906 * (T_w)^4 + 0.000000508299 * (T_w)^3 + 0.0000477395 * (T_w)^2 + 0.00222231 * (T_w) + 0.0361287\,]$$

= 0.9671 " Hg

VP = SVP - [(P_S - SVP) * (T_d - T_w) / (2800 - (1.3 * T_w))

= 0.9671 - ((30.13 - 0.9671) * (96 - 78) / (2800 - (1.3 * 78))

= 0.7683 " Hg

B_{ws} = VP / PS = 0.7683 / 30.13

B_{ws} = 0.0255 * 100 % = % Psychrometric Moisture

% H_2O = 2.55 % Psychrometric Moisture

Molecular Weight - Equation 3-2

M_d = 0.440 * (22.3 %CO_2) + 0.320 * (3.4 % O_2) + 0.160 * (24.7 % CH_4) + 0.280 * (100% 22.3 %CO_2 - 3.4 %O_2 - 24.7 CH_4 (%CO + %N_2))

= 28.74 g/g-mole (dry)

M_s = Md*(1-B_{ws})+18.0 *B_{ws} = 28.74 g/g-mole * (1 - 0.0255) + 18.0 g/g-mole * 0.0255

= 28.47 g/g-mole (wet)

Fo = (20.9 - % O_2)/ %CO_2 = 0.78

The above calculations are from the 40 CFR 60 and assume English units

EXAMPLE CALCULATION SHEET
EPA METHODS 1, 2, 3, AND 4
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX@CTL-M1-4 INLET
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Site: Perennial #1 Landfill Gas Combuster Inlet
Date: 7/19/07
Lab #: —
Run #: 1A - Method 2

Stack gas velocity and volumetric flow rate - Equations 2-9 and 2-10

$V_s = 85.49 * C_p \sqrt{(\Delta P * T_s\ ^\circ R / (M_s\ g/gmole * P_s\ "Hg)}$ [Ps = Pbar + Pstatic / 13.6]

$= 85.49 * 0.99 \sqrt{0.149 * 564.6 / (28.47 * 30.13)}$ [30.13 = 29.70 + 5.800 / 13.6]

$= 26.5$ ft/sec

$Q_{std} = 60 * (1 - B_{ws}) * V_s * A_s * T_{std}/T_s * P_s/P_{std}$ [$A_s = \pi (S_{dia})^2 /4/144$ (ft^2)] or [$A_s = W * L / 144$ (ft^2)]

$= 60 * (1 - 0.0255) * 26.5 * 0.545 * 528 / 564.6 * 30.13 / 29.92$

$= 795.9$ dscf/min (dry standard cubic feet per minute)

acfm = 26.5 ft/sec * 0.545 ft^2 * 60 sec/min

= 867.4 acfm (actual cubic feet per minute)

The above calculations are from the 40 CFR 60 and assume English units.

STRATA BIAS CORRECTION EXAMPLE CALCULATION
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX@CTL GASSUM-OUT
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Site: Perennial #1 Landfill Gas Combuster Outlet

$$C_{corrected} = C - C_o * [C_{ma}/(C_m - C_o)]$$

where: C = 11.598 concentration of gas, as indicated by analyzer (run average)

C_o = 0.003 (initial zero average - zero average) / 2

C_{ma} = 12.000 reference span gas cylinder concentration

C_m = 11.945 (initial span average - span average) / 2

	Analyte	Date	Run Time
Run 1	Oxygen (O_2)	7/19/07	1510-1732

Gas	C_{ma}	Initial zero average	zero average	C_o	initial span average	span average	C_m	C	$C_{corrected}$
O_2	12.000	0.003	0.003	0.003	11.947	11.943	11.945	11.598	11.651

11.652
PASS

EXAMPLE CALCULATION SHEET (O_2)
EPA METHOD 3C - OXYGEN (O_2)
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Site: Perennial #1 Landfill Gas Combuster Inlet
Date: 7/19/07
Run #: 1

Airflow = 791.2 dscf/min

Gas Constant = 24.055 mL/m-mole at 20°C (293.15°K) (68°F)

Oxygen (O_2) MW = 32.00 g/g-mole

OXYGEN (O_2) EMISSIONS

O_2 = 3.40 % 0.10 = O_2 Detection Limit (DL or U) (If the concentration is less than the DL then the DL is used in the calculations and qualified as U, Undetected.)

O_2 = 3.40 % O_2 * 10,000 ppm / %

= 34000 ppm

O_2 = 34000 ppm * 32.00 g/g-mole / 24.055 L/g-mole * 1000 L / m^3 / 1.E+06 ppm

= 45.2 g/m^3

O_2 = 45.2 g/m^3 * m^3 / 35.31 ft^3 * 791.2 dscf/min 453.6 g / lb * 60 min / hr

= 134.1 lb/hr

EXAMPLE CALCULATION SHEET (N_2)
EPA METHOD 3C - NITROGEN (N_2)
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Site: Perennial #1 Landfill Gas Combuster Inlet
Date: 7/19/07
Run #: 1

Airflow = 791.2 dscf/min

Gas Constant = 24.055 mL/m-mole at 20°C (293.15°K) (68°F)

Nitrogen (N_2) MW = 28.01 g/g-mole

NITROGEN (N_2) EMISSIONS

N_2 = 49.50 % 0.10 = N_2 Detection Limit (DL or U)

(If the concentration is less than the DL then the DL is used in the calculations and qualified as U, Undetected.)

N_2 = 49.50 % N_2 * 10,000 ppm / %

= 495000 ppm

N_2 = 495000 ppm * 28.01 g/g-mole / 24.055 L/g-mole * 1000 L / m^3 / 1.E+06 ppm

= 576.39 g/m^3

N_2 = 576.4 g/m^3 * m^3 / 35.31 ft^3 * 791.2 dscf/min 453.6 g / lb * 60 min / hr

= 1708.4 lb/hr

EXAMPLE CALCULATION SHEET (CO_2)
EPA METHOD 3C - CARBON DIOXIDE (CO_2)
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Site: Perennial #1 Landfill Gas Combuster Inlet
Date: 7/19/07
Run #: 1

Airflow = 791.2 dscf/min

Gas Constant = 24.055 mL/m-mole at 20°C (293.15°K) (68°F)

Carbon Dioxide (CO_2) MW = 44.01 g/g-mole

CARBON DIOXIDE (CO_2) EMISSIONS

CO_2 = 22.30 % 0.10 = CO_2 Detection Limit (DL or U) (If the concentration is less than the DL then the DL is used in the calculations and qualified as U, Undetected.)

CO_2 = 22.30 % CO_2 * 10,000 ppm / %

= 223000 ppm

CO_2 = 223000 ppm * 44.01 g/g-mole / 24.055 L/g-mole * 1000 L / m^3 / 1 E+06 ppm

= 408.0 g/m^3

CO_2 = 408.0 g/m^3 * m^3 / 35.31 ft^3 * 791.2 dscf/min 453.6 g / lb * 60 min / hr

= 1209.3 lb/hr

EXAMPLE CALCULATION SHEET (CO)
EPA METHOD 3C - CARBON MONOXIDE (CO)
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Site: Perennial #1 Landfill Gas Combuster Inlet
Date: 7/19/07
Run #: 1

Airflow = 791.2 dscf/min

Gas Constant = 24.055 mL/m-mole at 20°C (293.15°K) (68°F)

Carbon Monoxide (CO) MW = 28.01 g/g-mole

CARBON MONOXIDE (CO) EMISSIONS

CO = 0.10 % U 0.10 = CO Detection Limit (DL or U)

(If the concentration is less than the DL then the DL is used in the calculations and qualified as U, Undetected.)

CO = 0.10 % CO * 10,000 ppm / %

= 1000 ppm U

=

CO = 1000 ppm CO * 28.01 g/g-mole / 24.055 L/g-mole * 1000 L / m^3 * 1 / 1.E+06 ppm

= 1.16 g/m^3 U

=

CO = 1.16 g/m^3 CO * m^3 / 35.31 ft^3 * 791.2 dscf/min * lb / 453.6 g * 60 min / hr

= 3.45 lb/hr U

780

EXAMPLE CALCULATION SHEET (CH_4)
EPA METHOD 3C - METHANE (CH_4)
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Site: Perennial #1 Landfill Gas Combuster Inlet
Date: 7/19/07
Run #: 1

Airflow = 791.2 dscf/min

Gas Constant = 24.055 mL/m-mole at 20°C (293.15°K) (68°F)
Methane (CH_4) MW = 16.04 g/g-mole

EPA METHOD 3 - METHANE (CH_4)

CH_4 = 24.70 % 0.10 = CH_4 Detection Limit (DL or U) (If the concentration is less than the DL then the DL is used in the calculations and qualified as U, Undetected.)

CH_4 = 24.70 % CH_4 * 10,000 ppm / %

= 247000 ppm

CH_4 = 247000 ppm CH_4 * 16.04 g/g-mole / 24.055 L/g-mole * 1000 L / m^3 / 1.E+06 ppm

= 164.7 g/m^3

CH_4 = 164.7 g/m^3 CH_4 * m^3 / 35.31 ft^3 * 791.2 dscf/min / 453.6 g/lb * 60 min / hr

= 488.2 lb/hr

EXAMPLE CALCULATION SHEET (NMOC)
EPA METHOD 3C - NON-METHANE ORGANIC COMPOUNDS (AS CH_4)
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Site: Perennial #1 Landfill Gas Combuster Inlet
Date: 7/19/07
Run #: 1

Airflow = 791.2 dscf/min

Gas Constant = 24.055 mL/m-mole at 20°C (293.15°K) (68°F)
Methane (CH_4) MW = 16.04 g/g-mole

EPA METHOD 3 - NON-METHANE ORGANIC COMPOUNDS - NMOC (AS CH_4)

NMOC = 738.0 ppm 1.00 = CH_4 Detection Limit (DL or U) (If the concentration is less than the DL then the DL is used in the calculations and qualified as U, Undetected.)

NMOC = 738.0 ppm as CH_4 * 16.04 g/g-mole / 24.055 L/g-mole * 1000 L / m^3 / 1.E+06 ppm
= 0.492 g/m^3

NMOC = 0.492 g/m^3 as CH_4 * m^3 / 35.31 ft^3 * 791.2 dscf/min / 453.6 g/lb * 60 min / hr
= 1.46 lb/hr

EXAMPLE CALCULATION SHEET (SO_2)

EPA METHOD 6C - SULFUR DIOXIDE (SO_2)

AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Site: Perennial #1 Landfill Gas Combuster Outlet
Date: 7/19/07
Run #: 1

Oxygen Measured = 11.7 % O_2
Airflow = 9792.7 dscf/min

SO_2 Measured by analyzer = 0.2 ppm U 1.0 = SO_2 Detection Limit

SO_2 = 0.2 ppm * 1.660E-07 lb/scf * 9792.7 dscf/min * 60 min / hr

= 0.022 lb/hr U 1.660E-07 lb/scf is a conversion factor for SO_2 as specified in EPA Method 19, Table 19.1

EXAMPLE CALCULATION SHEET (NO_x)
EPA METHOD 7E - NITROGEN OXIDES (NO_x)
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Site: Perennial #1 Landfill Gas Combuster Outlet
Date: 7/19/07
Run #: 1

Oxygen Measured = 11.7 % O_2
Airflow = 9792.7 dscf/min

Gas Constant = 24.055 mL/m-mole at 20°C = 68°F (293.15°K)
NO_x as NO_2 MW = 46.01 g/g-mole

NITROGEN OXIDES (NOx as NO_2) EMISSIONS

NO_x Measured by analyzer = 10.6 ppm 0.1 = NO_x Detection Limit

NO_x = 10.6 ppm * 1.194E-07 lb/scf * 9792.7 dscf/min * 60 min

= 0.746 lb/hr 1.194E-07 lb/scf is a conversion factor for NO_x as specified in EPA Method 19, Table 19.1. This factor assumes a MW as NO_2

284

EXAMPLE CALCULATION SHEET (CO)
EPA METHOD 10 - CARBON MONOXIDE (CO)
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Site: Perennial #1 Landfill Gas Combuator Outlet
Date: 7/19/07
Run #: 1

Oxygen Measured = 11.7 % O_2
Airflow = 9792.7 dscf/min

Gas Constant = 24.056 mL/m-mole at 20°C = 68°F (293.15°K)
CO MW = 28.01 g/g-mole

CARBON MONOXIDE (CO EMISSIONS

CO Measured by analyzer = 45.9 ppm 1.0 = CO Detection Limit

CO = 45.9 ppm CO * 28.01 g/g-mole / 24.055 L/g-mole * 1000 L / m^3 1 E+06 ppm * 35.31 ft^3/m^3 * 9792.7 dscf/min * 453.6 g/lb * 60 min/hr

= 1.96 lb/hr

EXAMPLE CALCULATION SHEET (NMOC 1)
EPA METHOD 25A
NON-METHANE ORGANIC COMPOUNDS (NMOC)
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX@CTL GASSUM-OUT
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Site: Perennial #1 Landfill Gas Combuster Outlet
Date: 7/19/07
Run #: 1

Percent Moisture = 8.17 % Bws: 0.0817
Oxygen Concentration = 11.7 %
Stack Gas Airflow (STO) = 9792.7 dscf/min

Gas Constant = 24.055 mL/m-mole at 20°C = 68°F (293.15°K)
Methane (CH_4) Molecular Weight = 16.04 g/g-mole

EPA METHOD 25A - TOTAL HYDROCARBONS (THC)

(THC as methane)

THC Detection Limit = 1.0 ppm, dry

THC Measured by analyzer = 10.2 ppm, wet

THC = 10.2 ppm / (1 - 0.0817) (ppm, dry) = (ppm, wet) / (1 - Bws)

= 11.1 ppm, dry (If the THC is undetected "U" then there is no moisture correction and the Detection Limit ppm, dry is used.)

THC = 11.1 ppm * 16.04 g/g-mole / 24.055 L/g-mole * 1000 L/m^3 / 1 E+06 ppm

= 0.007 g/m^3 / 35.31 ft^3/m^3 * 9793 dscf/min / 453.6 g/lb * 60 min/hr

= 0.272 lb/hr 0.024 lb/hr Detection Limit

EPA METHOD 25A - METHANE (CH_4)

CH_4 Detection Limit = 1.0 ppm, dry

CH_4 Measured by M25A = 11.2 ppm, wet

CH_4 = 11.2 ppm / (1 - 0.0817) (ppm, dry) = (ppm, wet) / (1 - Bws)

= 12.2 ppm, dry (If CH_4 is undetected "U" then there is no moisture correction and the Detection Limit ppm, dry is used.)

CH_4 = 12.2 ppm * 16.04 g/g-mole / 24.055 L/g-mole * 1000 L/m^3 / 1.E+06 ppm

= 0.006 g/m^3 / 35.31 ft^3/m^3 * 9793 dscf/min / 453.6 g/lb * 60 min/hr

= 0.298 lb/hr

NON-METHANE ORGANIC COMPOUNDS

(NMOC, as methane)

NMOC = THC (lb/hr) - CH_4 (lb/hr) = NMOC (lb/hr)

= 0.272 - 0.298 (If the CH_4 or is "U", then 0 is used for the calculation.)

= 0.024 lb/hr U (If THC is "U" then the result is reported as the DL of THC or if CH_4 > THC then the result is reported as DL of THC.)

= 0.024 lb/hr / [16.04 g/g-mole / 24.055 L/g-mole * 1000 L/m^3 / 1 E+06 ppm

/ 35.31 ft^3/m^3 * 9793 dscf/min / 453.6 g/lb * 60 min/hr]

NMOC = 1.0 ppm U (Calculated from NMNEOC (lb/hr), as propane. As shown above.)

= 1.0 ppm * (20.9 - NA % O_2) / (20.9 - 11.7 % O_2)

EXAMPLE CALCULATION SHEET (NMOC 2)
EPA METHOD 25A
NON-METHANE ORGANIC COMPOUNDS (NMOC)
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Site: Perennial #1 Landfill Gas Combuster Outlet
Date: 7/19/07
Run #: 1

Bws: = 0.0817 % Moisture = Bws * 100% = 8.2 %
Oxygen Measured = 11.7 % O_2
Stack Gas Airflow(STD) = 9792.7 dscf/min

Gas Constant = 24.055 mL/m-mole at 20°C = 68°F (293.15°K)
Methane (CH_4) Molecular Weight = 16.04 g/g-mole
Carbon (C) Molecular Weight = 12.01 g/g-mole
Methane to Carbon Factor = 1

EPA METHOD 25A - NON-METHANE ORGANIC COMPOUNDS (NMOC)
(NMOC as methane)

NMOC from ExCalc - NMOC 1 = 0.024 lb/hr U

NMOC from ExCalc - NMOC 2 = 1.0 ppm- dry U

EPA METHOD 25A - NON-METHANE ORGANIC COMPOUNDS (NMOC)
(NMOC as Carbon)

= 1.0 ppm, dry as propane * 1 = ppm THC as Carbon (1 is the method 25A factor for converting methane to carbon, because methane contains 1 carbon atom.)

= 1.0 ppm, dry as carbon U

NMOC = 1.0 ppm * 12.01 g/g-mole / 24.055 L/g-mole * 1000 L/m^3 / 1.E+06 ppm

= 0.0005 g/m^3 / 35.31 ft^3/m^3 * 9792.7 dscf/min / 453.6 g/lb * 60 min/hr

= 0.018 lb/hr U

EXAMPLE CALCULATION SHEET

EPA METHODS 1, 2, 3, 4, AND 26A

AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX@CTL M26A
Client:	Parametrix @ City of Tacoma Landfill
Location:	Tacoma, Washington
Site:	1/0/00
Date:	7/19/07
Lab #:	4504
Run #:	1 - Method 26A

Dry Gas Meter Standard Volume - Equation 5-1

Vm_{std} = 17.647(°R/"Hg $_{(constant)}$) * volume sampled * Y_{factor} * (P_{bar} + ΔH / 13.6) / (460 + T_M)

= 17.647 * 84.358 ft^3 * 1.003 *(29.70 + 1.570 / 13.6)/(460 + 82.5 °F)

= 82.062 dscf / 35.31 ft^3/m^3 = 2.324 dscm

Moisture - Equation 5-2 and 5-3

Vw_{std} = 0.04715 ft^3/gm * 154.8 grams of H_2O collected in impingers = 7.299 scf H_2O

B_{WS} = (7.299) scf /(7.299 scf + 82.062 dscf) = 0.0817 B_{WS} * 100% = 8.17 % H_2O

Measured Moisture = 8.17 % **Psychrometric Moisture =** NA %

Actual Moisture = 8.17 % **Actual B_{WS} =** 0.0817

Actual moisture is determined by the lower of the measured moisture vs. the psychrometric moisture; since it is theoretically impossible for the % moisture to be higher than the psychrometric moisture. If the psychrometric moisture is higher than the measured moisture it is reported as NA.

Molecular Weight - Equation 3-2

M_d = 0.440 * (7.80 %CO_2)+0.320*(11.7 % O_2)+0.280*(100%- 7.80 %CO_2- 11.7 %O_2(%CO+%N_2))

= 29.72 g/g-mole (dry)

M_s = Md*(1-B_{WS})+18.0 *B_{WS} = 29.72 g/g-mole *(1- 0.0817)+18.0g/g-mole* 0.0817

= 28.76 g/g-mole (wet)

Fo = (20.9 - % O_2)/ %CO_2 = 1.18

Meter Box Calibration Error

$$Yqa = \frac{\theta}{Vm} * \sqrt{\frac{0.0319 * T_m * \Delta H_{avg} * 29}{\Delta H@ * (Pm) * Md}} = \frac{120}{84.358} \sqrt{\frac{0.0319 * 542.5 * 1.570 * 29}{1.941 * 29.82 * 29.72}}$$

= 0.963 (Pm = (Pbar + ΔH / 13.6) = 29.70 + 1.570 / 13.6 = 29.82)

% Error = (Y_{qa} - Y) / Y_{qa} * 100 % Y = 1.003 = (0.963 - 1.003) / 0.963 * 100% =

= -4.2 % Percent error must be less than 5% or a post test dry gas meter calibration is required.

The above calculations are from the 40 CFR 60 and assume English units.

EXAMPLE CALCULATION SHEET (2)

EPA METHODS 1, 2, 3, 4, AND 26A

AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name: 8752-001\PX@CTL M26A
Client: Parametrix @ City of Tacoma Landfill
Location: Tacoma, Washington
Site: 0
Date: 7/19/07
Lab #: 4504
Run #: 1 - Method 26A

Stack gas velocity and volumetric flow rate - Equations 2-9 and 2-10

$V_s = 85.49 * C_p \sqrt{(\Delta P * T_s\ ^\circ R / (M_s\ g/gmole * P_s\ "Hg)}$ [Ps = Pbar + Pstatic / 13.6]

$= \underline{85.49} * \underline{0.84} \sqrt{\underline{0.006} * \underline{1857.4} / (\underline{28.76} * \underline{29.70})}$ [29.70 = 29.70 + -0.01 / 13.6]

$= \underline{8.29}$ ft/sec

$Q_{std} = 60 * (1 - B_{ws}) * V_s * A_s * T_{std}/T_s * P_s/P_{std}$ [$A_s = \pi (S_{dia})^2 / 4 / 144$ (ft^2)] or [$As = L * W / 144$ (ft^2)]

$= \underline{60} * (1 - \underline{0.0817}) * \underline{8.29} * \underline{75.9} * \underline{528} / \underline{1857} * \underline{29.70} / \underline{29.92}$

$= \underline{9792.7}$ dscf/min (dry standard cubic feet per minute)

acfm = 8.29 ft/sec * 75.9 ft^2 * 60 sec/min

= **37792.4** acfm (actual cubic feet per minute)

Isokinetic Variation - Equation 5-8

$$\% \text{ Isokinetics} = \frac{0.0945 * Vm(std)\ dscf * Ts\ ^\circ R}{[P_s\text{" Hg} * Vs\ ft/sec * \theta\ minutes * A_n\ ft^2 * (1 - B_{ws})]}$$

[$An = \pi (Ndia)^2 / 4 / 144$ (ft^2)]

$$= \frac{\underline{0.0945} * \underline{82.06153} * \underline{1857.4}}{[\underline{29.70} * \underline{8.29} * \underline{120} * \underline{0.0052} * (\underline{1} - \underline{0.0817})]}$$

= **103** % Isokinetics

The above calculations are from the 40 CFR 60 and assume English units.

EXAMPLE CALCULATION SHEET (HCl)
EPA METHODS 1, 2, 3, 4 AND 26A
HYDROGEN CHLORIDE (HCl)
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX@CTL M26A
Client:	Parametrix @ City of Tacoma Landfill
Location:	Tacoma, Washington
Site:	Perennial #1 Landfill Gas Combuster Outlet
Date:	7/19/07
Lab #:	4504
Run #:	1 - Method 26A

Hydrogen Chloride (HCl) Emission Calculations (Blank Corrected)

Volume sampled ($V_{m\,STD}$):	**2.324** **dscm**	
Stack Airflow (dscf/m):	**9792.7** **dscf/min**	
Cl in Sample (µg):	**2200** **µg**	**(These results are blank corrected.)**
Cl in Sample (mg):	**2.200** **mg**	**(µg/1000 = mg)**
Cl Molecular Wt. (MW_{Cl^-}):	**35.453** **mg/mmole**	
HCl Molecular Wt. (MW_{HCl}):	**36.460** **mg/mmole**	
Gas Constant:	**24.055** **mL/m-mole at 20°C (293.15°R) (68°F)**	

mg Cl = µg as Cl * mg/1000 µg = mg as Cl

2200 µg* mg/1000 µg = **2.2** mg Cl

mg HCl = mg as Cl * 36.46 mg HCl /m-mole / 35.453 mg HCl /m-mole = mg as HCl

2.2 * 36.460 / 35.45 = **2.26** mg HCl

mg/dscm = HCl (mg) / Vm_{STD} dscm = mg/dscm

= 2.26 / 2.324

= **0.974** mg/dscm HCl

ppm = HCl (mg/dscm) * 24.055 mL/m-mole / 36.46 mg HCl / m-mole * m^3 / 10^6mL * 10^6ppm

= 0.974 * 24.055 / 36.46 * 10^6 / 10^6

= **0.642** ppm

lb/hr = HCl (mg/dscm) / 35.31 dscf/dscm * airflow (dscf/min) /453600 mg/lb * 60 min/hr

= 0.974 / 35.31 dscf/dscm * 9792.7 / 453600 * 60

= **0.036** lb/hr HCl

EXAMPLE CALCULATION SHEET (HF)
EPA METHODS 1, 2, 3, 4 AND 26A
HYDROGEN FLUORIDE (HF)
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX@CTL M26A
Client:	Parametrix @ City of Tacoma Landfill
Location:	Tacoma, Washington
Site:	Perennial #1 Landfill Gas Combuster Outlet
Date:	7/19/07
Lab #:	4504
Run #:	1 - Method 26A

Hydrogen Fluoride (HF) Emission Calculations (Blank Corrected)

Volume sampled ($V_{m\ STD}$):	**2.324** dscm	
Stack Airflow (dscf/m):	**9792.7** dscf/min	
F in Sample (µg):	**1700** µg	**(These results are blank corrected.)**
F in Sample (mg):	**1.700** mg	**(µg/1000 = mg)**
F Molecular Wt. (MW_{F^-}):	**19.00** mg/mmole	
F Molecular Wt. (MW_{HF}):	**20.01** mg/mmole	
Gas Constant:	**24.055** mL/m-mole at 20°C (293.15°R) (68°F)	

mg F = µg as F * mg/1000 µg = mg as F

1700 µg* mg/1000 µg = 1.7 mg F

mg HF = mg as F * 20.01mg HF /m-mole / 19 mg HF /m-mole = mg as HF

1.7 * 20.01 / 19.00 = **1.79** mg HF

mg/dscm = HF (mg) / Vm_{STD} dscm = mg/dscm

= 1.79 / 2.324

= **0.770** mg/dscm HF

ppm = HF (mg/dscm) * 24.055 mL/m-mole / 20.01 mg HF / m-mole * m^3 / 10^6mL * 10^6ppm

= 0.770 * 24.055 / 20.01 * 10^6 / 10^6

= **0.926** ppm

lb/hr = HF (mg/dscm) / 35.31 dscf/dscm * airflow (dscf/min) /453600 mg/lb * 60 min/hr

= 0.770 / 35.31 dscf/dscm * 9792.7 / 453600 * 60

= **0.028** lb/hr HF

EXAMPLE CALCULATION SHEET (1)
EMISSION CONCENTRATION RESULTS
TO-14A VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX@CTL TO-15
Client:	Parametrix @ City of Tacoma Landfill
Location:	Tacoma, Washington
Site:	#1 Perennial Combuster Inlet
Date:	7/19/07
Lab #:	4507
Run #:	1

Example Compound: Propylene

Stack Airflow: 791.2 dscf/min

Analyte in Sample: 4560.0 $\mu g/m^3$

lb/hr = (μg/dscm) / 1000 $\mu g/mg$ / 35.31 ft^3/m^3 * dscf/min / 453600 mg/lb * 60 min/hr

= 4560.0 / 1000 $\mu g/mg$ / 35.31 ft^3/m^3 * 791.2 / 453600 mg/lb * 60 min/hr

= 1.35E-02 lb/hr Propylene

EXAMPLE CALCULATION SHEET (VOLUME BY FLOW)

EPA SW-846 METHOD 0031

AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	**8752-001\PX @ CTL M0031**
Client:	**Parametrix @ City of Tacoma Landfill**
Location:	**Tacoma, Washington**
Site:	**Perennial #1 Landfill Gas Combuster Outlet**
Date:	**7/19/07**
Lab #:	**4511**
Run #:	1A

Dry Gas Meter Standard Volume

Average Sample Flow Rate:	495.13 mL/min	cc/min = mL/min
Sample Time:	40 min	
Barometric Pressure:	29.70 "Hg	
Ambient Temperature:	67 °F	
Ambient Temperature:	527 °R	(Degrees F + 460)

$$SVP = [\ 0.000000000000000177506 * (T_w)^6 + 0.0000000000321411 * (T_w)^5 + 0.0000000034906 * (T_w)^4 + 0.000000508299 * (T_w)^3 + 0.0000477395 * (T_w)^2 + 0.00222231 * (T_w) + 0.0361287\ ]$$

$$= 0.6675 \text{ " Hg}$$

$$VP = SVP - ((P_S - SVP) * (/ (2800 - (1.3 * T_a))$$

$$= 0.6675 - ((29.70 - 0.668) * (67.0 - 67.0) / (2800 - (1.3 * 67.0))$$

$$= 0.6675 \text{ " Hg}$$

Volume Sampled = 495.1 cc/min * 40 min / 1000 cc/l 19.8 **Liters**

= 19.81 L / 1000 = 0.0198 m^3

= 0.0198 m^3 * (P_{bar} - P_{vap}) / 29.92 "Hg * 528 °R / T_{amb}

= 0.0198 * (29.70 - 0.668) / 29.92 * 528 / 527.0

= 0.0193 dscm

EXAMPLE CALCULATION SHEET (1)
VOLATILE ORGANIC COMPOUNDS DESTRUCTION EFFICIENCY RESULTS
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031
Client:	Parametrix @ City of Tacoma Landfill
Location:	Tacoma, Washington
Site:	Perennial #1 Landfill Gas Combuster Outlet
Date:	7/18/07
Lab #:	4511 - 4513
Run #:	1

Example Compound: = Benzene

Stack Airflow: 9792.7 dscf/min

Analyte In Sample:	R1A	=	2.4	µg/sample	E
Analyte In Sample:	R1B	=	0.60	µg/sample	
Analyte in Sample:	R1C	=	0.17	µg/sample	
Volume Sampled:	R1A	=	0.0193	dscm	(ExCalc Vol by Flow 1)
Volume Sampled:	R1B	=	0.0191	dscm	
Volume Sampled:	R1C	=	0.0191	dscm	

µg/dscm = µg/sample / dscm

= 2.400 / 0.0193

µg/dscm R1A = 124.6 µg/dscm Benzene E 124 6 (The cell to the left has an if then statement for values of U)

= 0 600 / 0.0191

µg/dscm R1B = 31.5 µg/dscm Benzene 31 5 (The cell to the left has an if then statement for values of U)

= 0.170 / 0 0191

µg/dscm R1C = 8.88 µg/dscm Benzene 8 88 (The cell to the left has an if then statement for values of U.)

µg/dscm R1 = 165.0 µg/dscm Benzene E 165.0

lb/hr = (µg/dscm) / 1000 µg/mg / 35.31 ft^3/m^3 * dscf/min / 453600 mg/lb * 60 min/hr

= 165 0 / 1000 µg/mg / 35 31 ft^3/m^3 * 9792.7 / 453600 mg/lb * 60 min/hr

lb/hr R1 = 6.05E-03 lb/hr Benzene E

EXAMPLE CALCULATION SHEET (DE)
EPA SW-846 METHOD 0031
VOLATILE ORGANIC COMPOUNDS
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

File Name:	8752-001\PX @ CTL M0031
Client:	Parametrix @ City of Tacoma Landfill
Location:	Tacoma, Washington
Site:	Perennial #1 Landfill Gas Combuster Inlet/Outlet Destruction Efficiency
Date:	7/19/07
Lab #:	4511 - 4513
Run #:	1

Example Compound: = Acetone

Inlet Emission Rate = 1.18E-03 lb/hr J

Outlet Emission Rate = 1.98E-04 lb/hr J

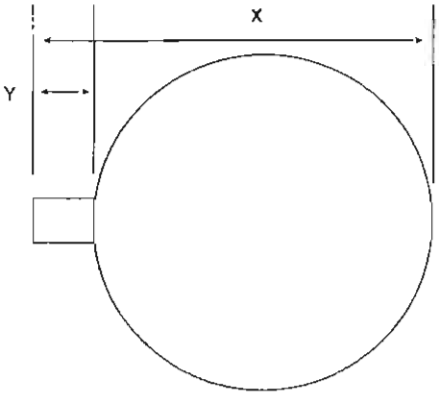
DE = [inlet (lb/hr) - outlet (lb/hr)] / inlet (lb/hr) * 100 %

DE = [1.18E-03 - 1.98E-04] / 1.18E-03 * 100 %

= 83.20%

CIRCULAR STACK SCHEMATIC AND LOCATION OF SAMPLE POINTS

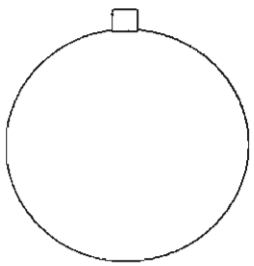
Client	Parametrix - City of Tacoma
Date Prepared	7/19/2007
Project Date	7/19/2007
Location	Tacoma WA
Sampling Location	Perennial Gas Combustor Inlet
Inside of far wall to outside of port (distance, X)	11.25
Inside of near wall to outside of port (distance, Y)	1.25
Stack I.D. (distance X - distance Y)	10.00
Initials/Date	KEF

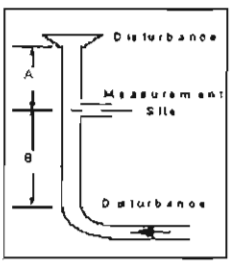


Schematic of Sampling Location

1 Traverse Point	2 Percentage of Duct Length (or Fraction)	3 Stack Inside Diameter (inches)	4 Column 2 X 3	5 Distance Y	6 Traverse Point Location from Outside of Port Columns 4 + 5
1	4.4	10.00	0.4	1.25	1.7
2	14.6		1 5		2.7
3	29.6		3.0		4 2
4	70 4		7.0		8 3
5	85 4		8 5		9.8
6	95.6		9.6		10 8
7					
8					
9					
10					
11					
12					

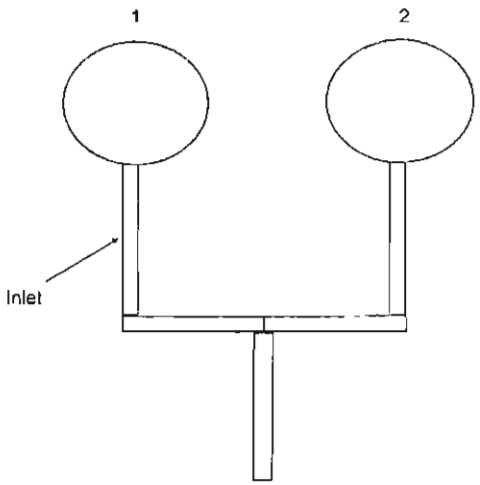
CROSS SECTION





Stack Height =	Ground level	
Port Diameter (ID)=	1/2 Inch NPT	
Distance A =	30 ft	downstream
Distance B =	2 ft	upstream

STACK, CONTROL DEVICE AND PROCESS FLOW DIAGRAM



VELOCITY AND TEMPERATURE TRAVERSE
AM TEST-AIR QUALITY, LLC

Client: Parametrix
Location: Tacoma Landfill
Stack Diameter: 10"
Sampling Site: #1 Perennial Combustor Inlet
Date: 7/19/07
Operator: TWG

Pitot Leak Check: Pre ✓ Post ✓
Thermocouple ID: T6Y
Pitot ID: 2' Standard Side: A Cp: 0.99
Mag / Man / SR (Circle one) ID: 5

Run #: 1A	Run #: 1B	Run #: 1C
Start Time: 1510	Start Time: 1620	Start Time: 1730
End Time: 1520	End Time: 1630	End Time: 1740
Barometric: 29.70	Barometric: 29.70	Barometric: 29.70
Static: + 5.8"	Static: + 6.4"	Static: 6.2

Point #	ΔP	Temp	Point #	ΔP	Temp	Point #	ΔP	Temp
1	0.10	104.6	1	0.12	100.6	1	0.12	96.1
2	0.15	104.5	2	0.14	100.9	2	0.13	96.2
3	0.16	104.8	3	0.15	101.6	3	0.14	96.8
4	0.17	104.9	4	0.15	101.7	4	0.15	96.7
5	0.14	104.7	5	0.14	101.7	5	0.16	96.3
6	0.16	104.3	6	0.14	101.3	6	0.16	95.3
Flare Temp		1740	Flare Temp		1721	Flare Temp		1763
		104.6			101.3			96.2

Comments: dry Bulb 96.4 Wet Bulb - 78.0

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VELOCITY AND TEMPERATURE TRAVERSE
AM TEST-AIR QUALITY, LLC

Page 1 of ____

Client Parametrix ~~of Tacoma Landfill~~ TG
Location Tacoma Landfill
Stack Diameter 10"
Sampling Site #2 Perennial Condenser Inlet
Date 7/20/07
Operator TWG

Pilot Leak Check: Pre ✓ Post ✓
Thermocouple ID T6Y
Pilot ID 2 ft Standard Side A Cp 0.99
(Mag) / Man / SR (Circle one) ID: Mag 5

Run #: 2A	Run #: 2B	Run #: 2C
Start Time: 0831	Start Time: 0931	Start Time: 1031
End Time: 0841	End Time: 0941	End Time: 1041
Barometric: 29.65	Barometric: 29.65	Barometric: 29.65
Static: 6.2"	Static: 6.2"	Static: 6.2"

Point #	ΔP	Temp
1	0.11	83.9
2	0.13	84.4
3	0.15	84.9
4	0.15	85.0
5	0.15	84.5
6	0.12	84.0
Flare		1765
Temp		
		84.5

Point #	ΔP	Temp
1	0.10	85.2
2	0.12	85.9
3	0.13	86.3
4	0.13	86.4
5	0.14	86.2
6	0.13	85.5
Flare		1710
Temp		
		85.9

Point #	ΔP	Temp
1	0.11	104.3
2	0.16	104.5
3	0.14	107.4
4	0.14	113.5
5	0.14	86.9
6	0.13	86.8
Flare		1733
Temp		
		86.6

Comments: dry bulb: 87.9 wet bulb: 76.0

(pw4\clients\tacoma\tacoma.xls)

VELOCITY AND TEMPERATURE TRAVERSE
AM TEST-AIR QUALITY, LLC

Client: Parametrix
Location: Tacoma Landfill
Stack Diameter: 10"
Sampling Site: #2 Perennial Combustor Inlet
Date: 7/20/07
Operator: TWG

Pitot Leak Check: Pre ✓ Post ✓
Thermocouple ID: T6Y
Pitot ID: 2 ft standard Side: A Cp: 0.99
Mag / Man / SR (Circle one) ID: Mag 5

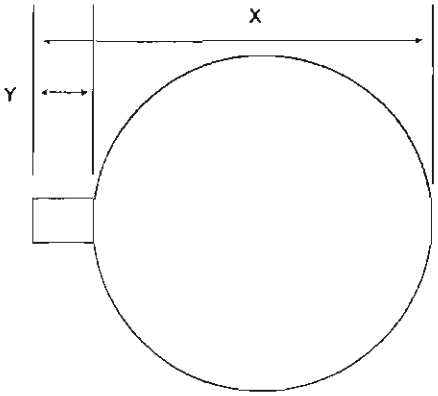
Run #: 3A	Run #: 3B	Run #: 3C
Start Time: 1138	Start Time: 1238	Start Time: 1338
End Time: 1148	End Time: 1248	End Time: 1348
Barometric: 29.65	Barometric: 29.65	Barometric: 29.65
Static: 6.4"	Static: 6.3"	Static: 6.5"

Point #	ΔP	Temp	Point #	ΔP	Temp	Point #	ΔP	Temp
1	0.12	86.3	1	0.11	85.7	1	0.12	92.5
2	0.13	86.8	2	0.13	86.5	2	0.15	92.7
3	0.14	87.5	3	0.13	87.9	3	0.13	92.9
4	0.14	87.7	4	0.13	88.3	4	0.14	93.0
5	0.15	87.3	5	0.14	88.1	5	0.16	92.9
6	0.12	86.4	6	0.12	86.9	6	0.13	92.3
Flare Temp		1746	Flare Temp		17.83	Flare Temp		1762
		87.0			87.2			92.7

Comments: dry bulb: 93.3 wet bulb: 80.0

CIRCULAR STACK SCHEMATIC AND LOCATION OF SAMPLE POINTS

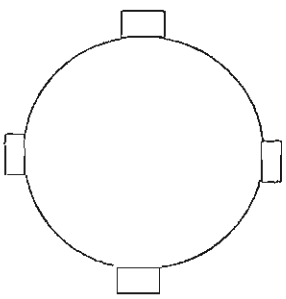
Client	Parametrix - City of Tacoma Landfill
Date Prepared	7/19/2007
Project Date	7/19/2007
Location	Tacoma WA
Sampling Location	Perennial Gas Combustor Stack
Inside of far wall to outside of port (distance, X)	124.00
Inside of near wall to outside of port (distance, Y)	6.00
Stack I.D. (distance X - distance Y)	118.00
Initials/Date	KEF

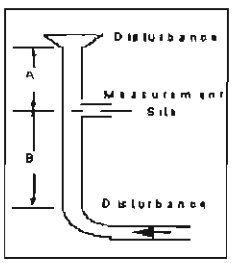


Schematic of Sampling Location

1 Traverse Point	2 Percentage of Duct Length (or Fraction)	3 Stack Inside Diameter (inches)	4 Column 2 X 3	5 Distance Y	6 Traverse Point Location from Outside of Port Columns 4 + 5
1	3.2	118.00	3.8	6.00	9.8
2	10.5	↓	12.4	↓	18.4
3	19.4	↓	22.9	↓	28.9
4	32.3	↓	38.1	↓	44.1
5					
6					
7					
8					
9					
10					
11					
12					

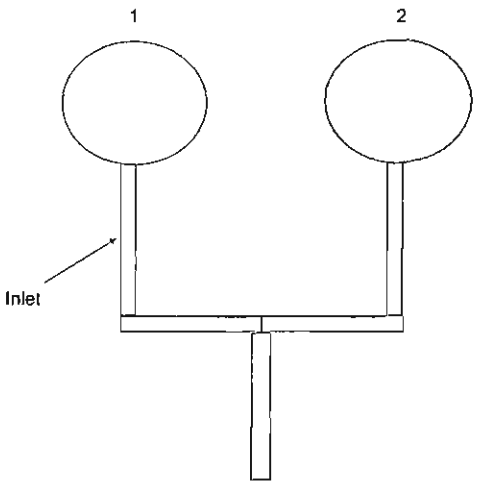
CROSS SECTION





Stack Height =	~ 24 ft	
Port Diameter (ID)=	3 Inch	
Distance A =	60 inch	downstream
Distance B =	193 inch	upstream

STACK, CONTROL DEVICE AND PROCESS FLOW DIAGRAM



300

AMTEST

ANALYZER CONFIGURATION DATA SHEET

Fill out one sheet per sample site and per CEMS system.

CLIENT: Parametrix - City of Tacoma Landfill

LOCATION: Tacoma WA

SITE: #1 Perennial Gas Combustor

TEST TEAM: KEF, RDR, KJR, TWG DATE: 6/19 - 6/20/07

RUN #'s: 1-3 METHOD: 3a, 6c, 7e, 10, 25a

Filter ____ In-Stack X Out of Stack

____ Sintered Metal X 47mm ____ Heated 90mm

Probe Type: X regular ____ tubing Calibration Tee: X tip of probe ____ probe exit

Sample Line: X Heated ____ Not Heated

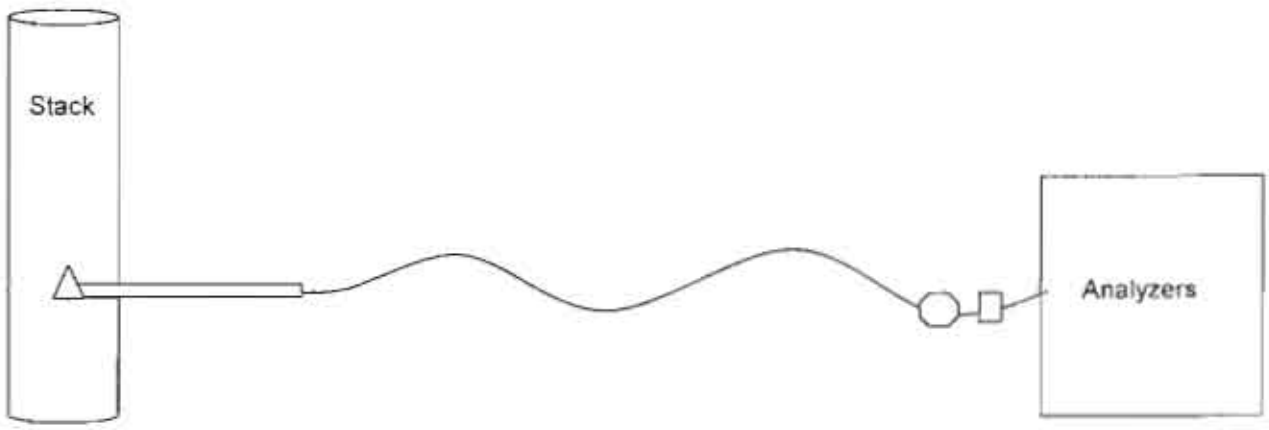
Filter Media: X quartz fiber ____ glass fiber ____ Teflon® ____ other

Gas Conditioner: X Glass Knockout ____ Teflon Knockout ____ TRS Train

____ Electric Chiller

Gas Conditioner Location: ____ After Probe X After Sample Line

Please draw in Locations: Legend - △ = Cal Tee □ = Filter ◯ = Gas Conditioner



If this information is not accurate for all runs, note all exceptions.

STRATA Configuration Page 1
07-19-2007 13:26:41
File Name: C:\Documents and Settings\Amtest\My Documents\STRATA\2007\KC_TRS\config.str

Operator:	KEF
Plant Name:	Parametrix, City of Tacoma
Location:	#[illegible] Perennial Gas Comb. Stack
Run Length:	120 minutes
Sample Rate:	30 per minute
Average Calibration Results:	1 minutes
Automatic Sequence, Calibration Error:	No
Automatic Sequence, System Bias:	No
Max Response Time:	Manual
Max Response Time:	1 minutes
Traverse During Run:	No

Active	Chan.	Analyte Name	Units	Span Units	Span Volts	Offset Volts
Yes	1	O2In	%	25	10	0
Yes	2	CO2In	%	25	10	0
Yes	3	CO	ppm	1000	10	0
Yes	4	NOx	ppm	100	10	0
Yes	5	SO2	ppm	100	1	0
Yes	7	CH4	ppm	1000	10	0
Yes	8	THC	ppm	1000	10	0

Measurement System Preparation Table

Gas Name	Reference Cylinder Numbers 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
O2In	Z	M	H													
CO2In	Z	M	H													
CO	Z	M	H													
NOx	Z			M	H											
SO2	Z			M	H											
CH4	Z					L	M	H								
THC	Z					L	M	H								

STRATA Configuration Page 2

Gas Name	Zero Reference Cylinder No.	Conc	ID Number	Low Reference Cylinder No.	Conc	ID Number
O2In	1	0	Nitrogen	1	1	
CO2In	1	0	Nitrogen	1	1	
CO	1	0	Nitrogen	1	1	
NOx	1	0	Nitrogen	1	1	
SO2	1	0	Nitrogen	1	1	
CH4	1	0	Nitrogen	6	30.1	CC115989
THC	1	0	Nitrogen	6	30.1	CC115989

Gas Name	Mid Reference Cylinder No.	Conc	ID Number	High Reference Cylinder No.	Conc	ID Number
O2In	2	12	CC143844	3	22	CC180131
CO2In	2	12	CC143844	3	22	CC180131
CO	2	479	CC143844	3	917	CC180131
NOx	4	51	CC253351	5	91.3	CC160620
SO2	4	50.4	CC253351	5	90	CC160620
CH4	7	49.7	CC61264	8	90	CC122541
THC	7	49.7	CC61264	8	90	CC122541

Seq Num	Calibration Error Test Sequence O2In	CO2In	CO	NOx	SO2	CH4	THC
1	Zero	Zero	Zero	Zero	Zero	Zero	Zero
2	High	High	High				
3	Mid	Mid	Mid				
4				High	High		
5				Mid	Mid		
6						High	High
7						Mid	Mid
8						Low	Low
9							
10							
11							
12							
13							
14							
15							

Seq Num	Calibration Error Valve Sequence 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	X															
2			X													
3		X														
4					X											
5				X												
6								X								
7							X									
8						X										
9																
10																
11																
12																
13																
14																
15																

STRATA Configuration Page 3

Seq Num	System Bias Check Sequence						
	O2In	CO2In	CO	NOx	SO2	CH4	THC
1	Zero	Zero	Zero	Zero	Zero	Zero	Zero
2	Mid	Mid	Mid				
3				Mid	Mid		
4						Mid	Mid
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

Seq Num	System Bias Valve Sequence														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	X															
2		X														
3				X												
4							X									
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																
15																

STRATA Configuration End

304

Calibration Error Test, Run 1 STRATA Version 3.01
Operator: KEF
Plant Name: Parametrix, City of Tacoma
Location: #1 Perennial Gas Comb. Stack

	Reference Cylinder Numbers			
	Zero	Low-range	Mid-range	High-range
O2In	Nitrogen		CC143844	CC180131
CO2In	Nitrogen		CC143844	CC180131
CO	Nitrogen		CC143844	CC180131
NOx	Nitrogen		CC253351	CC160620
SO2	Nitrogen		CC253351	CC160620
CH4	Nitrogen	CC115989	CC61264	CC122541
THC	Nitrogen	CC115989	CC61264	CC122541

Date/Time 07-19-2007 14:00:13 PASSED

Analyte	O2In	CO2In	CO	NOx	SO2	CH4	THC
Units	%	%	ppm	ppm	ppm	ppm	ppm
Zero Ref Cyl	0.000	0.000	0.0	0.00	0.00	0.0	0.0
Zero Avg	0.002	0.002	-0.7	0.15	-0.43	-0.4	0.0
Zero Error%	0.0%	0.0%	0.1%	0.1%	0.4%	0.0%	0.0%
Low Ref Cyl						30.1	30.1
Low Avg						29.6	29.6
Low Error%						0.1%	0.0%
Mid Ref Cyl	12.000	12.000	479.0	51.00	50.40	49.7	49.7
Mid Avg	11.982	12.154	479.7	51.30	51.25	49.7	50.0
Mid Error%	0.1%	0.6%	0.1%	0.3%	0.8%	0.0%	0.0%
High Ref Cyl	22.000	22.000	917.0	91.30	90.00	90.0	90.0
High Avg	21.963	22.079	909.9	91.45	90.33	91.4	90.8
High Error%	0.1%	0.3%	0.7%	0.1%	0.3%	0.1%	0.1%

Calibration Error Test End

X5

Initial System Bias Check, Run 1 STRATA Version 3.01
Operator: KEF
Plant Name: Parametrix, City of Tacoma
Location: #1 Perennial Gas Comb. Stack

	Reference Cylinder Numbers	
	Zero	Span
O2In	Nitrogen	CC143844
CO2In	Nitrogen	CC143844
CO	Nitrogen	CC143844
NOx	Nitrogen	CC253351
SO2	Nitrogen	CC253351
CH4	Nitrogen	CC61264
THC	Nitrogen	CC61264

Date/Time 07-19-2007 14:12:34 PASSED

Analyte	O2In	CO2In	CO	NOx	SO2	CH4	THC
Units	%	%	ppm	ppm	ppm	ppm	ppm
Zero Ref Cyl	0.000	0.000	0.0	0.00	0.00	0.0	0.0
Zero Cal	0.002	0.002	-0.7	0.15	-0.43	-0.4	0.0
Zero Avg	0.003	0.003	-0.9	0.17	0.18	-0.1	-0.4
Zero Bias%	0.0%	0.0%	0.0%	0.0%	0.6%	0.0%	0.0%
Zero Drift%							
Span Ref Cyl	12.000	12.000	479.0	51.00	50.40	49.7	49.7
Span Cal	11.982	12.154	479.7	51.30	51.25	49.7	50.0
Span Avg	11.947	12.105	479.5	51.05	51.20	50.5	50.5
Span Bias%	0.1%	0.2%	0.0%	0.3%	0.1%	0.1%	0.1%
Span Drift%							

System Bias Check End

306

Test Run 1 STRATA Version 3.01

	O2In	CO2In	CO	NOx	SO2	CH4	THC
	%	%	ppm	ppm	ppm	ppm	ppm
Begin calculating run averages							
07-19-2007 14:17:03	10.535	8.701	2.9	11.27	1.27	4.4	4.5
07-19-2007 14:18:03	10.289	8.917	1.2	12.67	1.45	1.2	2.7
07-19-2007 14:19:02	11.234	8.127	64.5	11.86	1.61	3.4	2.5
Begin Traverse							
07-19-2007 14:20:02	11.364	8.026	3.6	12.18	1.34	4.9	5.2
07-19-2007 14:21:03	12.492	7.086	2.6	10.41	0.65	0.1	0.4
07-19-2007 14:22:03	11.904	7.573	-0.4	11.76	0.59	0.2	0.6
Begin Traverse							
07-19-2007 14:23:02	10.744	8.531	0.3	12.12	0.60	0.0	0.5
07-19-2007 14:24:02	11.655	7.779	1.3	13.23	1.11	1.5	2.2
07-19-2007 14:25:03	11.581	7.842	15.7	11.42	0.62	0.0	0.5
Begin Traverse							
07-19-2007 14:26:03	9.577	9.510	53.7	12.95	1.07	5.3	6.4
07-19-2007 14:27:02	13.032	6.640	31.0	10.96	1.15	2.9	8.6
07-19-2007 14:28:02	13.046	6.629	13.7	10.57	-0.25	9.5	3.9
Begin Traverse							
07-19-2007 14:29:04	10.783	8.506	7.1	11.18	-0.15	0.1	0.6
07-19-2007 14:30:03	12.009	7.492	7.0	12.15	0.03	0.1	0.5
07-19-2007 14:31:03	12.372	7.184	0.0	10.61	-0.18	4.3	6.6
Begin Traverse							
07-19-2007 14:32:02	12.777	6.856	6.0	9.91	-0.63	5.7	4.7
07-19-2007 14:33:02	12.517	7.070	5.2	10.37	-0.26	0.9	1.0
07-19-2007 14:34:03	13.013	6.656	1.4	9.43	-0.56	1.7	1.7
Begin Traverse							
07-19-2007 14:35:03	12.597	7.007	2.7	10.33	-0.44	3.6	4.0
07-19-2007 14:36:02	12.520	7.068	7.4	10.06	-0.53	0.4	0.7
07-19-2007 14:37:02	13.962	5.868	4.7	9.15	-0.60	5.7	6.3
Begin Traverse							
07-19-2007 14:38:03	13.184	6.504	10.6	8.85	-0.09	16.1	18.8
07-19-2007 14:39:03	11.923	7.555	16.0	9.61	0.15	2.1	0.6
07-19-2007 14:40:02	11.740	7.711	5.2	10.63	0.26	5.9	14.6
Begin Traverse							
07-19-2007 14:41:02	12.955	6.695	19.6	9.55	0.22	31.5	33.7
07-19-2007 14:42:03	12.686	6.922	40.6	8.81	0.17	10.0	10.5
07-19-2007 14:43:03	14.009	5.815	13.5	9.20	0.10	11.3	2.8
Begin Traverse							
07-19-2007 14:44:02	12.887	6.748	3.8	8.39	0.04	11.2	14.2
07-19-2007 14:45:02	11.720	7.724	18.2	9.44	-0.02	1.2	0.7
07-19-2007 14:46:04	11.440	7.956	13.4	10.68	0.51	16.7	19.1
Begin Traverse							
07-19-2007 14:47:03	11.221	8.146	14.0	10.81	0.67	0.0	0.4
07-19-2007 14:48:03	11.272	8.096	0.1	11.77	0.64	0.8	3.7
07-19-2007 14:49:02	12.322	7.222	16.0	10.49	0.51	11.6	10.7
Begin Traverse							
07-19-2007 14:50:02	11.338	8.046	3.5	10.69	0.31	0.0	0.3
07-19-2007 14:51:03	11.663	7.771	7.1	11.31	0.57	13.5	20.8
07-19-2007 14:52:03	14.859	5.111	21.0	8.83	0.50	13.8	9.1
Run Averages	O2In	CO2In	CO	NOx	SO2	CH4	THC
	%	%	ppm	ppm	ppm	ppm	ppm
07-19-2007 14:52:03	12.088	7.420	12.1	10.65	0.34	5.6	6.2

Operator: KEF
Plant Name: Parametrix, City of Tacoma
Location: #2 Perennial Gas Comb. Stack
Test Run 1 End

Test Run 1 Begin. STRATA Version 3.01

		O2In	CO2In	CO	NOx	SO2	CH4	THC
		%	%	ppm	ppm	ppm	ppm	ppm
Begin calculating run averages								
7/19/2007	15:11:25	13.122	6.544	11.4	8.64	0.4	0.4	2.8
7/19/2007	15:12:25	12.967	6.671	2.1	8.76	0.37	1.6	0.1
7/19/2007	15:13:24	10.854	8.433	-0.4	12.09	0.34	-0.2	0.2
7/19/2007	15:14:24	10.908	8.394	0.8	13.04	0.73	-0.3	0.1
7/19/2007	15:15:25	9.864	9.262	0.4	12.81	0.7	0.9	1.4
7/19/2007	15:16:25	12.152	7.364	12.9	12.01	0.78	11.9	12.8
7/19/2007	15:17:24	12.452	7.109	10.3	11.05	0.54	-0.1	1.3
7/19/2007	15:18:24	12.408	7.141	3.7	11.08	0.48	7.7	7.6
7/19/2007	15:19:26	9.732	9.353	62.7	11.28	0.46	47	52
7/19/2007	15:20:25	9.619	9.461	225.4	11.86	0.97	-0.2	0 6
7/19/2007	15:21:25	9.15	9.853	33.4	13.33	1.19	0.3	0.4
7/19/2007	15:22:24	11.058	8.272	8.8	12.18	1.25	1.3	2.1
7/19/2007	15:23:26	6.919	11.695	78.5	13.13	1.16	19.8	33.1
7/19/2007	15:24:25	9.755	9.349	202.5	12.42	2.15	13.7	2.6
7/19/2007	15:25:25	8.474	10.418	86.6	13.95	2	0	0.2
7/19/2007	15:26:24	12.32	7.229	3	12.82	2.09	0	0.3
7/19/2007	15:27:24	8.542	10.35	34.7	11.67	1.71	20.9	25.9
7/19/2007	15:28:25	7.949	10.835	307.3	12.86	2.4	36.4	43
7/19/2007	15:29:25	9.496	9.574	136.2	13.95	3.15	9.1	17.9
7/19/2007	15:30:24	6.696	11.869	321.3	14.18	3.36	139.5	121.6
Pause								
End Pause								
7/19/2007	15:50:25	11.866	7.618	14.5	10.11	0.98	14	16 4
7/19/2007	15:51:24	11.219	8.138	5.4	10.14	0.88	3	6.8
7/19/2007	15:52:24	10.761	8.525	7.6	11.74	0.77	3.7	2.9
7/19/2007	15:53:26	11.144	8.203	2.5	10.99	0.8	1.7	3
7/19/2007	15:54:25	10.865	8.433	1.3	10.57	0.87	9	78.7
7/19/2007	15:55:25	11.242	8.116	70.2	8.46	0.83	64.4	22.9
7/19/2007	15:56:24	12.741	6.88	28.6	8.94	0.64	38.8	28.8
7/19/2007	15:57:26	12.068	7.424	55.6	7.6	0.64	6.9	8.3
7/19/2007	15:58:25	12.22	7.299	14.5	8.78	0.53	4.5	9.2
7/19/2007	15:59:25	7.725	11.043	64.2	11.03	0.48	11	37.2
7/19/2007	16:00:24	9.192	9.826	216	10.64	0.79	26.4	1.6
7/19/2007	16:01:24	10.408	8.829	39.3	12.27	0.79	1.4	2.6
7/19/2007	16:02:25	12.285	7.261	34.1	11	0.75	10	11.4
7/19/2007	16:03:25	12.577	7.013	15.3	9.72	0.38	3.9	7.2
7/19/2007	16:04:24	13.084	6.59	25.9	8.8	0.29	3.9	2.9
7/19/2007	16:05:24	13.158	6.535	3.9	9.53	0.16	12.8	24.3
7/19/2007	16:06:25	11	8.312	89.4	9.3	-0.09	96.4	29.8
7/19/2007	16:07:25	13.251	6.453	180.1	8.59	0.3	2.6	2.8
7/19/2007	16:08:24	13.052	6.611	17.6	8.46	0.15	33.4	43.7
7/19/2007	16:09:24	12.387	7.159	64.7	7.67	0.15	7.3	7.6
7/19/2007	16:10:26	11.402	7.99	7.3	11.15	0	1.1	1.7
7/19/2007	16:11:25	13.36	6.361	10.7	10.69	0.14	1.2	1.5
7/19/2007	16:12:25	12.578	7.008	1.8	10.64	0.07	0.9	1.3
7/19/2007	16:13:24	12.527	7.046	-0.4	9.36	-0.01	0.9	1.7
7/19/2007	16:14:26	13.677	6.097	2.9	9.94	-0.14	5.6	5.6
7/19/2007	16:15:25	12.973	6.674	6.3	9.26	0.08	1.8	2.3
7/19/2007	16:16:25	11.599	7.818	9.4	10.76	0	1.1	1.6
7/19/2007	16:17:24	14.241	5.63	6	9.73	-0.11	6.7	7
7/19/2007	16:18:24	14.791	5.164	3.4	6.89	-0.38	1	1.4
7/19/2007	16:19:25	13.971	5.828	2.4	7.51	-0.38	1.4	1.9
7/19/2007	16:20:25	14.575	5.343	1.1	8.73	-0.21	2.7	6.7
7/19/2007	16:21:24	12.131	7.361	41.1	9.14	-0.22	10.9	8.9
7/19/2007	16:22:24	13.39	6.319	11.9	9.54	-0.36	9.4	10.3

7/19/2007	16:23:25	13.719	6.046	5.8	8.77	-0.4	1.7	1.7
7/19/2007	16:24:25	11.584	7.825	2.7	11.04	-0.48	0.3	1
7/19/2007	16:25:24	10.252	8.934	27.7	12.4	-0.4	18.6	20.2
7/19/2007	16:26:24	13.713	6.074	120	10.99	-0.29	1.2	0.5
7/19/2007	16:27:26	12.768	6.846	1.1	9.36	-0.27	0	0.3
7/19/2007	16:28:25	10.551	8.695	-0.4	12.49	-0.51	-0.2	0.2
7/19/2007	16:29:25	12.849	6.796	13.4	11.73	-0.38	1.3	1.7
7/19/2007	16:30:24	12.587	6.992	4.7	8.31	-0.74	-0.3	0
7/19/2007	16:31:26	12.104	7.412	4.6	11.49	0.23	0.1	0.5
7/19/2007	16:32:25	12.494	7.081	4	10.58	0.71	3.9	4.4
7/19/2007	16:33:25	12.982	6.674	5.1	9.85	0.41	2.6	3.2
7/19/2007	16:34:24	13.539	6.214	2.8	10.76	0.38	1.3	1.7
7/19/2007	16:35:24	14.366	5.521	4.9	8.64	0.49	1.9	2.5
7/19/2007	16:36:25	12.536	7.038	16.1	9.43	0.07	4.9	17
7/19/2007	16:37:25	11.395	7.999	121.4	10.76	0.2	7.4	0.5
7/19/2007	16:38:24	12.505	7.078	7	11.22	0.42	2.3	2.7
7/19/2007	16:39:24	10.002	9.16	13.3	11.41	0.22	-0.2	0
7/19/2007	16:40:25	10.483	8.764	58.1	12.48	0.48	2.6	6.2
7/19/2007	16:41:25	11.518	7.908	47	12.35	0.41	2.3	0.6
7/19/2007	16:42:24	13.856	5.961	5.7	10.72	0.48	0.3	0.6
7/19/2007	16:43:24	14.865	5.11	4.8	7.9	0.18	15.5	21.6
7/19/2007	16:44:26	14.574	5.347	17.9	8.17	-0.05	18.8	24.1
7/19/2007	16:45:25	14.421	5.469	17	7.15	-0.02	14.2	8.6
7/19/2007	16:46:25	11.253	8.095	131.1	8.68	-0.17	172.7	116.2
7/19/2007	16:47:24	11.041	8.297	419.8	9.62	0.05	0.8	1
7/19/2007	16:48:26	10.412	8.824	16.1	11.2	0.4	21.9	25
7/19/2007	16:49:25	9.899	9.243	83.5	11.71	0.48	1.6	1.8
7/19/2007	16:50:25	11.521	7.911	57.1	12.85	0.44	0.2	0.5
7/19/2007	16:51:24	8.227	10.63	68.9	13.81	0.35	14.9	15
7/19/2007	16:52:24	10.626	8.654	86.2	13.15	0.37	0.4	1.7
7/19/2007	16:53:25	11.177	8.191	43.6	11.25	0.45	2.5	2.9
7/19/2007	16:54:25	11.129	8.234	5.4	11.16	0.19	-0.5	-0.2
7/19/2007	16:55:24	8.804	10.156	5.4	11.97	0.14	-0.6	-0.3
7/19/2007	16:56:24	10.446	8.816	3.9	12.05	0.32	-0.6	-0.3
7/19/2007	16:57:25	12.33	7.236	-1.4	10.71	0.34	-0.6	-0.3
7/19/2007	16:58:25	12.843	6.812	-1.1	11.01	0.32	-0.5	-0.1
7/19/2007	16:59:24	14.26	5.624	-0.4	8.14	0.08	0.5	1.1
7/19/2007	17:00:24	12.685	6.917	0.8	8.91	-0.11	-0.4	16.5
Pause								
End Pause								
7/19/2007	17:02:25	12.076	7.446	24.3	10.64	0.01	-2.3	-1.9
7/19/2007	17:03:25	11.851	7.62	11.7	10.11	-0.15	2.3	4.9
7/19/2007	17:04:24	12.671	6.948	5.5	9.59	0.03	2.7	7.5
7/19/2007	17:05:26	12.986	6.677	10.4	8.99	0.01	15.3	16.7
7/19/2007	17:06:25	11.794	7.675	80.8	10.05	-0.04	8.9	11.9
7/19/2007	17:07:25	11.524	7.896	4.2	9.88	-0.05	1.2	3.7
7/19/2007	17:08:24	11.262	8.128	9.8	10.5	-0.04	7.6	11.3
7/19/2007	17:09:24	12.364	7.207	4.7	9.57	-0.16	2.4	5
7/19/2007	17:10:25	11.565	7.869	-0.5	10.14	0.2	1.4	3.9
7/19/2007	17:11:25	11.159	8.203	-0.7	9.96	0.02	1.4	3.9
7/19/2007	17:12:24	11.016	8.334	-1.4	11.15	0.08	1.5	4.2
7/19/2007	17:13:24	11.636	7.805	3.1	10 28	-0.14	3.1	6
7/19/2007	17:14:25	13.707	6.081	13.6	7.91	-0.06	2.6	5.3
7/19/2007	17:15:25	12.451	7.13	5.2	9.37	0.02	2.6	4.9
Pause								
End Pause								
7/19/2007	17:18:26	9.5	9.571	2.6	12.33	0.22	2.3	4.6
7/19/2007	17:19:25	9.297	9.751	23.2	13.58	0.23	2.3	10.1
7/19/2007	17:20:25	9.299	9.754	66.1	13.95	0.32	6 8	4

7/19/2007	17:21:24	6.76	11.83	175.2	13.46	0.46	97.5	46.6
7/19/2007	17:22:26	8.926	10.07	488.4	12.23	0.87	3.5	4
7/19/2007	17:23:25	10.849	8.472	6.7	13.06	1.07	2.3	5.3
7/19/2007	17:24:25	11.146	8.225	3.3	12.44	0.91	2	5.4
7/19/2007	17:25:24	13.799	6.021	18.8	11.22	0.7	3.4	4.8
7/19/2007	17:26:24	13.144	6.547	4.6	8.4	0.53	1.7	3.9
7/19/2007	17:27:26	12.754	6.872	1.1	10.71	0.37	13.2	16.1
7/19/2007	17:28:25	11.459	7.948	13.9	10.99	0.43	1.7	4.1
7/19/2007	17:29:25	11.169	8.187	3	12.88	-0.01	1.9	4.3
7/19/2007	17:30:24	10.923	8.395	3.3	11.67	0.39	1.5	3.7
7/19/2007	17:31:26	10.573	8.688	-0.9	12.61	0.53	1.5	3.9
7/19/2007	17:32:25	11.926	7.571	-1.4	12.9	0.55	3.9	7.4
Average of Test Run		O2In	CO2In	CO	NOx	SO2	CH4	THC
		%	%	ppm	ppm	ppm	ppm	ppm
7/19/2007	17:32:34	11.598	7.827	44.4	10.71	0.43	11.3	10.7
Test Run 1 End								

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Final System Bias Check, Run 1 STRATA Version 3.01
Operator: KEF
Plant Name: Parametrix, City of Tacoma
Location: #2 Perennial Gas Comb. Stack

	Reference Cylinder Numbers	
	Zero	Span
O2In	Nitrogen	CC143844
CO2In	Nitrogen	CC143844
CO	Nitrogen	CC143844
NOx	Nitrogen	CC253351
SO2	Nitrogen	CC253351
CH4	Nitrogen	CC61264
THC	Nitrogen	CC61264

Date/Time 07-19-2007 17:47:27 PASSED

Analyte	O2In	CO2In	CO	NOx	SO2	CH4	THC
Units	%	%	ppm	ppm	ppm	ppm	ppm
Zero Ref Cyl	0.000	0.000	0.0	0.00	0.00	0.0	0.0
Zero Cal	0.002	0.002	-0.7	0.15	-0.43	-0.4	0.0
Zero Avg	0.003	0.003	-1.6	0.21	0.21	0.3	1.2
Zero Bias%	0.0%	0.0%	0.1%	0.1%	0.6%	0.1%	0.1%
Zero Drift%	0.0%	0.0%	-0.1%	0.0%	0.0%	0.0%	0.2%
Span Ref Cyl	12.000	12.000	479.0	51.00	50.40	49.7	49.7
Span Cal	11.982	12.154	479.7	51.30	51.25	49.7	50.0
Span Avg	11.943	12.104	471.6	50.34	53.13	49.6	50.6
Span Bias%	0.2%	0.2%	0.8%	1.0%	1.9%	0.0%	0.1%
Span Drift%	0.0%	0.0%	-0.8%	-0.7%	1.9%	-0.1%	0.0%
Ini Zero Avg	0.003	0.003	-0.9	0.17	0.18	-0.1	-0.4
Ini Span Avg	11.947	12.105	479.5	51.05	51.20	50.5	50.5
Run Avg	11.598	7.827	44.4	10.71	0.43	11.3	10.7
Co	0.003	0.003	-1.2	0.19	0.20	0.1	0.4
Cm	11.945	12.105	475.5	50.69	52.16	50.1	50.5
Correct Avg	11.652	7.758	45.9	10.63	0.23	11.2	10.2

System Bias Check End

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Initial System Bias Check, Run 2 STRATA Version 3.01
Operator: KEF
Plant Name: Parametrix, City of Tacoma
Location: #1 Perennial Gas Comb. Stack

	Reference Cylinder Numbers	
	Zero	Span
O2In	Nitrogen	CC143844
CO2In	Nitrogen	CC143844
CO	Nitrogen	CC143844
NOx	Nitrogen	CC253351
SO2	Nitrogen	CC253351
CH4	Nitrogen	CC61264
THC	Nitrogen	CC61264

Date/Time 07-20-2007 07:44:42 PASSED

Analyte	O2In	CO2In	CO	NOx	SO2	CH4	THC
Units	%	%	ppm	ppm	ppm	ppm	ppm
Zero Ref Cyl	0.000	0.000	0.0	0.00	0.00	0.0	0.0
Zero Cal	0.002	0.002	-0.7	0.15	-0.43	-0.4	0.0
Zero Avg	0.008	0.008	-0.4	0.17	-0.40	0.0	-0.2
Zero Bias%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Zero Drift%							
Span Ref Cyl	12.000	12.000	479.0	51.00	50.40	49.7	49.7
Span Cal	11.982	12.154	479.7	51.30	51.25	49.7	50.0
Span Avg	11.940	12.125	476.3	52.07	50.95	50.1	50.3
Span Bias%	0.2%	0.1%	0.3%	0.8%	0.3%	0.0%	0.0%
Span Drift%							

System Bias Check End

Test Run 2 Begin. STRATA Version 3.01
Operator: KEF
Plant Name: Parametrix, City of Tacoma
Location: #1 Perennial Gas Comb. Stack

		O2In	CO2In	CO	NOx	SO2	CH4	THC
		%	%	ppm	ppm	ppm	ppm	ppm
Begin calculating run averages								
7/20/2007	8:32:44	14.127	5.75	23.9	7.52	0.19	3.2	5.3
7/20/2007	8:33:43	14.917	5.11	7.1	7.54	0.3	1.1	2
7/20/2007	8:34:43	14.179	5.669	1.7	6.56	0.11	3.4	11.6
7/20/2007	8:35:42	13.338	6.443	-0.2	7.78	4.33	14.9	20.9
7/20/2007	8:36:44	16.114	4.123	21.6	6.86	3.59	10.6	14.6
7/20/2007	8:37:43	15.56	4.554	12	5.76	1.59	11.6	29.5
7/20/2007	8:38:43	13.87	5.948	24.5	7.41	0.52	30	7.5
7/20/2007	8:39:42	13.38	6.369	45.1	7.64	-0.18	8.6	11.9
7/20/2007	8:40:44	12.948	6.756	61	8.14	-0.11	12.9	16.6
7/20/2007	8:41:43	13.123	6.58	49.7	8.71	-0.21	12.9	15
7/20/2007	8:42:43	13.099	6.624	94.1	9.28	-0.49	-0.5	0
7/20/2007	8:43:42	14.851	5.182	6.1	9.19	-0.78	4.8	4.5
7/20/2007	8:44:44	14.986	5.03	24.4	7.54	-1.06	0.7	1.2
7/20/2007	8:45:44	13.228	6.482	11.3	9.44	-1.07	3.6	4.2
7/20/2007	8:46:43	13.053	6.674	10.6	10.62	0.74	4.1	4.9
7/20/2007	8:47:43	13.274	6.488	25	9.81	0.51	2.4	0.6
7/20/2007	8:48:44	13.004	6.686	10.7	9.7	0.55	0.8	1.2
7/20/2007	8:49:44	10.803	8.525	12.5	11.86	1.84	8.8	13.8
7/20/2007	8:50:43	11.856	7.661	40.3	11.63	5.52	0.5	4.1
7/20/2007	8:51:43	11.98	7.586	5.1	12.36	9.34	2.5	3.2
7/20/2007	8:52:42	11	8.374	6.6	12.85	9.64	3.5	11.2
7/20/2007	8:53:44	12.317	7.321	11.6	12.87	20.48	23	26.6
7/20/2007	8:54:43	13.215	6.521	125.2	10.28	15.3	19 8	20.6
7/20/2007	8:55:43	13.349	6.403	112.7	9.56	8.74	138.9	82.9
7/20/2007	8:56:42	14.311	5.631	171.4	9.36	5.47	4.5	2.1
7/20/2007	8:57:44	12.976	6.71	13.3	9.56	4	10.5	13.9
7/20/2007	8:58:44	13.556	6.242	40.8	9.61	4.07	2.8	5.4
7/20/2007	8:59:43	13.505	6.284	37	9.24	3.23	27.3	44.4
7/20/2007	9:00:43	15.041	5.032	90.4	8.69	2.39	11.5	11.5
7/20/2007	9:01:44	14.797	5.175	16.3	7.73	1.7	1.7	1.9
7/20/2007	9:02:44	13.377	6.395	9.2	10.4	1.53	6.3	7.4
7/20/2007	9:03:43	14.426	5.516	17.4	8.98	1.42	7	8.4
7/20/2007	9:04:43	14.017	5.847	26.9	9.32	1.15	82.6	20.8
7/20/2007	9:05:42	13.837	5.995	182.3	8.58	1.24	0.1	0.6
7/20/2007	9:06:44	12.98	6.719	6.7	10.05	1.31	-0.6	0.8
7/20/2007	9:07:43	13.59	6.225	2.6	10.16	1.38	3	2.7
7/20/2007	9:08:43	13.684	6.122	2.8	9.6	1.35	-0.4	-0.1
7/20/2007	9:09:42	12.438	7.167	3.1	11.44	1.48	-0.5	-0.5
7/20/2007	9:10:44	12.138	7.431	4.8	11.92	2.11	0.1	1
7/20/2007	9:11:43	13.266	6.494	18.2	11.12	2.49	30.3	45.7
7/20/2007	9:12:43	13.953	5.911	82.5	9.29	2.24	1.2	2.2
7/20/2007	9:13:42	13.953	5.916	5.1	10.23	1.83	7.3	22
7/20/2007	9:14:44	13.917	5.939	58.3	9.05	1.93	16.2	9.5
7/20/2007	9:15:44	14.976	5.052	23.7	7.66	1.86	1.2	1.3
7/20/2007	9:16:43	14.172	5.703	1.4	8.19	1.71	0.5	1
7/20/2007	9:17:43	14.407	5.538	9.4	9.49	1.57	8.6	18
7/20/2007	9:18:44	14.255	5.639	93	9.29	1.57	4.6	4.7
7/20/2007	9:19:44	15.236	4.85	50.7	8.36	1.55	4.1	4.2
7/20/2007	9:20:43	13.802	6.003	6.5	8.38	1.57	0.6	2.1
7/20/2007	9:21:43	14.419	5.506	2.4	7.86	1.81	1.1	0.9
7/20/2007	9:22:42	14.175	5.731	2.4	9.59	1.58	0.1	0.4
7/20/2007	9:23:44	13.673	6.124	4.2	9.67	1.52	0.8	9.1

7/20/2007	9:24:43	14.693	5.3	3.8	9.66	1.52	8.7	1.3
7/20/2007	9:25:43	15.701	4.443	9.9	7.76	1.47	1.8	1.5
7/20/2007	9:26:42	14.682	5.287	12	8.34	1.37	2.9	4.2
7/20/2007	9:27:44	13.939	5.884	64.1	8.7	1.59	53.5	78.5
7/20/2007	9:28:43	14.111	5.773	225.5	9.13	2.1	1.5	0.7
7/20/2007	9:29:43	14.461	5.479	29.3	9.3	1.82	0.8	0.8
7/20/2007	9:30:42	14.048	5.812	4.9	8.35	1.68	9.8	10.6
7/20/2007	9:31:44	13.67	6.121	11.1	8.81	1.47	5.5	7.1
7/20/2007	9:32:44	13.756	6.08	40	10.79	1.81	1.1	1
7/20/2007	9:33:43	14.764	5.24	16.2	9.52	1.76	1.3	1.6
7/20/2007	9:34:43	15.17	4.873	1.4	8.56	1.47	1.8	3.8
7/20/2007	9:35:44	14.77	5.216	4.1	9.1	1.73	3.7	4.1
7/20/2007	9:36:44	14.338	5.574	10.3	8.51	1.55	59.2	48.2
7/20/2007	9:37:43	13.536	6.235	76.9	8.62	1.43	22.3	1.9
7/20/2007	9:38:43	13.485	6.3	31	10.14	1.49	12.4	20.1
7/20/2007	9:39:42	14.257	5.64	55.4	8.26	1.45	1.3	1.5
7/20/2007	9:40:44	13.977	5.885	8.7	9.53	1.52	2.1	2.3
7/20/2007	9:41:43	14.99	5.048	7.8	8.88	1.17	1.6	1.6
7/20/2007	9:42:43	15.309	4.776	2.4	7.98	1.27	1.4	1.4
7/20/2007	9:43:42	15.571	4.545	1.1	7.83	1.05	3.6	4.9
7/20/2007	9:44:44	14.111	5.759	39	9.02	0.96	1.4	1.5
7/20/2007	9:45:43	14.655	5.304	8	9.26	1.06	1.7	1.7
7/20/2007	9:46:43	14.135	5.753	4.9	10.65	1.22	0.8	0.7
7/20/2007	9:47:42	13.385	6.384	1	11.73	1.48	3.2	4.1
7/20/2007	9:48:44	13.633	6.144	20.1	10.17	1.74	17	26.3
7/20/2007	9:49:44	14.724	5.281	34.6	10.22	1.86	14.7	20.9
7/20/2007	9:50:43	13.277	6.445	165.4	8.46	2.03	5.8	69.9
7/20/2007	9:51:43	14.095	5.767	158.6	9.29	2.62	52.2	2
7/20/2007	9:52:44	13.156	6.562	74.5	11.51	2.21	0.5	1.2
7/20/2007	9:53:44	14.93	5.105	2.2	10.06	2.28	1.3	1.1
7/20/2007	9:54:43	13.089	6.607	12.4	9.82	1.65	0.2	0.9
7/20/2007	9:55:43	13.381	6.389	5.5	11.5	2.13	0.7	0.3
7/20/2007	9:56:42	14.113	5.777	1	11.14	2.34	24.2	46.6
7/20/2007	9:57:44	12.389	7.198	185.6	11.36	2.5	6.2	3.4
7/20/2007	9:58:43	13.87	5.965	44.6	11.09	2.73	62.4	88.2
7/20/2007	9:59:43	12.937	6.758	198.6	11.11	3.37	11.4	4.6
7/20/2007	10:00:42	12.899	6.785	13.8	11.53	5.19	4.5	4.2
7/20/2007	10:01:44	14.26	5.674	7.7	10.85	4.49	3.7	3.5
7/20/2007	10:02:43	13.829	5.973	6.2	9.6	3.57	5.6	11.8
7/20/2007	10:03:43	12.259	7.327	7.2	12.53	8.17	2.6	16.2
7/20/2007	10:04:42	12.744	6.912	180.4	12.1	9.82	117	74.3
7/20/2007	10:05:44	14.295	5.639	296.5	8.54	12.5	17.9	27.7
7/20/2007	10:06:44	13.116	6.563	85.2	9.3	9.97	31.2	40.5
7/20/2007	10:07:43	13.534	6.272	80	9.76	9.05	1.4	4.3
7/20/2007	10:08:43	12.367	7.213	16.9	11.23	7.16	8.3	14.9
7/20/2007	10:09:44	12.071	7.519	98.6	12.17	6.75	144.1	66
7/20/2007	10:10:44	12.34	7.227	242.8	9.23	5.24	44.1	7.2
7/20/2007	10:11:43	12.168	7.412	197.1	11.39	4.28	-0.6	-0.2
7/20/2007	10:12:43	12.579	7.077	4.8	12.51	3.39	-0.5	-0.4
7/20/2007	10:13:42	12.211	7.365	0.7	12.43	2.95	-0.6	3.6
7/20/2007	10:14:44	11.799	7.702	44.1	12.9	3	2.5	0.2
7/20/2007	10:15:43	11.246	8.181	30.9	13.59	3.45	-0.6	0.1
7/20/2007	10:16:43	11.615	7.865	2	13.54	3.82	-0.7	0.6
7/20/2007	10:17:42	10.797	8.537	5	14.25	4.85	27.6	38.6
7/20/2007	10:18:44	11.19	8.245	105.1	14.23	6.53	-0.3	1.2
7/20/2007	10:19:43	12.169	7.414	4.8	13	5.83	-0.4	1.4
7/20/2007	10:20:43	9.922	9.248	0.5	14.35	6.46	3.7	14
7/20/2007	10:21:42	9.722	9.46	6.7	15.29	17.51	2.2	7 3
7/20/2007	10:22:44	11.341	8.118	18	14.11	15.7	-0.5	1.4

7/20/2007	10:23:44	12.366	7.261	4.9	13.54	9.67	4	6.2
7/20/2007	10:24:43	13.377	6.385	10.9	11.57	6.38	3.8	8.3
7/20/2007	10:25:43	11.798	7.685	20.6	12.03	4.3	4.8	3.2
7/20/2007	10:26:44	12.513	7.142	13.1	13.01	3.14	0.2	1.6
7/20/2007	10:27:44	13.003	6.696	7.3	11.25	2.16	22.8	40.4
7/20/2007	10:28:43	13.896	5.966	115.4	9.59	1.62	17.2	8.7
7/20/2007	10:29:43	13.766	6.055	36	9.33	1.1	2.7	2.4
7/20/2007	10:30:42	11.722	7.733	48.1	10.52	1.14	92.6	42.4
7/20/2007	10:31:44	10.387	8.884	236.2	13.2	2.56	6.8	57.2
Average of Test Run		O2In	CO2In	CO	NOx	SO2	CH4	THC
		%	%	ppm	ppm	ppm	ppm	ppm
7/20/2007	10:31:44	13.439	6.334	43.8	10.09	3.26	12.7	12.8
Test Run 2 End								

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Final System Bias Check, Run 2 STRATA Version 3.01
Operator: KEF
Plant Name: Parametrix, City of Tacoma
Location: #1 Perennial Gas Comb. Stack

	Reference Cylinder Numbers	
	Zero	Span
O2In	Nitrogen	CC143844
CO2In	Nitrogen	CC143844
CO	Nitrogen	CC143844
NOx	Nitrogen	CC253351
SO2	Nitrogen	CC253351
CH4	Nitrogen	CC61264
THC	Nitrogen	CC61264

Date/Time 07-20-2007 10:49:25 PASSED

Analyte	O2In	CO2In	CO	NOx	SO2	CH4	THC
Units	%	%	ppm	ppm	ppm	ppm	ppm
Zero Ref Cyl	0.000	0.000	0.0	0.00	0.00	0.0	0.0
Zero Cal	0.002	0.002	-0.7	0.15	-0.43	-0.4	0.0
Zero Avg	0.000	0.049	0.6	0.16	-0.03	0.1	-0.4
Zero Bias%	0.0%	0.2%	0.1%	0.0%	0.4%	0.0%	0.0%
Zero Drift%	0.0%	0.2%	0.1%	0.0%	0.4%	0.0%	0.0%
Span Ref Cyl	12.000	12.000	479.0	51.00	50.40	49.7	49.7
Span Cal	11.982	12.154	479.7	51.30	51.25	49.7	50.0
Span Avg	11.861	12.069	477.8	51.15	49.76	50.4	50.6
Span Bias%	0.5%	0.3%	0.2%	0.2%	1.5%	0.1%	0.1%
Span Drift%	-0.3%	-0.2%	0.2%	-0.9%	-1.2%	0.0%	0.0%
Ini Zero Avg	0.008	0.008	-0.4	0.17	-0.40	0.0	-0.2
Ini Span Avg	11.940	12.125	476.3	52.07	50.95	50.1	50.3
Run Avg	13.439	6.334	43.8	10.09	3.26	12.7	12.8
Co	0.004	0.028	0.1	0.17	-0.21	0.1	-0.3
Cm	11.901	12.097	477.1	51.61	50.36	50.3	50.5
Correct Avg	13.552	6.270	43.9	9.83	3.47	12.5	12.8

System Bias Check End

Test Run # Begin. STRATA Version 3.01
Operator: KEF
Plant Name: Parametrix, City of Tacoma
Location: #1 Perennial Gas Comb. Stack

		O2In	CO2In	CO	NOx	SO2	CH4	THC
		%	%	ppm	ppm	ppm	ppm	ppm
7/20/2007	11:03:25	11.908	7.646	43.4	12.59	0.69	8.6	1
7/20/2007	11:04:25	10.707	8.602	32.3	13.9	0.92	6.3	8.1
7/20/2007	11:05:24	11.072	8.344	81.3	15.04	1.43	0.5	0.2
7/20/2007	11:06:24	12.206	7.408	5.1	13.73	1.36	0.8	0.2
7/20/2007	11:07:25	12.239	7.332	2.2	12.68	1.03	0.7	0
7/20/2007	11:08:25	11.839	7.695	1.3	13.84	0.86	0.6	0.1
7/20/2007	11:09:24	12.12	7.447	1.6	13.09	0.82	0.8	1.2
7/20/2007	11:10:24	12.386	7.238	12.5	12.76	0.76	58.1	5.8
7/20/2007	11:11:25	11.683	7.799	82.7	13.48	0.66	3.2	3.5
7/20/2007	11:12:25	12.698	6.977	19.8	13.32	0.93	58	15.9
7/20/2007	11:13:24	12.725	6.943	178.7	12.28	0.88	67.6	14.1
7/20/2007	11:14:24	12.49	7.135	124	12.27	0.74	1.5	1.3
7/20/2007	11:15:26	11.264	8.149	31.8	13.49	1.12	1.3	1.9
7/20/2007	11:16:25	11.653	7.849	7.9	14.07	1.8	1	2
7/20/2007	11:17:25	11.674	7.84	5	14.36	2.15	0.8	1.4
7/20/2007	11:18:24	11.007	8.372	2.3	13.76	2.37	2.4	3
7/20/2007	11:19:24	12.4	7.252	3.9	14.02	2.37	8.6	10.1
7/20/2007	11:20:25	12.773	6.89	14.9	11.64	1.82	4.1	4.7
7/20/2007	11:21:25	11.477	7.993	13.4	12.35	1.61	1.8	1.4
7/20/2007	11:22:24	12.835	6.853	22.8	12	1.49	2	1.7
7/20/2007	11:23:24	12.067	7.475	22	11.06	1.25	0.8	1.3
7/20/2007	11:24:25	9.828	9.357	17	14.67	2.36	8.4	10.6
7/20/2007	11:25:25	11.613	7.889	138.7	13.48	3.12	18	30.1
7/20/2007	11:26:24	12.299	7.29	73.4	11.53	2.17	13.1	11.9
7/20/2007	11:27:24	12.598	7.052	113.8	12.43	1.78	6.7	6.4
7/20/2007	11:28:25	12.297	7.296	26.3	12.08	1.42	1.1	1.4
7/20/2007	11:29:25	12.91	6.794	21.6	12.22	1.37	62.1	38.9
7/20/2007	11:30:24	12.599	7.043	106.8	10.31	1.33	11.5	11.4
7/20/2007	11:31:24	11.569	7.847	157	11.34	1.09	166.7	19.5
7/20/2007	11:32:26	9.891	9.308	202.1	14.33	2.24	4.3	4.6
7/20/2007	11:33:25	11.018	8.37	77.3	14.47	3.27	0.5	0.3

Test Run 3 End

Test Run 3 Begin. STRATA Version 3.01
Operator: KEF
Plant Name: Parametrix, City of Tacoma
Location: #1 Perennial Gas Comb. Stack

		O2In	CO2In	CO	NOx	SO2	CH4	THC
		%	%	ppm	ppm	ppm	ppm	ppm
Begin calculating run averages								
7/20/2007	11:39:26	10.927	8.476	48.1	14.69	3.64	0.7	0.1
7/20/2007	11:40:25	11.185	8.207	18.2	14.65	2.96	3.2	3.4
7/20/2007	11:41:25	11.34	8.125	43.4	15.09	3.03	1.4	1.5
7/20/2007	11:42:25	11.322	8.114	11	13.74	2.74	1.4	0
7/20/2007	11:43:26	11.96	7.582	6.9	14.01	2.44	11.8	22.4
7/20/2007	11:44:26	11.077	8.305	89.4	13.38	2.12	32	34.1
7/20/2007	11:45:25	10.97	8.403	119.5	13.44	2.49	1.3	1.6
7/20/2007	11:46:25	11.434	8.01	23.5	14.5	2.88	2.8	3.1
7/20/2007	11:47:26	11.11	8.303	37.6	14.52	3.13	23.3	31.1
7/20/2007	11:48:26	11.168	8.222	59	13.68	3.03	125.2	28.1
7/20/2007	11:49:25	10.682	8.662	206.2	14.94	4.14	1	2.1
7/20/2007	11:50:25	10.661	8.646	12.5	14.84	4.08	10.7	14.4
7/20/2007	11:51:26	10.125	9.112	48	15.27	5.43	2.3	5.2
7/20/2007	11:52:26	10.706	8.634	4.7	15.66	6.3	19.4	20.7
7/20/2007	11:53:25	11.699	7.803	93.5	14.05	5.36	20.4	27.8
7/20/2007	11:54:25	12.112	7.464	156	12.72	4.03	1.6	41.5
7/20/2007	11:55:24	10.211	8.991	178	13.37	3.58	84.2	4
7/20/2007	11:56:26	10.216	9.053	116.5	15.49	4.56	2.1	3.3
7/20/2007	11:57:26	10.79	8.563	51.8	15.07	4.19	41.6	45.4
7/20/2007	11:58:25	11.322	8.102	179.7	12.95	5.59	6.5	8.6
7/20/2007	11:59:25	11.725	7.791	59.4	13.45	5.22	81.8	16.6
7/20/2007	12:00:26	12.991	6.725	248.5	11.82	4.04	1.3	1
7/20/2007	12:01:26	13.662	6.162	13.2	11.83	3.13	0.8	1.2
7/20/2007	12:02:25	14.364	5.552	3.1	10.22	2.4	2.5	1.5
7/20/2007	12:03:25	13.051	6.651	3.8	11.04	2.28	0.4	0
7/20/2007	12:04:26	12.712	6.956	6.7	13.17	1.86	29.6	43.6
7/20/2007	12:05:26	12.59	7.012	100.1	11.01	1 93	11	6.1
7/20/2007	12:06:25	12.036	7.532	27.8	13.12	2.03	85.6	21.1
7/20/2007	12:07:25	12.128	7.441	150.6	12.64	2.27	2.7	2.5
7/20/2007	12:08:26	11.992	7.511	40.2	11.88	2.4	0.9	6.8
7/20/2007	12:09:26	12.476	7.182	17	13.07	3.16	9.5	10.6
7/20/2007	12:10:25	12.365	7.224	21.5	11.59	3.22	5	3.1
7/20/2007	12:11:25	11.447	7.99	40.8	12.85	2.55	8.3	6.2
7/20/2007	12:12:24	11.869	7.679	36.8	13.27	2.45	1.3	5.1
7/20/2007	12:13:26	12.802	6.882	28.5	11.5	2.49	12.4	18.7
7/20/2007	12:14:26	11 971	7.548	49	11.95	2.1	15.4	13.2
7/20/2007	12:15:25	11.706	7.787	65.7	12.52	2.17	0	0.9
7/20/2007	12:16:25	10.591	8.719	33.7	14.4	2.63	1.6	2.5
7/20/2007	12:17:26	12.409	7.23	44.8	12.95	3.47	9.3	13.5
7/20/2007	12:18:26	11.718	7.742	69.8	12.2	3.36	2.8	4
7/20/2007	12:19:25	10.556	8.743	88.3	13.84	4.84	30.6	46.5
7/20/2007	12:20:25	10.623	8.712	120.5	13.34	9.16	1.6	3
7/20/2007	12:21:26	11.983	7.556	40.8	13.59	7.19	57.1	22
7/20/2007	12:22:26	12.85	6.841	176.9	12.36	5.33	1.6	1.3
7/20/2007	12:23:25	10.85	8.496	9.9	12.04	4.25	0.5	0.8
7/20/2007	12:24:25	11.09	8.307	6.8	14.03	3.77	12.8	17
7/20/2007	12:25:26	11.494	7.969	23.1	13.71	3.58	1.2	1
7/20/2007	12:26:26	11.986	7.583	6.5	13.93	3.32	2	2
7/20/2007	12:27:25	13.033	6.664	6.5	11.03	3.09	0.7	0.4
7/20/2007	12:28:25	11.603	7.863	3.2	14.05	2.93	0.4	0.4
7/20/2007	12:29:24	11.84	7.681	8.5	13.53	2.87	0.4	0.4
7/20/2007	12:30:26	10.684	8.648	12.4	15.64	3.27	0.3	2.8

7/20/2007	12:31:26	11.385	8.068	12.3	14.57	3.58	2	1
7/20/2007	12:32:25	8.6	10.319	34.2	14.02	5.29	6.5	10.6
7/20/2007	12:33:25	10.416	8.898	67.9	15.24	9.61	2.7	3.5
7/20/2007	12:34:26	11.115	8.31	38.9	14.61	7.37	0.3	0.6
7/20/2007	12:35:26	11.395	8.042	6	14.13	5.53	80.1	76.2
7/20/2007	12:36:25	11.751	7.763	85.1	13.96	6.12	15.2	33.7
7/20/2007	12:37:25	11.892	7.631	118.7	12.39	6.72	18.3	16.4
7/20/2007	12:38:26	12.04	7.483	63.5	12.74	5.45	0.3	0.2
7/20/2007	12:39:26	11.034	8.37	1.2	14.45	4.47	0.3	0.3
7/20/2007	12:40:25	10.364	8.89	18.8	14.52	4.05	59.4	58.5
7/20/2007	12:41:25	10.207	9.051	224.7	15.07	4.37	33.6	2.4
7/20/2007	12:42:26	12.139	7.429	53.4	13.24	4.48	0.5	1.3
7/20/2007	12:43:26	12.561	7.08	3.2	12.16	3.83	20.2	29.5
7/20/2007	12:44:25	11.434	8.017	63.5	12.54	3.78	3.2	5.6
7/20/2007	12:45:25	13.105	6.605	11.1	11.84	4.62	24.3	30.6
7/20/2007	12:46:24	11.149	8.234	179.2	13.32	3.95	0.8	5.2
7/20/2007	12:47:26	8.319	10.579	97.1	14.56	4.1	48.9	54.5
7/20/2007	12:48:26	12.011	7.565	239.8	13.54	4.72	0.7	1
7/20/2007	12:49:25	11.467	7.984	6.9	13.73	4.09	52.5	11.5
7/20/2007	12:50:25	10.676	8.642	114.8	13.37	3.54	4.4	6
7/20/2007	12:51:26	9.714	9.437	49.6	13.95	3.45	0.2	0.5
7/20/2007	12:52:26	10.71	8.631	12.2	14.93	3.54	0.1	0.2
7/20/2007	12:53:25	11.641	7.87	1.9	14.81	3.43	1.8	58.8
7/20/2007	12:54:25	13.168	6.56	82.2	10.86	2.94	42.4	1.4
7/20/2007	12:55:26	10.164	9.042	61.1	13.59	2.98	9	11.1
7/20/2007	12:56:26	10.131	9.091	77.1	14.79	3.74	1.5	2.4
7/20/2007	12:57:25	11.113	8.306	72.1	14.19	3.82	3.3	4.8
7/20/2007	12:58:25	12.083	7.485	42.3	12.4	3.56	1.3	4.8
7/20/2007	12:59:26	11.293	8.137	28.8	13.62	3.97	4.9	6.1
7/20/2007	13:00:26	12.158	7.408	37.2	12.08	4.6	10.9	16
7/20/2007	13:01:25	11.682	7.813	22	12.27	3.86	3.6	0.4
7/20/2007	13:02:25	12.317	7.3	7.5	13.08	3.63	6.1	7.6
7/20/2007	13:03:24	12.884	6.802	8.8	11.58	3.2	0.8	0.3
7/20/2007	13:04:26	11.721	7.778	3.2	12.62	2.8	0.2	20.7
7/20/2007	13:05:26	10.482	8.811	158.5	14.39	3.99	41	30.9
7/20/2007	13:06:25	11.677	7.82	186.1	11.89	5.63	2	3.9
7/20/2007	13:07:25	12.505	7.14	12.2	12.96	5.47	0.7	3.5
7/20/2007	13:08:26	14.257	5.654	3.9	10.53	5.25	1.3	0.9
7/20/2007	13:09:26	11.388	8.072	8.5	12.71	4.41	5	9
7/20/2007	13:10:25	12.246	7.338	97.6	12.34	4.02	1.5	0.6
7/20/2007	13:11:25	12.757	6.933	14.2	11.85	3.61	2.6	3.3
7/20/2007	13:12:26	14.89	5.128	11.7	8.91	3 09	186.6	26.2
7/20/2007	13:13:26	11.541	7.907	315.3	10.46	2.97	7	8.5
7/20/2007	13:14:25	11.547	7.93	41.1	12.51	2.88	22.2	67.1
7/20/2007	13:15:25	11.657	7.865	206.3	13.4	3.28	34.7	9.8
7/20/2007	13:16:26	13.356	6.409	83.5	10.45	3.13	6.9	25.9
7/20/2007	13:17:26	12.209	7.364	55.5	11.76	3.27	85.3	12.9
7/20/2007	13:18:25	13.306	6.483	68.7	10.86	3.09	1.2	1.1
7/20/2007	13:19:25	13.559	6.27	3.2	10.51	2.88	2	2
7/20/2007	13:20:24	13.066	6.64	9	10.82	2.74	107.5	75.1
7/20/2007	13:21:26	12.204	7.381	154.2	11.41	3.27	45.6	20.2
7/20/2007	13:22:26	11.667	7.808	78.7	11.66	3.97	1.3	5.6
7/20/2007	13:23:25	12.616	7.05	7.5	12.4	6.03	12.7	16
7/20/2007	13:24:25	10.242	9.028	87	13.34	7.84	8.1	10.4
7/20/2007	13:25:26	12.089	7.485	29.6	13.53	7.39	3.8	4.6
7/20/2007	13:26:26	10.713	8.629	60.6	13.47	5.71	3	5.9
7/20/2007	13:27:25	9.685	9.493	48.7	14.39	6.54	5.4	10.4
7/20/2007	13:28:25	10.646	8.72	20.2	14.83	8.35	1	3.1
7/20/2007	13:29:26	12.527	7.128	13.6	12.35	7.3	0.9	1.2

7/20/2007	13 30 26	10 964	8.401	23.5	13.04	5.59	7.2	11
7/20/2007	13 31 29	10 957	8.442	68.9	13.5	4.58	0.2	1.3
7/20/2007	13 32 26	13 029	6.717	2.5	13.33	4.09	1.3	0.3
7/20/2007	13 33 26	11 586	7.898	152.2	11.97	3.59	116.8	52.7
7/20/2007	13 34 26	10 341	8 942	94.5	14.09	3.75	0.4	0.8
7/20/2007	13 35 27	11 926	7.65	2.9	14.3	4.05	1.1	7.7
7/20/2007	13 36 26	11 927	7 593	54.8	11.74	4.24	7.2	2.5
7/20/2007	13 37 [illegible]	[illegible]	8.314	50.6	13.72	4.09	1.7	3.4
7/20/2007	13 38 26	14 186	5.749	40.2	10.77	3.83	2	1
Average of Test Run		[illegible]	CO2In	CO	NOx	SO2	CH4	THC
			%	ppm	ppm	ppm	ppm	ppm
7/20/2007	[illegible]	[illegible]	7 832	60.6	13.1	4.06	16.5	12.5

Test Run 3 End

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Final System Bias Check, Run 3 STRATA Version 3.01
Operator: KEF
Plant Name: Parametrix, City of Tacoma
Location: #1 Perennial Gas Comb. Stack

	Reference Cylinder Numbers	
	Zero	Span
O2In	Nitrogen	CC143844
CO2In	Nitrogen	CC143844
CO	Nitrogen	CC143844
NOx	Nitrogen	CC253351
SO2	Nitrogen	CC253351
CH4	Nitrogen	CC61264
THC	Nitrogen	CC61264

Date/Time 07-20-2007 13:58:49 PASSED

Analyte	O2In	CO2In	CO	NOx	SO2	CH4	THC
Units	%	%	ppm	ppm	ppm	ppm	ppm
Zero Ref Cyl	0.000	0.000	0.0	0.00	0.00	0.0	0.0
Zero Cal	0.002	0.002	-0.7	0.15	-0.43	-0.4	0.0
Zero Avg	0.002	0.039	0.7	0.17	-0.22	0.4	0.0
Zero Bias%	0.0%	0.2%	0.1%	0.0%	0.2%	0.1%	0.0%
Zero Drift%	0.0%	0.0%	0.0%	0.0%	-0.2%	0.0%	0.0%
Span Ref Cyl	12.000	12.000	479.0	51.00	50.40	49.7	49.7
Span Cal	11.982	12.154	479.7	51.30	51.25	49.7	50.0
Span Avg	11.909	12.211	489.9	50.98	49.71	50.1	50.4
Span Bias%	0.3%	0.2%	1.0%	0.3%	1.5%	0.0%	0.0%
Span Drift%	0.2%	0.6%	1.2%	-0.2%	-0.1%	0.0%	0.0%
Ini Zero Avg	0.000	0.049	0.6	0.16	-0.03	0.1	-0.4
Ini Span Avg	11.861	12.069	477.8	51.15	49.76	50.4	50.6
Run Avg	11.659	7.832	60.6	13.10	4.06	16.5	12.5
Co	0.001	0.044	0.7	0.17	-0.12	0.2	-0.2
Cm	11.885	12.140	483.9	51.07	49.73	50.3	50.5
Correct Avg	11.772	7.726	59.4	12.96	4.23	16.1	12.4

System Bias Check End

AMTEST
AIR QUALITY, LLC

CLIENT: Parametrix – City of Tacoma Landfill DATE: 7/19/07

CONTINUOUS ANALYZER CHECKLIST

OXYGEN (O_2) ANALYZERS				
Servomex *Model 1420B*	#1___	#2___	#3___	#4___
Infrared Industries *Model 2200*			#1___	#2___
CAI Model 200				___
CAI 600 Series			#1_X_	#2___
CARBON DIOXIDE (CO_2) ANALYZERS				
Servomex *Model 1410B*	#1___	#2___	#3___	#4___
Automated Custom Systems *Model 3300*				___
Infrared Industries *Model 702D*				___
CAI Model 200				___
CAI 600 Series			#1_X_	#2___
SULFUR DIOXIDE (SO_2) ANALYZERS				
BOVAR Western Research *Model 721* AT				X
Monitor Labs *Model 8850* with STI/Am Test SO_2 Dilution Module				___
BOVAR Western Research Model 721 M			#1___	#2___
NITROGEN OXIDES (NO_x) ANALYZERS				
Thermo Environmental Instruments *Model 42H*			#1_X_	#4___
Thermo Environmental Instruments *Model 10S*			#1___	#2___
Monitor Labs *Model 8840* with ML *Model 8730* Dilution Module				___
CAI Model 400-CLD			#1___	#2___
CARBON MONOXIDE (CO) ANALYZERS				
Thermo Environmental Instruments *Model 48*	#1___	#2___	#3___	#4_X_ #5___ #6___
Automated Custom Systems *Model 3300*				___
HYDROCARBON ANALYZERS				
Thermo Environmental Instruments *Model 51* HC Analyzer	#1___		#2___	#3___
J.U.M. Engineer *Model 109A* Non-Methane HC Analyzer			#1_X_	#2___
Infrared Industries *Model 702D* HC Analyzer				___
Infrared Industries *Model 703* HC Analyzer				___
Thermo Environmental Instruments *Model 680* Methane Analyzer				___
GAS CHROMATOGRAPH				
SRI Model 8610A GC				___
DATA ACQUISITION SYSTEMS				
STRATA				X
Yokogawa w/STRATA				___
Yokogawa *Model HR2400* w/ Portable Computer				___
Manually Recorded				___
BUBBLE METER				
Gilian Bubble Meter #1 (SN 18844-S)				___
Gilian Bubble Meter #2 (SN 18445-S)				___
Gilian Bubble Meter #3 (SN 18445-S)				X

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GAS CYLINDER CHECKLIST

CLIENT: Parametrix - City of Tacoma Landfill DATE: 7/19/2007

	Cylinder #	Gas Concentrations	Exp. Date
		Carbon Monoxide, Carbon Dioxide, Oxygen	
	AL2908	898 ppm CO, 22.1% CO_2, 22.0% O_2	04/12/10
	ALM003519	485 ppm CO, 12.0% CO_2, 12.1% O_2	06/18/10
	ALM016630	485 ppm CO, 11.9% CO_2, 12.2% O_2	06/18/10
	ALM042710	486 ppm CO, 12.0% CO_2, 12.1% O_2	06/18/10
	ALM044100	485 ppm CO, 11.9% CO_2, 12.1% O_2	06/18/10
	CC18810	482 ppm CO, 12.0% CO_2, 12.0% O_2	01/17/10
	CC49005	482 ppm CO, 12.0% CO_2, 12.0% O_2	01/17/10
	CC53479	482 ppm CO, 12.0% CO_2, 11.9% O_2	01/17/10
	CC62336	479 ppm CO, 11.9% CO_2, 12.0% O_2	01/17/10
	CC69301	903 ppm CO, 22.2% CO_2, 21.9% O_2	04/12/10
	CC92340	474 ppm CO, 11.9% CO_2, 12.0% O_2	06/28/09
	CC94381	482 ppm CO, 12.0% CO_2, 12.0% O_2	06/28/09
	CC132488	481 ppm CO, 12.0% CO_2, 12.0% O_2	04/12/10
X	CC143844	479 ppm CO, 12.0% CO_2, 12.0% O_2	04/12/10
	CC160030	909 ppm CO, 22.0% CO_2, 22.0% O_2	08/21/09
	CC160566	467 ppm CO, 12.1% CO_2, 12.0% O_2	06/28/07
	CC160851	898 ppm CO, 22.5% CO_2, 21.9% O_2	06/15/07
	CC162057	908 ppm CO, 21.9% CO_2, 22.1% O_2	01/17/10
	CC174911	881 ppm CO, 22.1% CO_2, 21.9% O_2	01/17/10
X	CC180131	917 ppm CO, 22.0% CO_2, 22.0% O_2	08/21/09
		Sulfur Dioxide, Nitrogen Oxides, Carbon Monoxide	
	CC20272	90.2 ppm SO_2, 90.7 ppm NO_x, 89.4 ppm CO	09/30/07
	CC52410	98.6 ppm SO_2, 97.1 ppm NO_x, 83.6 ppm CO	06/15/09
	CC55858	50.4 ppm SO_2, 50.7 ppm NO_x, 49.3 ppm CO	07/19/08
	CC58255	50.9 ppm SO_2, 51.9 ppm NO_x, 48.4 ppm CO	06/08/07
	CC62845	50.7 ppm SO_2, 50.3 ppm NO_x, 49 ppm CO	01/30/09
	CC70106	197 ppm SO_2, 201 ppm NO_x, 200 ppm CO	04/04/08
	CC70170	50.4 ppm SO_2, 50.8 ppm NO_x, 49.5 ppm CO	01/30/09
	CC139660	99.3 ppm SO_2, 97.6 ppm NO_x, 82.3 ppm CO	06/15/09
	CC140325	193 ppm SO_2, 192 ppm NO_x, 190 ppm CO	10/03/07
X	CC160620	90.0 ppm SO_2, 91.3 ppm NO_x, 89.5 ppm CO	09/30/07
	CC160736	191 ppm SO_2, 193 ppm NO_x, 191 ppm CO	06/15/09
	CC160795	90.2 ppm SO_2, 91.2 ppm NO_x, 89.6 ppm CO	09/30/07
	CC161042	90.2 ppm SO_2, 91.1 ppm NO_x, 89.5 ppm CO	09/30/07
	CC191210	193 ppm SO_2, 193 ppm NO_x, 190 ppm CO	06/09/07
	CC192220	191 ppm SO_2, 194 ppm NO_x, 191 ppm CO	06/15/09
	CC192224	51.1 ppm SO_2, 51.9 ppm NO_x, 48.9 ppm CO	08/17/07
X	CC253351	50.4 ppm SO_2, 51 ppm NO_x, 49.9 ppm CO	01/30/09
	CC259848	98.8 ppm SO_2, 96.8 ppm NO_x, 82.7 ppm CO	06/15/09
	CC259835	190 ppm SO_2, 193 ppm NO_x, 189 ppm CO	06/15/09
	CC259895	55.0 ppm SO_2, 54.3 ppm NO_x, 46.3 ppm CO	06/15/09
	CC259952	54.7 ppm SO_2, 54.0 ppm NO_x, 46.2 ppm CO	06/15/09
		Sulfur Dioxide, Nitrogen Oxides	
	CC70054	479 ppm SO_2, 481 ppm NO_x	04/20/09
	CC144125	475 ppm SO_2, 475 ppm NO_x	08/17/07
	CC155872	949 ppm SO_2, 954ppm NO_x	09/12/08
	CC254017	476 ppm SO_2, 471 ppm NO_x	04/20/09
	CC259899	967 ppm SO_2, 948 ppm NO_x	06/15/09
	CC259936	966 ppm SO_2, 948 ppm NO_x	06/15/09
	CC259947	911 ppm SO_2, 915 ppm NO_x	05/16/09
		Nitrogen Oxides	
	CC181005	1800 ppm NO_x	05/11/09
	CC259873	1840 ppm NO_x	06/01/09
	CC259875	1840 ppm NO_x	06/01/09

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GAS CYLINDER CHECKLIST

	Cylinder #	Gas Concentrations	Exp. Date
		Propane	
	AAL12394	49.9 % Propane	06/24/09
	ALM018370	1.04 % Propane	06/26/08
	ALM049011	29.9 % Propane	06/24/09
	ALM052917	90 % Propane	06/24/09
	AL1603	3030 ppm Propane	03/29/08
	CC12800	51.5 ppm Propane	03/30/08
	CC18804	902 ppm Propane	04/15/08
	CC26506	95.2 ppm Propane	09/07/09
	CC61118	89.7 ppm Propane	08/21/09
	CC68674	89.7 ppm Propane	08/21/09
	CC82755	95.6 ppm Propane	09/07/09
	CC113695	30.3 ppm Propane	03/30/08
	CC114790	30 ppm Propane	09/07/06
	CC122424	4880 ppm Propane	04/15/08
	CC122490	9440 ppm Propane	04/15/08
	CC122505	50.3 ppm Propane	04/11/08
	CC122601	89.9 ppm Propane	08/21/09
	CC122493	2910 ppm Propane	04/15/08
	CC148616	846 ppm Propane	04/19/09
	CC161804	50.1 ppm Propane	04/11/08
	CC163086	301 ppm Propane	04/19/09
	CC165096	8900 ppm Propane	03/30/08
	CC175635	892 ppm Propane	03/29/08
	CC180732	496 ppm Propane	03/29/08
	CC215688	300 ppm Propane	04/19/09
		Methane	
	CC49031	2960 ppm Methane	03/30/08
	CC55519	301 ppm Methane	04/11/08
	CC58365	49.8 ppm Methane	06/04/10
	CC58369	2970 ppm Methane	04/11/08
X	CC61264	49.7 ppm Methane	10/18/07
	CC69808	303 ppm Methane	10/18/07
	CC105857	914 ppm Methane	04/11/08
	CC108168	907 ppm Methane	04/11/08
X	CC115989	30.1 ppm Methane	04/11/08
X	CC122541	90.0 ppm Methane	04/11/08
	CC122578	49.8 ppm Methane	06/04/10
	CC153098	499 ppm Methane	10/18/07
	CC153164	89.8 ppm Methane	04/11/08
	CC161826	500 ppm Methane	04/11/08
	CC161853	50.6 ppm Methane	04/11/08
	CC163318	89.8 ppm Methane	03/31/08

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TRAVERSE SAMPLING DATA SHEET

Page 1 of ____

Lab Number 4504

Client Parametrix @ Transit L.F.
Location Tacoma, WA
Sample Site #2 Perennial Gas Combustor
Stack Diameter 118"
Date 7/19/07
Operators Rory / KJR
Run # 1 Method 26A

Stack Schematic Completed ✓
Sample Train Info Completed ✓
Pitot # 195-6B Side A
Thermocouple # 195-6B
Meter Box ID #6
Pressure Meas. Device
Mag. / Man. (S.R.) I.D. #4
Filter # ____ Imp. Set G-1

Start Time 1500 hours
Stop Time 1745 hours
Barometric Press. 29.70 "Hg
Static Press. -0.01 "H_2O
Production Rate tons 1530-155

Cyclonic Flow Check ____
(Attach sheet if applicable)

EQUIPMENT CHECKS

	Initial	Final
Leak Rate cfm	0.006	0.004
Leak Test Vacuum	16"	12"
Pitots, Leak Check	✓	✓
Gas Sampling System	✓	
Integrated Bag		
Probe Wash	Ace / (H_2O) / Other	

Alt. TC Cal. TC Temp. 62
Thermometer ID 8359 Therm Temp. 62

Imp	Final Wt. grams		Initial Wt. grams		Net Wt. grams
#1	645.9	-	549.6	=	96.3
#2	675.0	-	643.4	=	31.6
#3	583.8	-	576.4	=	7.4
#4		-		=	
#5		-		=	
#6		-		=	
SG	972.7	-	953.2	=	19.5

Total Volume = 154.8

SAMPLING PARAMETERS

% Moisture 10% 8.2
Meter Temp. 74
Stack Temp. 1400
ΔH@ 1.941
Y 1.003
Cp 0.84
Nozzle Diameter ~~0.995~~ 0.974 inch

D1 0.974 D2 0.973 D3 0.974
K Factor 268.815 246.178

Sample Point	Elapsed Time min	Dry Gas Meter Reading cu. ft.	Pitot Reading ΔP "H_2O	Orifice Setting ΔH "H_2O Ideal	Orifice Setting ΔH "H_2O Actual	Gas Meter Temp Deg. F In	Gas Meter Temp Deg. F Out	Pump Vac. Gauge "Hg	Filter Box Temp. Deg. F	Imp. Exit Temp. Deg. F	Stack Temp. Deg. F	O_2 %
A 4	0	28.476	0.005	1.23	1.23	74	74	1	249	60	1440	
3	7.5	32.85	0.009	2.22	2.22	77	75	1	252	60	1427	
2	15	38.43	0.009	2.22	2.22	77	75	1	252	60	1474	
1	22.5	44.58	0.006	1.48	1.48	80	78	1	246	60	1467	
B 4	30	47.61	0.002	0.49	0.49	80	79	1	245	58	1451	
3	37.5	—	0.007	1.72	1.72	80	79	1	244	57	1438	
2	45	56.92	0.007	1.72	1.72	81	79	1	246	57	1329	
1	52.5	62.54	0.010	2.46	2.46	83	79	1	249	57	1238	
C 4	60	68.531	0.006	1.48	1.48	84	79	1	255	57	1410	
3	67.5	73.60	0.008	1.97	1.97	86	82	1	257	59	1375	
2	75	79.38	0.007	1.72	1.72	86	82	1	260	59	1349	
1	82.5	84.97	0.006	1.48	1.48	88	84	1	259	59	1390	
D 4	90	92.306	0.003	0.74	0.74	90	85	1	252	58	1382	
3	97.5	99.020	0.005	1.23	1.23	91	88	1	261	58	1450	
2	105	103.392	0.003	0.74	0.74	92	90	1	262	56	1401	
1	112.5	106.84	0.009	2.22	2.22	94	90	1	260	56	1338	
END	120	112.834										
		84.356			1.523	82.5					1397.4	
			$(\sqrt{\Delta P_{avg}})^2$		ΔH_{avg}	T_m					T_s	O_2 %

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TRAVERSE SAMPLING DATA SHEET

Lab Number 4505

Client Parametrics @ Tacoma L.F
Location Tacoma WA
Sample Site #1 Perennial Combustion Stack
Stack Diameter 118"
Date 7/20/07
Operators RDR / KJR
Run # 2 Method 26A

Stack Schematic Completed ✓
Sample Train Info Completed ✓
Pitot # 195-6B Side A
Thermocouple # 195-6B
Meter Box ID #6
Pressure Meas. Device
Mag. / Man. / S.R. I.D. #4
Filter # _____ Imp. Set G-2

Start Time 0831 hours
Stop Time 1042 hours
Barometric Press. 29.65 "Hg
Static Press. -0.01 "H_2O
Production Rate _____
Cyclonic Flow Check _____
(Attach sheet if applicable)

EQUIPMENT CHECKS

	Initial	Final
Leak Rate cfm	0.007	0.004
Leak Test Vacuum	16"	16"
Pitots, Leak Check	✓	✓
Gas Sampling System	✓	
Integrated Bag		
Probe Wash	Ace / H_2O / Other	
Alt. TC Cal.	TC Temp.	
Thermometer ID	Therm Temp.	

Imp	Final Wt. grams		Initial Wt. grams		Net Wt. grams
#1	972.1	-	875.0	=	97.1
#2	768.0	-	728.4	=	39.6
#3	576.4	-	572.4	=	4.0
#4		-		=	
#5		-		=	
#6		-		=	
SG	913.9	-	890.9	=	23.0
			Total Volume =		163.7

SAMPLING PARAMETERS

% Moisture 8%
Meter Temp. 68
Stack Temp. _____
ΔH@ 1.941
Y 1.008
Cp 0.84
Nozzle Diameter 0.974 inch
D1 0.974 D2 0.973 D3 0.974
K Factor 257.477 283.592

Sample Point	Elapsed Time min	Dry Gas Meter Reading cu. ft.	Pitot Reading ΔP "H_2O	Orifice Setting ΔH "H_2O Ideal	Orifice Setting ΔH "H_2O Actual	Gas Meter Temp Deg. F In	Gas Meter Temp Deg. F Out	Pump Vac. Gauge "Hg	Filter Box Temp. Deg. F	Imp. Exit Temp. Deg. F	Stack Temp. Deg. F	O_2 %
A 4	0	113.278	0.007	1.80	1.80	68	68	1	242	50	1270	
3	7.5	118.98	0.005	1.42	1.42	70	68	1	257	50	1230	
2	15	124.11	0.010	2.84	2.84	71	68	1	260	50	1373	
1	22.5	—	0.006	1.70	1.70	71	68	1	260	50	1282	
B 4	30	136.53	0.008	2.27	2.27	74	69	1	262	51	1165	
3	37.5	142.84	0.007	1.98	1.98	75	71	1	260	51	1251	
2	45	148.83	0.007	1.98	1.98	77	72	1	261	52	1164	
1	52.5	154.90	0.006	1.70	1.70	78	73	1	259	52	1307	
C 4	60	160.27	0.010	2.84	2.84	80	75	1	260	52	1225	
3	67.5	167.09	0.006	1.70	1.70	81	76	1	261	53	1258	
2	75	174.07	0.007	1.98	1.98	82	76	1	262	53	1379	
1	82.5	179.99	0.009	2.55	2.55	82	77	1	262	55	1362	
D 4	90	185.80	0.006	1.70	1.70	82	78	1	260	55	1182	
3	97.5	191.65	0.006	1.70	1.70	83	78	1	260	55	1491	
2	105	197.14	0.005	1.42	1.42	84	80	1	263	55	1445	
1	112.5	202.08	0.010	2.84	2.84	84	80	1	261	56	1223	
END	120	208.876										
		95.598										

$(\sqrt{\Delta P_{avg}})^2$ 2.026 ΔH_{avg} 75.6 T_m [illegible] T_s O_2 %

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TRAVERSE SAMPLING DATA SHEET

Page 1 of _____

Lab Number 4506

Client Paramount @ Tacoma L.F
Location Tacoma, WA
Sample Site #1 Perennial Combustion Inlet
Stack Diameter 118"
Date 7/20/07
Operators ROR / KJR
Run # 3 Method 26A

EQUIPMENT CHECKS

	Initial	Final
Leak Rate cfm	0.008	0.008
Leak Test Vacuum	15"	15"
Pitots, Leak Check	✓	✓
Gas Sampling System	✓	
Integrated Bag		
Probe Wash	Ace / (H2O) / Other	

Alt. TC Cal. TC Temp.
Thermometer ID Therm Temp.

Stack Schematic Completed ✓
Sample Train Info Completed ✓
Pitot # 195-68 Side A
Thermocouple # 195-68
Meter Box ID #6
Pressure Meas. Device
Mag. / Man. (S.R.) I.D. #4
Filter # _____ Imp. Set G-3

Imp	Final Wt. grams		Initial Wt. grams		Net Wt. grams
#1	813.0	-	711.6	=	
#2	1069.4	-	638.9	=	
#3	500.8	-	495.6	=	
#4		-		=	
#5		-		=	
#6		-		=	
SG	957.6	-	923.0	=	
			Total Volume =		171.7

Start Time 1130 hours
Stop Time 1351 hours
Barometric Press. 29.65 "Hg
Static Press. -0.01 "H2O
Production Rate _____
Cyclonic Flow Check _____
(Attach sheet if applicable)

SAMPLING PARAMETERS

% Moisture 8%
Meter Temp. 83
Stack Temp. 1400
ΔH@ 1.941
Y 1.003
Cp 0.84
Nozzle Diameter 0.974 inch
D1 0.974 D2 0.973 D3 0.974
K Factor 254.533

Sample Point	Elapsed Time min	Dry Gas Meter Reading cu. ft.	Pitot Reading ΔP "H2O	Orifice Setting ΔH "H2O Ideal	Orifice Setting ΔH "H2O Actual	Gas Meter Temp Deg. F In	Gas Meter Temp Deg. F Out	Pump Vac. Gauge "Hg	Filter Box Temp. Deg. F	Imp. Exit Temp. Deg. F	Stack Temp. Deg. F	O_2 %
A 4	0	209.227	0.005	1.27	1.27	84	84	1	245	50	1480	
3	7.5	———	0.009	2.29	2.29	84	82	1	244	50	1508	
2	15.0	219.81	0.010	2.55	2.55	83	81	1	259	50	1444	
1	22.5	226.25	0.007	1.78	1.78	85	82	1	263	50	1361	
B 4	30.0	231.74	0.007	1.78	1.78	85	82	1	264	51	1480	
3	37.5	236.97	0.005	1.27	1.27	86	83	1	266	51	1376	
2	45.0	241.61	0.010	2.55	2.55	85	82	1	263	51	1403	
1	52.5	—	0.010	2.55	2.55	87	83	1	262	51	1388	
C 4	60.0	255.04	0.004	1.02	1.02	88	85	1	263	51	1373	
3	67.5	259.07	0.004	1.02	1.02	88	84	1	261	51	1545	
2	75.0	262.91	0.008	2.04	2.04	88	85	1	261	52	1419	
1	82.5	268.70	0.008	2.04	2.04	89	85	1	262	52	1334	
D 4	90.0	274.49	0.011	2.80	2.80	90	86	1	263	52	1393	
3	97.5	281.44	0.010	2.55	2.55	91	86	1	260	53	1322	
2	105.0	287.85	0.005	1.27	1.27	90	86	1	260	54	1345	
1	112.5	292.45	0.006	1.53	1.53	90	87	1	261	54	1410	
End	120.0	297.435										
		83.208		1.274		85.5					1411.1	
		$(\sqrt{\Delta P_{avg}})^2$		ΔH_{avg}		T_m					T_s	O_2 %

AMTEST AIR QUALITY, LLC

SAMPLE TRAIN INFORMATION

Fill out one sheet per site and per method.

CLIENT: Parametrix @ City of Tacoma Landfill
LOCATION: Tacoma WA
SITE: #1 Perennial Gas Combustion
TEST TEAM: KEF, RDR, KJR, TWG DATE: 7/19 - 7/20/07
RUN #'s: 1-3 METHOD: 26A (HX only)

Probe/Filter Temperature: ✓ 248±25 °F ____ 320 °F ____ other

Impinger Temperature: ✓ <68 °F ____ ≤45 °F ____ other

Nozzle Type: ✓ quartz ____ steel Probe Type: ✓ regular ____ water-cooled

Probe Liner: ✓ quartz ____ glass ____ steel ____ Teflon®

Front-Half Filter: ✓ yes ____ no Size (mm): ____ 90 ✓ 110 ____ 125 ____ other

Filter Media: ✓ quartz fiber ____ glass fiber ____ Teflon® ____ other

Support: ____ steel ____ glass frit ____ Teflon® Gasket: ____ silicone ____ Teflon®

Back-Half Filter: ____ yes ✓ no Tared: ____ yes ____ no

Filter Media: ____ quartz fiber ____ glass fiber ____ Teflon®

Note: Show the back-half filter location with an arrow on the table below.

Purge Required: ____ yes ✓ no Comments: ____

Blanks/Spikes Required: ✓ reagent blanks ____ field blank ____ spike ____ other

	Contents	Initial Volume (mL)	Cleanup Solution Used	Bottle Type	Comments
	Nozzle/Probe Rinse				
	Filter				
B	#1 0.1 N H_2SO_4	100	DI H_2O	1 L NM	
I	#2 0.1 N H_2SO_4	100	↓	↓	
T	#3 MT	--	↓	↓	
S	#4 SG	--			
	#5				
	#6				
	#7				

If this information is not accurate for all runs, note all exceptions.

328 Lab No 4507

AMTEST
AIR QUALITY, LLC

COMPENDIUM METHOD TO-14
CANISTER SAMPLING FIELD DATA SHEET

CLIENT: PARAmetrix

LOCATION: TAcoma LAndfill

SAMPLE LOCATION: #1 Perennial Combustor Inlet

SAMPLE DATE: 7/19/07

OPERATOR(s): TWG

CANISTER IDENTIFICATION NO.: 000428

RUN NUMBER: R-1 BAROMETRIC PRESSURE (" Hg): 29.70

SAMPLING INFORMATION:

TEMPERATURE

	GAS	AMBIENT	MAXIMUM	MINIMUM
START	104.6	64		
STOP	103.3	63		

PRESSURE

CANISTER PRESSURE	
	-30"
	-2"

SAMPLING TIMES

	LOCAL TIME
	1510
	1730
Sample length	120 (minutes)

CANISTER FLOW RATE	FLOW CONTROLLER READOUT

SUMMA CANISTER CERTIFICATION DATE: 7/3/07

TYPE OF SAMPLE LINE (circle one): none, teflon, stainless steel, other_____

KNOCKOUT IMPINGERS (circle one): yes, no

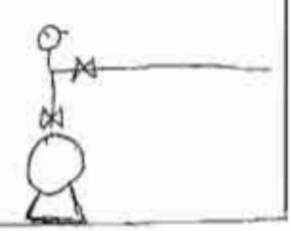
CONDENSATE PRESENT (circle one): yes, no

VOA VIAL(s): _____ mls

SIZE OF SUMMA CANISTER (circle one): 3 L, 6 L, Other_____

SAMPLING COMMENTS, NOTES: 20 min PAuse

Sketch of Sampling System



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329

Lab No 4508

AMTEST
AIR QUALITY, LLC

COMPENDIUM METHOD TO-14
CANISTER SAMPLING FIELD DATA SHEET

CLIENT: Parametrix

LOCATION: Tacoma Landfill

SAMPLE LOCATION: #2 Perennial Combustor Inlet

SAMPLE DATE: 7/20/07

OPERATOR(s): TWG

CANISTER IDENTIFICATION NO.: 000484

RUN NUMBER: R-2 Canister 2

BAROMETRIC PRESSURE (" Hg): 29.65

SAMPLING INFORMATION:

TEMPERATURE

	GAS	AMBIENT	MAXIMUM	MINIMUM
START	84.0	63		
STOP	88.3	64		

PRESSURE

CANISTER PRESSURE	
	-30"
	0"

SAMPLING TIMES

	LOCAL TIME	
	0831	
	1031	
Sample length	120	(minutes)

CANISTER FLOW RATE	FLOW CONTROLLER READOUT

SUMMA CANISTER CERTIFICATION DATE: 7/3/07

TYPE OF SAMPLE LINE (circle one): none, teflon, stainless steel, other_____

KNOCKOUT IMPINGERS (circle one): yes, no

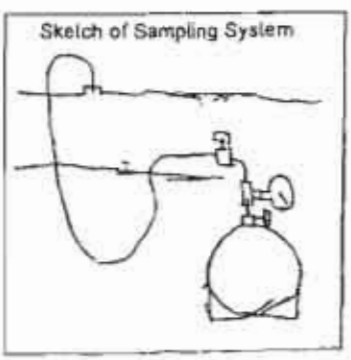
CONDENSATE PRESENT (circle one): yes, no

VOA VIAL(s): _____ mls

SIZE OF SUMMA CANISTER (circle one): 3 L, 6 L, Other_____

SAMPLING COMMENTS, NOTES: _____

Sketch of Sampling System



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Lab NO. 4504

330

AMTEST
AIR QUALITY, LLC

COMPENDIUM METHOD TO-14
CANISTER SAMPLING FIELD DATA SHEET

CLIENT: Parametrix

LOCATION: Tacoma Landfill

SAMPLE LOCATION: #2 Perennial Combustor Inlet

SAMPLE DATE: 7/20/07

OPERATOR(s): TWG

CANISTER IDENTIFICATION NO.: 000526

RUN NUMBER: 3A Canister 3 BAROMETRIC PRESSURE (" Hg): 29.65

SAMPLING INFORMATION:

TEMPERATURE

	GAS	AMBIENT	MAXIMUM	MINIMUM
START	86	62		
STOP	93	65		

PRESSURE

CANISTER PRESSURE	
	-30"
	0

SAMPLING TIMES

	LOCAL TIME	
	1138	
	1338	
Sample length	120	(minutes)

CANISTER FLOW RATE	FLOW CONTROLLER READOUT

SUMMA CANISTER CERTIFICATION DATE: 6/20/07

TYPE OF SAMPLE LINE (circle one): none, teflon, stainless steel, other_____

KNOCKOUT IMPINGERS (circle one): yes, no

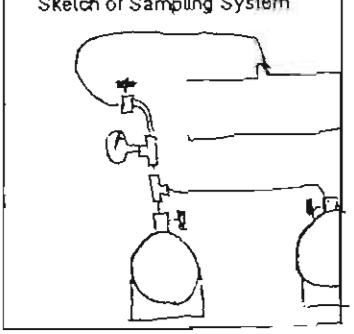
CONDENSATE PRESENT (circle one): yes, no

VOA VIAL(s): _____ mls

SIZE OF SUMMA CANISTER (circle one): 3 L, 6 L, Other_____

SAMPLING COMMENTS, NOTES: _____

Sketch of Sampling System



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Lab No 4510

331

AMTEST
AIR QUALITY, LLC

COMPENDIUM METHOD TO-14
CANISTER SAMPLING FIELD DATA SHEET

CLIENT: Parametrix

LOCATION: Tacoma Landfill

SAMPLE LOCATION: #2 Perennial Combustor Inlet

SAMPLE DATE: 7/20/07

OPERATOR(s): TWG

CANISTER IDENTIFICATION NO.: 000 399

RUN NUMBER: 3B Canister 4 BAROMETRIC PRESSURE (" Hg): 29.65

SAMPLING INFORMATION:

TEMPERATURE

	GAS	AMBIENT	MAXIMUM	MINIMUM
START	86	62		
STOP				

PRESSURE

CANISTER PRESSURE	
	-30"
	-2.5"

SAMPLING TIMES

	LOCAL TIME	
	1138	
	1338	
Sample length	120	(minutes)

CANISTER FLOW RATE	FLOW CONTROLLER READOUT

SUMMA CANISTER CERTIFICATION DATE: 6/20/07

TYPE OF SAMPLE LINE (circle one): none, teflon, stainless steel, other_____

KNOCKOUT IMPINGERS (circle one): yes, no

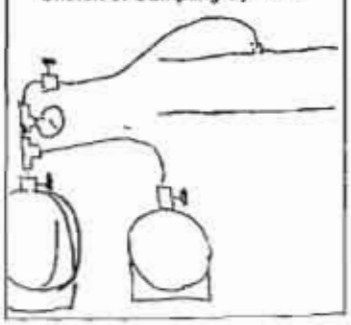
CONDENSATE PRESENT (circle one): yes, no

VOA VIAL(s): _____ mls

SIZE OF SUMMA CANISTER (circle one): 3 L, 6 L, Other_____

SAMPLING COMMENTS, NOTES: _____

Sketch of Sampling System



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METHOD 0031 SAMPLING DATA SHEET

Client: Parametrix @ Tacoma L.F

Date: 7/19/07

Meter Box: #27 Barometric Press. ("Hg): 29.70

Y Factor: #3 Bubble Meter

Test Run # 1A Approx. Sampling Rate: .5 LPM Lab NO 4511

Tenax Tube #1 I.D.: R-1 A1

Tenax Tube #2 I.D.: R-1 A2 Pre-test Leak Check ✓ Ambient 67 °F

Anasorb Tube #3 I.D.: R-1 A3 Pre-test Leak Check ✓

Clock Time	Run Time	Gas Meter Volume (cf)	Meter Inlet Temp (°F)	Meter Outlet Temp (°F)	Pump Vacuum (in. Hg)	Sorbent Inlet Temp (°F)	
1510	~~0~~	738.712	73	73	5	41	472 cc/m
	~~5~~	———	75	75	5	41	507 cc/m
	10	738.776	76	75	5	41	492 cc/m
	~~15~~	738.862	78	75	5	40	485 cc/m
Pause	20	738.945	84	82	5	40	501 cc/m
	25	738.966	85	83	5	40	497 cc/m
	30	739.093	85	82	3	40	495 cc/m
	35	739.211	85	82	4	41	512 cc/m
~~1610~~ 1620	40	739.300	1530–1550 Pause				
		0.588	79.3				

Test Run # 1B Approx. Sampling Rate: 0.5 liter/min Lab No: 4512

Tenax Tube #1 I.D.: R-1 B1

Tenax Tube #2 I.D.: R-1 B2 Pre-test Leak Check ✓ Ambient 68 °F

Anasorb Tube #3 I.D.: R-1 B3 Pre-test Leak Check ✓

Clock Time	Run Time	Gas Meter Volume (cf)	Meter Inlet Temp (°F)	Meter Outlet Temp (°F)	Pump Vacuum (in. Hg)	Sorbent Inlet Temp (°F)	
1620	0	739.304	87	84	5	40	515 cc/min
	5						
	10	739.365	90	86	2.1	40	505.2 cc/
	15	739.382	91	88	2.7	40	483 cc/min
	20	739.425	94	90	3.5	40	486.1 cc/min
	25	739.454	95	93	5.9	40	416.7 cc/min
	30	739.488	98	93	7.2	40	510.3 cc/min
	35	739.516	99	95	6.9	40	527.0 cc/min
1700	40	739.607					
		0.303	91.6				

METHOD 0031 SAMPLING DATA SHEET

Client: Parametrix @ Tacoma Landfill
Date: 7/19/07

Meter Box: #27
Barometric Press. ("Hg): 29.70
Y Factor: #3 Bubble Meter

Test Run # 1C
Approx. Sampling Rate: 0.5 liter/min Lab No. 4513

Tenax Tube #1 I.D.: R-1 C1
Tenax Tube #2 I.D.: R-1 C2
Anasorb Tube #3 I.D.: R-1 C3

Pre-test Leak Check ✓
Pre-test Leak Check ✓

Ambient 69 °F

Clock Time	Run Time	Gas Meter Volume (cf)	Meter Inlet Temp (°F)	Meter Outlet Temp (°F)	Pump Vacuum (in. Hg)	Sorbent Inlet Temp (°F)	
1719	0	739.607	103	101	3.2	40	629.7 cc/m
	5	739.662	103	101	3.6	40	476.4 cc/m
	10	739.797	105	101	3.4	40	496.6 cc/m
	15	739.744	105	102	4.2	40	454.2 cc/min
	20	739.895	106	101	4.4	40	491.7 cc/min
	25	—	105	102	4.7	40	~~450~~
	30	739.994	109	102	5.3	40	450.4 cc/min
	35	—	105	102	5.4	40	466.5 cc/m
1759	40	740.065					

103.1°

No Condensate Present 0.458

Test Run # _____
Approx. Sampling Rate: 0.5 liter/min

Tenax Tube #1 I.D.: _____
Tenax Tube #2 I.D.: _____
Anasorb Tube #3 I.D.: _____

Pre-test Leak Check _____
Pre-test Leak Check _____

Clock Time	Run Time	Gas Meter Volume (cf)	Meter Inlet Temp (°F)	Meter Outlet Temp (°F)	Pump Vacuum (in. Hg)	Sorbent Inlet Temp (°F)

METHOD 0031 SAMPLING DATA SHEET

Client: Porometrix @ Tacoma L.E
Date: 7/20/07

Meter Box: #27
Y Factor:

Barometric Press. ("Hg): 29.65

Test Run # 2A

Approx. Sampling Rate: 500 cc/min Lab No. 4514

Tenax Tube #1 I.D.: R2 A1
Tenax Tube #2 I.D.: R2 A2
Anasorb Tube #3 I.D.: R2 A3

Pre-test Leak Check ✓
Pre-test Leak Check ✓

Ambient 57 °F

Clock Time	Run Time	Gas Meter Volume (cf)	Meter Inlet Temp (°F)	Meter Outlet Temp (°F)	Pump Vacuum (in. Hg)	Sorbent Inlet Temp (°F)	Bubble Meter
0831	0	739.966	71	70	3	41	496.3 cc/m.
	5	740.055	71	71	3	41	495.0 "
	10	740.144	72	71	3	41	495.1 "
-	15	740.233	~~76~~ TG	~~72~~ TG	~~3~~ TG	~~41~~ TG	482.2
	20	740.322	76	72	3	41	488.0
	25	740.411	78	74	3	41	486.6
	30	740.500	81	74	3	41	493.0
	35	740.589	82	77	3	41	475.0
0911	40	740.678					

Test Run # 2B

Approx. Sampling Rate: 0.5 liter/min Lab Pc. 4515

Tenax Tube #1 I.D.: R2 B1
Tenax Tube #2 I.D.: R2 B2
Anasorb Tube #3 I.D.: R2 B3

Pre-test Leak Check ✓
Pre-test Leak Check ✓

Ambient 60 °F

Clock Time	Run Time	Gas Meter Volume (cf)	Meter Inlet Temp (°F)	Meter Outlet Temp (°F)	Pump Vacuum (in. Hg)	Sorbent Inlet Temp (°F)	Bubble Meter (cc/min)
0926	0	740.811	87	83	3.5	41	470.2
	5	740.896	87	84	3.5	41	488.4
	10	740.971	88	84	3.5	41	491.4
	15	741.066	89	86	3.5	41	490.1
	20	741.151	91	86	4.0	41	499.4
	25	741.237	92	88	4.0	41	506.2
	30	741.322	94	88	4.5	41	478.3
	35	741.407	94	91	4.5	41	472.0
1006	40	741.492					

METHOD 0031 SAMPLING DATA SHEET

Client: Parametrix @ Tacoma L.F

Date: 7/20/07

Meter Box: #27 Barometric Press. ("Hg): 29.65

Y Factor:

Test Run # 2c

Approx. Sampling Rate: 0.5 LPM Lab No. 4516

Tenax Tube #1 I.D.: R2 C1

Tenax Tube #2 I.D.: R2 C2 Pre-test Leak Check ✓ Ambient 61 °F

Anasorb Tube #3 I.D.: R2 C3 Pre-test Leak Check ✓

Clock Time	Run Time	Gas Meter Volume (cf)	Meter Inlet Temp (°F)	Meter Outlet Temp (°F)	Pump Vacuum (in. Hg)	Sorbent Inlet Temp (°F)	Bubble Meter (cc/min)
1028	0	741,427	96	91	2.5	41	518.4
	5	741.520	94	92	2.5	41	470.8
	10	741.612	94	92	2.5	41	483.3
	15	741.705	97	91	3	41	473.2
	20	741.797	97	93	5	41	463.6
	25	741.889	98	92	5	41	519.8
	30	741.982	98	94	5	41	547.4
	35	742075	101	93	5	41	510.8
1108	40	742.167					

0.740

4.6

No Condensate Reset

Test Run #

Approx. Sampling Rate: 0.5 liter/min

Tenax Tube #1 I.D.:

Tenax Tube #2 I.D.: Pre-test Leak Check

Anasorb Tube #3 I.D.: Pre-test Leak Check

Clock Time	Run Time	Gas Meter Volume (cf)	Meter Inlet Temp (°F)	Meter Outlet Temp (°F)	Pump Vacuum (in. Hg)	Sorbent Inlet Temp (°F)

METHOD 0031 SAMPLING DATA SHEET

Client: Parametrix @ Tacoma L.F
Date: 7/20/07

Meter Box: #27 Barometric Press. ("Hg): 29.65
Y Factor: 1.093 @ 1.0 l/m - #3 Bubble Meter

Test Run # 3A Approx. Sampling Rate: 0.5 LPM Lab No. 4517

Tenax Tube #1 I.D.: R3 A1
Tenax Tube #2 I.D.: R3 A2
Anasorb Tube #3 I.D.: R3 A3

Pre-test Leak Check ✓
Pre-test Leak Check ✓

Ambient 61 °F

Clock Time	Run Time	Gas Meter Volume (cf)	Meter Inlet Temp (°F)	Meter Outlet Temp (°F)	Pump Vacuum (in. Hg)	Sorbent Inlet Temp (°F)	Bubble Mtr cc/min
1138	0	742.171	95	94	3.5	41	511.5
	5	742.258	95	94	3.5	42	511.1
	10	742.345	95	91	2.5	42	505.3
	15	742.432	95	90	4	44	505.6
	20	742.519	96	90	4	44	496.1
	25	742.606	96	90	4	45	498.8
	30	742.693	96	90	4	43	510.2
	35	742.780	98	91	4	43	507.1
1218	40	742.867					

0.696 93.5

Test Run # 3B Approx. Sampling Rate: 0.5 liter/min Lab. No. 4518

Tenax Tube #1 I.D.: R3 B1
Tenax Tube #2 I.D.: R3 B2
Anasorb Tube #3 I.D.: R3 B3

Pre-test Leak Check ✓
Pre-test Leak Check ✓

Ambient 61 °F

Clock Time	Run Time	Gas Meter Volume (cf)	Meter Inlet Temp (°F)	Meter Outlet Temp (°F)	Pump Vacuum (in. Hg)	Sorbent Inlet Temp (°F)	Bubble Mtr cc/min
1232	0	742.873	95	94	3	41	496.4
	5	742.960	96	91	4.5	41	485.4
	10	743.047	94	92	5.5	41	483.9
	15	743.134	96	91	6.5	42	470.9
	20	743.221	95	92	6.5	42	490.9
	25	743.308	96	91	7.5	42	488.1
	30	743.395	96	92	7.5	42	478.4
	35	743.482	97	91	7.5	42	473.2
1312	40	743.569					

0.696 93.7

METHOD 0031 SAMPLING DATA SHEET

Client: Parametrix at Tacoma Landfill
Date: 7/20/07

Meter Box: 27
Barometric Press. ("Hg): 29.65
Y Factor: #3 Bubble Meter

Test Run # 3C

Approx. Sampling Rate: 0.5 liter/min Lab. No. 4579

Tenax Tube #1 I.D.: R-3 C1
Tenax Tube #2 I.D.: R-3 C2
Anasorb Tube #3 I.D.: R-3 C3

Pre-test Leak Check ✓
Pre-test Leak Check ✓

Ambient 61 °F

Clock Time	Run Time	Gas Meter Volume (cf)	Meter Inlet Temp (°F)	Meter Outlet Temp (°F)	Pump Vacuum (in. Hg)	Sorbent Inlet Temp (°F)	Bubble Meter (cc/min)
1325	0	743.574	95	94	4.5	42	502.4
	5	743.660	96	92	4	42	508.1
	10	743.746	95	92	4	42	501.1
	15	743.832	97	91	4	42	498.3
	20	743.918	96	93	6	43	480.5
	25	744.004	98	92	7.5	43	472.9
	30	744.090	97	94	7	43	477.8
	35	744.176	99	93	7.5	43	490.2
1405	40	744.262		94.6			

No Condensate Present 0.688

Test Run #

Approx. Sampling Rate: 0.5 liter/min

Tenax Tube #1 I.D.:
Tenax Tube #2 I.D.:
Anasorb Tube #3 I.D.:

Pre-test Leak Check
Pre-test Leak Check

Clock Time	Run Time	Gas Meter Volume (cf)	Meter Inlet Temp (°F)	Meter Outlet Temp (°F)	Pump Vacuum (in. Hg)	Sorbent Inlet Temp (°F)

AMTEST AIR QUALITY, LLC

SAMPLE TRAIN INFORMATION

Fill out one sheet per site and per test type.

CLIENT: Parametrix @ City of [illegible] Landfill

LOCATION: [illegible] WA

SITE: Flare Circled

TEST TEAM: [illegible] DATE(S) [illegible]

RUN #'S: 1-3 (A,B,C) TYPE: M0031

Probe/Filter Temperature: ✓ 248±25°F ____ 320°F ____ Other

Impinger Temperature: ____ <68°F ____ Other

THIMBLE: ____ yes ✓ no NOZZLE TYPE: ✓ quartz ____ steel

PROBE LINER: ____ quartz ✓ glass ____ steel ____ teflon

PROBE TYPE: ____ regular ____ water-cooled

FRONT-HALF FILTER: ____ yes ✓ no SIZE (mm): ____ 90 ____ 110 ____ 125

FRONT-HALF FILTER MEDIA: ____ quartz fiber ____ glass fiber ____ teflon

SUPPORT: ____ steel ____ glass frit ____ teflon GASKET: ____ silicon ____ teflon

BACK-HALF FILTER: ____ yes ✓ no

BACK-HALF FILTER MEDIA: ____ quartz fiber ____ glass fiber ____ teflon ____ tared ____ untared

NOTE: Show the back-half filter location with an arrow on the table below.

Use no silicone grease! One field blank per 2-hour run.

CONTENTS	Initial Volume (mL)	Cleanup Solution Used	Bottle Type	Comments
Probe /Quarte wool				
Three-Way Valve				
Coil condenser				
Tenax tube				Cap, place in ziploc bag, Keep cold.
Tenax tube				↓
Condensate Trap		3X HPLC Grade H2O	40mL VOA vial (1 or more)	Ziploc bag, keep cold.
Condenser				
Anasorb tube				Cap, place in ziploc bag, Keep cold.
Silica Gel				Use NEW SG for each run.

IF THIS INFORMATION IS NOT ACCURATE FOR ALL RUNS, NOTE ALL EXCEPTIONS.

[jaa\c\excel\sampltm.xls] 1/27/94

APPENDIX D

Supporting Information

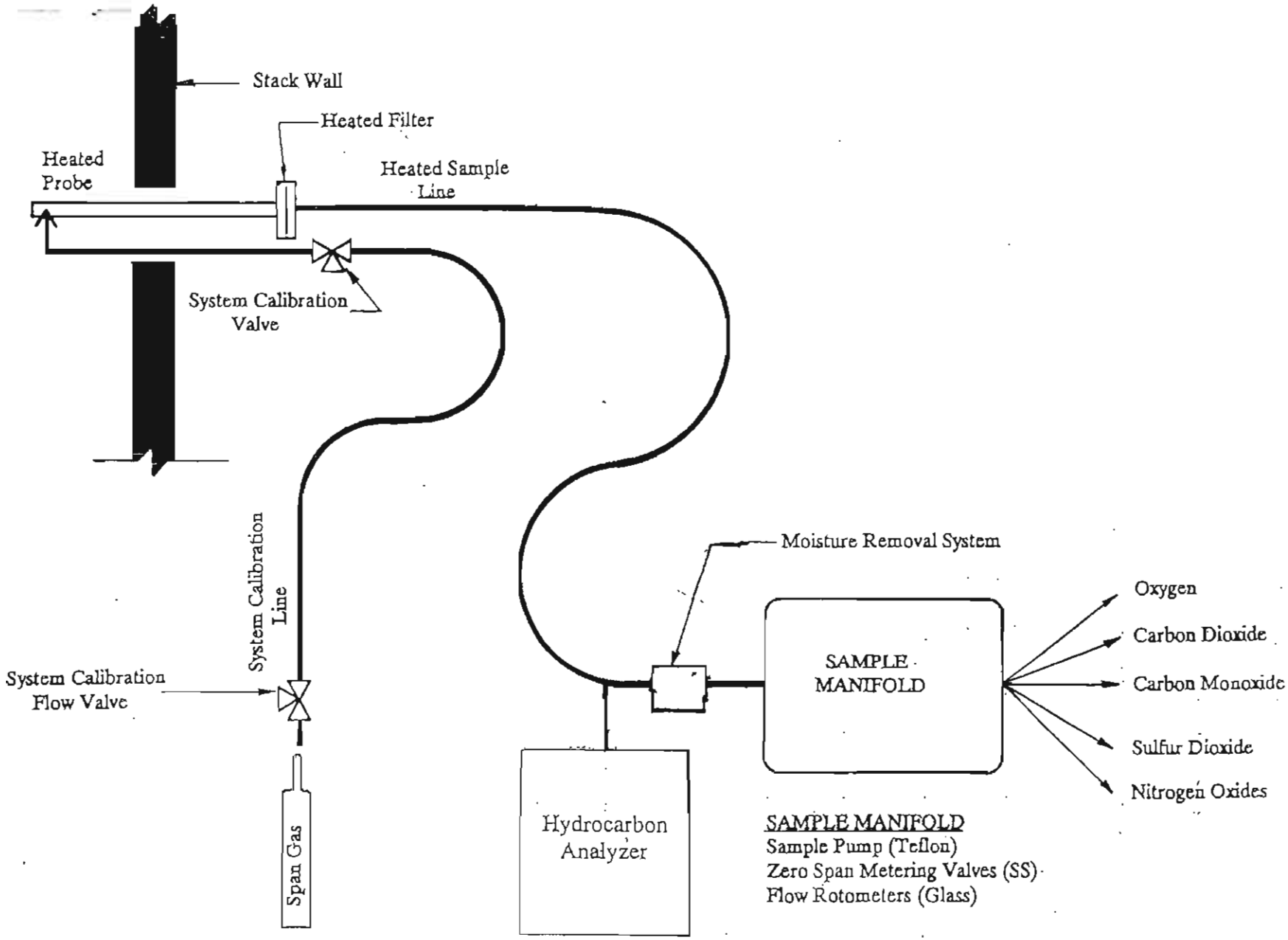

Figure 1. EPA Method 3A, 6C, 7E, 10, and 25A Sampling System Schematic

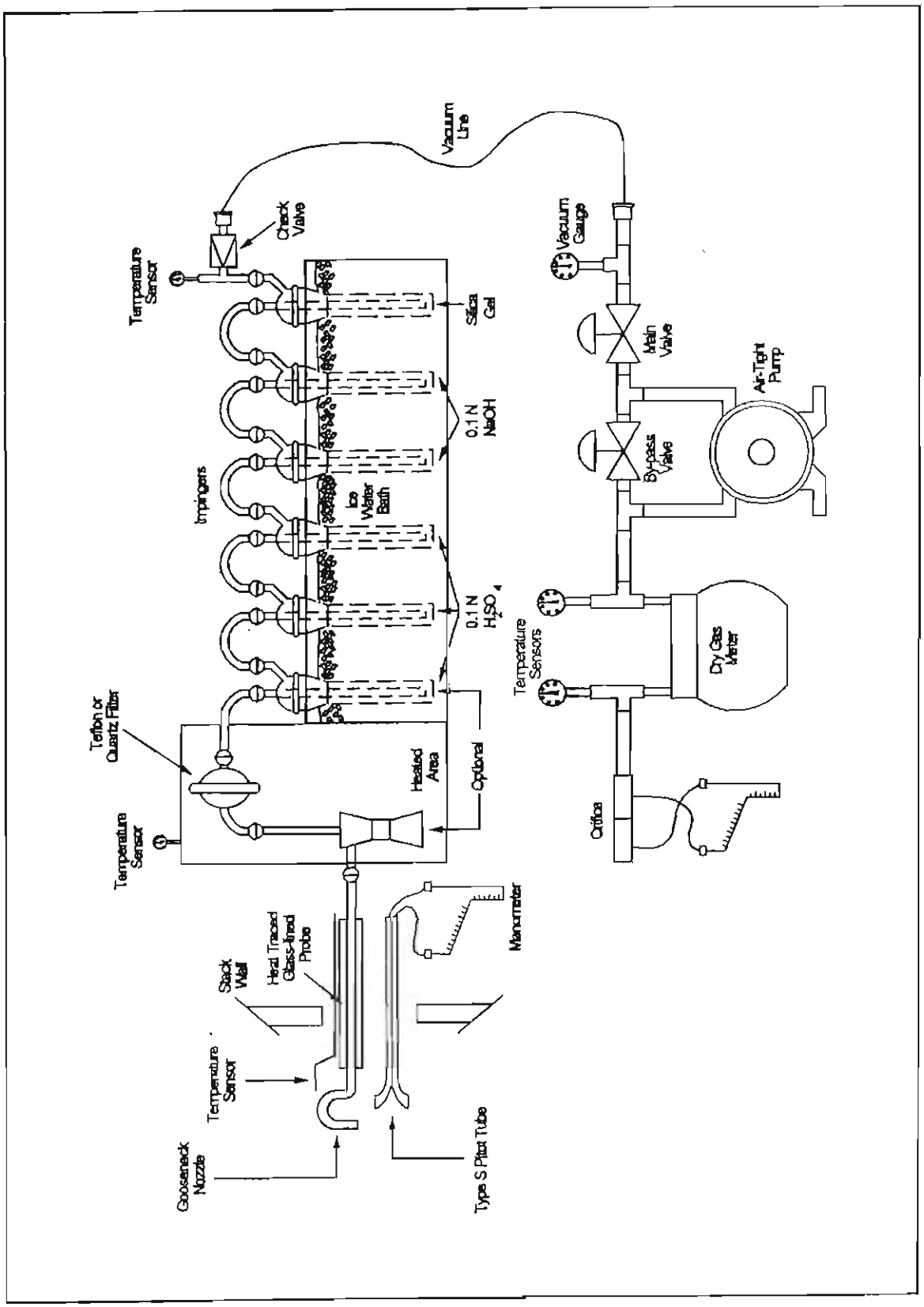

FIGURE 2. METHOD 26A SAMPLE TRAIN

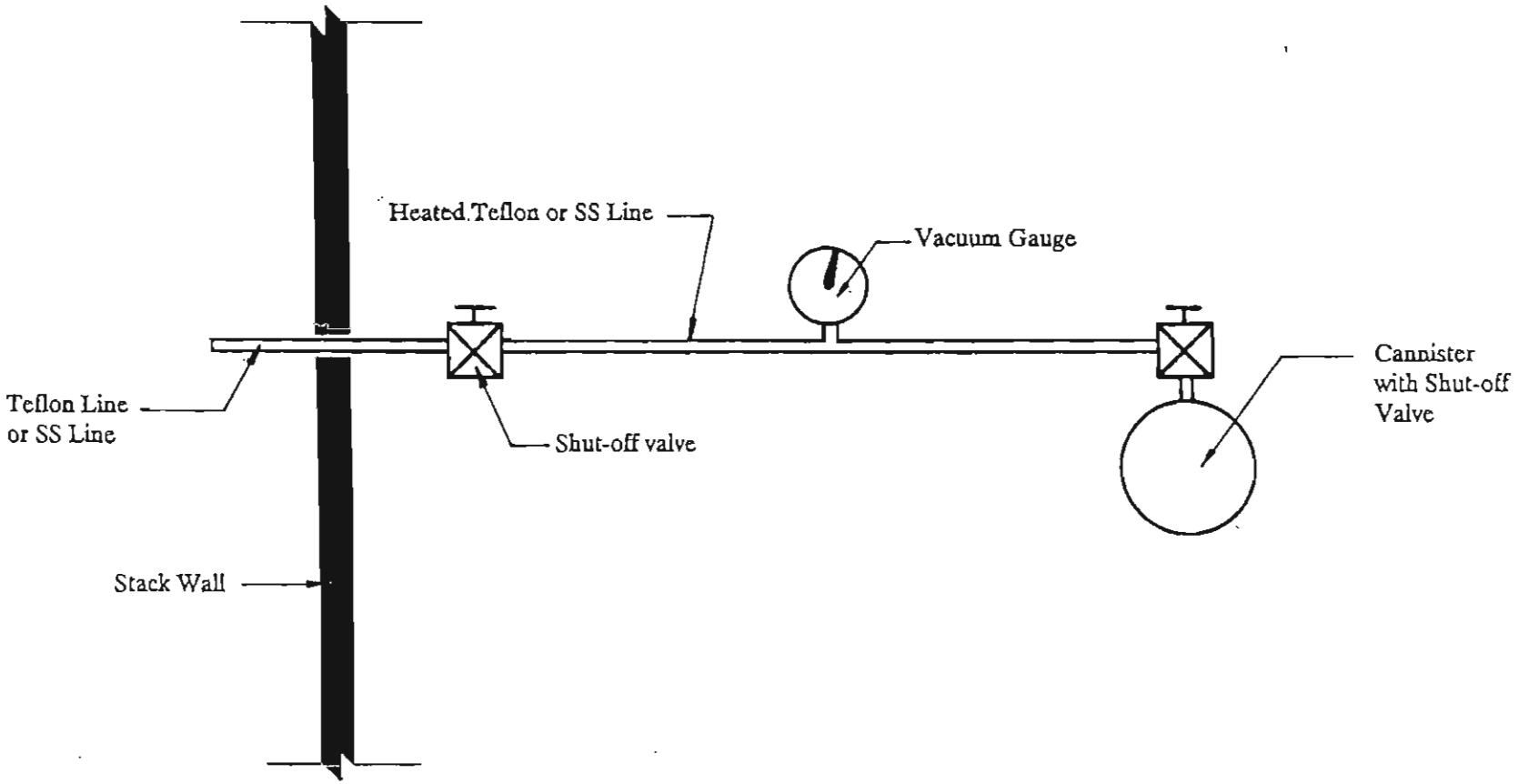

Figure 3 . TO-1HA Sample System Schematic.

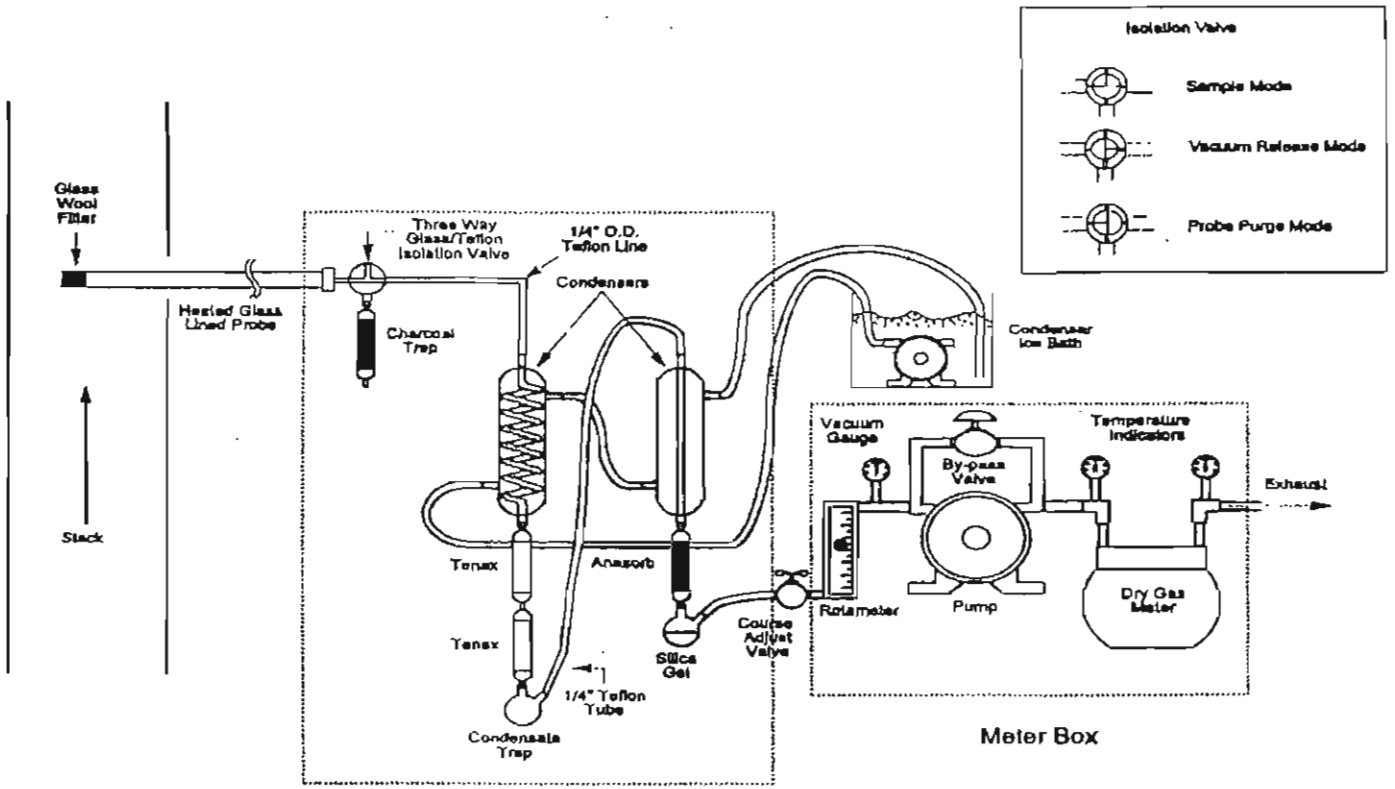

FIGURE 4: SW-846 METHOD 0031 VOLATILE ORGANIC COMPOUNDS

METHOD 1 – LOCATION OF TRAVERSE POINTS

Circular Stacks

Figure 1-3. Example showing a 60° circular stack cross-section divided into 12 equal areas, with location of traverse points indicated.

Traverse Point	% of Diameter	Location of Sample Point
1	4.4	2.64
3	29.6	17.76
5	85.4	51.24

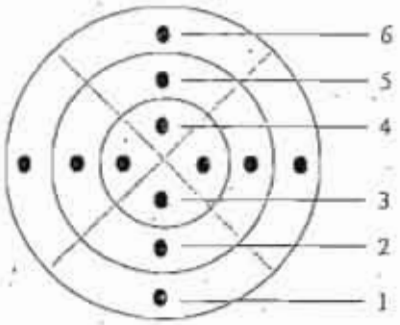

Table 1-2. Location of traverse points in circular stacks (percent of stack diameter from inside wall to traverse points).

Number of Traverse Points on a Diameter											
2	4	6	8	10	12	14	16	18	20	22	24
2	85.4	25.0	14.6	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
4	93.3	70.4	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
6	95.6	80.6	65.8	35.6	26.9	22.0	18.8	16.5	14.6	13.2
8	96.8	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
10	97.4	88.2	79.9	71.7	61.8	38.8	31.5	27.2
12	97.9	90.1	83.1	76.4	69.4	60.7	39.8
14	98.2	91.5	85.4	79.6	73.8	67.7
16	98.4	92.5	87.1	82.0	77.0
18	98.6	93.3	88.4	83.9
20	98.7	94.0	89.5
22	98.9	94.5
24	98.9

Rectangular Stacks

For a rectangular cross section, an equivalent diameter (D_e) shall be calculated from the following equation, to determine the upstream and downstream distances:

$$D_e = \frac{2LW}{(L+W)}$$

where L = length and W = width.

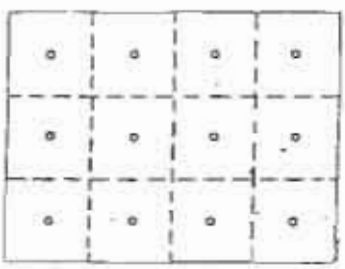

Figure 1-4. Example showing rectangular stack cross-section divided into 12 equal areas, with a traverse point at centroid of each area.

METHOD 1 - MINIMUM NUMBER OF TRAVERSE POINTS

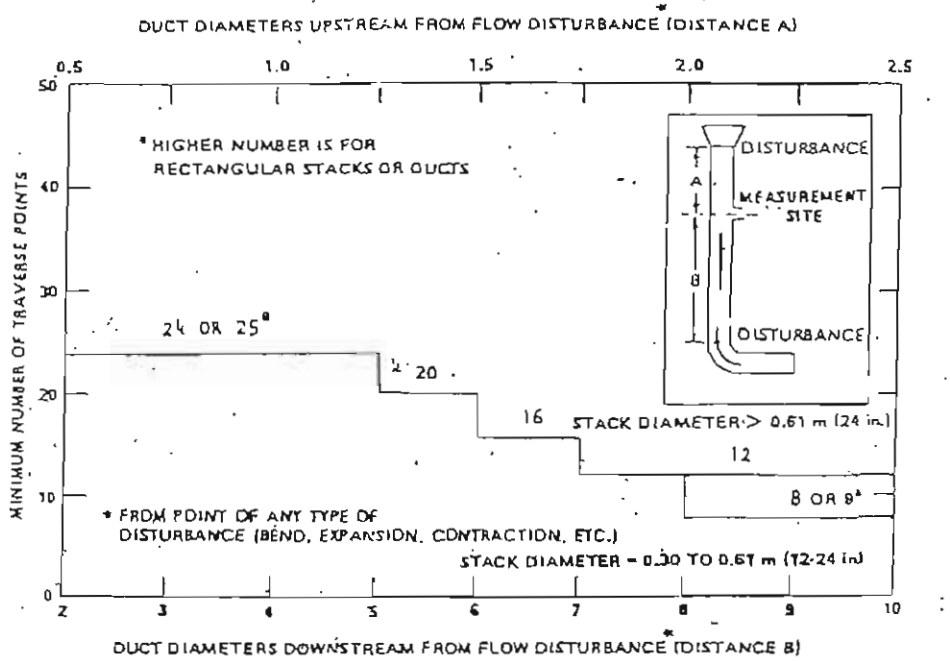

Figure 1-1. Minimum number of traverse points for particulate traverses.

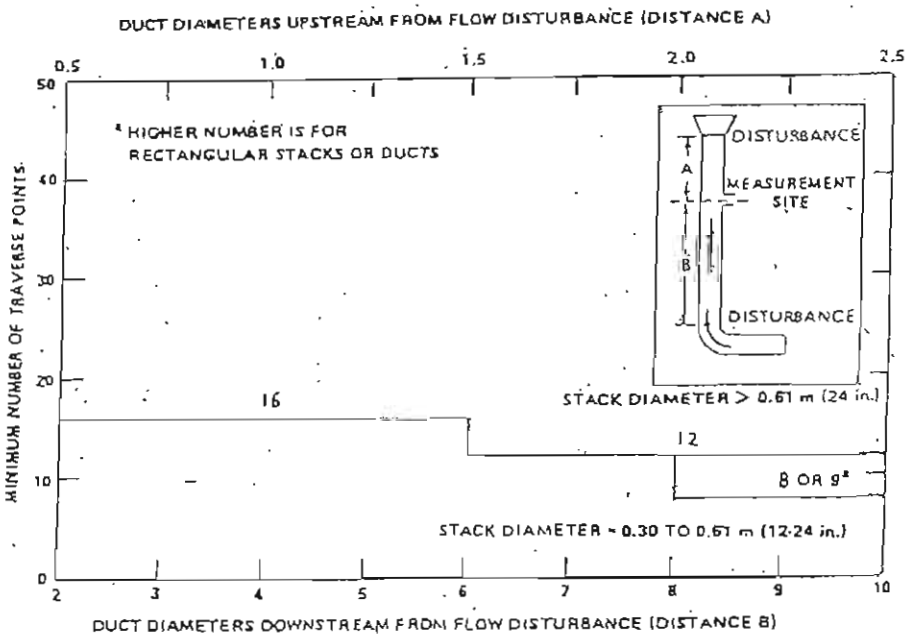

Figure 1-2. Minimum number of traverse points for velocity (nonparticulate) traverses.

METHOD 2 - STACK GAS VELOCITY AND VOLUMETRIC FLOW CALCULATIONS

5.1 Nomenclature.

A = Cross-sectional area of stack, m^2 (ft^2).
B_{ws} = Water vapor in the gas stream (from Method 5 or Reference Method 4), proportion by volume.
C_p = Pitot tube coefficient, dimensionless.
K_p = Pitot tube constant,

$$34.97 \frac{m}{sec}\left[\frac{(g/g\text{-mole})(mm\ Hg)}{(°K)(mm\ H_2O)}\right]^{1/2}$$

for the metric system and

$$85.49 \frac{ft}{sec}\left[\frac{(lb/lb\text{-mole})(in.\ Hg)}{(°R)(in.\ H_2O)}\right]^{1/2}$$

for the English system.

M_d = Molecular weight of stack gas, dry basis (see Section 3.6) g/g-mole (lb/lb-mole).
M_s = Molecular weight of stack gas, wet basis, g/g-mole (lb/lb-mole).

$$= M_d(1-B_{ws}) + 18.0\,B_{ws} \qquad \text{Eq. 2-5}$$

P_{bar} = Barometric pressure at measurement site, mm Hg (in. Hg).
P_g = Stack static pressure, mm Hg (in. Hg).
P_s = Absolute stack gas pressure, mm Hg (in. Hg).

$$= P_{bar} + P_g \qquad \text{Eq. 2-6}$$

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).
Q_{sd} = Dry volumetric stack gas flow rate corrected to standard conditions, dscm/hr (dscf/hr).
t_s = Stack temperature, °C (°F).
T_s = Absolute stack temperature, °K (°R).

$$= 273 + t_s \text{ for metric.} \qquad \text{Eq. 2-7}$$

$$= 460 + t_s \text{ for English.} \qquad \text{Eq. 2-8}$$

T_{std} = Standard absolute temperature, 293 °K (528° R).
v_s = Average stack gas velocity, m/sec (ft/sec).
Δp = Velocity head of stack gas, mm H_2O (in. H_2O).
3,600 = Conversion factor, sec/hr.
18.0 = Molecular weight of water, g/g-mole (lb/lb-mole).

5.2 Average Stack Gas Velocity.

$$v_s = K_p C_p (\sqrt{\Delta p})_{avg} \sqrt{\frac{T_s(avg)}{P_s M_s}}$$

Equation 2-9

5.3 Average Stack Gas Dry Volumetric Flow Rate.

$$Q_{sd} = 3{,}600(1-B_{ws})v_s A\left(\frac{T_{std}}{T_s(avg)}\right)\left(\frac{P_s}{P_{std}}\right)$$

Eq. 2-10

METHOD 3 - MOLECULAR WEIGHT AND EXCESS AIR CALCULATIONS

6.1 Nomenclature.

M_d = Dry molecular weight, g/g-mole (lb/lb-mole).
%EA = Percent excess air.
$\%CO_2$ = Percent CO_2 by volume (dry basis).
$\%O_2$ = Percent O_2 by volume (dry basis).
%CO = Percent CO by volume (dry basis).
$\%N_2$ = Percent N_2 by volume (dry basis).
0.264 = Ratio of O_2 to N_2 in air, v/v.
0.280 = Molecular weight of N_2 or CO, divided by 100.
0.320 = Molecular weight of O_2 divided by 100.
0.440 = Molecular weight of CO_2 divided by 100.

6.2 Percent Excess Air. Calculate the percent excess air (if applicable), by substituting the appropriate values of percent O_2, CO, and N_2 (obtained from Section 4.1.3 or 4.2.4) into Equation 3-1.

$$\%EA = \frac{\%O_2 - 0.5\%\ CO}{0.264\%\ N_2 - (\%O_2 - 0.5\%\ CO)} \times 100$$

Eq. 3-1

NOTE: The equation above assumes that ambient air is used as the source of O_2, and that the fuel does not contain appreciable amounts of N_2 (as do coke oven or blast furnace gases). For those cases when appreciable amounts of N_2 are present (coal, oil, and natural gas do not contain appreciable amounts of N_2) or when oxygen enrichment is used, alternate methods, subject to approval of the Administrator, are required.

6.3 Dry Molecular Weight. Use Equation 3-2 to calculate the dry molecular weight of the stack gas

$$M_d = 0.440(\%CO_2) + 0.320(\%O_2) + 0.280(\%N_2 + \%CO)$$

Eq. 3-2

METHOD 4 - STACK GAS MOISTURE CALCULATIONS

2.3.1 Nomenclature.

B_{ws} = Proportion of water vapor, by volume, in the gas stream.

M_w = Molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole).

P_m = Absolute pressure (for this method, same as barometric pressure) at the dry gas meter, mm Hg (in. Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

R = Ideal gas constant, 0.06236 (mm Hg)(m³)/(g-mole)(°K) for metric units and 21.85 (in. Hg)(ft³)/(lb-mole)(°R) for English units.

T_m = Absolute temperature at meter, °K (°R).

T_{std} = Standard absolute temperature, 293° K (528°R).

V_m = Dry gas volume measured by dry gas meter, dcm (dcf).

ΔV_m = Incremental dry gas volume measured by dry gas meter at each traverse point, dcm (dcf).

$V_{m(std)}$ = Dry gas volume measured by the dry gas meter, corrected to standard conditions, dscm (dscf).

$V_{wc(std)}$ = Volume of water vapor condensed corrected to standard conditions, scm (scf).

$V_{wg(std)}$ = Volume of water vapor collected in silica gel corrected to standard conditions, scm (scf).

V_f = Final volume of condenser water, ml.

V_i = Initial volume, if any, of condenser water, ml.

W_f = Final weight of silica gel or silica gel plus impinger, g.

W_i = Initial weight of silica gel or silica gel plus impinger, g.

Y = Dry gas meter calibration factor.

ρ_w = Density of water, 0.9982 g/ml (0.002201 lb/ml).

2.3.2 Volume of Water Vapor Condensed.

$$V_{wc(std)} = \frac{(V_f - V_i)\rho_w R T_{std}}{P_{std} M_w}$$

$$= K_1 (V_f - V_i)$$

Eq. 4-1

K_1 = 0.001333 m³/ml for metric units
= 0.04707 ft³/ml for English units

2.3.3 Volume of Water Vapor Collected in Silica Gel.

$$V_{wg(std)} = \frac{(W_f - W_i) R T_{std}}{P_{std} M_w}$$

$$= K_2 (W_f - W_i)$$

Eq. 4-2

Where:

K_2 = 0.001335 m³/g for metric units
= 0.04715 ft³/g for English units

2.3.4 Sample Gas Volume.

$$V_{m(std)} = V_m Y \frac{(P_m)(T_{std})}{(P_{std})(T_m)}$$

$$= K_3 Y \frac{V_m P_m}{T_m}$$

Eq. 4-3

Where:

K_3 = 0.3858 °K/mm Hg for metric units
= 17.64 °R/in. Hg for English units

NOTE: If the post-test leak rate (Section 2.2.6) exceeds the allowable rate, correct the value of V_m in Equation 4-3, as described in Section 6.3 of Method 5.

2.3.5 Moisture Content.

$$B_{ws} = \frac{V_{wc(std)} + V_{wg(std)}}{V_{wc(std)} + V_{wg(std)} + V_{m(std)}}$$

Eq. 4-4

NOTE: In saturated or moisture droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one using a value based upon the saturated conditions (see Section 1.2), and another based upon the results of the impinger analysis. The lower of these two values of B_{ws} shall be considered correct.

NOMENCLATURE
METHOD 5 CALCULATIONS

Vm_{std} = Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscm (dscf).

Y = Dry gas meter calibration factor

P_b = Barometric pressure at the sampling site, mm Hg (in. Hg)

H = Average pressure differential across the orifice meter, mm H_2O (in. H_2O)

T_m = Absolute average dry gas meter temperature, ° K (° R)

dscm = Dry standard cubic meters

dscf = Dry standard cubic feet

W_a = Weight of residue in acetone wash

M_a = Mass of residue of acetone after evaporation, mg

C_a = Acetone blank residue concentration, mg/g

V_a = Volume of acetone blank

V_{aw} = Volume of acetone used in wash, ml

M_n = Total amount of particulate matter collected, mg

C_s = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, mg/dscm (gr/dscf)

gr/dscf = grains per dry standard cubic foot

Vw_{std} = Volume of water vapor in the gas sample, corrected to standard conditions, scm (scf)

B_{ws} = Water vapor in the gas stream, proportion by volume

M_d = Molecular weight of stack gas, g/g-mole on dry basis

M_s = Molecular weight of stack gas, g/g-mole on wet basis

V_s = Stack gas velocity, calculated by Method 2, Equation 2-9, using data obtained from Method 5, m/sec (ft/sec)

C_p = Pitot tube coefficient, dimensionless

Δ_p = Velocity head of stack gas, mm H_2O (in. H_2O)

P_s = Absolute stack gas pressure, mm Hg (in. Hg)

NOMENCLATURE (continued)
METHOD 5 CALCULATIONS

Q_{std} = Dry volumetric stack gas flow rate corrected to standard conditions, dscm/hr (dscf/hr)

dscf/min = dry standard cubic feet per minute (also identified as dcfm or scfm).

acfm = actual cubic feet per minute

I = Percent of isokinetic sampling

A_n = Cross-sectional area of nozzle, m^2 (ft^2)

EMISSION MEASUREMENT CENTER
APPROVED ALTERNATIVE METHOD (ALT-009)

ALTERNATIVE METHOD 5 POST-TEST CALIBRATION

INTRODUCTION AND BACKGROUND

EPA Method 5 requires the calibration of the metering system after each field use. Because the post-test calibration requires the use of a spirometer or wet test meter, the calibration is often conducted in the laboratory. However, a field calibration procedure is highly desirable for two reasons: (1) it eliminates questions about the possibility of the damage to the metering system occurring during transport and (2) it eliminates travel costs for a retest if the metering system fails the post-test calibration.

The alternative post-test calibration procedure described below is based on the principles of the optional pretest orifice meter coefficient check in Section 4.4.1 of Method 5. Since the orifice meter coefficient check will not detect leakages between the inlet of the metering system and the dry gas meter, the alternative procedure includes two additional steps: (1) a leak check from either the inlet of the sampling train or the inlet of the metering system and (2) a leak check of that portion of the sampling train from the pump to the orifice meter.

PROCEDURE

The alternative to the post-test calibration in Section 5.3.2 of Method 5 is as follows:

After each test run, do the following:

1. Ensure that the metering system has passed the post-test leak-check. If not, conduct a leak-check of the metering system from its inlet.

2. Conduct the leak-check of that portion of the train from the pump to the orifice meter as described in Section 5.6 of Method 5.

3. Calculate Y_{qa} for each test run using the following equation:

$$Y_{qa} = \frac{\dot{V}_m}{\sqrt{\frac{0.0319 T_m}{\Delta H_@ \left(P_b + \frac{H_{avg}}{13.6}\right)} \frac{29}{M_d}}} \left(\sqrt{\Delta H}\right)_{avg}$$

where:

Y_{qa} = dry gas meter calibration check value, dimensionless.
• = total run time, min.
V_m = total sample volume measured by dry gas meter, dcf.
T_m = absolute average dry gas meter temp., °R.
P_b = barometric pressure, in. Hg.
0.0319 = (29.92/528)(0.75)² (in. Hg/°R) cfm².
$•h_{avg}$ = average orifice meter differential, in. H_2O.
•H@ = orifice meter calibration coefficient, in. H_2O.
M_d = dry molecular weight of stack gas, lb/lb-mole.
29 = dry molecular weight of air, lb/lb-mole.
13.6 = specific gravity of mercury.

After each test run series, do the following:

4. Average the three or more Y_{qa}'s obtained from the test run series and compare this average Y_{qa} with the dry gas meter calibration factor, Y. The average Y_{qa} must be within 5 percent of Y.

5. If the average Y_{qa} does not meet the ±5 percent criterion, recalibrate the meter over the full range of orifice settings, as detailed in Section 5.3.1 of Method 5. Then follow the procedure in Section 5.3.3 of Method 5.

REFERENCE

1. Roger T. Shigehara, P.G. Royals, and E.W. Steward, "Alternative Method 5 Post-Test Calibration", Entropy, Inc, contained in the EMTIC TSAR Library.

AMTEST
AIR QUALITY, LLC

DRY GAS METER CALIBRATION
AmTest Air Quality

File Name: V:\\amtest_company\Field Staff ...\calibrations\#27RedLowFlow\#27@0.5lpm 072707
Meter Box #: #27 RedLow Flow @ 0.5 L/min
Calibration Date: 7/27/07
Operator: KEF
Method of Calibration: Standard Wet Test Meter

	Dry Gas Meter Readings					Wet Test Meter Readings						
Total Time (min)	Meter Vol V_i (ft^3)	Meter Vol V_f (ft^3)	Temp In (°F)	Temp Out (°F)	P_{bar} ("Hg)	WTM V_i (ft^3)	WTM V_f (ft^3)	WTM Temp (°F)	WTM ΔH ("H_2O)	Actual Flow Rate (lpm)	Y Factor	Y Factor Criteria
33.5	3.138	3.676	78	76	29.60	49.442	49.990	74	-0.1	0.45	1.024	1
32.5	3.676	4.206	80	78	29.60	49.990	50.525	74	-0.1	0.46	1.019	1
39.7	4.206	4.863	82	80	29.60	50.525	51.183	75	-0.1	0.47	1.013	1
								AVERAGE			1.018	

1 = ok, 0 = fail

Initial Y Factor 0.994
%ERROR -2.5 must be within ± 5%

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Magnehelic Calibrations

Meter box ID: Rad #27
Date: 7/27/07
Barometer: 29.60
Ambient Temp.: 75
Calibrated by: KEF

Magnehelic ID	Manometer (reference) (inches H_2O)	Magnehelic Reading (inches H_2O)	Difference (inches H_2O)	Difference (%)
0-1 +	0.92	0.91	0.01	
	0.57	0.57	0.0	
	0.33	0.33	0.0	
0-1 −	0.95	0.94	0.01	
	0.49	0.49	0.0	
	0.28	0.28	0.0	

(ref pres - test pres) / (ref pres) x 100= (<5%)

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Thermocouple I.D. 27 Meter In

Thermocouple Calibration Data Sheet

Date 7/27/07

Initials KEF

Ambient Temperature 75 F

Barometric Pressure 29.60 "Hg

T.C. Indicator Fluke

Reference I.D. _____

	Reference Temperature*	Thermocouple Temperature*	Temperature Difference**	
	F	F	F	%
Ice Bath	33	33	0	
	34	33	1	
	33	33	0	
Ambient	75	76	1	
	75	76	1	
	75	76	1	
Boiling Water	210	211	1	
	211	212	1	
	211	211	0	

*Readings taken at one minute intervals

** (ref. temp. F + 460) - (test T.C. temp. F + 460)/(ref.temp.F + 460) x 100 < 1.5

Thermocouple I.D. #27 Meter O.

Thermocouple Calibration Data Sheet

Date 7/27/07
Initials KEF
Ambient Temperature 75 F
Barometric Pressure 29.60 "Hg

T.C. Indicator Fluke
Reference I.D. ____

	Reference Temperature*	Thermocouple Temperature*	Temperature Difference**	
	F	F	F	%
Ice Bath	33	34	1	
	34	34	0	
	33	33	0	
Ambient	75	75	0	
	75	75	0	
	75	75	0	
Boiling Water	210	210	0	
	211	210	1	
	211	210	1	

*Readings taken at one minute intervals

** (ref. temp. F + 460) - (test T.C. temp. F + 460)/(ref.temp.F + 460) x 100 < 1.5

AMTEST AIR QUALITY, LLC

DRY GAS METER CALIBRATION

Am Test-Air Quality, LLC

File Name: Groove\#6BlueMag\41007
Meter Box #: #6 KAH Blue
Calibration Date: 4/10/07
Operator: Torres
Method of Calibration: STANDARD DRY GAS METER 4 (Method 5 Section 16.1)

	Meter Box Dry Gas Meter Readings						Standard Dry Gas Meter Readings									
Total Time (min)	ΔH ("H_2O)	Meter Vol V_i (ft^3)	Meter Vol V_f (ft^3)	Temp In (°F)	Temp Out (°F)	P_{bar} ("Hg)	Std DGM V_i (ft^3)	Std DGM V_f (ft^3)	Std DGM Temp In (°F)	Std. DGM Temp Out (°F)	Std DGM Yds Factor	Y Factor	ΔH@	Volume Criteria[1]	Y Factor Criteria[2]	ΔH@ Criteria[3]
18.0	0.5	496.470	503.159	61	61	29.76	73.294	79.928	61	61	1.0135	1.0039	1.989	1	1	1
13.0	1.0	503.485	510.436	62	61	29.76	80.255	87.166	62	62	1.0135	1.0042	1.919	1	1	1
9.0	1.5	510.863	516.793	64	62	29.76	87.611	93.475	62	62	1.0135	1.0038	1.913	1	1	1
9.0	2.0	517.549	524.443	65	62	29.76	94.224	101.047	62	62	1.0135	1.0010	1.884	1	1	1
11.0	2.5	547.484	556.706	65	64	29.76	123.859	133.002	63	63	1.0135	1.0015	1.959	1	1	1
7.0	3.0	532.897	539.285	68	64	29.76	109.409	115.732	62	62	1.0135	1.0034	1.983	1	1	1
										AVERAGE		1.003	1.941		1 = pass, 0 = fail	

Orifice Leak Check Okay

Initial Y Factor 0.999
% Error[4] -0.4 needs to be within +/- 5%

[1] difference between V_i and V_f is greater than 5 ft^3

[2] if Y-factor is greater than the average Y factor, Y factor - 0.02
if Y-factor is less than the average Y factor, Y factor + 0.02

[3] if ΔH@ is less than the average ΔH@, ΔH@ + 0.2
if ΔH@ is greater than the average ΔH@, ΔH@ - 0.3

[4] if % error is within +/- 5%, calibration passes
if % error is greater +/- 5%, calibration fails

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Thermocouple I.D. OUTLET
METER BOX #6

Thermocouple Calibration Data Sheet

Date 4-9-07
Initials PET
Ambient Temperature 59.5 F
Barometric Pressure 29.76 "Hg

T.C. Indicator #6 METER BOX
Reference I.D. E95-1082

	Reference Temperature*	Thermocouple Temperature*	Temperature Difference**	
	F	F	F	%
Ice Bath	33	32	-1	
	33	32	-1	
	33	32	-1	
Ambient	59.5	57	2.5	
	59.5	57	2.5	
	59.5	57	2.5	
Boiling Water	212	213	1	
	212	213	1	
	212	213	1	

*Readings taken at one minute intervals

** (ref. temp. F + 460) - (test T.C. temp. F + 460)/(ref.temp.F + 460) x 100 < 1.5

Thermocouple I.D. INLET
METE BOX #6

Thermocouple Calibration Data Sheet

Date 4-9-07
Initials PBT
Ambient Temperature 61 F
Barometric Pressure 29.75 "Hg

T.C. Indicator #6 METER BOX
Reference I.D. E95-1082

	Reference Temperature*	Thermocouple Temperature*	Temperature Difference**	
	F	F	F	%
Ice Bath	32.5	33	.5	
	32.5	33	.5	
	32.5	33	.5	
Ambient	60.5	59	1.5	
	61	59	2	
	61	59	2	
Boiling Water	212	213	1	
	212	213	1	
	212	213	1	

*Readings taken at one minute intervals

** (ref. temp. F + 460) - (test T.C. temp. F + 460)/(ref.temp.F + 460) x 100 < 1.5

Magnehelic Calibrations

Meter box ID: #6
Date: 4/10/07
Barometer: 29.76
Ambient Temp.: 61
Calibrated by: PET

Magnehelic ID	Manometer (reference) (inches H_2O)	Magnehelic Reading (inches H_2O)	Difference (inches H_2O)	Difference (%)
~~0-5~~ + 1.0	+ 0.90	+ 0.89	.01	1.11%
0-4 + 2.5	+ 2.5	+ 2.45	.05	2.00%
+ 4.0	+ 3.5	+ 3.49	.01	.29%
0-1 + .20	+ .01	+ .0099	.001	1.0%
+ .50	+ .50	+ ~~.50~~ .499	.001	0.2%.
+ .80	+ .80	+ .799	.001	0.125%
~~0-5~~ - 1.0	- .99	- 1.0	.01	1.01%
0-4 - 2.5	- 2.6	- 2.599	.001	.04%
- 4.0	- 4.0	- 4.0	0	0%
-				
0-1 - .20	- .01	- .0099	.0001	1%
- .50	- .50	- .499	.001	0.2%
- .80	- .90	- .899	.001	0.11%

(ref pres - test pres) / (ref pres) x 100= (<5%)

Magnehelic Calibrations

Meter box ID: 6
Date: 4/11/07
Barometer: 29.43
Ambient Temp.: 57
Calibrated by: PET

Magnehelic ID	Manometer (reference) (inches H_2O)	Magnehelic Reading (inches H_2O)	Difference (inches H_2O)	Difference (%)
0-2 + .50	.50	.50	0	
1.00	1.0	1.0	0	
1.50	1.50	+1.49	.01	0.7%
0-2 − .50	−.50	−.50	0	
− 1.00	−1.0	−1.0	0	
− 1.50	−1.50	−1.50	0	
0-6 − 1	−1.0	−1.0	0	
− 3	−3.0	−3.0	0	
− 6	−5.00	−5.0	0	
0-6 + 1	+ 1.0	+ 1.0	0	
+ 3	+ 3.0	+ 3.05	−.05	1.7%
+ 6	+ 5.0	+ 5.0	0	

(ref pres - test pres) / (ref pres) x 100= (<5%)

Std. Dry Gas Meter #5

APEX INSTRUMENTS REFERENCE METER CALIBRATION
USING WET-TEST METER #11AE6
15-POINT ENGLISH UNITS

Calibration Meter Information	
Wet Test Meter Model #	AL20
Wet Test Meter Serial #	11AE6
Wet Test Meter Gamma	1.00000

Calibration Conditions			
Date	Time	13-Feb-07	11:20
Barometric Pressure		29.7	in Hg
Calibration Technician		SH	
DGM Model-Serial Number		S110-360863	

Factors/Conversions		
Std Temp	528	°R
Std Press	29.92	in Hg
K_1	17.647	°R/in Hg

Calibration Data										Results		
Run Time	Dry Gas Meter					Calibration Meter				Dry Gas Meter		
										Calibration Factor		Flowrate
Elapsed	Meter Pressure	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final	Value	Variation	Std & Corr
(H)	(P_m)	(V_m)	(V_m)	(t_m)	(t_m)	(Vw)	(Vw)	(t_w)	(t_w)	(Y)	(T_{max}-Y_{min})	($Q_{m(std)}$)
mm	in H_2O	cubic feet	cubic feet	°F	°F	cubic feet	cubic feet	°F	°F			cfm
5.00	-4.7	812.377	818.793	73	73	945.113	951.453	66.60	66.60	1.0118		1.262
5.00	-4.7	818.793	825.216	73	73	951.453	957.779	66.60	66.75	1.0085		1.259
5.00	-4.7	825.216	831.608	73	73	957.779	964.080	66.75	66.60	1.0097	0.003	1.254
										1.0100	Averages	1.258
6.00	-3.5	831.608	837.794	73	73	964.080	970.211	66.8	66.7	1.0115		1.017
6.00	-3.5	837.794	843.987	73	73	970.211	976.314	66.7	66.6	1.0094		1.012
6.00	-3.5	843.987	850.129	73	73	976.314	982.407	66.6	66.7	1.0094	0.002	1.011
										1.0101	Averages	1.013
7.00	-2.6	850.129	855.899	72	72	982.407	988.153	67.3	67.0	1.0115		0.816
7.00	-2.6	855.899	861.625	72	72	988.153	993.855	67.0	67.0	1.0117		0.810
7.00	-2.6	861.625	887.315	72	72	993.855	999.517	67.0	67.0	1.0112	0.001	0.804
										1.0115	Averages	0.810
13.00	-1.9	872.170	877.365	73	73	1004.388	1009.588	67.0	67.1	1.0174		0.398
13.00	-1.9	877.365	882.556	73	73	1009.588	1014.787	67.0	67.1	1.0176		0.398
13.00	-1.9	882.556	887.735	73	73	1014.787	1019.974	67.1	67.1	1.0175	0.000	0.397
										1.0175	Averages	0.397
38.00	-1.5	887.735	896.646	73	74	1019.974	1028.908	67.1	67.5	1.0182		0.234
23.00	-1.5	896.646	902.012	74	74	1028.908	1034.290	67.5	67.7	1.0188		0.232
23.00	-1.5	902.012	907.357	74	74	1034.290	1039.647	67.7	67.7	1.0180	0.001	0.231
										1.0183	Averages	0.232
									Overall Average Y	1.0135		

Note: For Calibration Factor Y, the rate of the reading of the calibration meter in the dry gas meter, the variation between the maximum and minimum values at each flow rate must not exceed 0.030

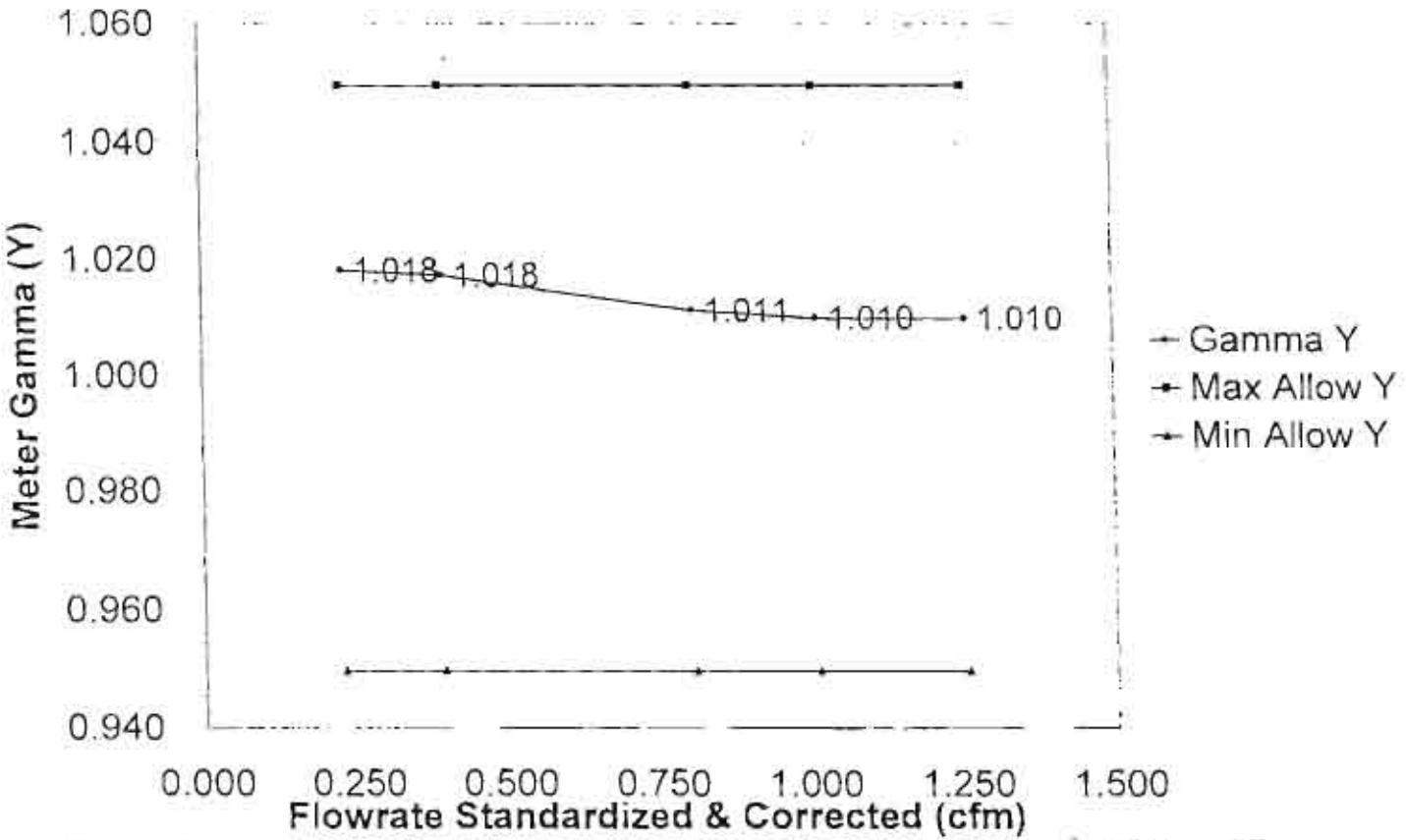
Note: For the Overall Average Calibration Factor Y, the acceptable range is between 0.95 and 1.05

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the Precision Wet Test Meter # 11AE6 which in turn was calibrated using the American Bell Prover # 3785, certificate # 5107 which is traceable to the National Bureau of Standards (N I S T)

Signature Sherman Howell Date 2-13-07

Calibration Date 2-13-2007 Calibration Technician SH

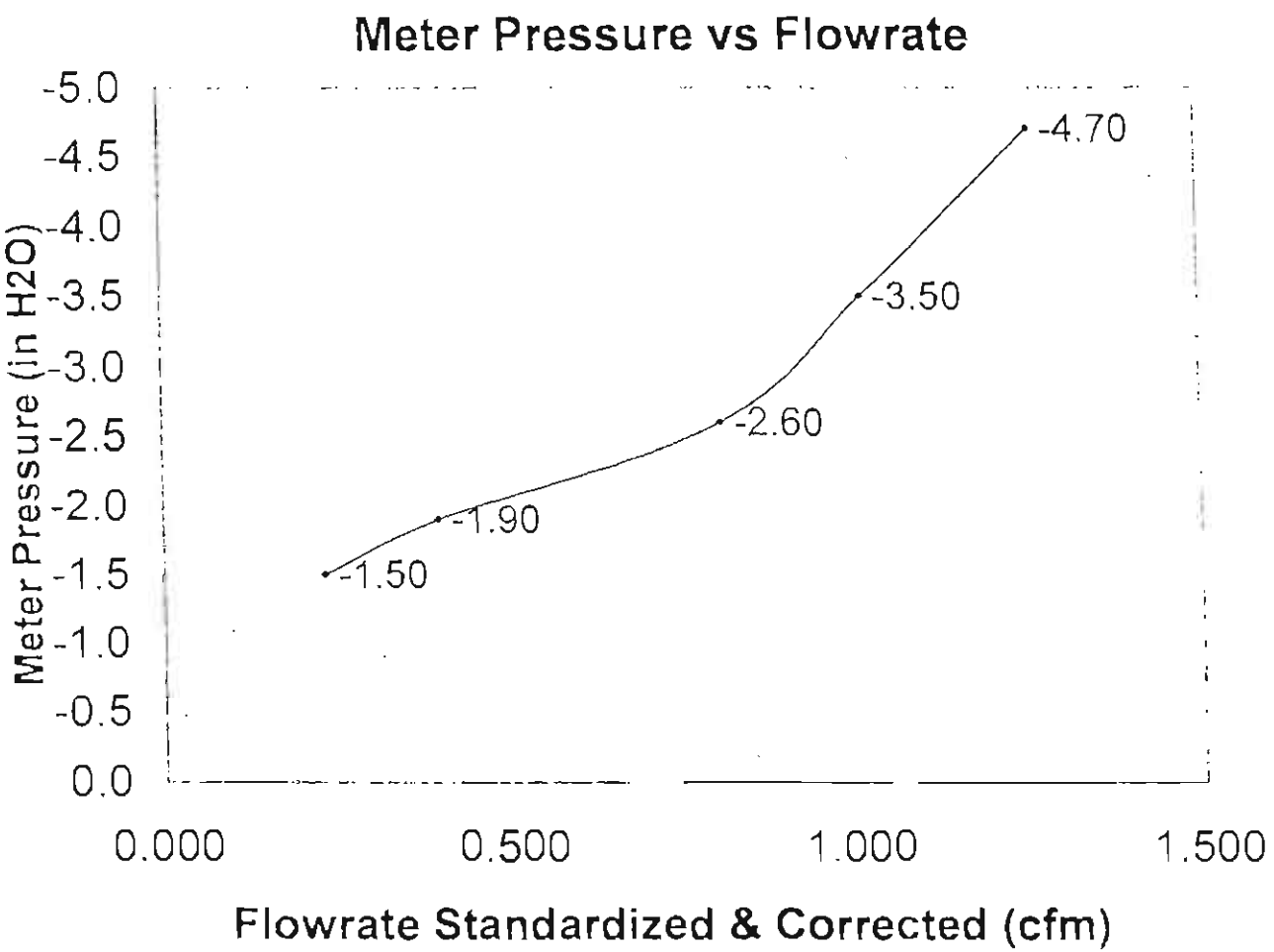
Meter Gamma vs Flowrate



Console Serial 11AE8 Console Model AL20

S-110-380963-2007 Customer-AM Test Air Quality Sales Order Number-0029354

Calibration Date 2-13-2007 Calibration Technical



Console Model

Console Serial 11AE6

#3

364

SENSIDYNE, INC.

CALIBRATION CERTIFICATE

CELL S/N: 02127443-S DATE: 03 - 17 - 2006

This is to certify that the above referenced Gilibrator Flow Cell was calibrated using film flowmeter MCS-102-A, which has been calibrated by instruments directly traceable to the National Institute of Standards and Technology. NIST Report 8361604.

Results:

REFERENCE MCS-102-A cc/min	S/N 02127443-S cc/min	RELATIVE DIFF. cc/min	PERCENT DIFF.
2013	2014	1	0.05
2013	2013	0	0.0
2010	2012	2	0.1
2016	2013	-3	-0.15
2013	2013	0	0.0
2009	2010	1	0.05
2012	2014	2	0.1
2014	2013	-1	-0.05
2010	2012	2	0.1
2013	2012	-1	-0.05
MAX		-3	-0.15
MEAN 2012.3	2012.6		

CALIBRATED BY Agnes Bagfield DATE: 03 - 17 - 2006

CODE 000

LITHO. IN U.S.A.

© 2004 GORE 44110H

Magnehelic Calibrations

Meter box ID: MAG Box #5
Date: 1/26/05
Barometer: 29.50
Ambient Temp.: 66°F
Calibrated by: RDR

Magnehelic ID	Manometer (reference) (inches H_2O)	Magnehelic Reading (inches H_2O)	Difference (inches H_2O)	Difference (%)
0-15 HIGH	13.0	13.0	—	—
R010925ML72	9.4	9.5	0.1	
	0.97	1.0	0.03	
0-15 LOW	14.0	13.5	0.5	
	9.4	9.5	0.1	
	0.98	1.00	0.02	
0-5 HIGH	4.6	4.7	0.1	
R050924JM25	2.4	2.5	0.1	
	0.50	0.50	—	—
0-5 LOW	4.7	4.75	0.05	
	2.5	2.6	0.1	
	0.4	0.4	—	—
0-2 HIGH	1.9	1.9	—	—
W39MWW	0.97	1.0	0.03	
	0.22	0.22	—	—
0-2 LOW	1.9	1.9	—	—
	0.98	1.00	0.02	
	0.20	0.20	—	—

(ref pres - test pres) / (ref pres) x 100= (<5%)

Magnehelic Calibrations

Meter box ID: Mag Box #5
Date: 1/26/05
Barometer: 29.5
Ambient Temp.: 66°F
Calibrated by: RON

Magnehelic ID	Manometer (reference) (inches H_2O)	Magnehelic Reading (inches H_2O)	Difference (inches H_2O)	Difference (%)
0-0.25 HIGH	0.24	0.24	—	—
R01091208N27	0.13	0.13	—	—
	0.03	0.03	—	—
0-0.25 LOW	0.22	0.22	—	—
	0.10	0.10	—	—
	0.03	0.03	—	—
0-1 HIGH	0.93	0.93	—	—
R01020708R114	0.53	0.52	0.01	
	0.09	0.09	—	—
0-1 LOW	1.00	0.99	0.01	
	0.54	0.53	0.01	
	0.06	0.06	—	—

$\frac{\text{(ref pres - test pres)}}{\text{(ref pres)}} \times 100 =$ (<5%)

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SHORTRIDGE #A

CO ID: 10527 AIRDATA MULTIMETER/FLOWMETER CERTIFICATE OF CALIBRATION S/N: M02657
Customer: RM TEST - Air Quality LLC State: WA Order #: 021827
Model #: 850-F03 PO #: Calibration Due Date: QA Code: 10CFR21:

Final Test By LL	Test By	Test By
Date 09/03/02 Rh 47	Date NA Rh	Date NA Rh
Ambient Temperature 76	Ambient Temperature	Ambient Temperature
Within spec (YES) NO NA	Within spec YES NO	Within spec YES NO

ABSOLUTE PRESSURE TEST (in Hg)
TEST METER TOLERANCE = ± 2.0 % ± .1 in Hg

Pressure Standard: Heise #02-R S/N: 41741/42451	Calibration Date: 04/16/02	Calibration Due Date: 10/2002	Test 1 Test 2 Test 3
Pressure Standard: Heise #04-R S/N: 41743/42453	Calibration Date: 05/20/02	Calibration Due Date: 11/2002	(Test 1) Test 2 Test 3
Pressure Standard: Heise #06-R S/N: 41742/42452	Calibration Date: 06/20/02	Calibration Due Date: 12/2002	Test 1 Test 2 Test 3
Pressure Standard: Heise #08-R S/N: 42186/43328	Calibration Date: 01/12/02	Calibration Due Date: 07/2002	Test 1 Test 2 Test 3
Pressure Standard: Heise #10-R S/N: 42203/43352	Calibration Date: 03/08/02	Calibration Due Date: 09/2002	Test 1 Test 2 Test 3
Pressure Standard: Heise #12-R S/N: 43166/44731	Calibration Date: 05/06/02	Calibration Due Date: 11/2002	Test 1 Test 2 Test 3

Above Heise used for Absolute Pressure Set Points Rated Accuracy: 0.05% fs (0.02 in Hg) Uncertainty: < 0.01 in Hg

Approx Set Point	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff
14.0	14.04	14.1	.43						
28.4	28.27	28.4	.39						
40.0	40.18	40.2	.05						

DIFFERENTIAL PRESSURE TEST (in wc)
TEST METER TOLERANCE = ± 2.0 % ± 0.001 in wc

Pressure Standard: Heise #01-L S/N: 41739/42449	Calibration Date: 04/15/02	Calibration Due Date: 10/2002	Test 1 Test 2 Test 3
Pressure Standard: Heise #03-L S/N: 41738/42448	Calibration Date: 05/23/02	Calibration Due Date: 11/2002	(Test 1) Test 2 Test 3
Pressure Standard: Heise #05-L S/N: 41740/42450	Calibration Date: 06/26/02	Calibration Due Date: 12/2002	Test 1 Test 2 Test 3
Pressure Standard: Heise #07-L S/N: 42185/42186	Calibration Date: 01/16/02	Calibration Due Date: 07/2002	Test 1 Test 2 Test 3
Pressure Standard: Heise #09-L S/N: 42202/43351	Calibration Date: 03/10/02	Calibration Due Date: 09/2002	Test 1 Test 2 Test 3
Pressure Standard: Heise #11-L S/N: 43165/44551	Calibration Date: 05/08/02	Calibration Due Date: 11/2002	Test 1 Test 2 Test 3

Above Heise units used for 0.05 in wc Differential Pressure Set Point Rated Accuracy: > 0.07% fs (0.000175 in wc) Uncertainty: < 0.00066

Pressure Standard: AirData Multimeter S/N: M96455	Calibration Date: 09/26/01	Calibration Due Date: 09/2002	(Test 1) Test 2 Test 3
Pressure Standard: AirData Multimeter S/N: M96099	Calibration Date: 09/26/01	Calibration Due Date: 09/2002	Test 1 Test 2 Test 3
Pressure Standard: AirData Multimeter S/N: M98326	Calibration Date: 10/29/01	Calibration Due Date: 10/2002	Test 1 Test 2 Test 3
Pressure Standard: AirData Multimeter S/N: M99420	Calibration Date: 09/26/01	Calibration Due Date: 09/2002	Test 1 Test 2 Test 3

Rated Accuracy: Differential Pressure ± 0.5 % ± 0.0001 in wc Uncertainty: See Uncertainty Table

Approx Set Pt	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff
.0500	.0510	.0511	.20						
.1250	.1240	.1246	.48						
.2250	.2258	.2269	.49						
.2700	.2734	.2735	.04						
2.000	2.037	2.040	.15						
3.600	3.654	3.693	.03						
4.400	4.398	4.402	.09						
27.00	27.06	27.12	.22						
50.00	49.25	49.37	.24						
Overange	✓	✓							

LOW VELOCITY/FLOW CONFIRMATION (AIRFOIL/FLOW MODE)
TEST METER TOLERANCE = ± 3.0% ± 7 FPM/CFM

Flow Standard: AirData Multimeter S/N: M96455	Calibration Date: 09/26/01	Calibration Due Date: 09/2002	(Test 1) Test 2 Test 3
Flow Standard: AirData Multimeter S/N: M96099	Calibration Date: 09/26/01	Calibration Due Date: 09/2002	Test 1 Test 2 Test 3
Flow Standard: AirData Multimeter S/N: M98326	Calibration Date: 10/29/01	Calibration Due Date: 10/2002	Test 1 Test 2 Test 3
Flow Standard: AirData Multimeter S/N: M99420	Calibration Date: 09/26/01	Calibration Due Date: 09/2002	Test 1 Test 2 Test 3

Rated Accuracy: Velocity ± 2.0 % ± 3 fpm; Flow ± 2.0 % ± 3 cfm Uncertainty: See Uncertainty Table

Approx Set Point	Standard	Test Meter	Diff	Standard	Test Meter	Diff	Standard	Test Meter	Diff
100	118.2	117	-1.2						
500	575.9	576	.1						

850 and ADM-860 AirData Multimeters are read in AirFoil Mode. ADM-850 and CFM-88 meters are read in air flow.

AIRDATA MULTIMETER/FLOWMETER CERTIFICATE OF CALIBRATION

S/N: M02657
Order #:

TEMPERATURE TEST - AIRDATA MULTIMETER (° F)
TEST METER TOLERANCE = ± 0.2° F

Simulator: S/N 249	Calibration Date: 01/24/2002	Calibration Due Date: 01/2004	Test 1	Test 2	Test 3	Set Point: 35.6° F	95° F 154.4° F
Simulator: S/N 250	Calibration Date: 01/24/2002	Calibration Due Date: 01/2004	Test 1	Test 2	Test 3	Set Point: 35.6° F	95° F 154.4° F
D Simulator: S/N 253	Calibration Date: 01/24/2002	Calibration Due Date: 01/2004	Test 1	Test 2	Test 3	Set Point: 35.6° F	95° F 154.4° F
RTD Simulator: S/N 254	Calibration Date: 03/28/2002	Calibration Due Date: 03/2004	Test 1	Test 2	Test 3	Set Point: 35.6° F	95° F 154.4° F
Simulator: S/N 256	Calibration Date: 03/28/2002	Calibration Due Date: 03/2004	Test 1	Test 2	Test 3	Set Point: 35.6° F	95° F 154.4° F
Simulator: S/N 257	Calibration Date: 03/28/2002	Calibration Due Date: 03/2004	Test 1	Test 2	Test 3	Set Point: 35.6° F	95° F 154.4° F

D Simulators Model RTD-1000/500 Rated Accuracy: 0.005% of setting Range: 100 Ω to 11111.10 Ω Uncertainty: < 32 ppm

RTD Simulator Temperature Equivalent Set Point	Test Meter	Diff	Test Meter	Diff	Test Meter	Diff
35.60	35.6	0				
95.00	95.0	0				
154.40	154.6	.2				

UNCERTAINTY TABLE (All AirData Multimeter Calibration Standards)

ode	Differential Pressure (in wc)								Absolute Pressure (in Hg)			Velocity (fpm)		Flow (cfm)	
t Point	.1250	.2250	.2700	2.000	3.500	4.400	27.00	50.00	14.0	28.4	40.0	100	500	100	800
2 X '	< .00022	< .00023	< .00031	< .0005	< .0015	< .0023	< .006	< .007	< .02	< .02	< .02	< 2.25	< 2.5	< 4.4	< 5.0

ertainties are expressed in expanded terms (twice the calculated uncertainty). Uncertainties shown for Low Velocity/Flow Confirmation represent ertainty of the Transfer Standard Meter exposed to the pressure source only.

s:

re used: Calibration Procedure for AirData Multimeters SIP-CP01 Revision: 08 Dated: 11/12/01

strument has been calibrated using Calibration Standards which are traceable to NIST (National Institute of Standards and Technology). Quality ce Program and calibration procedures meet the requirements for 10CFR50 Appendix B; ANSI/N45.2; ANSI/NCSL Z540-1-1994; MIL-STD 45662A ufacturers specifications. Calibration accuracy is certified when meters are used with properly functioning accessories only. This report shall not produced, except in full, without the written approval of Shortridge Instruments, Inc. Results relate only to the item calibrated.

s on use: See Shortridge Instruments, Inc. Instruction Manual for the use of AirData Multimeters

ation Technician(s): L. Lankmeier Calibration Date: 09/03/2002

n Approved by: Title: Prod. Mgr. Date: 9-4-2002

Shortridge Instruments, Inc.
7855 E. Redfield Rd Scottsdale, AZ 85260
(480) 991-6744 Fax (480) 443-1267

AMTEST
AIR QUALITY, LLC

TYPE S PITOT TUBE INSPECTION DATA FORM

Pitot Tube #: P175-63

Date: 1/4/06

Calibrated by: RDR

Pitot tube assembly level? ✓ yes ____ no

Pitot tube openings damaged? ____ yes (explain below) ✓ no

α_1 = 2 (<10°) α_2 = 3 (<10°) β_1 = 3 (<5°) β_2 = 3 (<5°)

Y = 1.5 ° θ = 1.5 ° A = 1.12 in

z = A sin Y = 0.029 in (< 0.125 in)

w = A sin θ = 0.029 in (< 0.031 in)

D_t = 0.188 in (0.375 in) (circle one)

P_A = 0.56 in P_B = 0.56 in

note: P_A must equal P_B
If 0.188 in D_t, P_A/P_B must be 0.197-0.282 in
If 0.375 in D_t, P_A/P_B must be 0.394-0.563 in

Does P_A/P_B meet the above criteria? (yes) if no, *REPAIR/RECALIBRATE*

Comments:

Repair/Calibration required? ____ yes* ✓ no

*If yes, tag and take out of service until repaired

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Thermocouple I.D. T6Y

Thermocouple Calibration Data Sheet

Date 10/17/95
Initials ERL/SA
Ambient Temperature 65 °F
Barometric Pressure 29.40 "Hg

T.C. Indicator Fluke (KAH)
Reference I.D. 78316/L14004
H_2O OIL

	Reference Temperature* °F	Thermocouple Temperature* °F	Temperature Difference** °F	Temperature Difference** %
Ice Bath	32	32	0	
	32	32	0	
	32	32	0	
Boiling Water	213	214	1	0.15
	213	214	1	0.15
	213	214	1	0.15
Hot Oil	414	412	2	0.23
	421	417	4	0.45
	426	422	4	0.45

*Readings taken at one minute intervals

** (ref. temp.°F + 460) - (test T.C. temp.°F + 460)/(ref.temp.°F + 460) x 100 < 1.5

Thermocouple I.D. T195-GB

Thermocouple Calibration Data Sheet

Date 8-21-96
Initials AEP
Ambient Temperature 66 °F
Barometric Pressure 29.81 "Hg

T.C. Indicator Blue KAH
Reference I.D. Mercury in Glass

	Reference Temperature*	Thermocouple Temperature*	Temperature Difference**	
	°F	°F	°F	%
Ice Bath	32	32	—	—
	32	32	—	—
	32	32	—	—
Boiling Water	212	211	1	0.2
	212	211	1	0.2
	212	211	1	0.2
Hot Oil	318	317	1	0.2
	318	317	1	0.1
	318	316	2	0.1

*Readings taken at one minute intervals

** (ref. temp.°F + 460) - (test T.C. temp.°F + 460)/(ref.temp.°F + 460) x 100 < 1.5

EMISSION MEASUREMENT CENTER
APPROVED ALTERNATIVE METHOD (ALT-011)

ALTERNATIVE METHOD 2
THERMOCOUPLE CALIBRATION PROCEDURE

INTRODUCTION

In EPA Method 2, EPA recommended the use of an extrapolation technique for a simplified, post-test, thermocouple calibration procedure using a two point calibration: (1) ice bath and (2) boiling water. Because of the inherent accuracy and precision of the thermocouple within ±1.3□F in the range of -32□F to 2500□F, the two-point post-test calibration procedure may be replaced with a single-point check.

A single-point calibration procedure that checks the operation of a thermocouple system within ±1.0 percent of the absolute measured temperature is all that is necessary to check the system for the presence of disconnected wire junctions, other loose connections, or a potential miscalibrated emf readout. A system that performs accurately at one temperature is expected to behave similarly at other temperatures.

Therefore, an alternative to the Method 2, two-point, thermocouple calibration can be used and the procedure is as follows:

ALTERNATIVE POST-TEST AND RECOMMENDED PRETEST CALIBRATION PROCEDURE

After each test run series, check the accuracy (and, hence, the calibration) of each thermocouple system at ambient temperature, or any other temperature, within the range specified by the manufacture, using a reference thermometer (either ASTM reference thermometer or a thermometer that has been calibrated against an ASTM reference thermometer). The temperatures of the thermocouple and reference thermometers shall agree to within ±2□F.

A crimp in the connecting wires or crossed lines that change the location of the reference junction will affect readings. Check the continuity of the thermocouple by subjecting it to a change in the temperature (e.g.., removing it from the stack or touching an ice cube). This step will also check for loose connections and reversed connections (noted by a wrong change in the temperature).

To ensure linearity of the measurements, it is recommended that the emf meter be originally calibrated against a NIST traceable or a comparable voltage source at several points covering the range of intended use, e.g., 0, 500, 1000, and 2000□F.

REFERENCE

1. Shigehara, R.T., E.W. Stewart, Kenneth Alexander, "Simplified Thermocouple Calibration Procedure", Entropy, Incorporated, contained in the EMTIC TSAR Library.

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Davis
Calibration Laboratory

Certificate of Calibration

723810

Company ID: AMT228

PO Number: 426398

AMTEST-AIR QUALITY, LLC
30545 S.E. 84TH ST. #5
PRESTON, WA 98050

Instrument ID: 8359
Manufacturer: ERTCO
Description: THERMOMETER, LIQUID IN GLASS

Model Number: ASTM59F
Serial Number: 8359

ACCURACY: ±1.0°F

Reason For Service: CALIBRATION
Type of Cal: NORMAL
As Found Condition: IN TOLERANCE
As Left Condition: LEFT AS FOUND
Procedure: NA-17-20ST-03 LIQUID- IN- GLASS THERMOMETER
Remarks:

Technician: JEFF DANIELS
Cal Date: 09May2007
Cal. Due Date: 09May2008
Temperature: 23.0 C
Humidity: 33.0 %

The instrument on this certification has been calibrated against standards traceable to the National Institute of Standards and Technology (NIST) or other recognized national metrology institutes, derived from ratio type measurements, or compared to nationally or internationally recognized consensus standards.

A test uncertainty ratio (T.U.R.) of 4:1 [K=2, approx. 95% Confidence Level] was maintained unless otherwise stated.

Davis Inotek Instruments Calibration Laboratory is certified to ISO 9001:2000 by Eagle Registrations (certificate # 3046). Lab Operations meet the requirements of ANSI NCSL Z540-1-1994, ISO 10012, 10CFR50 AppB, and 10CFR21.

ISO IEC 17025-2005 accredited calibrations are per ACLASS certificate # AC-1121 within the scope for which the lab is accredited.
All results contained within this certification relate only to item(s) calibrated. Any number of factors may cause the calibration item to drift out of calibration before the instrument's calibration interval has expired.

This certificate shall not be reproduced except in full and with the written consent of Davis Inotek Instruments Calibration Laboratory.

Approved By: SUNHEE PAIK
Service Representative

NIST Traceable#	Inst. ID#	Description	Model	Cal Date	Date Due
508877	01-1107	STANDARD SPRT (INCONEL SHEATH)	5680	07Feb2007	07Feb2008
422943	21-0023	SUPER THERMOMETER II	1590	28Nov2006	28Nov2007

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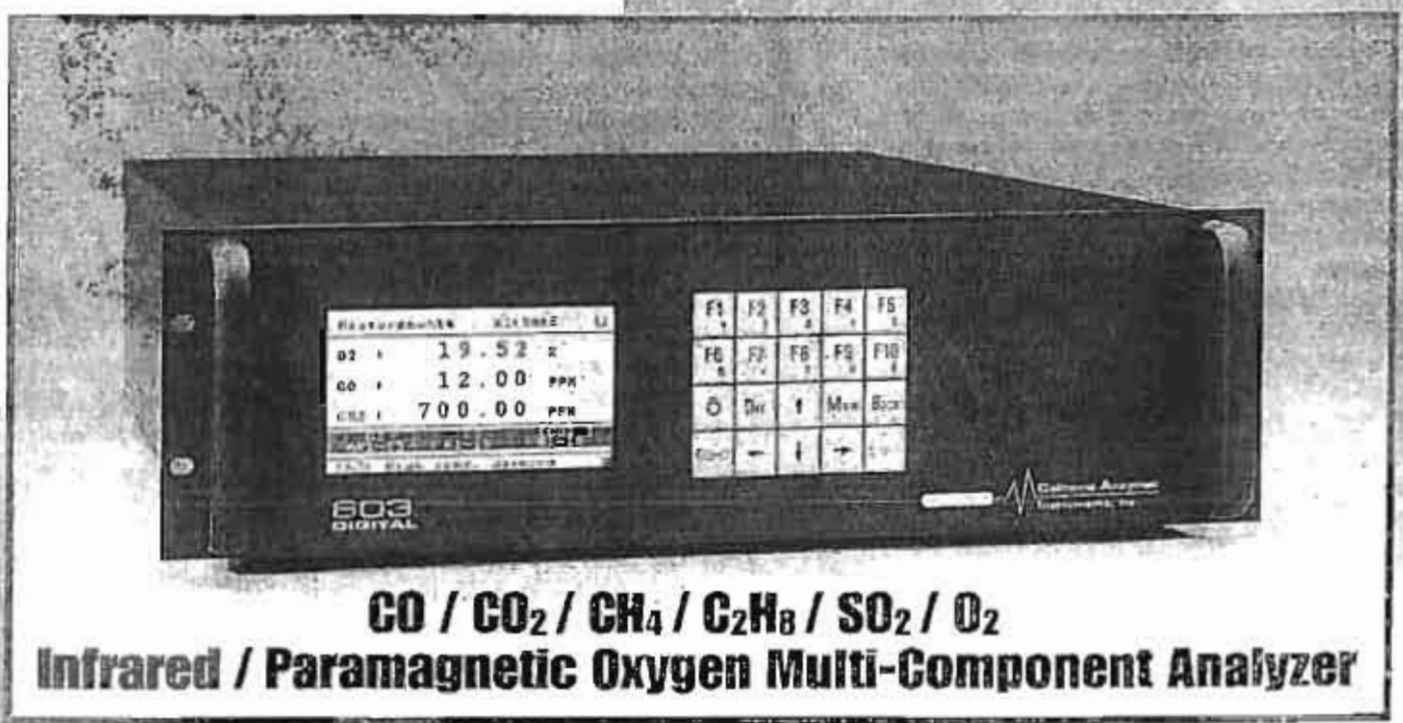
600 DIGITAL NDIR/O_2



CO / CO_2 / CH_4 / C_2H_8 / SO_2 / O_2
Infrared / Paramagnetic Oxygen Multi-Component Analyzer

APPLICATIONS
- Stack Gases (CEM)
- Combustion Efficiency
- Turbine/Generator Feedback Control
- Process Chemical Gas Analysis
- Personnel Safety
- Fuel Cell Analysis
- Vehicle Emissions

Model 600P Oxygen Only
Model 601 Any 1 NDIR Component
Model 602 Any 2 NDIR Components
Model 603 Any 3 NDIR Components
Model 601P Any NDIR Component & O_2
Model 602P Any 2 NDIR Components & O_2

OPTIONS:
- Zero/Span/Sample Valves - Consult Factory
- 19" Rack Mount Slides
- Internal Sample Pump - Consult Factory
- Sample Flow Control
- Multiple Inputs

Other custom features available upon request

FEATURES
- Measures from 0-50 ppm up to 100% Full Scale (CO / CO_2 / CH_4 / C_3H_8 / SO_2)
- Measures Oxygen (O_2) from 0-1% up to 100%
- Multi-Component
- Four User Definable Ranges per Component
- Fast Response Time
- Auto Ranging / Auto Calibration
- Comprehensive Diagnostics
- Temp. & Barometric Pressure Compensation
- Output Options: Analog (User Scalable), (RS232) using AK Protocol & TCP/IP
- Displays & Outputs: Concentrations, Diagnostics, Alarms & Preventative Maintenance
- Remote Monitoring & Control

California Analytical Instruments, Inc.

1312 W. Grove Avenue, Orange, CA 92865-4134
Phone 714 974 5560 • Fax 714 921 2531
www.gasanalyzers.com

Series 600
NDIR/O_2 Analyzer

DESCRIPTON

The California Analytical Inc. Models 601-2-3 NDIR/O_2 digital analyzer product line is designed around a state of the art 16 bit microprocessor, with 16 digital inputs, 16 digital outputs, 16 analog inputs and 4 analog outputs. The analyzer can be manually operated from the keypad or remotely via TCP/IP, RS-232C communications and discrete inputs. The analyzer display includes screen presentation of all analyzer alarms. Four levels of password protection are provided. For precision measurements, the analyzer's accuracy is increased by entering calibration curve fit polynomials. Automatic calibration may be activated locally or remotely and includes auto cal via preset times.

METHOD OF OPERATION - NDIR

The California Analytical Instruments' NDIR analyzer is based on the infrared absorption characteristics of gases. Using a single infrared beam to measure gas concentrations, this analyzer produces highly stable and reliable results. A single infrared light beam is modulated by a chopper system and passed through a sample cell of predetermined length containing the gas sample to be analyzed. As the beam passes through the cell, the sample gas absorbs some of its energy. The attenuated beam (transmittance) emerges from the cell and is introduced to the front chamber of a two-chamber infrared microflow detector. The detector is filled with the gas component of interest and consequently the beam experiences further energy absorption. This absorption process increases the pressure in both of the chambers. The differential pressure between the front and rear chambers of the detector causes a slight gas flow between the two chambers. This flow is detected by a mass-flow sensor and is converted into an output signal.

METHOD OF OPERATION - O_2

The California Analytical oxygen analyzer section utilizes the paramagnetic method to determine the percent level of oxygen contained in the sample gas. The oxygen level is displayed on the LCD panel in engineering units.

SPECIFICATIONS

IR Analysis Method: Non-Dispersive Infrared (NDIR)
NDIR Components: CO / CO_2 / CH_4 / C_3H_8 / SO_2
Detector Type: Microflow
NDIR Ranges: From 0-50 ppm up to 0-100%
(Dependent upon gas & cell length)
Range Ratio: 50:1 (Highest Range/50=Lowest Range)
Response Time (IR): T90 <2 Seconds to 60 Seconds
Adjustable (Depending on configuration)
IR Sample Cell: Stainless Steel w/Replaceable gold cell liner
Resolution: 0.0001 (Displays 5 Significant Digits)
Repeatability: Better than 1.0% of Full Scale
Linearity: Better than 0.5% of Full Scale of Factory
Calibrated Ranges
Noise: Less than 1% of Full Scale of Factory
Calibrated Ranges
Zero & Span Drift: Less than 1% of Full Scale per 24 Hours
Zero & Span Adjustment: Via front panel, TCP/IP or RS-232
Sample Flow Rate: 0.25 to 2.0 LPM (Consult Factory for other flow rates)
Oxygen Analysis Method: Paramagnetic
O_2 Ranges: 0-1% up to 0-100% O_2 Full Scale,
Four Definable Ranges
O_2 Response Time: T90 < 2 Seconds

600 SERIES FEATURES:

Outputs available: TCP/IP, RS232, Four Scalable Analog
0-10V / 4-20mA (Allows Offset & Expandable Range DC Analog Outputs)
Discrete Control: Remote/Local Control, Range Change,
Range Sense Mode (All TTL Logic)
Discrete Alarms: (Local & Remote adjustable)
General Fault/TTL Logic (Ground True)
Calibration Failure/ TTL Logic (Ground True)
Concentration (2 each) TTL Logic (Ground True)
Digital Diagnostics: Pressure - Pressure Control Voltages,
Temperatures - Flow Parameters
Keypad Displays: Factory Settings , TCP/IP address,
Passwords(4), Scalable Analog Output Voltages,
Full Scale Range Select, Auto Cal Times
Special Features: Auto Ranging, Data Streaming,
Auto Calibration (adjustable through internal clock)
Display: 3" x 5" Back lit LCD
Sample Temperature: Up to 50°C, Non-condensing
Ambient Temperature: 5 to 45°C
Ambient Humidity: Less than 90% RH(Non-condensing)
Fittings: 1/4 Inch Tube
Power Requirements: 115/230 (±10%) VAC: 50/60Hz,
300 watts maximum
Dimensions: 5-1/4"H x 19"W x 23"D
Weight: 30-45 lbs. (Depending on configuration)

Specifications subject to change without notice.

California Analytical Instruments, Inc.
1312 W. Grove Avenue, Orange, CA 92865
Phone 714 974 5560 • Fax 714 921 2531
www. gasanalyzers.com

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Model 721AT

Western Research

SO_2 Analyzer

Continuous Emission Monitoring

Benefits and Features

- EPA certifiable.
- Wide dynamic "dual range" capability.
- Single point calibration.
- Seven user selectable outputs.
- Portability.
- Reduced maintenance.
- Start-up time — 5 minutes.

Specifications

- Accuracy — typically ±0.5% of full-scale.
- Electronic Response −90% in less than three seconds.
- Stability (zero drift) — better than ±0.5% of full-scale in 24 hours.
- Sensitivity — better than ±0.5% of full-scale.
- Zero and span check (manual) — recommended frequency once per 24 hours or per EPA requirements.
- Electrical requirements — approximately 50 watts, 120 ±10% 50-60 Hz or 220 V ±10% 50 hz.
- Weight — 27 lbs.
- Output signals: field selectable 0-100 mV, 200 mV, 500 mV, 1 00V, 2.00V, 5.00V or 10.00V — two of which are available simultaneously for each range. Isolated 4-20 mA output available.
- Area Classification — General Purpose.
- Sample gas flow rate — non critical 1-2 litres/min (2-5 SCF/H).
- Permissible ambient operating temperature 15-35°C (59-95°F).
- Temperature stability: 0.25 percent per °C (15-35°C).
- Non condensing operating conditions.

Western Research
Division of
Dow Valley Resource Services Ltd

Head Office: 1313 - 44 Ave. N.E.
Calgary, Alberta
Canada, T2E 6L5
TEL: (403) 291-1313
TLX: 03 827569
FAX: (403) 291-1128

U.S. Office: 122, 1300 South Potomac
Aurora, California
80012
TEL: (303) 751-8990
TLX: 00 62936430
FAX: (303) 751-8994

Representatives In: Europe, Middle East, South America, Asia and Pacific Rim

Printed in Canada by Ronalds Printing Ltd

Designed by Douglas Mitchell Design Ltd

721AT2 ANALYZER DATA

S/N 90 -721AT2 -7722

CUSTOMER: AMTEST INC

LOCATION: WASH.

P.O. #: 0976

CALIBRATION

CELL LENGTH 35.0 cm
CALIBRATION PRESSURE 760 mm Hg
CALIBRATION TEMP. 25 °C + 273 = 298 °K
MOLAR ABSORBTIVITY CONSTANT "k" 258

ELECTRONIC SPAN VALUE 809 ppm
SCALING RATIO 2mV /ppm

	RANGE 1	RANGE 2
FULL SCALE	200 ppm	2000 ppm
LOW OUTPUT	0.1 VDC	0.1 VDC
HIGH OUTPUT	1.0 VDC	1.0 VDC
V/I	- mA	- mA

LAMP TYPE SMG15MB MEASURING PMT S/N 1A0361
PMT TYPE R423HA REFERENCE PMT S/N YC6031

MEASURING FILTER WAVELENGTH 285 nM S/N 89-12
REFERENCE FILTER WAVELENGTH 585 nM S/N 90-04

PRIMARY OUTPUT CARD

TJ1 (DPM)	0.00	Vdc
TJ2 (AGC1)	3.49	Vdc
TJ3 (AGC2)	3.56	Vdc
TJ4 (I_{avg})	4.00	Vdc
TJ5 (M1)	9.00	Vdc
TJ6 (M2)	7.98	Vdc
TJ7 (M1B)	4.51	Vdc
TJ8 (M2B)	4.50	Vdc
TJ9 (OPACITY)	0.00	Vdc

JUMPERS

JH1	A	(B)	C					
JH2	A	(B)	C	D				
JH3	A	(B)	C	D				
JH4	(A)	B	(C)	D				

SWITCHES

SW1-1	(OP)	CAL
SW1-2	(ZERO)	SPAN

SECONDARY OUTPUT CARD

JUMPERS

JH1	(A)	B	C	(D)				
JH2	(A)	(B)	C	D				
JH3	(1)	(2)	3	4	5	6	7	8
JH4	(1)	2	3	4	(5)	6	7	8
JH5	(1)	(2)	3	4	5	6	7	8
JH6	(1)	2	3	4	(5)	6	7	8

HARD WIRED JUMPERS

JW1	JW6
JW2	JW7
(JW3)	(JW8)
(JW4)	(JW9)
(JW5)	(JW10)

Rev. 0

721AT2 ANALYZER DATA

LAMP POWER SUPPLY

TEST POINTS

TP1	10.15 Vdc (OC1)	
TP2	10.15 Vdc (OC2)	
TP3 (Scope Measurement)		
Base	0.50 Vdc	
Measuring Pulse	8.80 Vdc	
Reference Pulse	2.60 Vdc	
TJ1 I_{avg}	4.00 Vdc	
LAMP VOLTAGE	150.1 Measured Across TB2 Terminals	

JUMPERS

JH1 (1) 3
JH2 (1) 3
JH3 (1) 3

DETECTOR CARD

TEST JACKS

TJ1 (AGC1)	3.49 Vdc
TJ2 (AGC2)	3.56 Vdc
TJ3 (R1)	8.03 Vdc
TJ4 (R2)	8.05 Vdc
TJ5 (M1)	9.00 Vdc
TJ6 (M2)	7.98 Vdc

TEST POINTS

TP1 (RSIG1)	-0.80 Vdc
TP2 (RSIG2)	-0.80 Vdc
TP3 (MSIG1)	-0.90 Vdc
TP4 (MSIG2)	-0.80 Vdc
TP5 (PMTSIG1)	-1.71 Vdc
TP6 (PMTSIG2)	-1.61 Vdc

SWITCHES

SW1-1	(AUTO)	MANUAL
SW1-2	AUTO	MANUAL
SW1-3	(ON)	OFF
SW1-4	(ON)	OFF

INSTRUCTION MANUAL

MODEL 42

CHEMILUMINESCENCE $NO-NO_2-NO_X$ ANALYZER

DESIGNATED REFERENCE METHOD NUMBER
RFNA - 1289 - 074

THERMO ENVIRONMENTAL INSTRUMENTS INC.
8 WEST FORGE PARKWAY
FRANKLIN, MA 02038
TEL: (508) 520-0430
FAX: (508) 520-1460

P/N 7687

This Manual Issued For:

Serial No. _____

Program _____

Options _____

Date _____

Revised
2/12/92

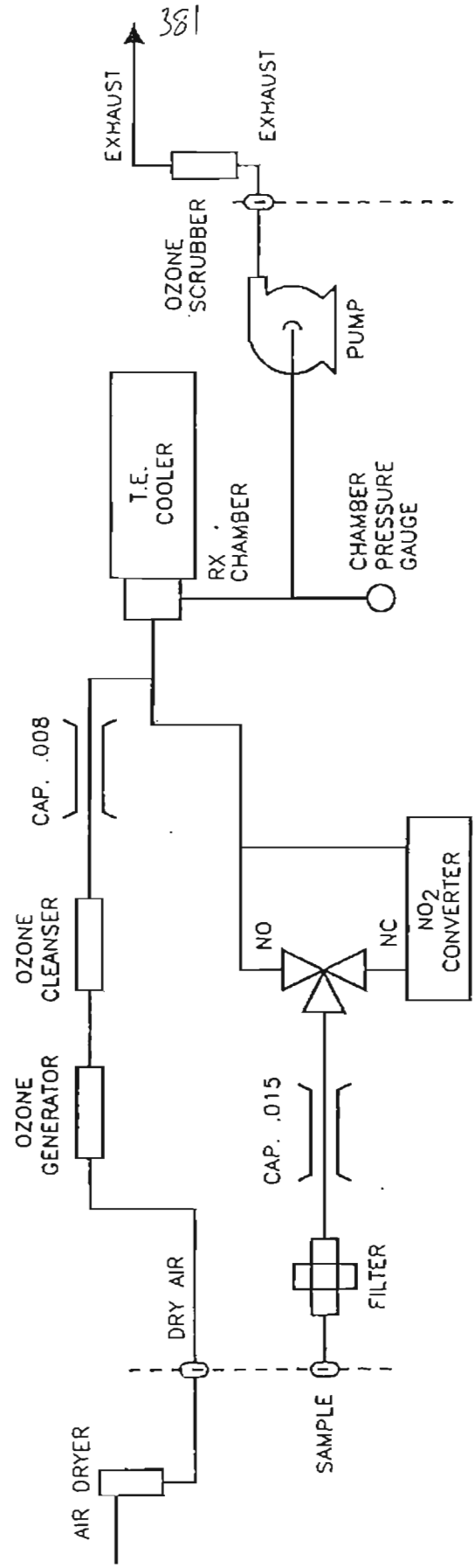


Figure I-2
Flow Schematic of Model 42

C. SPECIFICATIONS

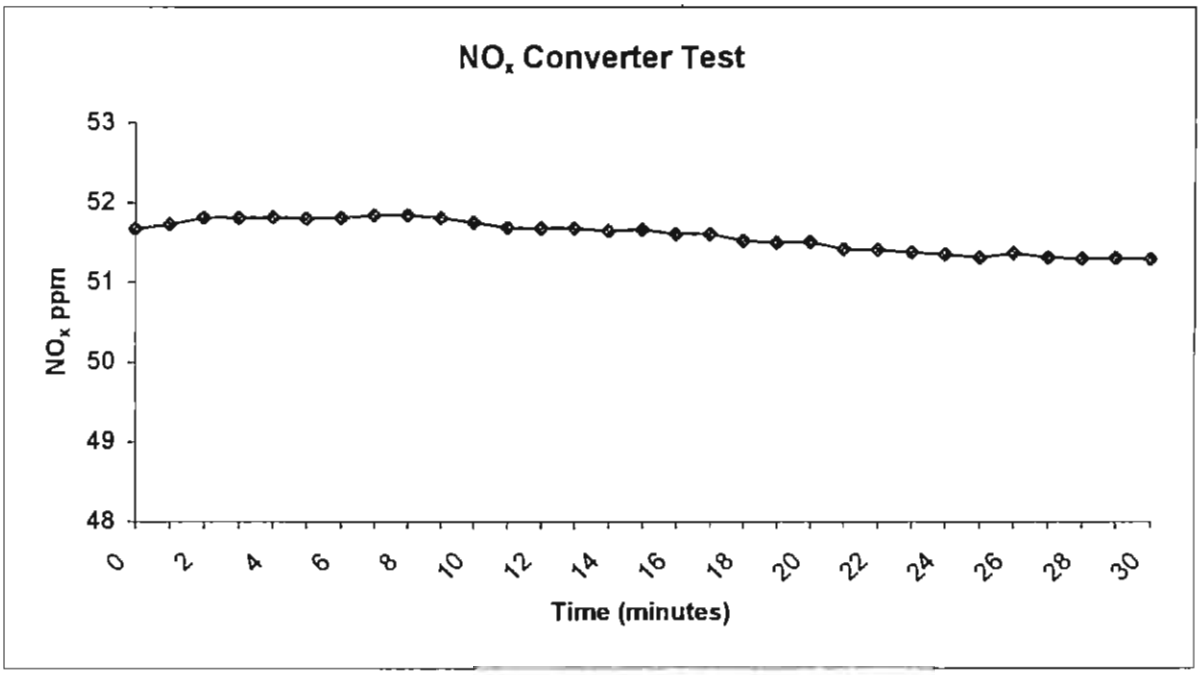
Ranges	0-10, 20, 50, 100, 200 500, 1000, 2000, 5000 PPM
Noise	25 PPB
Detection Limit	50 PPB
Zero Drift (24 hour)	50 PPB
Span Drift (24 hour)	+/- 1% Full Scale
Rise, Fall times (0-90%)	2.5 seconds NO 5.0 seconds NO_x
Linearity	+/- 1% Full Scale
Sample Flow Rate	25 cc/min.
Vacuum	28.5" HG
Power Requirements	500 Watts 115 ± 10 Volts 220 ± 20 Volts 50/60 HZ
Physical Dimensions	17" W x 5 3/4" H x 23" D
Weight	70 lbs. (including external pump)
Outputs	NO, NO_2, NO_x Selectable Voltage 4-20 ma

AMTEST AIR QUALITY, LLC

NO_2 TO NO CONVERTER EFFICIENCY TEST
AMTEST AIR QUALITY, A DIVISION OF HOEFLER CONSULTING GROUP

Analyzer ID:	Thermo Model 42H #1
Converter Type:	Molybdenum Converter @ 325 degrees C
Date:	July 19, 2007
Operator:	Farwell
Procedure:	Method 20 Section 5.6.1

Converter Performance Test Result: Acceptable Performance



Time (minutes)	Nitrogen Oxides (ppm)	Time (minutes)	Nitrogen Oxides (ppm)
1	51.73	16	51.61
2	51.81	17	51.61
3	51.81	18	51.53
4	51.82	19	51.50
5	51.80	20	51.51
6	51.81	21	51.42
7	51.84	22	51.41
8	51.84	23	51.38
9	51.81	24	51.36
10	51.75	25	51.32
11	51.69	26	51.37
12	51.68	27	51.32
13	51.68	28	51.30
14	51.65	29	51.31
15	51.66	30	51.29

% Difference: 0.9

INTERFERENCE RESPONSE TEST
AM TEST-AIR QUALITY, LLC

Analyzer ID: Thermo Environmental Instruments, Inc. Model 42H #1
Date: March 20, 2001
Operator: ASP
Procedure: Method 20 Section 5.4

Interference Response Test Result: Acceptable Performance*

Span Gas Concentration: 49.7
Analyzer Span (0-__): 100

Test Gas Type	Gas Cylinder Number	Concentration (ppm)	Analyzer Response (ppm)
Carbon Monoxide	SG9150893	499	0.31
Sulfur Dioxide		204	
Carbon Dioxide		10.1	
Oxygen	SG91387563	21.4	0.0

Thermo Environmental Instruments Inc.

Gas Filter Correlation CO Analyzer

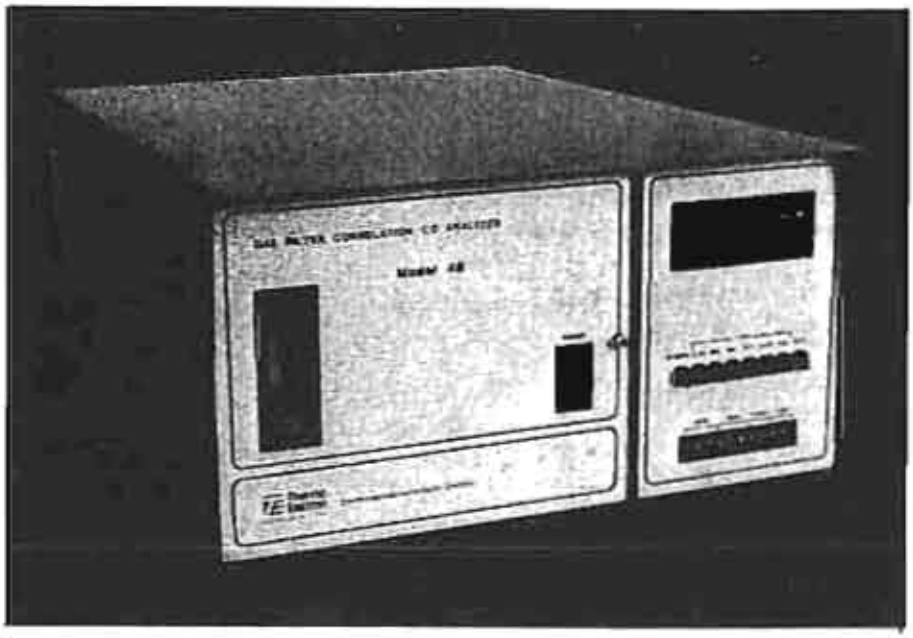
Model 48

For Continuous Ambient Air Monitoring

Thermo Electron's Microprocessor Based Model 48 Ambient CO Analyzer provides unequaled ease of operation, reliability, precision and specificity. The unique Gas Filter Correlation principle of operation offers the significant advantages of unequaled specificity and sensitivity and increased resistance to shock and vibration.

Key Features

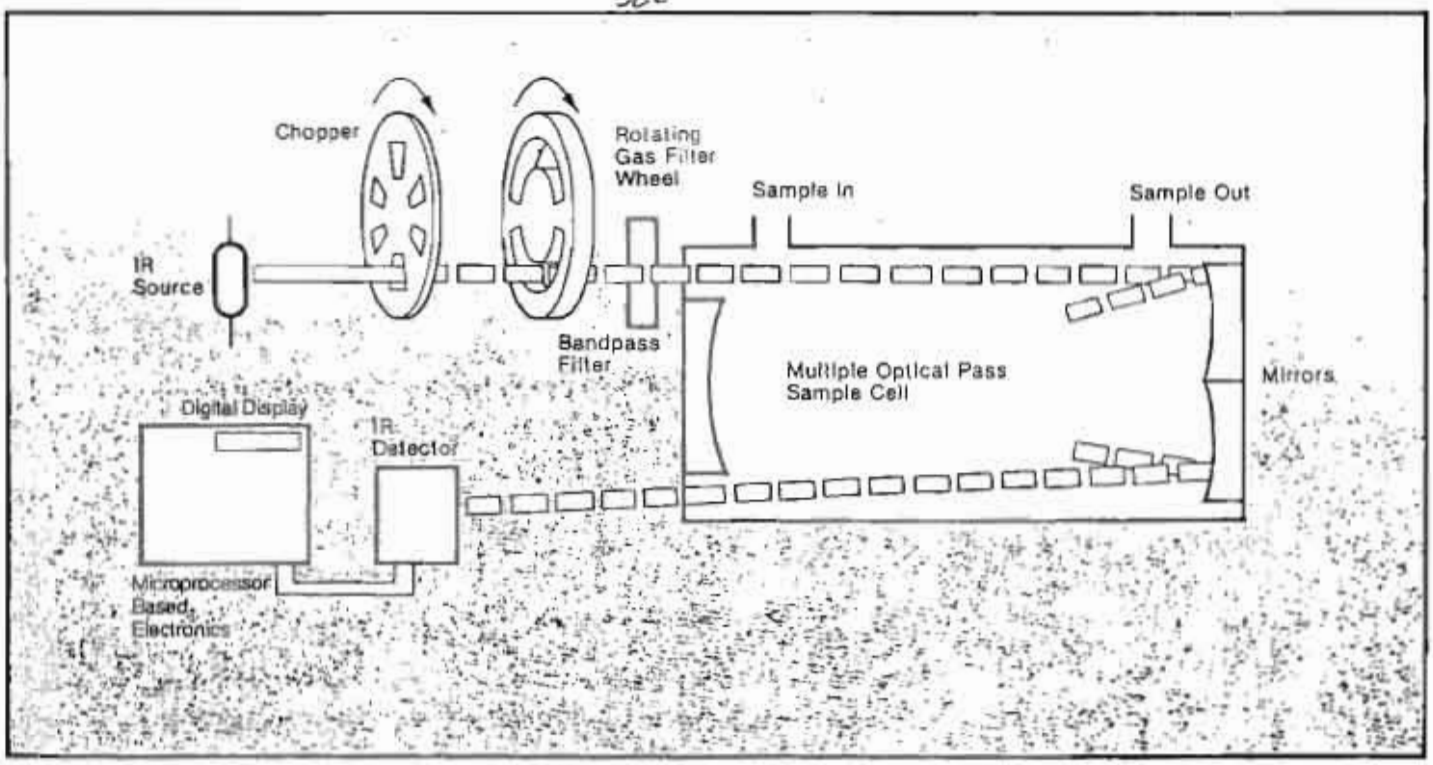
- Microprocessor Based
- Automatic pressure and temperature correction
- Dual fully independent outputs standard
- Hourly average output standard
- Lower ranges, wide dynamic range (suitable for both ambient and source)
- Highly specific to CO
- Long term zero and span stability
- Vibration and shock resistant
- Powerful diagnostics made possible by microprocessor
- Linear through all ranges
- Unaffected by changes in flow
- Self-aligning optics
- U.S.A.—EPA reference method RFCA-0981-054, range 0-50ppm time constant — 30 seconds



Model 48 Specifications

Ranges	0-1, 0-2, 0-5, 0-10, 0-20, 0-50*, 0-100, 0-200, 0-500, 0-1000 ppm
Zero Noise	0.05 ppm RMS — With time constant = 30 seconds
Minimum Detectable Limit	0.10 ppm
Zero Drift, 24 Hours	± 0.2 ppm
Span Drift, 24 hours	± 1% Full Scale
Rise/Fall Times (0-95%) (at 1 lpm flow, 30 second integration time)	1 minute
Precision	± 0.1 ppm
Linearity	± 1%
Flow Rate	1 lpm standard
Rejection Ratio	Negligible interference from water and CO_2
Operating Temperature	Performance specifications maintained over the range 15–35° C (may be operated safely over the range 5–45° C)
Power Requirements	100 Watts; 105–125 VAC, 60Hz; 220-240VAC 50Hz
Physical Dimensions	17" wide × 8¾" high × 23" deep
Weight	45 lbs.
Dual Outputs (standard)	Selectable to 0-10mV, 0-100mV 0-1V, 0-5V, 0-10V; digital display; 1 hour integrated value. Other outputs available upon request (4-20ma, IEEE488)

* See Federal Register, Tuesday, February 18, 1975, Volume 40, Number 33, Part II for definitions and Federal specifications. Performance specifications over 15–35°C range.



Principle of Operation

The basic components of a Gas Correlation System are illustrated in the above diagram. Radiation from an infrared source is chopped and then passed through a gas filter which alternates between CO and N_2 due to Rotation of the filter wheel. The radiation then passes through a narrow bandpass filter and a multiple optical pass sample cell where absorption by the sample gas occurs. The IR radiation exits the sample cell and falls on a solid state IR detector.

The CO gas filter acts to produce a reference beam which cannot be further affected by CO in the sample chamber. The N_2 side of the filter wheel is transparent to IR radiation and therefore produces a measure beam which *can* be absorbed by CO. The chopped detector signal is modulated by the alternation between the two gas filters with an amplitude proportional to the concentration of CO in the sample chamber. Other gases do not cause modulation of the detector signal since they absorb the reference and measure beams equally. Thus, the Gas Filter Correlation System responds solely to CO.

Options

48-001 — Particulate Filter

48-002 — Rack Mounts

48-003 — Remote activation of zero and span solenoids.

Thermo Environmental Instruments Inc.
8 West Forge Parkway
Franklin, MA 02038
(508) 520-0430
Telex: 200205 THEMO UR
FAX: (508) 520-1460

Printed in U.S.A 10/89 5M

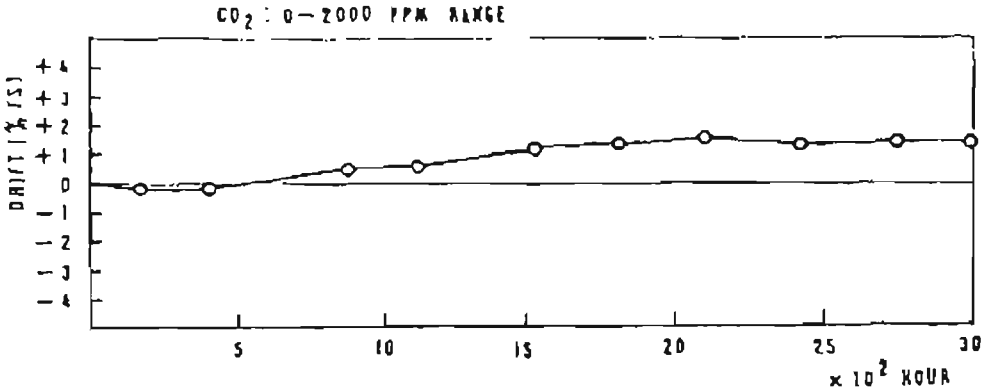
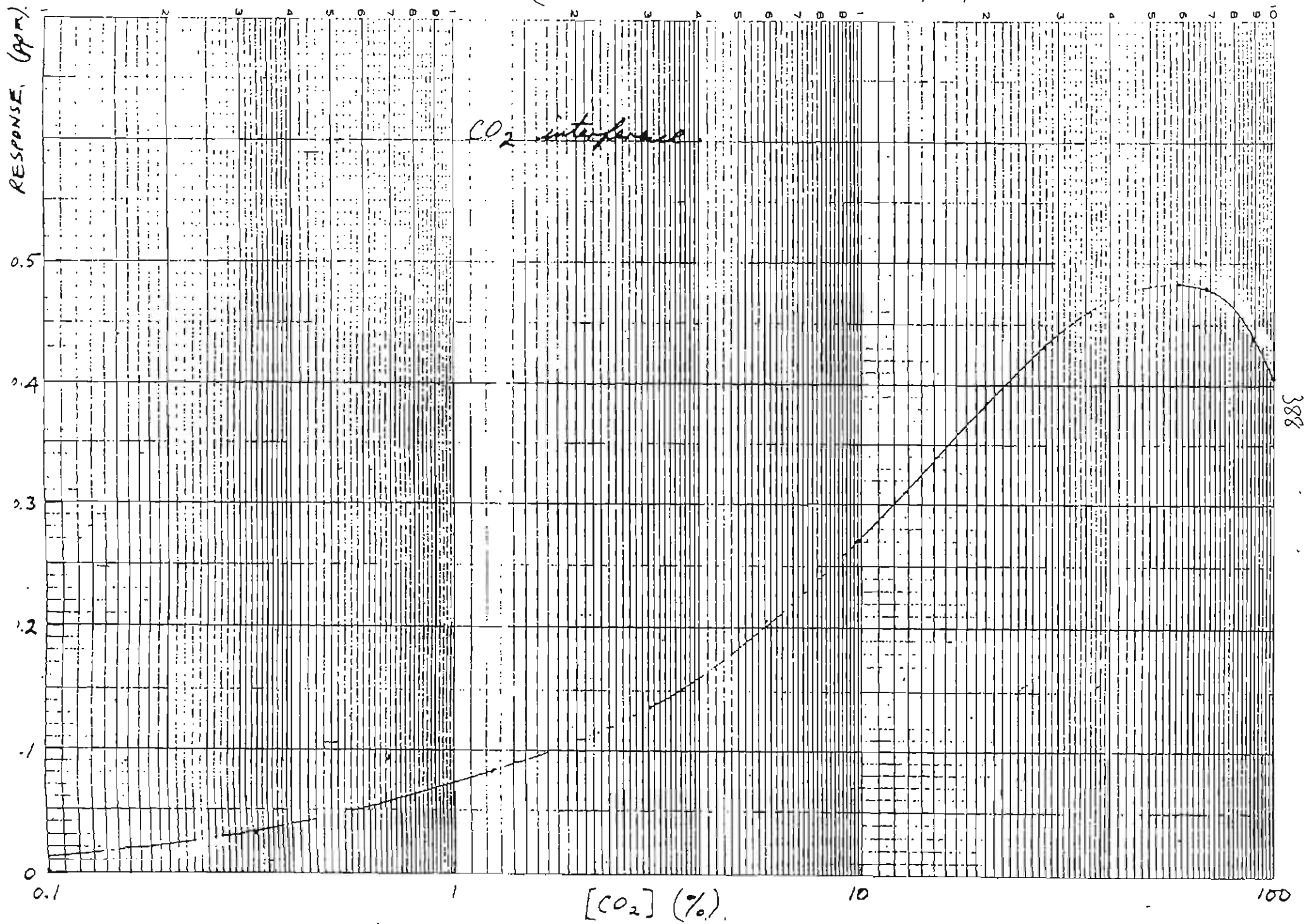


FIGURE 9 ZERO DRIFT

INTERFERENT COMP. / RANGE	CO 1000 PPM	CO_2 20%	SO_2 1000 PPM	H_2O 25 °C SAT.
CO : 0—1000 PPM	———	0.02 %FS	≃ 0	−0.5 %FS
CO_2 : 0—400 PPM	0.12 %FS	———	≃ 0	−0.5 %FS

TABLE 1 . INTERFERENCE

MODEL 48 (Baseline unit). 4/29/87.



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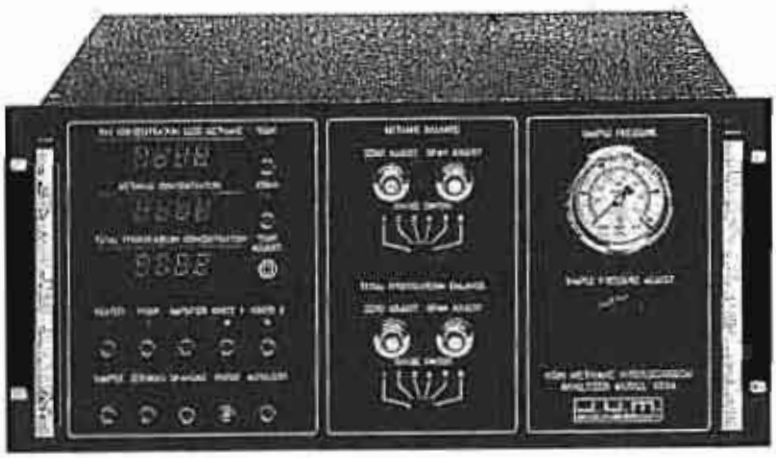
J.U.M.® ENGINEERING

HEATED NON METHANE HYDROCARBON ANALYZER

MODEL 109 A



The Model 109A Non Methane Hydrocarbon Analyzer is a compact, heated analysis system using the FID (Flame Ionization Detector) principle. For easy maintenance it has been modularly constructed. No additional sample handling equipment is required. The sample pump, the sample filter and all pressure and flow regulating components are built in. All sample wetted parts of the Model 109 A are operating at a temperature of 374 degrees F or above. To avoid reading errors due to calibration gas pressure fluctuations, the analyzer has an integral calibration gas overflow system before the sample filter.

The permanent sample filter is cleaned by backpurging and has a replaceable stainless mesh filter disc. A rear adapter plate allows quick installation of a heated sample line inside of the oven without the need for special tools.

Features

- Simultaneous Signal of:
  a) Total Hydrocarbon
  b) Methane
  c) Total HC less Methane
- 19 Inch relay rack mount
- Modular construction
- Permanent sample filter with replaceable filter disc
- Auto filter purge option
- Fast response
- Low sample flow rate
- Dual detector / Dual Amplifier design

Applications

The J.U.M. Model 109 A Non Methane Hydrocarbon Analyzer has been designed for Industrial needs as follow

- Raw automotive and diesel exhaust analysis
- Stack gas emissions monitoring
- Ambient air monitoring to low concentration levels
- Thermal reactor and combustor emissions monitoring

Principle of Flame Ionization Detection

The Model 109 A uses the Flame Ionization Detection (FID) method to determine the presence of total hydrocarbon, and methane concentrations in a gaseous sample. Burning hydrocarbon free hydrogen in an atmosphere of hydrocarbon free air, produces a negligible number of ions. A hydrocarbon sample introduced into this flame starts a very complex ionization which creates a larger number of ions. A polarizing high voltage is applied between two electrodes around the burner jet and produces an electrostatic field. Positive ions migrate to the collector electrode, and negative ions migrate to the high voltage electrode. The so generated ionization current between the two electrodes is directly proportional to the hydrocarbon concentration in the flame and is measured by the electrometer amplifier.

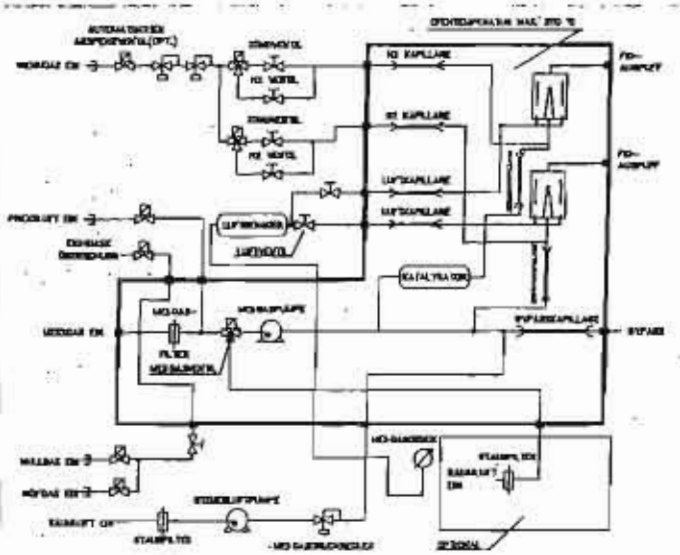
Description

Matched dual hydrogen flame ionization detectors are used in the J.U.M. Model 109 A to separate methane and non-methane hydrocarbons. A common sample is introduced into detector (#1) directly via sample capillary and into detector (#2) via a proprietary design non-CH_4 hydrocarbon cutter. The cutter oxidizes and removes all hydrocarbons except methane. Detector #1 therefore detects all hydrocarbons (THC) including methane, while detector #2 detects only methane (CH_4). The outputs of the two detectors are coupled to individual electrometers. The dual detector dual electrometer design provides a real time analysis of methane only (CH_4), total hydrocarbons including methane (THC) and total hydrocarbons less methane (NMHC). Individual analog outputs and digital front panel meters are provided for all three gas components.

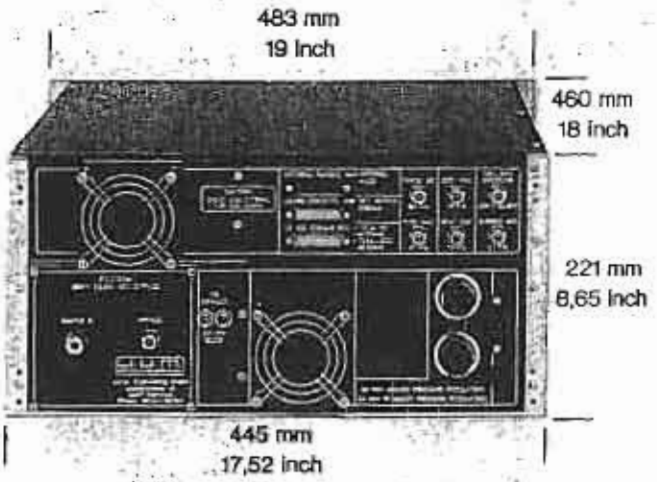
Standard specifications:

Analysis Method:	Flame Ionization Detector (FID)
Sensitivity:	Max.: 1 ppm CH_4 full scale
Response Time:	90% of full scale in 1 second (THC) 4 seconds (NMHC)
Zero Drift:	1,5% of full scale per 24 hours
Span Drift:	1,5% of full scale per 24 hours
Linearity:	Within 1%
Oxygen Synergism:	Less then 1% of selected range
Ranges:	Any five of the following: 0–10, 100, 1000, 10,000, 100,000 ppm or 50, 100, 500, 1000, 5000, 10,000 or 0–100% LEL or other to be specified
Outputs:	0–10 Volts D.C.
Display:	Digital
Zero/Span Adjust:	Manual on front panel
Fuel Consumption:	Hydrogen: 40 cc/min at 22 psig (1,5 Bar) 40% H_2/60% He: 160 cc/min at 22 psig (1,5 Bar)
Analysis Temperature:	Adjustable 200 to 400 °F (93 to 204 °C)
Power Requirements:	110 Volts, 60 Hertz AC, 800 Watts 220 Volts, 50 Hertz AC, 800 Watts (other on request)
Ambient Temperature:	41 °F to 110 °F (5 to 43 °C)
Dimensions:	Width 483 mm (19 inch) Depth 460 mm (18 inch) Height 132 mm (5,19 inch)
Weight:	41 lbs (19 kg)

FLOW DIAGRAM



OUTLINE DIMENSIONS



J.U.M. Engineering Ges.m.b.H.: reserves the right, at any time and without notice, to change specifications presented within this data sheet, and assumes no responsibility for the application or use of devices herein described.

Warranty

J.U.M. Engineering Ges.m.b.H.: warrants each new unit of its manufacture to be free of defects in material and workmanship for one year from the date of delivery.

Made in Germany.

© J.U.M. Engineering GmbH

J.U.M. Engineering Ges.m.b.H.
Liebigstraße 13
85757 Karlsfeld
Phone 011-49-8131-9 87 95
Fax 011-49-8131-9 88 94

Represented By:

J.U.M. of North America Inc.
26677 West 12 Mile Road
Southfield, Mi. 48034
USA
Phone (810) 354-0100
Fax (810) 354-0060

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AIR LIQUIDE

CC180131

CERTIFICATE OF ANALYSIS

Interference-Free Multi-Component EPA Protocol Gases

Note: Analytical uncertainty and NIST traceability are in compliance with EPA-600/R-97/121

Section No. 2.2, Procedure . G-1

Cylinder Number: CC180131

Customer: PACIFIC RIM OXYGEN SERVICE INC
TUKWILA, WA

P.O. Number: 200134
Item Number:

Shipping Order Number 22034374
Transfer Number:
Lot Number: SFS99613
Valve CGA 590
Cyl. Pressure:* 2000 PSIG

*Cylinder should not be used when gas pressure is below 150 psig

Assay Date: 28-Aug-06

Expiration Date: 21-Aug-09

Component	Requested Concentration	Assay Concentration
Carbon Monoxide	900 ppm	917 ± 11 ppm
Carbon Dioxide	22 %	22.0 ± 0.2 %
Oxygen	22 %	22.0 ± 0.3 %
Nitrogen	Balance	Balance

Reference Standard Employed For Analysis

Concentration				Component	Balance	Cyl. No.	SRM NTRM No.	Exp. Date	Sample No.	Type
1002	±	7	ppm	Carbon Monoxide	Nitrogen	CC88363	SFS75305	12/16/07	SJ	GMIS
21.93	±	0.11	%	Carbon Dioxide	Nitrogen	CC55253	950801	06/28/08	PO	GMIS
22.41	±	0.16	%	Oxygen	Nitrogen	CC62835	82659x	09/01/06	98080803	NTRM

Analysis Information

Component	Carbon Monoxide		First Triad Analysis		8/21/2006			Second Triad Analysis		8/28/2006		
Analyzer Information			Trial 1	Trial 2	Trial 3	Units		Trial 1	Trial 2	Trial 3	Units	
Manufacturer:	Varian(B)	Zero	0	0	0	ppm	Zero	0	0	0	ppm	
Model Number:	3400	Reference	1002.9	1003.0	999.9	ppm	Reference	1003.3	1003.0	1004.8	ppm	
Serial Number:	2806	Candidate	915.8	918.2	915.1	ppm	Candidate	917.8	920.8	921.2	ppm	
MPR Last Calibrated:	08/28/06	Result	915.0	917.3	917.0	ppm	Result	916.4	919.9	918.6	ppm	
Analytical Principle:	FID & TCD	Evaluation	VALID	VALID	VALID		Evaluation	VALID	VALID	VALID		
			MEAN ANALYTICAL RESULT:			916.4	ppm	MEAN ANALYTICAL RESULT:			918.3	ppm

Component	Carbon Dioxide		First Triad Analysis		8/21/2006		
Analyzer Information			Trial 1	Trial 2	Trial 3	Units	
Manufacturer:	Varian(B)	Zero	0	0	0	%	
Model Number:	3400	Reference	21.94	21.95	21.95	%	
Serial Number:	2806	Candidate	21.99	22.02	22.00	%	
MPR Last Calibrated:	08/08/06	Result	21.98	22.00	21.98	%	
Analytical Principle:	FID & TCD	Evaluation	VALID	VALID	VALID		
			MEAN ANALYTICAL RESULT:			21.99	%

Component	Oxygen		First Triad Analysis		8/21/2006		
Analyzer Information			Trial 1	Trial 2	Trial 3	Units	
Manufacturer:	Varian(B)	Zero	0	0	0	%	
Model Number:	3400	Reference	22.45	22.43	22.42	%	
Serial Number:	2806	Candidate	22.01	22.02	22.01	%	
MPR Last Calibrated:	08/15/06	Result	21.97	22.00	22.00	%	
Analytical Principle:	FID & TCD	Evaluation	VALID	VALID	VALID		
			MEAN ANALYTICAL RESULT:			21.99	%

Analyst: _____ Eric Barron

Approved by: _____ David Connolly

AIR LIQUIDE AMERICA, L.P. Region Office • 8832 Dice Road, Santa Fe Springs, CA 90670-2516
Phone: (562) 945-1383 • Fax: (562) 693-1156

AIR LIQUIDE

CC143844

CERTIFICATE OF ANALYSIS

Interference-Free Multi-Component EPA Protocol Gases

Note: Analytical uncertainty and NIST traceability are in compliance with EPA-600/R-97/121

Section No. 2.2, Procedure . G-1

Cylinder Number: CC143844

Customer: PACIFIC RIM OXYGEN SERVICE
TUKWILA, WA
P.O. Number: 200190
Item Number:

Shipping Order Number 24758866
Transfer Number:
Lot Number: SFS106842
Valve CGA 590
Cyl. Pressure:* 2000 PSIG
*Cylinder should not be used when gas pressure is below 150 psig

Assay Date: 18-Apr-07

Expiration Date: 12-Apr-10

Component	Requested Concentration		Assay Concentration			
Carbon Monoxide	475	ppm	479	±	6	ppm
Oxygen	12	%	12.0	±	0.1	%
Carbon Dioxide	12	%	12.0	±	0.2	%
Nitrogen	Balance		Balance			

Reference Standard Employed For Analysis

Concentration				Component	Balance	Cyl No	SRM NTRM No	Exp. Date	Sample No	Type
1002	±	7	ppm	Carbon Monoxide	Nitrogen	CC68363	SFS75305	12/18/07	SJ	GMIS
10.00	±	0.07	%	Oxygen	Nitrogen	CC16688	SFS76760	07/16/07	SO	GMIS
7.01	±	0.08	%	Carbon Dioxide	Nitrogen	CC3245	SFS12252	12/07/08	CR	GMIS

Analysis Information

Component	Carbon Monoxide		First Triad Analysis		4/11/2007		Second Triad Analysis		4/18/2007	
Analyzer Information			Trial 1	Trial 2	Trial 3	Units	Trial 1	Trial 2	Trial 3	Units
Manufacturer:	Varian(B)	Zero	0	0	0	ppm	0	0	0	ppm
Model Number:	3400	Reference	1002	1007.59	1009.41	ppm	958.51	959.67	957.69	ppm
Serial Number:	2805	Candidate	482.44	480.91	480.38	ppm	457.6	456.57	457.62	ppm
MPR Last Calibrated:	04/09/07	Result	482.4	478.2	476.9	ppm	478.4	478.8	478.8	ppm
Analytical Principle:	FID & TCD	Evaluation	VALID	VALID	VALID		VALID	VALID	VALID	
			MEAN ANALYTICAL RESULT:			478.2 ppm	MEAN ANALYTICAL RESULT:			478.0 ppm

Component	Oxygen		First Triad Analysis		4/12/2007	
Analyzer Information			Trial 1	Trial 2	Trial 3	Units
Manufacturer:	Varian(B)	Zero	0.022	0.025	0.021	%
Model Number:	3400	Reference	9.908	9.903	9.89	%
Serial Number:	2806	Candidate	11.907	11.902	11.883	%
MPR Last Calibrated:	03/16/07	Result	12.02	12.02	12.02	%
Analytical Principle:	FID & TCD	Evaluation	VALID	VALID	VALID	
			MEAN ANALYTICAL RESULT:			12.02 %

Component	Carbon Dioxide		First Triad Analysis		4/12/2007	
Analyzer Information			Trial 1	Trial 2	Trial 3	Units
Manufacturer:	Varian(B)	Zero	0	0	0	%
Model Number:	3400	Reference	8.981	8.971	8.959	%
Serial Number:	2806	Candidate	11.914	11.937	11.928	%
MPR Last Calibrated:	03/20/07	Result	12.00	12.00	12.02	%
Analytical Principle:	FID & TCD	Evaluation	VALID	VALID	VALID	
			MEAN ANALYTICAL RESULT			12.01 %

Analyst: Aldan Ifland

Approved by: Thuan Tran

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AIR LIQUIDE

CC253351

CERTIFICATE OF ANALYSIS

Interference-Free Multi-Component EPA Protocol Gases

Note: Analytical uncertainty and NIST traceability are in compliance with EPA-600/R-97/121

Section No. 2.2, Procedure . G-1

Cylinder Number: CC253351

Customer: PACIFIC RIM OXYGEN SERVICE INC.
TUKWILA, WA

P.O. Number: 200172
Item Number:

Shipping Order Number: 23934586
Transfer Number:
Lot Number: SFS104419
Valve: CGA 660
Cyl. Pressure:* 2000PSIG

Assay Date: 30-Jan-07

Expiration Date: 30-Jan-09

Component	Requested Concentration	Assay Concentration
Nitric Oxide	50 ppm	51.0 ± 0.7 ppm
Sulfur Dioxide	50 ppm	50.4 ± 0.6 ppm
Carbon Monoxide	50 ppm	49.9 ± 0.6 ppm
NOx		51.0 ppm
Nitrogen	Balance	Balance

Reference Standard Employed For Analysis

Concentration				Component	Balance	Cyl. No.	SRM, GMIS NTRM No.	Exp. Date	Sample No	Type
50.2	±	0.4	ppm	Nitric Oxide	Nitrogen	CC148644	SFS82446	05/02/08	SU	GMIS
51.0	±	0.4	ppm	Sulfur Dioxide	Nitrogen	CC70191	870803	11/17/08	QW	GMIS
50.74	±	0.41	ppm	Carbon Monoxide	Nitrogen	CC82364	SFS82317	05/10/08	PJ	GMIS

Analysis Information

Component	Nitric Oxide		First Triad Analysis 1/22/2007					Second Triad Analysis 1/30/2007			
Analyzer Information			Trial 1	Trial 2	Trial 3	Units		Trial 1	Trial 2	Trial 3	Units
Manufacturer:	MKS Instruments	Zero	-0.052	-0.048	-0.087	ppm	Zero	-0.056	-0.046	-0.060	ppm
Model Number:	2031	Reference	49.721	49.612	49.624	ppm	Reference	49.728	49.664	49.622	ppm
Serial Number:	10387278	Candidate	50.459	50.456	50.435	ppm	Candidate	50.553	50.541	50.562	ppm
MPR Last Calibrated:	01/05/07	Result	50.84	51.05	51.02	ppm	Result	51.03	51.10	51.15	ppm
Analytical Principle:	FTIR	Evaluation	VALID	VALID	VALID		Evaluation	VALID	VALID	VALID	
			MEAN ANALYTICAL RESULT:			51.00	ppm	MEAN ANALYTICAL RESULT:			51.09 ppm

Component	Sulfur Dioxide		First Triad Analysis 1/22/2007					Second Triad Analysis 1/30/2007			
Analyzer Information			Trial 1	Trial 2	Trial 3	Units		Trial 1	Trial 2	Trial 3	Units
Manufacturer:	MKS Instruments	Zero	-0.075	-0.009	-0.115	ppm	Zero	-0.164	-0.078	-0.098	ppm
Model Number:	2031	Reference	50.784	50.822	50.720	ppm	Reference	50.790	50.832	50.882	ppm
Serial Number:	10387278	Candidate	50.214	50.135	50.273	ppm	Candidate	50.084	50.096	50.137	ppm
MPR Last Calibrated:	01/18/07	Result	50.43	50.31	50.55	ppm	Result	50.29	50.26	50.27	ppm
Analytical Principle:	FTIR	Evaluation	VALID	VALID	VALID		Evaluation	VALID	VALID	VALID	
			MEAN ANALYTICAL RESULT:			50.43	ppm	MEAN ANALYTICAL RESULT:			50.28 ppm

Component	Carbon Monoxide		First Triad Analysis 1/22/2007					Second Triad Analysis 1/30/2007			
Analyzer Information			Trial 1	Trial 2	Trial 3	Units		Trial 1	Trial 2	Trial 3	Units
Manufacturer:	MKS Instruments	Zero	0.008	-0.001	-0.006	ppm	Zero	0.007	0.008	0.027	ppm
Model Number:	2031	Reference	50.475	50.522	50.545	ppm	Reference	50.481	50.527	50.443	ppm
Serial Number:	10387278	Candidate	49.637	49.657	49.715	ppm	Candidate	49.637	49.609	49.633	ppm
MPR Last Calibrated:	01/04/07	Result	49.80	49.87	49.91	ppm	Result	49.89	49.82	49.93	ppm
Analytical Principle:	FTIR	Evaluation	VALID	VALID	VALID		Evaluation	VALID	VALID	VALID	
			MEAN ANALYTICAL RESULT:			49.89	ppm	MEAN ANALYTICAL RESULT:			49.88 ppm

Analyst: Thuan Tran

Approved by: Aidan Bland

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CC160620

AIR LIQUIDE

CERTIFICATE OF ANALYSIS

Interference-Free Multi-Component EPA Protocol Gases

Note: Analytical uncertainty and NIST traceability are in compliance with EPA-600/R-97/121

Section No. 2.2, Procedure . G-1

Cylinder Number: CC160620

Customer: ALA-CYL-TACOMA
TACOMA, WA
P.O. Number: 196865 AMTEST
Item Number:

Shipping Order Number: 17968002
Transfer Number: 17968002
Lot Number: SFS89839
Valve: CGA 660
Cyl. Pressure:* 2000PSIG

Assay Date: 30-Sep-05

Expiration Date: 30-Sep-07

Component	Requested Concentration	Assay Concentration
Nitric Oxide	90 ppm	91.3 ± 2.0 ppm
Sulfur Dioxide	90 ppm	90.0 ± 1.3 ppm
Carbon Monoxide	90 ppm	89.5 ± 1.3 ppm
NOx		91.3 ppm
Nitrogen	Balance	Balance

Reference Standard Employed For Analysis

Concentration				Component	Balance	SRM, GMIS Cyl No.	NTRM No	Exp Date	Sample No	Type
100	±	2	ppm	Nitric Oxide	Nitrogen	CC 155872	SFS52228	05/26/07	MC	GMIS
102.0	±	1.0	ppm	Sulfur Dioxide	Nitrogen	CC 89288	81694	07/01/06	98080102	NTRM
101.8	±	1.1	ppm	Carbon Monoxide	Nitrogen	CC-70048	970802	02/01/07	97080202	NTRM

Analysis Information

Component	Nitric Oxide		First Triad Analysis 9/23/2005				Second Triad Analysis 9/30/2005			
Analyzer Information			Trial 1	Trial 2	Trial 3	Units	Trial 1	Trial 2	Trial 3	Units
Manufacturer:	Beckman	Zero	0	1	1	Vdc	0	0	0	Vdc
Model Number:	951A	Reference	999	998	999	Vdc	999	1000	1001	Vdc
Serial Number:	00100508	Candidate	911	910	911	Vdc	913	914	913	Vdc
MPR Last Calibrated:	09/07/05	Result	91.19	91.17	91.18	ppm	91.39	91.40	91.21	ppm
Analytical Principle:	Chemiluminescent	Evaluation	VALID	VALID	VALID		VALID	VALID	VALID	
		MEAN ANALYTICAL RESULT:				91.18 ppm	MEAN ANALYTICAL RESULT:			91.33 ppm

Component	Sulfur Dioxide		First Triad Analysis 9/23/2005				Second Triad Analysis 9/30/2005			
Analyzer Information			Trial 1	Trial 2	Trial 3	Units	Trial 1	Trial 2	Trial 3	Units
Manufacturer:	Horiba	Zero	0	0	0	Vdc	0	0	0	Vdc
Model Number:	CMA-331A	Reference	115	114	114	Vdc	113	113	113	Vdc
Serial Number:	56674503	Candidate	101	101	100	Vdc	100	100	100	Vdc
MPR Last Calibrated:	09/15/05	Result	89.58	90.37	89.47	ppm	90.27	90.27	90.27	ppm
Analytical Principle:	NDIR	Evaluation	VALID	VALID	VALID		VALID	VALID	VALID	
		MEAN ANALYTICAL RESULT:				89.81 ppm	MEAN ANALYTICAL RESULT:			90.27 ppm

Component	Carbon Monoxide		First Triad Analysis 9/23/2005				Second Triad Analysis 9/30/2005			
Analyzer Information			Trial 1	Trial 2	Trial 3	Units	Trial 1	Trial 2	Trial 3	Units
Manufacturer:	Rosemount Analytical CO	Zero	-1	0	0	Vdc	1	1	1	Vdc
Model Number:	8802-18	Reference	1021	1022	1022	Vdc	1028	1028	1028	Vdc
Serial Number:	2000224	Candidate	897	899	899	Vdc	903	903	903	Vdc
MPR Last Calibrated:	09/16/05	Result	89.45	89.55	89.55	ppm	89.41	89.41	89.41	ppm
Analytical Principle:	NDIR	Evaluation	VALID	VALID	VALID		VALID	VALID	VALID	
		MEAN ANALYTICAL RESULT:				89.51 ppm	MEAN ANALYTICAL RESULT:			89.41 ppm

Analyst: _____ Thuan Tran

Approved by: _____ David Connolly

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CC115989

AIR LIQUIDE

CERTIFICATE OF ANALYSIS

Interference-Free Multi-Component EPA Protocol Gases

Note: Analytical uncertainty and NIST traceability are in compliance with EPA-600/R-97/121
Section No. 2.2, Procedure . G-1

Cylinder Number: CC115989

Customer: ALA-CYL-TACOMA
TACOMA, WA
P.O. Number: 186811
Item Number:

Shipping Order #: 15877656
Transfer #: 15877656
Lot Number: SFS85149
Valve: CGA 350
Cyl. Pressure:* 2000PSIG
*Cylinder should not be used when gas pressure is below 150 psig

Assay Date: 11-Apr-05
Expiration Date: 11-Apr-08

Component	Requested Concentration	ASSAY Concentration
Methane	30 ppm	30.1 ± 0.4 ppm
Nitrogen	**Balance**	**Balance**

Reference Standard Employed For Analysis:

Concentration	Component	Balance	Cyl. No.	SRM or GMIS NTRM No.	Exp. Date	Sample No.	Type
44.1 ± 0.4 ppm	Methane	Air	CC 62898	82750	06/25/05	99080117	GMIS

Analysis Information:

Component	Methane		First Triad Analysis: 04/11/05			
Analyzer Information			Triad 1	Triad 2	Triad 3	Units
Manufacturer:	Varian(A)	Zero	0	0	0	ppm
Model Number:	3400	Reference	44.18	44.17	44.12	ppm
Serial Number:	2805	Candidate	30.13	30.10	30.11	ppm
MPR Last Calibrated:	04/04/05	Result	30.09	30.05	30.10	ppm
Analytical Principle:	FID & TCD	Evaluation	VALID	VALID	VALID	
			MEAN ANALYTICAL RESULT:			30.08 ppm

Analyst Signature: _____ Eric Barron

Approved by: _____ Thuan Tran

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CC122541

AIR LIQUIDE

CERTIFICATE OF ANALYSIS

Interference-Free Multi-Component EPA Protocol Gases

Note: Analytical uncertainty and NIST traceability are in compliance with EPA-600/R-97/121
Section No. 2.2, Procedure . G-1

Cylinder Number: CC122541

Customer: ALA-CYL-TACOMA
TACOMA, WA
P.O. Number: 186811
Item Number:

Shipping Order #: 15877656
Transfer #: 15877656
Lot Number: SFS85155
Valve: CGA 350
Cyl. Pressure:* 2000PSIG
*Cylinder should not be used when gas pressure is below 150 psig

Assay Date: 11-Apr-05 Expiration Date: 11-Apr-08

Component	Requested Concentration	ASSAY Concentration
Methane	90 ppm	90.0 ± 1.0 ppm
Nitrogen	Balance	Balance

Reference Standard Employed For Analysis:

Concentration				Component	Balance	Cyl. No.	SRM or GMIS NTRM No.	Exp. Date	Sample No.	Type
98.28	±	0.52	ppm	Methane	Air	FF23292	2751	06/01/08	212-C-16	SRM

Analysis Information:

Component	Methane		First Triad Analysis: 04/11/05			
Analyzer Information			Triad 1	Triad 2	Triad 3	Units
Manufacturer:	Varian(B)	Zero	0	0	0	ppm
Model Number:	3400	Reference	98.07	97.82	97.84	ppm
Serial Number:	2808	Candidate	89.77	89.50	89.39	ppm
MFR Last Calibrated:	03/22/05	Result	89.98	89.92	89.98	ppm
Analytical Principle:	FID & TCD	Evaluation	VALID	VALID	VALID	
			MEAN ANALYTICAL RESULT:			89.95 ppm

Analyst Signature: _____ Eric Barron

Approved by: _____ Thuan Tran

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RESUME OF
KRIS A. HANSEN, QEP

SENIOR CONSULTANT

EDUCATION

- B.S., Chemistry, Central Washington University, 1973
- Coursework and 2.5 years research completed towards M.S., Chemistry, Central Washington University
- Several workshops, courses and conferences annually on the subjects of CEMS/PEMS/CAM Rule, the Clean Air Act Amendments, and advanced emissions measurement.

PROFESSIONAL MEMBERSHIPS/CERTIFICATIONS

- Institute of Professional Environmental Practice (IPEP), Qualified Environmental Professional (QEP), July 1995
- Air and Waste Management Association (A&WMA), member since 1978
- Pacific Northwest International Section of A&WMA (PNWIS)
- Source Evaluation Society (SES)

PROFESSIONAL EXPERIENCE

AmTest Air Quality was formed under the direction of Mr. Hansen in 1982. This company conducts full-service source testing activities. Mr. Hansen follows developments in EPA testing methodology and has developed sampling and analysis techniques for many sources for which EPA guidelines are not available. He has worked at numerous types of industrial facilities throughout the United States and internationally. Mr. Hansen manages an experienced field testing and laboratory analysis staff. He manages all phases of project development, including cost estimation, scheduling, sample collection, analysis, and report preparation. He also manages all other aspects of the business, including business development and personnel issues.

Prior to joining Am Test, Inc., Mr. Hansen's professional experience included 4.5 years with an environmental consulting firm, and 2 years as a laboratory instructor and research fellow while attending graduate school at Central Washington University, where his research emphasis was in gas chemistry. Mr. Hansen has 30 years of professional experience.

Mr. Hansen has assisted in the instruction of EPA Air Pollution Training Institute (APTI) courses offered by the EPA in cooperation with the University of Washington. Mr. Hansen was the recipient of the 1987 PNWIS/APCA "Hardhat Award" which was presented in recognition of his contributions to the advancement of source sampling technology in the Pacific Northwest. He is a past board member of the Puget Sound Chapter of PNWIS/A&WMA. In 1995, Mr. Hansen received his Qualified Environmental Professional (QEP) certification. Through the QEP certification, environmental professionals demonstrate their breadth and depth of knowledge and experience, and commit to abide by the Code of Ethics of the Institute of Professional Environmental Practice (IPEP). Mr. Hansen is a Regional Coordinator for QEP certification testing.

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RESUME OF
ANGELA F. HANSEN, QSTI

SENIOR CONSULTANT

EDUCATION/PROFESSIONAL CERTIFICATIONS

- Qualified Source Test Individual (QSTI), Source Evaluation Society (SES) Groups I, II, and III
- B.S., Marine Resources, Western Washington University, Bellingham, Washington, 1980, Minors in Chemistry and Biology
- Several workshops, courses and conferences annually, including Dr. Jahnke's Continuous Emission Monitoring System (CEMS) workshop, and A&WMA workshops on Title V Operating Permits, Advanced Emission Measurement, Title III MACT, and Enhanced Monitoring.

PROFESSIONAL MEMBERSHIPS

- Air and Waste Management Association (A&WMA)
- Pacific Northwest International Section of A&WMA (PNWIS)
- Source Evaluation Society (SES)
- ASTM International Committee D22 on Air Quality

PROFESSIONAL EXPERIENCE

Ms. Hansen has worked with AmTest Air Quality since 1984 and has over 25 years of professional experience in the field of air quality. She participates in all aspects of source test projects, including initial client contact, scope of work preparation, scheduling, pre-test coordination, implementation of quality assurance programs for field sampling, analysis, data reduction, final data review, and report preparation and review. Ms. Hansen has assisted in the instruction of the EPA-APTI 464L "Continuous Emission Monitoring" course, the EPA 450 "Source Sampling for Particulate Pollutants" course, and the EPA 502 Course "Hazardous Waste Incineration" offered by the EPA's Air Pollution Training Institute in cooperation with the University of Washington. She is the General Conference Chair for the 2008 Annual Conference and Exhibition (ACE) of A&WMA in Portland, Oregon. She co-chaired the PNWIS annual meeting in 1996 and 2002. She was the General Chair of the 1994 PNWIS Spring Specialty Conference on Enhanced Monitoring, and has been a session chair and speaker at numerous PNWIS annual meetings and specialty conferences. Angela is the past President, Vice President, Secretary, and Treasurer for PNWIS and the Puget Sound Chapter of A&WMA. Ms. Hansen was the recipient of the 2005 PNWIS/A&WMA "Hardhat Award," the 2001 PNWIS/A&WMA "Robert Stockman Distinguished Achievement Award" and the 1991 PNWIS/A&WMA "Labcoat Award." She is an active member and the past Chair of A&WMA AM-4 Source Monitoring Technical Coordinating Committee. She has also been a speaker and session chair for the Source Evaluation Society annual meetings. She is certified as a Qualified Source Test Individual (QSTI) for Group I, Group II, and Group III from the SES. She is the Secretary of the Board for the Stack Testing Accreditation Council (STAC) which is the group working on a program to accredit stack testing firms.

Prior to joining ATAQ, Ms. Hansen acted as a Project Leader and Office Manager for an environmental engineering consulting firm in the Seattle area for 2 years. Experience with that firm involved sample collection, analysis and report preparation for source and ambient air, water, and industrial hygiene studies. Ms. Hansen also worked on various research projects in the Chemistry department while attending Western Washington University.

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RESUME OF
JAMES A. GUENTHOER

MANAGER, SOURCE TESTING SERVICES
PROJECT MANAGER

EDUCATION

- B.S., Geology, Juniata College, Huntington, Pennsylvania, 1972
- M.S.E., Environmental Engineering Division, Department of Civil Engineering, University of Washington, Seattle, Washington, 1985
- Continuous Emission Monitoring System (CEMS) Workshop, taught by Dr. James Jahnke, April 1993.

PROFESSIONAL MEMBERSHIPS

- Pacific Northwest International Section of AWMA (PNWIS)
- Source Evaluation Society (SES)

PROFESSIONAL EXPERIENCE

Mr. Guenthoer has worked for AmTest Air Quality since 1983 and has over 24 years of professional experience. Mr. Guenthoer specializes in performing field sampling for source emission evaluations and managing projects for Am Test. He is experienced in the collection of samples to be analyzed for particulate matter, particle size distribution, sulfur and nitrogen oxides, hydrogen sulfide, semi-volatile and volatile organic compounds (including dioxins and furans), toxic air pollutants, and other chemical species. Mr. Guenthoer was the recipient of the 1989 PNWIS/APCA "Hardhat Award" which is presented each year to an individual to recognize his contribution to the advancement of source sampling technology in the Pacific Northwest.

Mr. Guenthoer was formerly the Operations Manager for Pollution Control Systems, Inc. of Seattle, Washington for 4 years and handled the design, technical services and sales of in-stack source test Cascade impactors. He assists in the instruction of EPA 450 and EPA 468 Source Sampling Short Courses for particulate and gaseous pollutants which are offered each year by the EPA in cooperation with the University of Washington. He has also assisted in presenting workshops to demonstrate the use of in-stack source test Cascade impactors.

Prior to his association with PCSC, Mr. Guenthoer was associated with Air Pollution Systems of Kent, Washington conducting research and development studies on novel particulate control technology. Prior to his association with Air Pollution Systems, Mr. Guenthoer was the Testing Manager for Rossnagel and Associates of Medford, New Jersey and was in charge of all water quality, industrial hygiene, and source testing for 3 branch offices. During his 5 years with this environmental testing firm, Mr. Guenthoer has conducted compliance source tests for local, state and federal government in over 40 states and in Canada and served as a professional expert witness in environmental legal cases.

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RESUME OF
KEVIN FARWELL

SENIOR TEST LEAD

EDUCATION

- Eastern Arizona College, Thatcher, Arizona
- State of Arizona Plume Evaluation Training
- Course R450-97, Source Sampling for Pollutants
- Hazardous Material Handler (HAZWOPER)
- RCRA Certification
- AHERA Asbestos Inspector Certification – C5299
- Toxic Release Inventory Seminar
- MSHA Certified

PROFESSIONAL EXPERIENCE

Mr. Farwell began his employment with AmTest Air Quality in August 2001. He conducts source emission testing and activities related to source emission testing, including field sampling, test equipment maintenance and calibration, test planning and preparation, and data reduction and evaluation. In the laboratory and office, he performs test equipment trouble-shooting, maintenance, fabrication, and calibration. He helps keep the Air Quality shop and mobile laboratories organized and stocked with the necessary sampling supplies and parts.

Mr. Farwell is experienced at performing the following test methods: EPA Methods 1, 2, 3A, 4, 5, 6, 6C, 7E, 8, 9, 10, 12, 17, 25A, 26, 26A, 29 (multiple metals sampling), 101A, 201A, 202, particle size distribution, and other miscellaneous EPA methodology.

Prior to his position with AmTest Air Quality, Mr. Farwell was a Hazardous Waste Specialist for Phelps Dodge Morenci Inc. in Morenci, Arizona. His responsibilities included solid and hazardous waste disposal, spill response and remediation, toxic release inventory upkeep, spill prevention controls, emergency response plans, and other duties related to hazardous waste tracking and reporting. He also worked as an Environmental Technician for the mine where he performed inspections, training, visible emission observations, remediation oversight, and waste management. Before that, he worked for Phelps Dodge Hidalgo Inc. as a Testman III conducting stationary source sampling for 10 years at the Phelps Dodge's various smelter, refinery, or corporation's facilities.

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RESUME OF
KEVIN E. FARWELL, JR.

FIELD TECHNICIAN II

EDUCATION

- 2002-2006, Kent Lake High School, Kent, Washington

PROFESSIONAL EXPERIENCE

Mr. Farwell began his employment with AmTest Air Quality as a Field Technician II in August 2006. He conducts source emission testing and activities related to source emission testing, including field sampling, test equipment maintenance and calibration, test planning and preparation, and data recording. In the laboratory and office, he performs test equipment trouble-shooting, maintenance, fabrication, and calibration. He helps keep the Air Quality shop and mobile laboratories organized and stocked with the necessary sampling supplies and parts.

Mr. Farwell is experienced at performing the following test methods: EPA Methods 1, 2, 3A, 4, 5, 8, 13B, 16A/6C, 17, 23, 26, 29, ammonia, volatile organic compound testing by TO-15, continuous emission monitoring systems certifications, and other miscellaneous EPA methodology.

Prior to his position with AmTest, Mr. Farwell worked Fred Meyer, Inc. at several positions, ending his tenure there as a stocker. Previous positions included a veterinary assistant/kennel keeper at Covington Veterinary Hospital and a file manager with responsibilities including controlling archives and up-to-date files of thousands for Insulation Contractors in Kent, Washington.

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RESUME OF
RYAN D. RADONSKI

FIELD TECHNICIAN III

EDUCATION

- 1993-1996, Pre-Engineering and Autobody, Lower Columbia College, Longview, Washington
- 1992-1998, Communications Specialist, U.S. Marine Corps
- Numerous Safety and Hazard Communication Courses
- OSHA 40-Hour HAZWOPER Training, 1997

PROFESSIONAL EXPERIENCE

Mr. Radonski began his employment with AmTest Air Quality in January 1998. He conducts source emission testing and activities related to source emission testing, including field sampling, test equipment maintenance and calibration, test planning and preparation, and data recording. In the laboratory and office, he performs test equipment trouble-shooting, maintenance, fabrication, and calibration. He helps keep the Air Quality shop and mobile laboratories organized and stocked with the necessary sampling supplies and parts.

Mr. Radonski is experienced at performing the following test methods: EPA Methods 1, 2, 3A, 4, 5, 8, ODEQ 8, 12, 13B, 16A/6C, 17, 23, 26, 29, 201A/202, 301, ammonia, volatile organic compound testing by TO-14, continuous emission monitoring systems certifications, and other miscellaneous EPA methodology.

Prior to beginning his position with AmTest, Mr. Radonski worked in the environmental services field conducting oil spill clean-up and decontamination and hazardous materials handling and disposal. He was a Communications Specialist in the U.S. Marine Corps, where he was in charge of nuclear, biological, and chemical weapons training.

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RESUME OF MATTHEW S. CARON

ASSOCIATE SCIENTIST II

EDUCATION

- B.S., Chemistry, The Evergreen State College, Olympia, Washington, 2005
- South Puget Sound Community College, General Studies, 2000-2002

PROFESSIONAL EXPERIENCE

Mr. Caron began his employment with AmTest Air Quality in April 2006. He conducts source emission testing and activities related to source emission testing, including field sampling, test equipment maintenance and calibration, test planning and preparation, and data recording. In the laboratory and office, he performs test equipment trouble-shooting, maintenance, fabrication, and calibration. He helps keep the Air Quality shop and mobile laboratories organized and stocked with the necessary sampling supplies and parts. He is currently undergoing training in basic EPA source test methodology.

Prior to his position with AmTest, Mr. Caron worked as a research and development chemist, specializing in new product development at Aloecorp of Lacey, Washington. Prior to his employment at Aloecorp, Mr Caron worked at REI as a salesperson and Evergreen State College as a chemistry tutor. Some of Mr. Caron's undergraduate research includes mathematical modeling of phosphorescence lifetime and analysis of lake and groundwater samples for assorted organic and inorganic compounds. Mr. Caron's experience using analytical instrumentation includes work with ICP-AES, IC, FTIR, GC/GC-MS, UV/VIS, Polarograph, and NMR.

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RESUME OF
CHRISTINE L. RAMSEY

MANAGER, OFFICE AND LABORATORY SERVICES
ASSOCIATE SCIENTIST III

EDUCATION

- B.S., Biology and Psychology, Virginia Polytechnic Institute and State University, 1989
- Cooperative Education Program Certificate, Virginia Polytechnic Institute and State University, 1989

PROFESSIONAL EXPERIENCE

Ms. Ramsey began her employment with AmTest Air Quality in June 1996. In the office, Ms. Ramsey assists with project coordination, performs data reduction, data review, and report preparation. She creates specialized spreadsheets to perform data handling for source test work. Ms. Ramsey has also acted as an alternate Chemist/Lab Manager when needed. She is experienced at performing the following test methods: EPA Methods 1, 2, 3A, 4, 5, 8, 13B, 15, 17, 23, 26, 29, 201A/202, 301, 315, ammonia, and other miscellaneous EPA methodology.

In the laboratory, Ms. Ramsey is experienced in gravimetric analysis of particulate matter samples and particle size distribution samples and solvent extractions. She assists in preparation and analysis of samples for quantifying sulfur oxides, reduced sulfur compounds, toxic metals (including hexavalent chromium), semi-volatile compounds (including dioxins and furans), and volatile organic compounds.

Prior to her employment with AmTest, Ms. Ramsey worked as a contract employee in assorted long-term contract positions, which included Ostex International in Seattle and the Ste. Michelle Winery in Woodinville, Washington. Prior to that, she was a Section Leader for the Conventional Chemistry & Microbiology departments at Pacific Northern Analytical in Redmond, Washington. Ms. Ramsey has also worked as a contract employee to Wacker Siltronic in Portland, Oregon and as a Chemist/Lead Microbiologist for Lapteff Associates, Consulting Engineers in Woodbridge, Virginia. During college, she worked as a Physical Science Technician for the US Food and Drug Adminstration.

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RESUME OF
SUSAN D. LYON

ASSOCIATE SCIENTIST III

EDUCATION

- B.S., Chemistry, Western Washington University, Bellingham, Washington, 1995.
- IATA Dangerous Goods Transportation Seminar, 2000, 2002, 2004, 2006
- Dangerous Waste Management Seminar, 2005
- CSTOP Training from Northwest Safety Training Council, 2006

PROFESSIONAL EXPERIENCE

Ms. Lyon began her employment with AmTest Air Quality in September of 1999. In the office, Ms. Lyon assists with project coordination, performs data reduction, data review, and report preparation. In the laboratory, she is responsible for pre-field preparation for air quality projects and preparation of sample trains, glassware, labware and sampling hardware to be used on each specific project. In the field, Ms. Lyon has acted as a Project Assistant, assisting the Project Manager, Project Engineer, or Project Leader in setting up the equipment at each sample site, performing tests and recording data, recovering the samples after each test, performing any in-field analysis, and in demobilizing. When working in the field, she is responsible for properly labeling and identifying each sample, and initiating chain-of-custody procedures. Ms. Lyon has also acted as an alternate Air Quality Specialist I when needed. She is experienced at performing the following test methods: EPA Methods 1, 2, 3A, 4, 5, 8, 13B, 15, 17, 23, 26, 29, 201A/202, 301, 315, ammonia, and other miscellaneous EPA methodology.

In the laboratory, Ms. Lyon is experienced in gravimetric analysis of particulate matter samples and particle size distribution samples. She is responsible for the preparation and analysis of samples for quantifying sulfur oxides, reduced sulfur compounds, toxic metals (including hexavalent chromium), semi-volatile compounds (including dioxins and furans), and volatile organic compounds.

Prior to accepting a position at AmTest, Ms. Lyon worked for the QCM Company, Inc. of Kent, Washington as a Lab Technician from 1995-1997 and as the Laboratory Supervisor from 1997-1999. From 1994 to 1995, she was employed as an Instructor's Assistant in Western Washington University's Chemisty Department.

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HCG, Inc. dba AMTEST AIR QUALITY

CAPABILITIES

AmTest Air Quality has been providing comprehensive air emissions source testing services to industry and governmental services since 1982. On January 2, 2007, Am Test-Air Quality, LLC merged with HCG, Inc. dba Hoefler Consulting Group of Anchorage, Alaska, and today AmTest Air Quality operates as a division of HCG, Inc. HCG, Inc. provides considerable management and engineering depth to complement AmTest's well-established field and laboratory services. AmTest Air Quality's main office and laboratory facility is located in Preston, Washington where AmTest employs a staff of 14 engineers, scientists, and technicians to support work throughout the Pacific Northwest and Alaska. We take pride in the quality, experience, and motivation of our personnel, which we feel is unsurpassed in the Northwest and Alaska. Our staff uses state-of-the-art equipment to conduct source tests from the routine to the highly complex. We design our test teams to suit the size of the project ranging from a single technician to an organized field team of as many as ten. Whether projects are large or small, our attention to detail remains extremely high.

AmTest Air Quality performs source-testing projects at all types of facilities throughout the United States and Canada. Some of the types of facilities tested include:

- Oil and Gas Refineries
- Pulp and Paper Mills
- Gas, Oil, Wood, Coal and Nuclear-Fired Power Plants
- Chemical Plants
- Aluminum Reduction Facilities
- Wood Products Industries
- Smelters
- Cement Kilns
- Hazardous Waste Incinerators
- Municipal and Medical Waste Combustors
- Landfill Gas Flares
- Wastewater and Sewage Treatment Facilities
- Coating and Finishing Facilities
- Manufacturers
- Superfund Clean-Up Sites
- Asphalt Plants

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Examples of the types of services AmTest Air Quality provides include:

- Regulatory compliance with NSPS, MACT, BIF, TSCA, RCRA requirements
- Continuous emission monitoring system (CEMS) certifications and periodic monitoring performance tests
- Enhanced monitor certifications (CEMS, CRMS, CPMS)
- Emission inventories for Title V, MACT, NESHAP, SARA
- FTIR - Real-time Air Toxics
  Analysis of ~100 compounds possible, including Formaldehyde, NH_3, HCl, VOCs, methanol
- Portable Gas Chromatograph (GC with FID/TCD/FPD)
- VOCs, Fixed gases, sulfur compounds
- Title III and SIP determinations
- Air pollution control equipment warranty/guarantee/design testing
- Combustion or control device optimization
- Air toxics studies for hazardous air pollutants (HAPs)
- Particle size distribution studies (PM_{10})
- Soil remediation unit (SRU) evaluations
- Vapor recovery unit (VRU) efficiency evaluations
- Destruction/capture efficiency studies for VOCs
- Ammonia slip evaluations
- Pilot plant or engineering-scale trial burns
- Hands-on stack sampling training workshops
- Industry-agency liaison support

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AMTEST AIR QUALITY TESTING SERVICES DIVISION

EMISSIONS TESTING SERVICES

AmTest Air Quality's Testing Services Division performs all recognized EPA source test methods for many types of industries. We also perform NIOSH methods, BIF Regulation methods, SW-846 methods, toxic organic (TO) methods and are experienced at developing test methods for specialized applications where published methods do not exist. Am Test personnel keep current on new method development by attending training courses and utilizing the EPA Emission Measurement Center (EMC) web site. A partial list of pollutants measured using manual test methods follows:

- Particulate Matter
- Particle Size Distribution
- Sulfur Oxides
- Nitrogen Oxides
- Opacity Measurement
- Carbon Monoxide and Fixed Gases
- Hydrogen Sulfide
- Multi-Metals
  - Hexavalent Chromium
  - ICP Metals
  - Low-Level Mercury
- Particulate and Gaseous Fluoride
- Total Reduced Sulfur Compounds
- Volatile Organic Compounds
  - 8240 list of VOCs
  - Alcohols and Acetates
  - BTEX
  - Formaldehyde/Aldehydes
  - Perfluorocompounds
- Semi-Volatile Organic Compounds
  - Dioxin and Furan Isomers
  - PAHs
  - BNAs
  - PCBs
  - POMs
  - Pesticides and Herbicides
- Acid Gases
  - Hydrochloric Acid
  - Hydrofluoric Acid
  - Nitric Acid
  - Sulfuric Acid
- Chlorine, Chlorine Dioxide and Chloroform
- Ammonia and Urea
- Radionuclides
- Hazardous Air Pollutants (HAPs)

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CONTINUOUS EMISSION MONITORING SYSTEMS AND INSTRUMENTAL TESTING SERVICES

AmTest Air Quality's Testing Services Division has four (4) complete continuous emission monitor (CEM) instrument vans or systems, some of which can be shipped to remote locations. We maintain an inventory of approximately 100 EPA Protocol 1 (or best available grade) certified calibration gas mixtures to tailor calibration gases to each source. Each mobile laboratory is equipped with:

- O_2, CO_2, SO_2, NO_x, and CO analyzers
- Total hydrocarbon (THC), methane, and non-methane hydrocarbon (NMHC) analyzers
- PC-based data acquisition systems for collecting and reducing data to provide on-site results
- Cylinder racks for calibration gases
- Heated or unheated Teflon sample transport lines
- Sample extraction systems, including sample probes, fine particulate filters, moisture removal systems, and Teflon-lined sample pumps
- Laboratory bench space which can be equipped with analytical balances, wet chemical analysis equipment and instrumental methods, including gas chromatography

AmTest Air Quality's mobile laboratories are used to perform New Source Performance Standard (NSPS) testing and to conduct continuous emission monitoring system (CEMS) performance specification tests and audits. We provide a variety of CEMS services, including:

- Performance Specification Tests (PST)
- Relative Accuracy Test Audits (RATA)
- Relative Accuracy Audits (RAA)
- Cylinder Gas Audits (CGA)
- Quality Assurance Plans (QAP)

In addition, AmTest Air Quality's senior-level staff are extremely knowledgeable in the field of CEMS and can assist in monitor selection, calibration gas selection, stratification testing to locate CEMS probes, sampling system troubleshooting, and act as a liaison with the regulatory agency.

Appendix C
Liner Leakage Calculation

$$q = C_B a (2gh)^{0.5}$$

q = flow rate per acre (m^3/acre/s)
C_B = flow coefficient
a = area of circular hole in liner (m^2)
g = acceleration due to gravity (m/s^2)
h = head above liner (m)
Source: EPA, 1991, Design and Construction of RCRA/CERCLA Final Covers. Environmental Protection Agency, Seminar Publication, EPA/625/4-91/025.

Assumptions:

C_B	0.6	Source: EPA, 1991
g (m/s^2)	9.81	
h (m)	0.305	Maximum head on liner - design (1 ft)
drainage area (acres)	31	Assumes that entire Central Area drains to the leachate collection system due to the steep slopes of the liner; assumes no leakage through sidewall liners.
leachate collection flow (gpm)	1.01	Average gpm from May 2007 to April 2008
q (m^3/acre/s)	2.06E-06	

Calculations

$$a = \frac{q}{C_B (2gh)^{0.5}}$$

a	1.40E-06	m^2
a - area of circular hole	**0.014**	**cm^2**
q - flow rate per acre	**47**	**gal/acre/day**

Liner Classifications (Source: EPA, 1991.)

	Great	Good	Poor
#Hole/Acre @ size in cm^2	1 @ 0.1	1 @ 1.0	30 @ 0.1
Rate of Flow gal/acre/day	330	3300	10000

1.0 INTRODUCTION

Leachate meters were re-installed in the Leachate Collection Manhole (LCM) and Leachate Detection Manhole (LDM) during 2005 in accordance with the Second Closure Extension requirements. The purpose of the meters is to collect long-term flow data to evaluate Central Area liner performance.

2.0 LEACHATE METERS MAINTENANCE

2.1.1 The leachate meters will be removed from the LCM and LCD manholes during March and September for maintenance. In the event that a meter fails at another time, it will be replaced with a backup meter within 10 days.

2.1.2 Confined space entry work will be conducted by qualified and experienced personell.

2.1.3 The flow channels in both manholes will be cleaned with an eductor truck when the LCM and LDM meters are removed.

2.1.4 Backup leachate meters will be installed after the manholes are cleaned by the eductor truck.

2.1.5 Basic meter cleaning, calibration, and maintenance will be performed by City staff. The meters will be sent to the manufacturers for more advanced repair, or component replacement.

2.1.6 Backup meters and appurtenances, for the LCM and LCD manholes, will be kept on hand at Tacoma Landfill.

3.0 REPORTING

3.1 CONSENT DECREE REPORT

Leachate meters maintenance and replacement will be documented in the Consent Decree annual report.

1.0 INTRODUCTION

Rainfall into a landfill cell generates leachate. Leachate moves down through the solid waste in the lined Central Area cell to the liner then flows through a leachate collection line to the leachate collection manhole where it is discharged to the sanitary sewer. Some leachate remains perched in the solid waste and drains to gas extraction wells. The leachate is periodically pumped from gas extraction wells to maintain gas extraction performance and reduce the amount of leachate that flows to the sewer system.

2.0 CENTRAL AREA LEACHATE EXTRACTION

2.1 PURPOSE OF LEACHATE EXTRACTION

From the City of Tacoma's perspective, the main purpose of pumping leachate from gas extraction wells in the Central Area is to maintain good control on the flow of gas to prevent odors problems. A secondary benefit is to help increase the flow of higher quality gas to the flares.

When the levels of leachate have been monitored in the Central Area, the City observed leachate perched intermittently throughout the cell. The concern was that the leachate would "drown" the screened area of the extraction wells, making them ineffective at controlling gas, reducing odors and collecting gas to be transferred to the flare system. The City of Tacoma Landfill has not had an odor complaint related to the Central Area in several years. Part of the reason is the ongoing addition of extraction wells to cover gaps in the system and improved condensate removal in the Central Area. When the Gas to Energy Plant was in operation, the City began pumping leachate from selected wells in the Central Area to increase gas quality and British Thermal Units (BTU) to the Gas to Energy system. It was found that keeping selected well screens clear helped to reduce the odor emissions. It has been determined that this is a beneficial practice that should continue as needed until the Central Area is permanently closed.

There is a secondary benefit with some increase in gas production as well. It should be noted that the leachate extraction wells can remove a relatively small amount of perched leachate and that most leachate generated in the cell leaves via the leachate collection system. Because the flare is operating efficiently at this time and a smaller flare station is in the design phase, the concern for maximizing BTU's was not a primary consideration.

2.2 LEACHATE EXTRACTION SCHEDULE

The City will implement its current schedule of pumping. The current schedule is to pump regularly during working hours five days per week. Leachate is pumped from the Central Area wells nearly every working day.

Historically, the City began with the pumps working 24/7 using a diesel generator. Pumping 24/7 was found that to be a waste of fuel. Landfill staff found that nearly as

much leachate was pumped when the system was used during just the working day, with the use of much less fuel. It is likely that when the pumps are working 24/7, it draws the leachate down faster than the leachate in the well can recover. So while the generator is still active and the pumps are available for pumping, there is no liquid available to pump. The actual pumping of leachate is at a much slower rate when the liquid levels are drawn down. And compounding the issue is the pump controllers use just enough energy to require the generator to operate off of idle.

2.3 EXTRACTION WELL SELECTION

Specific wells have been chosen, based on the following criteria:

- Six inch diameter HDPE Wells. The six inch diameter HDPE wells are favorable because they are much less likely to be impacted by the landfill which could prevent the removal of the pump from the well. In the past 4" diameter PVC and HDPE extraction wells were used. The 4" diameter wells allows for a very small margin for problems (3" diameter pumps are used) before the pump is lost, and the PVC wells are much older and more likely to fail due to settling and horizontal strains. The new wells are also constructed with larger boreholes and additional gravel, which should help prevent the clogging of the extraction wells with sediment. There are 12 wells constructed in this manner.
- The wells with the six-inch diameter construction are also in key areas where the City determined that "holes" in our extraction system could lead to odor issues.
- The wells chosen were in the center area of the Central Area, in the deeper areas of the landfill. They are also located in areas that historically had some odor issues.
- The wells selected originally were GWCA-3, GWCA-4 and GW06-4. As of October of 2008, pumping of GW06-4 has been discontinued with no increase in odor issues.

As the LFG odor issues have been controlled effectively using the current approach, the current extraction wells will continue to be pumped. If odor issues are identified in other areas of the Central Area, additional wells can be targeted should leachate be identified as the cause of the problems.

2.4 PUMPING EQUIPMENT

Generator - Landfill staff is currently using a smaller propane powered generator. Propane was selected so waste propane generated from our HHW facility could be used to power the system. When recycled propane is not available, propane purchased from a vendor is used. The generator is 6500 watt liquid cooled model.

Pumps - The system uses Grundfos Redi-Flo3 pumps. After trying other pumps such as pneumatic 2" diameter pumps and solar powered 2" diameter pumps, The Grundfos Redi-Flo3 has proven to be the most reliable and maintenance free system. The lowest volume pump ends are used for this application. In addition to the pumps, a Grundfos controller is required for each pump in operation. The controller allows the user to control the pump rates for the system.

3.0 SURFACE GAS MONITORING

Purpose: Monitor for potential methane gas release and odor control for central area.

The surface emission monitoring will be done on a quarterly basis. Weather will be a consideration on when the monitoring will be done.

Monitoring will be done with a gas tech 201 at waist to knee level and measured in the PPM range. Measurements of 500 ppm or less will not be considered a problem, but will be designated by feet and direction from a well I.D. and re-measured quarterly.

Monitoring will be done by walking north and south for a total of two passes. Each quarter the pattern will vary to assure coverage. Only the uncapped parts of the central area will be monitored.

4.0 REPORTING

Central Area leachate extraction and surface gas monitoring will be documented in the Bi-Annual Gas Report.

City of Tacoma
HELP Evaluation of Existing Tacoma Landfill

PREPARED FOR: City of Tacoma

PREPARED BY: CH2M HILL

DATE: May 3, 2005

This technical memorandum presents the results of the existing landfill performance evaluation prepared for the City of Tacoma. The purpose of this evaluation is to perform a hydraulic analysis using the current landfill configuration, with an emphasis in determining the possible monthly leachate production rate for both the maximum year and the average year that is collected within the existing Leachate Collection System (LCS). The landfill hydraulic performance was modeled using the latest version of the U.S. Environmental Protection Agency (EPA) Hydrologic Evaluation of Landfill Performance (HELP) Model Version 3.07.

HELP Model

The *Hydraulic Evaluation of Landfill Performance (HELP) Model* Version 3.07 (November 1997) was used to evaluate the cover system configurations. This program is a quasi-two dimensional hydrologic model used for conducting water balance analyses of liner systems for waste containment facilities, including both base liner systems and final covers. The HELP model is considered to be a conservative model that generates steady state, saturated flow through the various liner cross-sections. The model accepts weather, soil, and general design data and uses solution techniques that account for the effects of surface water storage, lateral surface drainage, unsaturated vertical drainage, and leakage. Following input of weather, soil, and design data, the model estimates the amounts of runoff, evapotranspiration (ET), drainage, and percolation/leakage that may occur through the liner system as a result of the simulated conditions. This technical memorandum presents the design input data and the results of the model simulations for each cover system.

The model was developed by the U.S. Army Corps of Engineers (ACOE) Waterways Experiment Station (WES) for the U.S. Environmental Protection Agency (EPA) to meet the needs of the regulatory requirements. The primary purpose of the model is to help compare design alternatives with respect to their water balances (Schroeder et al 1994a). For this application, the model is being used to estimate possible leachate generation from an existing landfill.

It should be noted that the model was meant to be used for comparison of design alternatives, and is not known for its accuracy. Recent comparison of hydrologic design software indicates that most software underpredicts the amount of runoff from the cover system, thereby

increasing the infiltration into the system (Scanlon et al, 2002). The HELP model does predict some runoff, but does not adequately account for actual runoff when compared with field data.

Data Requirements

Three types of information are required to perform the HELP model evaluation: climatic data, soil and material data, and general site design data. Input options are presented below.

Climatic Data

Climatic data input includes daily precipitation, temperature, and solar radiation that may be entered using actual historic data input by the user, generated stochastically, or taken from an existing limited historical database covering more than 100 U.S. cities.

Evaporative Zone Depth. Evaporative zone depth, or the maximum depth from which stored water may be removed by ET, must be input either by the user or by using model defaults. The evaporative depth is typically at least equal to the expected average depth of root penetration when vegetation is present. The evaporative zone depth may not exceed the depth to the top of the topmost barrier soil layer.

Leaf Area Index. Leaf area index (LAI) is defined as the dimensionless ratio of the leaf area of the actively transpiring vegetation to the nominal surface area on which the vegetation is growing. The LAI is chosen from either known values or typical values included in the program.

Soil and Material Data

Soil and material data input consists of the final cover system's hydrologic and hydraulic characteristics. Default soil and material characteristics may be obtained from existing typical data, or may be based on actual soil and material properties specific to the site. General descriptions for the soil and material characteristics are presented below:

- Soil Water Content - the ratio of the volume of water within the soil to the total volume occupied by the soil.
- Porosity - the soil water content at saturation.
- Field Capacity - the soil water content at which a soil begins to drain water
- Wilting Point - the lowest soil water content at which plants wilt and fail to recover their turgidity.
- Water Capacity - the difference between the soil water contents at field capacity and wilting point.
- Hydraulic Conductivity - the rate at which water drains vertically through a saturated soil with no vertical pressure gradient

Site Design Data

Site design data includes information that describes the general physical design characteristics of the landfill surface area to be analyzed. Typical design requirements include:

- Slope of the uppermost layer (typically minimum slope, most conservative due to reduced runoff potential)
- Maximum lateral drainage distance corresponding to the minimum, conservative slope, and
- The fraction of daily potential runoff that can leave the landfill cover.

Model Input Data

The performance of the existing landfill was evaluated using the HELP model and existing/design conditions at the site.

Landfill Design

Per the City, the landfill is covered with 1-2 feet of glacial till. In addition, the southern area of the landfill, approximately 7.9 acres out of a total 29.9 acres (per City personnel), is covered with an 8-mil scrim-reinforced HDPE liner (Griffylon), increasing the amount of runoff from the landfill cover and decreasing the amount of infiltration through the landfill layers. The landfill generally consists of the following layers (with the exception of the 8-mil Griffylon), from top to bottom:

Floor Area

- Average 1.5 feet of glacial till, assumed to be silty sand (SM) with a poor stand of grass (with the exception of HDPE-covered area).
- A layer of typical MSW.
- A 12-inch layer of high permeability protective material (assumed gravel), that acts as a LCS.
- A 60-mil HDPE geomembrane.
- A composite drainage net (geotextile/geonet/geotextile).
- A 60-mil HDPE geomembrane.

Sideslope Area

- Average 1.5 feet of glacial till, assumed to be silty sand (SM) with a poor stand of grass (with the exception of HDPE-covered area).
- A layer of typical MSW.
- A composite drainage net (geotextile/geonet/geotextile).
- A 60-mil HDPE geomembrane.

Climatic Data

Historic climatic data for Tacoma, Washington were used for all simulations, and included daily values for precipitation and temperature obtained from the Tacoma 1 weather station. Solar radiation data was artificially generated using default equations in conjunction with the latitude, precipitation, and temperature. The data was obtained from over 20 years of historic climatic data ranging from 1983 to 2004. The precipitation scenario modeled was the data set containing the maximum 10-year mean annual precipitation from ten consecutive years during the period from 1983 to 2004.

Relative humidity, evaporative zone depth, average annual wind speed, and growing season were obtained from the default data contained in the HELP model database for the city of Seattle.

Soil Data

The following is a summary of the soil/materials used to model the different components of the landfill. Material properties are summarized in Table 1.

Cover Soil. Based on discussions with the City of Tacoma, it was determined that the cover soil consists of a glacial till. Glacial till can have many different qualities, ranging from silty sand to silt. However, for this analysis, it was assumed the material was silty sand (SM) with a hydraulic conductivity of approximately 1×10^{-2} cm/sec.

Waste. There is little information regarding the existing waste material. However, the waste is relatively old, and has undergone primary consolidation, thus reducing the porosity of the waste and increasing the density. However, without further information, the default properties for waste were used, without allowing for channeling within the waste.

Drainage Layer. Over the floor, the drainage layer was assumed to be a gravel layer typical for MSW landfills. On the sideslopes, a composite drainage net, or geonet sandwiched between geotextile, was assumed to be the drainage layer over the geomembrane. These layers will decrease the potential for buildup of head over the geomembrane, and will allow for horizontal drainage to an adjacent subsurface drainage system.

60-mil HDPE Geomembrane. Without further information on the actual HDPE material used, the default HDPE material properties contained within the model were used.

TABLE 1
Summary of Material Properties

Layer	Porosity (vol/vol)	Field Capacity (vol/vol)	Wilting Point (vol/vol)	Initial Soil Water Content (vol/vol)	Saturated Hydraulic Conductivity (cm/sec)
Cover soil	0.457	0.131	0.058	NA[2]	2.00×10^{-3}
Waste Layer	0.671	0.292	0.077	NA[2]	1.00×10^{-5}
HDPE geomembrane[1]	.003[3]	.002[3]	.001[3]	.003[3]	2.00×10^{-13}

Drainage Layer	0.850	0.01	0.005	NA[2]	10.00

[1] Additional geosynthetic liner properties include a pinhole density (manufacturing defect) of 1 holes/acre, installation defects of 4.00 holes per acre, and a general placement quality rated as good.

[2] Initial soil water content for the 10-year simulation was determined by running the model until it equalized. From this run, the final water storage values for each layer were obtained, and placed in the final model run. Therefore, this value varies for each model run.

[3] These properties were assumed for use of the HDPE geomembrane as a vertical percolation layer over the top of the landfill. Porosity of actual HDPE geomembrane is measured in micrometers, and would be much smaller than reported here.

NA = not applicable

Site Design Data

Design data was obtained from discussions with, and plan and profile AutoCAD drawings obtained from the City of Tacoma. Based on the existing plan view, the minimum slope for the cover system is 2%. Longest surface areas were obtained from the average over each area (west shallow sideslope, west steep sideslope, the floor, and the east sideslope). Based on the drawing, it appears that the entire surface area is available for runoff potential.

Model Areas

The plan and section drawings obtained from the City of Tacoma were used to develop the leachate quantities for the landfill. After reviewing the design sections, it was determined that the landfill could be broken into four different slope configurations: west shallow sideslope, west steep sideslope, the floor area, and the east sideslope.

Sections showing the design slopes for the southerly covered portion of the landfill were unavailable. Therefore, it was assumed that the proportion of each slope area in the uncovered area was identical to the southerly area.

West Shallow Sideslope

To determine the average slopes for the west shallow sideslope, a total of seven design sections were reviewed. The resulting average slope was calculated to be 18.5%. Comparing existing grades with the design grades, the average depth was calculated to be 13.2 feet thick. This number was assumed to be the thickness of the waste.

West Steep Sideslope

The seven design sections were further reviewed for the west steep sideslope. The majority of the slopes were 50%, with two others substantially steeper. The average slope was calculated to be 69.6%, with an average thickness of 38.3 feet.

Floor

The slope of the floor was relatively uniform at 2%. The average thickness, based on the seven cross sections, was 57.9 feet.

East Sideslope

The east sideslope was relatively shallow and uniform, with the exception of the northerly end. The average slope for the eastern side was 20.6%, with an average thickness of 29.0 feet.

Help Modeling Results

The landfill was modeled using the maximum consecutive 10-year mean annual precipitation. The maximum and average yearly volumes of leachate were obtained from the model runs for each area. The model results were then input into a spreadsheet that calculated the monthly and yearly leachate volumes based on the measured areas. The results can be found in Appendix A. The entire HELP model results from the final cover evaluation are included in Appendix B.

The monthly modeling results are summarized in Table 2. The results show that the maximum and average monthly leachate generation rates are 3,784,000 gallons/month and 2,517,000 gallons/month, respectively. The minimum leachate expected during a high precipitation year is 266,000 gallons/month, with an average low of 98,000 gallons per month. In addition, the maximum head buildup over the liner system is 1.214 inches (from Appendix B), which is much less than the 12 inch maximum allowed by regulations.

TABLE 2
Summary of Precipitation and associated Maximum and Average Help Modeling Results per Month

Month	Precipitation (gallons)	Maximum Leachate Generation Rate (gallons)	Average Leachate Generation Rate (gallons)	Monthly Summary Avg. Daily Head (inch)[a]
January	3,858,000	2,230,000	1,969,000	0.098
February	3,080,000	3,391,000	2,298,000	0.145
March	3,274,000	2,773,000	2,279,000	0.213
April	1,859,000	3,784,000	2,517,000	0.579
May	1,759,000	2,480,000	1,790,000	0.458
June	1,694,000	1,399,000	1,105,000	0.361
July	1,181,000	986,000	462,000	0.299
August	753,000	313,000	179,000	0.240
September	719,000	266,000	98,000	0.157
October	1,853,000	539,000	199,000	0.000
November	3,312,000	847,000	657,000	0.008
December	2,021,000	1,087,000	1,071,000	0.022
Yearly Total	**25,363,000**	**20,095,000**	**14,624,000**	NA

[a] Occurs over the uncovered floor area.

Head over liner assumes adequate leachate removal practices are being performed.

References

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HELP -- SUMMARY OF RESULTS

Note: Area in Acres (areas from system drawings found using AutoCad)

MAXIMUM LEACHATE PRODUCTION

Uncovered Area - Maximum Leachate Production

Area Names	Area (Ac)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	mo total
West Shallow Sideslope - Uncovered	5.6	31.2	42.7	37.1	28.2	8.1	0.6	2.9	0.0	0.0	3.6	5.9	19.1	179.4
West Steep Sideslope - Uncovered	1.4	5.7	6.8	8.7	10.0	6.8	6.5	4.9	5.2	4.4	1.8	1.0	2.2	63.9
Floor - Uncovered	4.7	2.6	3.4	5.6	14.7	12.1	9.2	7.9	6.3	4.0	0.0	0.2	0.6	66.6
East Sideslope - Uncovered	10.2	28.2	52.5	35.4	64.8	47.6	31.9	19.8	0.0	1.4	10.2	17.9	10.1	319.7
	Sum (in-Ac)	67.6	105.5	86.7	117.7	74.5	48.2	35.5	11.5	9.7	15.6	25.0	32.0	629.5
	gpm	41.9	65.4	53.8	72.9	46.2	29.9	22.0	7.2	6.0	9.7	15.5	19.8	**Total Annual**
	monthly (gal)	1,835,000	2,864,000	2,354,000	3,195,000	2,024,000	1,308,000	965,000	313,000	264,000	423,000	678,000	869,000	**17,092,000**

Covered Area - Maximum Leachate Production

Area Names	Area (Ac)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	mo total
West Shallow Sideslope - Covered	2.0	6.9	7.5	4.5	6.0	0.9	0.0	0.1	0.0	0.0	1.5	2.1	2.8	32.3
West Steep Sideslope - Covered	0.5	0.6	1.2	1.1	1.5	1.7	0.5	0.0	0.0	0.0	0.4	0.5	0.6	8.2
Floor - Covered	1.7	0.9	0.4	1.0	2.4	2.3	1.8	0.6	0.0	0.0	0.0	0.1	0.2	9.6
East Sideslope - Covered	3.7	6.1	10.4	8.8	11.8	12.0	0.9	0.1	0.0	0.0	2.4	3.6	4.4	60.6
	Sum (in-Ac)	14.5	19.4	15.4	21.7	16.8	3.3	0.8	0.0	0.0	4.3	6.2	8.0	110.5
	gpm	9.0	12.0	9.6	13.5	10.4	2.1	0.5	0.0	0.0	2.6	3.9	5.0	**Total Annual**
	monthly (gal)	395,000	527,000	419,000	589,000	456,000	91,000	22,000	-	1,000	116,000	169,000	218,000	**3,003,000**

Total - Maximum Leachate Production

Area Names	Area (Ac)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	mo total
West Shallow Sideslope	7.7	38.0	50.2	41.6	34.2	9.0	0.6	3.0	0.0	0.0	5.1	8.0	21.9	211.7
West Steep Sideslope	1.9	6.3	8.0	9.8	11.5	8.5	7.0	4.9	5.2	4.4	2.2	1.4	2.8	72.0
Floor	6.4	3.5	3.8	6.6	17.1	14.3	11.0	8.4	6.3	4.0	0.0	0.3	0.8	76.1
East Sideslope	13.9	34.3	62.9	44.2	76.6	59.6	32.8	19.9	0.0	1.4	12.6	21.5	14.5	380.2
	Sum (in-Ac)	82.1	124.9	102.1	139.4	91.3	51.5	36.3	11.5	9.8	19.8	31.2	40.0	740.0
	gpm	50.9	77.4	63.3	86.4	56.6	31.9	22.5	7.2	6.1	12.3	19.3	24.8	**Total Annual**
	monthly (gal)	2,230,000	3,391,000	2,773,000	3,784,000	2,480,000	1,399,000	986,000	313,000	266,000	539,000	847,000	1,087,000	**20,095,000**

AVERAGE LEACHATE PRODUCTION

Uncovered Area - Average Leachate Production

Area Names	Area (Ac)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	mo total
West Shallow Sideslope - Uncovered	5.6	26.3	26.9	20.8	19.0	9.9	4.2	1.0	0.6	0.8	3.6	9.3	19.4	141.7
West Steep Sideslope - Uncovered	1.4	4.0	4.8	5.3	6.0	5.8	4.9	4.3	3.2	1.6	1.2	1.7	2.3	44.9
Floor - Uncovered	4.7	2.3	3.4	4.6	7.9	7.6	6.5	5.3	2.5	1.0	0.1	0.7	0.8	42.6
East Sideslope - Uncovered	10.2	26.9	35.5	38.0	43.9	34.5	23.4	6.1	0.1	0.2	1.9	8.5	10.7	229.6
	Sum (in-Ac)	59.5	70.5	68.8	76.7	57.8	39.0	16.6	6.4	3.5	6.7	20.1	33.1	458.8
	gpm	36.9	43.7	42.6	47.6	35.8	24.2	10.3	4.0	2.2	4.2	12.5	20.5	**Total Annual**
	monthly (gal)	1,614,000	1,916,000	1,867,000	2,083,000	1,570,000	1,060,000	450,000	174,000	95,000	183,000	546,000	900,000	**12,458,000**

Covered Area - Average Leachate Production

Area Names	Area (Ac)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	mo total
West Shallow Sideslope - Covered	2.0	5.3	5.2	4.7	3.6	0.5	0.2	0.1	0.1	0.0	0.2	1.3	2.6	23.9
West Steep Sideslope - Covered	0.5	0.8	0.9	1.1	1.3	0.9	0.2	0.0	0.0	0.0	0.0	0.3	0.4	5.8
Floor - Covered	1.7	0.7	0.8	1.0	1.4	1.3	0.5	0.1	0.0	0.0	0.0	0.3	0.3	6.4
East Sideslope - Covered	3.7	6.3	7.2	8.3	9.7	5.5	0.7	0.2	0.1	0.1	0.3	2.2	3.0	43.6
	Sum (in-Ac)	13.1	14.1	15.1	16.0	8.1	1.6	0.4	0.2	0.1	0.6	4.1	6.3	79.7
	gpm	8.1	8.7	9.4	9.9	5.0	1.0	0.3	0.1	0.1	0.4	2.5	3.9	**Total Annual**
	monthly (gal)	354,000	382,000	411,000	434,000	220,000	44,000	12,000	6,000	3,000	16,000	110,000	171,000	**2,163,000**

Total - Average Leachate Production

Area Names	Area (Ac)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	mo total
West Shallow Sideslope	7.7	31.6	32.1	25.5	22.6	10.4	4.4	1.1	0.6	0.8	3.8	10.6	22.0	165.6
West Steep Sideslope	1.9	4.8	5.6	6.4	7.3	6.6	5.1	4.3	3.2	1.6	1.2	1.9	2.7	50.8
Floor	6.4	3.0	4.1	5.6	9.3	8.9	7.1	5.3	2.5	1.0	0.1	0.9	1.1	49.0
East Sideslope	13.9	33.2	42.8	46.4	53.6	40.0	24.2	6.3	0.2	0.2	2.2	10.7	13.7	273.2
	Sum (in-Ac)	72.5	84.6	83.9	92.7	65.9	40.7	17.0	6.6	3.6	7.3	24.2	39.4	538.5
	gpm	44.9	52.5	52.0	57.5	40.9	25.2	10.6	4.1	2.2	4.5	15.0	24.4	**Total Annual**
	monthly (gal)	1,969,000	2,298,000	2,279,000	2,517,000	1,790,000	1,105,000	462,000	179,000	98,000	199,000	657,000	1,071,000	**14,624,000**

PRECIPITATION

Uncovered Area - Precipitation

Area Names	Area (Ac)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	mo total
West Shallow Sideslope - Uncovered	5.6	48.6	46.8	28.3	8.6	10.4	10.0	5.7	2.5	1.1	16.5	60.1	28.7	267.5
West Steep Sideslope - Uncovered	1.4	12.1	11.6	7.0	2.1	2.6	2.5	1.4	0.6	0.3	4.1	14.9	7.1	66.4
Floor - Uncovered	4.7	13.3	16.0	17.9	20.2	19.4	16.3	14.3	10.8	5.3	4.0	5.5	7.6	150.5
East Sideslope - Uncovered	10.2	5.0	7.4	10.1	17.2	16.6	14.3	11.5	5.5	2.2	0.1	1.5	1.7	93.1
	Sum (in-Ac)	79.0	81.8	63.4	48.1	48.9	43.1	32.9	19.4	8.9	24.8	82.1	45.2	577.4
	gpm	49.0	50.7	39.3	29.8	30.3	26.7	20.4	12.0	5.5	15.3	50.9	28.0	**Total Annual**
	monthly (gal)	2,145,000	2,221,000	1,721,000	1,306,000	1,327,000	1,170,000	894,000	526,000	241,000	672,000	2,229,000	1,226,000	**15,678,000**

Covered Area - Precipitation

Area Names	Area (Ac)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	mo total
West Shallow Sideslope - Covered	2.0	15.8	5.8	15.9	5.8	4.2	5.3	2.9	2.5	5.6	12.6	7.1	6.8	90.3
West Steep Sideslope - Covered	0.5	3.9	1.4	3.9	1.4	1.0	1.3	0.7	0.6	1.4	3.1	1.8	1.7	22.4
Floor - Covered	1.7	14.5	14.0	8.5	2.6	3.1	3.0	1.7	0.7	0.3	4.9	18.0	8.6	79.9
East Sideslope - Covered	3.7	28.8	10.5	28.9	10.5	7.6	9.7	5.3	4.5	10.2	22.8	13.0	12.3	164.0
	Sum (in-Ac)	63.1	31.6	57.2	20.4	15.9	19.3	10.6	8.3	17.6	43.5	39.9	29.3	356.6
	gpm	39.1	19.6	35.5	12.6	9.9	12.0	6.6	5.2	10.9	27.0	24.7	18.2	**Total Annual**
	monthly (gal)	1,712,000	859,000	1,553,000	553,000	432,000	524,000	288,000	226,000	478,000	1,180,000	1,082,000	795,000	**9,682,000**

Total - Precipitation

Area Names	Area (Ac)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	mo total
West Shallow Sideslope	7.7	64.4	52.6	44.3	14.4	14.5	15.3	8.6	5.0	6.8	29.1	67.3	35.5	357.8
West Steep Sideslope	1.9	16.0	13.0	11.0	3.6	3.6	3.8	2.1	1.2	1.7	7.2	16.7	8.8	88.8
Floor	6.4	27.9	30.0	26.3	22.7	22.5	19.3	16.0	11.5	5.6	9.0	23.5	16.2	230.4
East Sideslope	13.9	33.8	17.8	39.0	27.7	24.1	24.0	16.8	10.0	12.4	23.0	14.5	13.9	257.1
	Sum (in-Ac)	142.1	113.4	120.6	68.5	64.8	62.4	43.5	27.7	26.5	68.2	122.0	74.4	934.0
	gpm	88.1	70.3	74.8	42.4	40.2	38.7	27.0	17.2	16.4	42.3	75.6	46.1	**Total Annual**
	monthly (gal)	3,858,000	3,080,000	3,274,000	1,859,000	1,759,000	1,694,000	1,181,000	753,000	719,000	1,853,000	3,312,000	2,021,000	**25,363,000**

HELP -- Raw Results

File Name Description:

W	West
E	East
FLR	floor
SS	sideslope
SH	shallow
ST	steep
R1	final model run
1	uncovered
2	covered

HELP run and description

wsssh1r2	Western sideslope, shallow, uncovered
wsssh2r1	Western sideslope, shallow, covered
wssst1r2	Western sideslope, steep, uncovered
wssst2r1	Western sideslope, steep, covered
floorR2	floor, uncovered
floor2r1	floor, covered
ess1r2	Eastern sideslope, uncovered
ess2r1	Eastern sideslope, covered

HELP Run	Data Used	Jan	Feb	Mar	Apr	May
	Monthly Precipitation, 1999	8.62	8.31	5.03	1.53	1.84
wsssh1r2	Highest Leachate Production, 1999	5.5287	7.5758	6.5813	5.0002	1.4365
	Avg 10 yr pd.	4.6632	4.7692	3.6822	3.3629	1.7640
	Monthly Precipitation, 1997	7.81	2.84	7.84	2.86	2.06
wsssh2r1	Highest Leachate Production, 1997	3.3941	3.6782	2.2251	2.9751	0.4304
	Avg 10 yr pd.	2.6286	2.5731	2.3381	1.7828	0.2313
	Monthly Precipitation, 1999	8.62	8.31	5.03	1.53	1.84
wssst1r2	Highest Leachate Production, 1999	4.0626	4.8661	6.1889	7.1372	4.8679
	Avg 10 yr pd.	2.8517	3.4100	3.8189	4.3053	4.1375
	Monthly Precipitation, 1997	7.81	2.84	7.84	2.86	2.06
wssst2r1	Highest Leachate Production, 1997	1.2712	2.3784	2.2518	2.9982	3.3215
	Avg 10 yr pd.	1.5322	1.7405	2.1105	2.5500	1.7142
	Monthly Precipitation, 1999	8.62	8.31	5.03	1.53	1.84
floorR2	Highest Leachate Production, 1999	0.5528	0.7344	1.1972	3.1492	2.577
	Avg 10 yr pd.	0.4910	0.7197	0.9893	1.6799	1.6169
	Monthly Precipitation, 1999	8.6200	8.3100	5.0300	1.5300	1.8400
floor2r1	Highest Leachate Production, 1999	0.5235	0.2439	0.5661	1.4026	1.3359
	Avg 10 yr pd.	0.3919	0.4551	0.6045	0.8416	0.7918
	Monthly Precipitation, 1997	7.81	2.84	7.84	2.86	2.06
ess1r2	Highest Leachate Production, 1997	2.7516	5.1323	3.4539	6.3265	4.6466
	Avg 10 yr pd.	2.6266	3.4711	3.7164	4.2871	3.3709
	Monthly Precipitation, 1997	7.81	2.84	7.84	2.86	2.06
ess2r1	Highest Leachate Production, 1997	1.6626	2.8104	2.3939	3.2025	3.2610
	Avg 10 yr pd.	1.7066	1.9600	2.2603	2.6256	1.4795

In Inches

Jun	Jul	Aug	Sep	Oct	Nov	Dec	sum
1.78	1.01	0.44	0.2	2.93	10.67	5.1	47.4600
0.1011	0.521	0.0068	0	0.6442	1.0454	3.3902	31.8312
0.7469	0.1756	0.1023	0.1375	0.6419	1.6491	3.4461	25.1409
2.62	1.43	1.22	2.78	6.2	3.52	3.33	44.5100
0.0238	0.0332	0.0000	0.0088	0.7333	1.0230	1.3821	15.9071
0.1010	0.0585	0.0291	0.0150	0.1007	0.6590	1.2618	11.7790
1.78	1.01	0.44	0.2	2.93	10.67	5.1	47.4600
4.6417	3.5245	3.7108	3.1344	1.286	0.6822	1.5866	45.6889
3.4750	3.0479	2.2996	1.1268	0.8600	1.1805	1.6291	32.1423
2.62	1.43	1.22	2.78	6.2	3.52	3.33	44.5100
1.0394	0.0340	0.0033	0.0026	0.7338	0.9253	1.2394	16.1989
0.3853	0.0733	0.0306	0.0123	0.0946	0.5629	0.7780	11.5844
1.78	1.01	0.44	0.2	2.93	10.67	5.1	47.4600
1.9651	1.6787	1.3478	0.8547	0	0.0423	0.1238	14.2230
1.3980	1.1273	0.5402	0.2145	0.0118	0.1487	0.1613	9.0986
1.7800	1.0100	0.4400	0.2000	2.9300	10.6700	5.1000	47.4600
1.0907	0.3460	0.0000	0.0004	0.0004	0.0519	0.1172	5.6786
0.3046	0.0381	0.0018	0.0009	0.0195	0.1507	0.1814	3.7819
2.62	1.43	1.22	2.78	6.2	3.52	3.33	44.5100
3.1178	1.9347	0.0001	0.1321	0.9918	1.7515	0.9879	31.2268
2.2896	0.5918	0.0074	0.0147	0.1816	0.8280	1.0436	22.4288
2.62	1.43	1.22	2.78	6.2	3.52	3.33	44.5100
0.2511	0.0349	0.0000	0.0078	0.6511	0.9724	1.1918	16.4395
0.1940	0.0600	0.0348	0.0163	0.0849	0.5946	0.8256	11.8422

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**                                                                           **
**                                                                           **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                 **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
**                    USAE WATERWAYS EXPERIMENT STATION                      **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY               **
**                                                                           **
**                                                                           **
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PRECIPITATION DATA FILE:    C:\tlf\PRECIP.D4
TEMPERATURE DATA FILE:      C:\tLF\TEMP.D7
SOLAR RADIATION DATA FILE:  C:\tLF\SOLARRAD.D13
EVAPOTRANSPIRATION DATA:    C:\tLF\EVAPTRAN.D11
SOIL AND DESIGN DATA FILE:  C:\tLF\WSSSH1R2.D10
OUTPUT DATA FILE:           C:\tLF\WSSSH1R2.OUT


TIME:  16:50     DATE:   5/ 2/2005



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     TITLE:  Tacoma Landfill Central Area HELP Evaluation - WSS - Shallow

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.



                                  LAYER  1
                                  --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   5
          THICKNESS                     =     18.00   INCHES
          POROSITY                      =      0.4570 VOL/VOL
          FIELD CAPACITY                =      0.1310 VOL/VOL
          WILTING POINT                 =      0.0580 VOL/VOL
          INITIAL SOIL WATER CONTENT    =      0.1962 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.100000005000E-02 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
                 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
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LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	158.00	INCHES
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3265	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.25	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0214	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	18.46	PERCENT
DRAINAGE LENGTH	=	150.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	4.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A
POOR STAND OF GRASS, A SURFACE SLOPE OF 2.%
AND A SLOPE LENGTH OF 150. FEET.

SCS RUNOFF CURVE NUMBER	=	77.90	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	24.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	5.491	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	12.252	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.506	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	55.124	INCHES
TOTAL INITIAL WATER	=	55.124	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
Tacoma WASHINGTON

STATION LATITUDE	=	47.25	DEGREES
MAXIMUM LEAF AREA INDEX	=	1.00	
START OF GROWING SEASON (JULIAN DATE)	=	126	
END OF GROWING SEASON (JULIAN DATE)	=	287	
EVAPORATIVE ZONE DEPTH	=	24.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	9.10	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	75.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	70.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	79.00	%

NOTE: PRECIPITATION DATA FOR TACOMA WA
WAS ENTERED FROM AN ASCII DATA FILE.

NOTE: TEMPERATURE DATA FOR TACOMA WA
WAS ENTERED FROM AN ASCII DATA FILE.

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SEATTLE WASHINGTON
AND STATION LATITUDE = 47.25 DEGREES

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1994

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.54	4.72	4.02	2.44	1.63	2.04
	0.27	0.36	1.82	4.52	5.24	7.52
RUNOFF	0.000	0.000	0.008	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.003	0.034
EVAPOTRANSPIRATION	1.276	1.227	2.496	2.106	1.623	2.082
	0.363	0.344	0.341	0.291	1.006	0.995
LATERAL DRAINAGE COLLECTED	3.9342	3.0121	2.7422	2.7333	2.3866	0.4473
FROM LAYER 3	0.0817	0.0000	1.1011	0.6664	1.7608	2.6987
PERCOLATION/LEAKAGE THROUGH	0.1880	0.1538	0.1319	0.1540	0.1364	0.0323
LAYER 4	0.0051	0.0000	0.0673	0.0441	0.1059	0.1357

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.002	0.002	0.001	0.001	0.001	0.000
TOP OF LAYER 4	0.000	0.000	0.001	0.000	0.001	0.001
STD. DEVIATION OF DAILY	0.001	0.000	0.001	0.000	0.001	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.001	0.000	0.001	0.001

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ANNUAL TOTALS FOR YEAR 1994

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.12	138375.609	100.00
RUNOFF	0.046	166.424	0.12
EVAPOTRANSPIRATION	14.150	51365.391	37.12
DRAINAGE COLLECTED FROM LAYER 3	21.5645	78279.086	56.57
PERC./LEAKAGE THROUGH LAYER 4	1.154466	4190.713	3.03
AVG. HEAD ON TOP OF LAYER 4	0.0009		

CHANGE IN WATER STORAGE	1.205	4374.018	3.16
SOIL WATER AT START OF YEAR	55.129	200119.109	
SOIL WATER AT END OF YEAR	56.334	204493.125	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.019	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1995

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.29	5.37	4.19	2.30	0.96	0.91
	1.49	1.12	1.70	4.23	9.90	7.40
RUNOFF	0.000	0.164	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.202	0.000
EVAPOTRANSPIRATION	1.226	1.438	2.382	2.213	0.726	0.190
	0.931	0.342	0.219	1.276	1.169	1.016
LATERAL DRAINAGE COLLECTED	5.1925	2.9903	4.3152	3.6420	1.6034	0.6858
FROM LAYER 3	0.2783	1.0139	0.2056	1.2703	2.0937	4.6239
PERCOLATION/LEAKAGE THROUGH	0.2122	0.1417	0.1910	0.1786	0.0940	0.0472
LAYER 4	0.0233	0.0657	0.0139	0.0862	0.1184	0.1762

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.002	0.002	0.002	0.002	0.001	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.001	0.001	0.002
STD. DEVIATION OF DAILY	0.001	0.001	0.001	0.001	0.001	0.000
HEAD ON TOP OF LAYER 4	0.000	0.001	0.000	0.000	0.001	0.002

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ANNUAL TOTALS FOR YEAR 1995

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.86	159211.797	100.00
RUNOFF	0.366	1326.976	0.83
EVAPOTRANSPIRATION	13.129	47657.738	29.93
DRAINAGE COLLECTED FROM LAYER 3	27.9149	101331.109	63.65
PERC./LEAKAGE THROUGH LAYER 4	1.348317	4894.390	3.07
AVG. HEAD ON TOP OF LAYER 4	0.0011		
CHANGE IN WATER STORAGE	1.102	4001.663	2.51
SOIL WATER AT START OF YEAR	56.334	204493.125	
SOIL WATER AT END OF YEAR	57.437	208494.781	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.074	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1996

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.55	8.56	1.61	7.69	2.55	1.66
	0.59	0.43	1.32	5.09	6.61	11.27
RUNOFF	0.025	0.810	0.000	0.228	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.114
EVAPOTRANSPIRATION	1.195	1.433	2.056	4.109	2.833	1.515
	1.304	0.744	0.916	0.905	1.010	0.938
LATERAL DRAINAGE COLLECTED	5.1692	8.1291	5.6013	2.1871	1.7156	1.6227

FROM LAYER 3	0.4017	0.0054	0.0020	0.4288	2.3511	3.2834
PERCOLATION/LEAKAGE THROUGH	0.1990	0.2559	0.2280	0.1173	0.1152	0.1080
LAYER 4	0.0310	0.0008	0.0004	0.0295	0.1284	0.1424

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.002	0.004	0.003	0.001	0.001	0.001
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.001	0.002
STD. DEVIATION OF DAILY	0.001	0.002	0.000	0.001	0.001	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.001	0.001

ANNUAL TOTALS FOR YEAR 1996

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.93	199395.891	100.00
RUNOFF	1.176	4267.932	2.14
EVAPOTRANSPIRATION	18.958	68817.133	34.51
DRAINAGE COLLECTED FROM LAYER 3	30.8976	112158.172	56.25
PERC./LEAKAGE THROUGH LAYER 4	1.356074	4922.550	2.47
AVG. HEAD ON TOP OF LAYER 4	0.0013		
CHANGE IN WATER STORAGE	2.543	9230.090	4.63
SOIL WATER AT START OF YEAR	57.437	208494.781	
SOIL WATER AT END OF YEAR	59.979	217724.875	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.012	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1997

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.81	2.84	7.84	2.86	2.06	2.62
	1.43	1.22	2.78	6.20	3.52	3.33
RUNOFF	0.098	0.000	0.024	0.000	0.000	0.000
	0.000	0.000	0.000	0.009	0.000	0.039
EVAPOTRANSPIRATION	1.180	1.308	2.276	3.038	2.169	2.855
	2.075	0.782	1.062	1.517	1.091	0.942
LATERAL DRAINAGE COLLECTED	7.0647	5.8985	3.2556	5.7897	2.0217	0.3186
FROM LAYER 3	0.7809	0.0296	0.4843	1.9482	1.9099	2.0149
PERCOLATION/LEAKAGE THROUGH	0.2290	0.2198	0.1540	0.2275	0.1183	0.0390
LAYER 4	0.0540	0.0031	0.0333	0.1156	0.1107	0.1239

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.003	0.003	0.002	0.003	0.001	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.001	0.001	0.001
STD. DEVIATION OF DAILY	0.002	0.001	0.001	0.001	0.001	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 1997

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.51	161571.266	100.00
RUNOFF	0.170	617.693	0.38
EVAPOTRANSPIRATION	20.296	73674.766	45.60
DRAINAGE COLLECTED FROM LAYER 3	31.5165	114404.992	70.81
PERC./LEAKAGE THROUGH LAYER 4	1.428172	5184.264	3.21
AVG. HEAD ON TOP OF LAYER 4	0.0013		

CHANGE IN WATER STORAGE	-8.901	-32310.371	-20.00
SOIL WATER AT START OF YEAR	59.979	217724.875	
SOIL WATER AT END OF YEAR	51.078	185414.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.075	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1998

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.38	2.59	4.52	0.98	2.09	0.83
	0.94	0.00	0.24	3.53	11.21	9.17
RUNOFF	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.365	0.090
EVAPOTRANSPIRATION	1.173	1.394	2.174	1.555	1.433	0.517
	0.862	0.153	0.069	0.258	1.112	0.960
LATERAL DRAINAGE COLLECTED	1.8433	4.5402	2.9089	3.2387	1.2804	0.9206
FROM LAYER 3	0.3762	0.0000	0.0000	0.9962	1.4884	5.4702
PERCOLATION/LEAKAGE THROUGH	0.1047	0.1891	0.1522	0.1697	0.0736	0.0634
LAYER 4	0.0416	0.0000	0.0000	0.0658	0.0872	0.2044

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.001	0.002	0.001	0.002	0.001	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.001	0.003
STD. DEVIATION OF DAILY	0.001	0.001	0.001	0.000	0.001	0.001
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.001	0.002

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ANNUAL TOTALS FOR YEAR 1998

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.48	161462.453	100.00
RUNOFF	0.455	1652.365	1.02
EVAPOTRANSPIRATION	11.659	42322.738	26.21
DRAINAGE COLLECTED FROM LAYER 3	23.0631	83719.008	51.85
PERC./LEAKAGE THROUGH LAYER 4	1.151795	4181.014	2.59
AVG. HEAD ON TOP OF LAYER 4	0.0009		
CHANGE IN WATER STORAGE	8.151	29587.262	18.32
SOIL WATER AT START OF YEAR	51.078	185414.500	
SOIL WATER AT END OF YEAR	59.229	215001.766	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.066	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1999

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.62	8.31	5.03	1.53	1.84	1.78
	1.01	0.44	0.20	2.93	10.67	5.10
RUNOFF	0.124	0.017	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.239	0.129
EVAPOTRANSPIRATION	1.226	1.351	2.384	2.129	2.330	1.576
	2.150	0.801	0.134	0.347	1.112	0.974
LATERAL DRAINAGE COLLECTED	5.5287	7.5758	6.5813	5.0002	1.4365	0.1011

FROM LAYER 3	0.5210	0.0068	0.0000	0.6442	1.0454	3.3902
PERCOLATION/LEAKAGE THROUGH	0.2064	0.2310	0.2391	0.2107	0.0960	0.0268
LAYER 4	0.0416	0.0008	0.0000	0.0485	0.0707	0.1539

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.003	0.004	0.003	0.002	0.001	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.001	0.002
STD. DEVIATION OF DAILY	0.001	0.002	0.001	0.001	0.001	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.001

ANNUAL TOTALS FOR YEAR 1999

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.46	172279.812	100.00
RUNOFF	0.509	1849.380	1.07
EVAPOTRANSPIRATION	16.513	59942.781	34.79
DRAINAGE COLLECTED FROM LAYER 3	31.8313	115547.555	67.07
PERC./LEAKAGE THROUGH LAYER 4	1.325691	4812.258	2.79
AVG. HEAD ON TOP OF LAYER 4	0.0013		
CHANGE IN WATER STORAGE	-2.720	-9872.178	-5.73
SOIL WATER AT START OF YEAR	59.229	215001.766	
SOIL WATER AT END OF YEAR	56.510	205129.594	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.018	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2000

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.04	5.93	4.18	1.56	2.56	1.33
	0.72	0.77	0.87	3.53	3.65	2.80
RUNOFF	0.000	0.022	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	1.124	1.349	2.292	2.296	2.466	1.494
	0.880	0.847	0.249	0.291	0.304	0.997
LATERAL DRAINAGE COLLECTED	4.7847	3.3874	3.3069	3.3606	2.0462	0.7324
FROM LAYER 3	0.0114	0.0393	0.0458	1.2076	2.0057	2.5462
PERCOLATION/LEAKAGE THROUGH	0.2023	0.1621	0.1716	0.1732	0.1344	0.0516
LAYER 4	0.0015	0.0099	0.0055	0.0858	0.1083	0.1453

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.002	0.002	0.002	0.002	0.001	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.001	0.001	0.001
STD. DEVIATION OF DAILY	0.001	0.001	0.001	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.001	0.001

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ANNUAL TOTALS FOR YEAR 2000

	INCHES	CU. FEET	PERCENT
PRECIPITATION	31.94	115942.289	100.00
RUNOFF	0.022	80.421	0.07
EVAPOTRANSPIRATION	14.589	52959.559	45.68
DRAINAGE COLLECTED FROM LAYER 3	23.4742	85211.430	73.49
PERC./LEAKAGE THROUGH LAYER 4	1.251514	4542.995	3.92
AVG. HEAD ON TOP OF LAYER 4	0.0010		

CHANGE IN WATER STORAGE	-7.397	-26852.229	-23.16
SOIL WATER AT START OF YEAR	56.510	205129.594	
SOIL WATER AT END OF YEAR	49.112	178277.359	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.115	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2001

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.77	2.36	3.24	3.70	1.93	3.53
	0.20	2.25	0.46	3.32	10.13	6.82
RUNOFF	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.840	0.077
EVAPOTRANSPIRATION	1.209	1.359	0.695	0.692	1.262	1.840
	0.208	1.157	0.086	0.451	1.131	1.017
LATERAL DRAINAGE COLLECTED	1.7778	1.8616	1.7371	1.7428	2.8329	1.6894
FROM LAYER 3	0.4639	0.2110	0.9140	1.0804	0.9883	3.3993
PERCOLATION/LEAKAGE THROUGH	0.1073	0.1179	0.1060	0.1025	0.1520	0.1054
LAYER 4	0.0289	0.0165	0.0566	0.0771	0.0661	0.1425

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.001	0.001	0.001	0.001	0.001	0.001
TOP OF LAYER 4	0.000	0.000	0.000	0.001	0.000	0.002
STD. DEVIATION OF DAILY	0.001	0.001	0.001	0.001	0.001	0.001
HEAD ON TOP OF LAYER 4	0.000	0.000	0.001	0.000	0.001	0.001

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ANNUAL TOTALS FOR YEAR 2001

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.71	147777.328	100.00
RUNOFF	0.917	3328.169	2.25
EVAPOTRANSPIRATION	11.107	40318.230	27.28
DRAINAGE COLLECTED FROM LAYER 3	18.6985	67875.453	45.93
PERC./LEAKAGE THROUGH LAYER 4	1.078759	3915.895	2.65
AVG. HEAD ON TOP OF LAYER 4	0.0008		
CHANGE IN WATER STORAGE	8.909	32339.547	21.88
SOIL WATER AT START OF YEAR	49.112	178277.359	
SOIL WATER AT END OF YEAR	58.021	210616.906	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.032	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2002

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.53	3.56	4.16	3.64	1.14	1.36
	0.42	0.06	0.36	0.41	2.96	6.58
RUNOFF	0.000	0.000	0.000	0.004	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	1.200	1.407	2.329	2.210	1.282	1.263
	0.984	0.517	0.223	0.086	0.685	1.043
LATERAL DRAINAGE COLLECTED	5.4876	3.8928	3.1001	3.1166	3.3104	0.3636

FROM LAYER 3	0.5017	0.0000	0.0001	0.0033	0.9210	1.4864
PERCOLATION/LEAKAGE THROUGH	0.2198	0.1790	0.1594	0.1574	0.1748	0.0368
LAYER 4	0.0353	0.0000	0.0000	0.0012	0.0649	0.0864

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.003	0.002	0.001	0.002	0.002	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.001
STD. DEVIATION OF DAILY	0.001	0.001	0.001	0.001	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.001

ANNUAL TOTALS FOR YEAR 2002

	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.18	109553.453	100.00
RUNOFF	0.005	17.030	0.02
EVAPOTRANSPIRATION	13.230	48023.605	43.84
DRAINAGE COLLECTED FROM LAYER 3	22.1835	80526.273	73.50
PERC./LEAKAGE THROUGH LAYER 4	1.115031	4047.561	3.69
AVG. HEAD ON TOP OF LAYER 4	0.0009		
CHANGE IN WATER STORAGE	-6.353	-23061.088	-21.05
SOIL WATER AT START OF YEAR	58.021	210616.906	
SOIL WATER AT END OF YEAR	51.668	187555.828	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.078	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2003

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.50	1.71	5.08	3.30	0.55	0.36
	0.13	0.29	0.69	8.88	6.15	4.65
RUNOFF	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.736	0.005	0.000
EVAPOTRANSPIRATION	1.280	1.369	2.417	3.536	0.129	0.061
	0.024	0.067	0.122	1.425	1.035	1.024
LATERAL DRAINAGE COLLECTED	3.3820	4.1589	3.2578	3.3618	0.4890	0.2498
FROM LAYER 3	0.1026	0.2077	0.5294	0.3630	2.5461	3.0648
PERCOLATION/LEAKAGE THROUGH	0.1564	0.1738	0.1622	0.1724	0.0366	0.0178
LAYER 4	0.0065	0.0154	0.0368	0.0283	0.1351	0.1447

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.002	0.002	0.002	0.002	0.000	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.001	0.001
STD. DEVIATION OF DAILY	0.001	0.001	0.001	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.001	0.001

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ANNUAL TOTALS FOR YEAR 2003

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.29	146252.687	100.00
RUNOFF	0.740	2687.929	1.84
EVAPOTRANSPIRATION	12.488	45331.953	31.00
DRAINAGE COLLECTED FROM LAYER 3	21.7128	78817.500	53.89
PERC./LEAKAGE THROUGH LAYER 4	1.086203	3942.917	2.70
AVG. HEAD ON TOP OF LAYER 4	0.0009		

CHANGE IN WATER STORAGE	4.262	15472.394	10.58
SOIL WATER AT START OF YEAR	51.668	187555.828	
SOIL WATER AT END OF YEAR	55.931	203028.219	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.004	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1994 THROUGH 2003

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	6.10	4.60	4.39	3.00	1.73	1.64
	0.72	0.69	1.04	4.26	7.00	6.46
STD. DEVIATIONS	2.31	2.44	1.57	1.89	0.67	0.93
	0.49	0.68	0.85	2.22	3.22	2.60
RUNOFF						
TOTALS	0.025	0.101	0.003	0.023	0.000	0.000
	0.000	0.000	0.000	0.074	0.165	0.048
STD. DEVIATIONS	0.047	0.254	0.008	0.072	0.000	0.000
	0.000	0.000	0.000	0.232	0.271	0.051
EVAPOTRANSPIRATION						
TOTALS	1.209	1.364	2.150	2.388	1.625	1.339
	0.978	0.575	0.342	0.685	0.966	0.991
STD. DEVIATIONS	0.047	0.063	0.527	0.971	0.836	0.872
	0.714	0.347	0.353	0.543	0.269	0.036
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	4.4165	4.5447	3.6806	3.4173	1.9123	0.7131
	0.3519	0.1514	0.3282	0.8608	1.7110	3.1978
STD. DEVIATIONS	1.6862	2.0479	1.4374	1.2064	0.8057	0.5540

	0.2374	0.3143	0.4123	0.5569	0.5794	1.1691

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.1825	0.1824	0.1695	0.1663	0.1132	0.0528
	0.0269	0.0112	0.0214	0.0582	0.0996	0.1456
STD. DEVIATIONS	0.0448	0.0426	0.0406	0.0375	0.0400	0.0311
	0.0177	0.0202	0.0255	0.0342	0.0258	0.0308

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0021	0.0024	0.0018	0.0017	0.0009	0.0004
	0.0002	0.0001	0.0002	0.0004	0.0008	0.0015
STD. DEVIATIONS	0.0008	0.0011	0.0007	0.0006	0.0004	0.0003
	0.0001	0.0002	0.0002	0.0003	0.0003	0.0006

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1994 THROUGH 2003

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.65 (7.244)	151182.3	100.00
RUNOFF	0.441 (0.4030)	1599.43	1.058
EVAPOTRANSPIRATION	14.612 (3.0668)	53041.39	35.084
LATERAL DRAINAGE COLLECTED FROM LAYER 3	25.28569 (4.80651)	91787.062	60.71284
PERCOLATION/LEAKAGE THROUGH LAYER 4	1.22960 (0.12797)	4463.456	2.95237
AVERAGE HEAD ON TOP OF LAYER 4	0.001 (0.000)		
CHANGE IN WATER STORAGE	0.080 (6.2782)	290.91	0.192

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PEAK DAILY VALUES FOR YEARS 1994 THROUGH 2003

	(INCHES)	(CU. FT.)
PRECIPITATION	4.20	15245.999
RUNOFF	0.808	2932.1130
DRAINAGE COLLECTED FROM LAYER 3	0.46621	1692.34717
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.011856	43.03823
AVERAGE HEAD ON TOP OF LAYER 4	0.007	
MAXIMUM HEAD ON TOP OF LAYER 4	0.038	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	0.42	1516.4022

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3385
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0627

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 2003

LAYER	(INCHES)	(VOL/VOL)
1	4.2663	0.2370
2	51.6533	0.3269
3	0.0057	0.0227
4	0.0000	0.0000
SNOW WATER	0.000	

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 **                                                                           **
 **              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                **
 **                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                 **
 **                  DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
 **                    USAE WATERWAYS EXPERIMENT STATION                      **
 **             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY               **
 **                                                                           **
 **                                                                           **
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 PRECIPITATION DATA FILE:    C:\tlf\PRECIP.D4
 TEMPERATURE DATA FILE:      C:\tLF\TEMP.D7
 SOLAR RADIATION DATA FILE:  C:\tLF\SOLARRAD.D13
 EVAPOTRANSPIRATION DATA:    C:\tLF\ET_CVR.D11
 SOIL AND DESIGN DATA FILE:  C:\tLF\WSSSH2R1.D10
 OUTPUT DATA FILE:           C:\tLF\WSSSH2R1.OUT

 TIME:  10:42     DATE:   4/27/2005

 *******************************************************************************

      TITLE:  Tacoma Landfill Central Area HELP Evaluation - Cover Area

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      NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
               WERE SPECIFIED BY THE USER.

                                    LAYER  1
                                    --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER  45
               THICKNESS                    =      0.01   INCHES
               POROSITY                     =      0.0030 VOL/VOL
               FIELD CAPACITY               =      0.0020 VOL/VOL
               WILTING POINT                =      0.0010 VOL/VOL
               INITIAL SOIL WATER CONTENT   =      0.0010 VOL/VOL
               EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
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LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 5

THICKNESS	=	18.00	INCHES
POROSITY	=	0.4570	VOL/VOL
FIELD CAPACITY	=	0.1310	VOL/VOL
WILTING POINT	=	0.0580	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2404	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	158.00	INCHES
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3083	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 4

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.25	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0953	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	18.46	PERCENT
DRAINAGE LENGTH	=	150.0	FEET

LAYER 5

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL

INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY	=	1.00 HOLES/ACRE
FML INSTALLATION DEFECTS	=	4.00 HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #17 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 150. FEET.

SCS RUNOFF CURVE NUMBER	=	96.90	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	24.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	6.175	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	12.247	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.505	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	53.062	INCHES
TOTAL INITIAL WATER	=	53.062	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM Tacoma WASHINGTON

STATION LATITUDE	=	47.25	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	126	
END OF GROWING SEASON (JULIAN DATE)	=	287	
EVAPORATIVE ZONE DEPTH	=	24.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	9.10	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	75.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	70.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	79.00	%

NOTE: PRECIPITATION DATA FOR TACOMA WA WAS ENTERED FROM AN ASCII DATA FILE.

NOTE: TEMPERATURE DATA FOR TACOMA WA
WAS ENTERED FROM AN ASCII DATA FILE.

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SEATTLE WASHINGTON
AND STATION LATITUDE = 47.25 DEGREES

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1994

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.54	4.72	4.02	2.44	1.63	2.04
	0.27	0.36	1.82	4.52	5.24	7.52
RUNOFF	0.884	1.392	1.230	0.482	0.246	0.253
	0.001	0.004	0.347	2.148	1.665	3.512
EVAPOTRANSPIRATION	1.273	1.225	2.493	1.902	1.424	1.841
	0.397	0.275	1.592	0.570	1.005	0.992
LATERAL DRAINAGE COLLECTED	2.3695	2.8782	1.4623	1.5530	0.1804	0.0925
FROM LAYER 4	0.0863	0.0575	0.0112	0.0010	0.5608	1.2755
PERCOLATION/LEAKAGE THROUGH	0.0320	0.0347	0.0214	0.0241	0.0083	0.0057
LAYER 5	0.0061	0.0052	0.0011	0.0001	0.0126	0.0193

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.012	0.015	0.007	0.008	0.001	0.000
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.003	0.006
STD. DEVIATION OF DAILY	0.005	0.003	0.006	0.006	0.000	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.003	0.007

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ANNUAL TOTALS FOR YEAR 1994

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.12	138375.609	100.00
RUNOFF	12.165	44157.691	31.91
EVAPOTRANSPIRATION	14.989	54409.141	39.32
DRAINAGE COLLECTED FROM LAYER 4	10.5283	38217.762	27.62
PERC./LEAKAGE THROUGH LAYER 5	0.170577	619.193	0.45
AVG. HEAD ON TOP OF LAYER 5	0.0045		
CHANGE IN WATER STORAGE	0.268	971.807	0.70
SOIL WATER AT START OF YEAR	53.086	192702.891	
SOIL WATER AT END OF YEAR	53.354	193674.703	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.015	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1995

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.29	5.37	4.19	2.30	0.96	0.91
	1.49	1.12	1.70	4.23	9.90	7.40
RUNOFF	1.171	2.627	1.002	0.209	0.126	0.024
	0.433	0.273	0.401	1.482	5.185	3.161
EVAPOTRANSPIRATION	1.221	1.433	2.376	2.011	1.101	0.736
	1.313	0.518	0.702	1.809	1.145	1.000
LATERAL DRAINAGE COLLECTED	2.5743	2.1731	2.1233	1.8121	0.2241	0.1127
FROM LAYER 4	0.0249	0.0009	0.0110	0.0069	0.6395	1.4186
PERCOLATION/LEAKAGE THROUGH	0.0329	0.0284	0.0305	0.0269	0.0098	0.0067
LAYER 5	0.0018	0.0001	0.0007	0.0006	0.0154	0.0209

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.013	0.012	0.010	0.009	0.001	0.001
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.003	0.007
STD. DEVIATION OF DAILY	0.007	0.007	0.006	0.005	0.000	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.004	0.006

ANNUAL TOTALS FOR YEAR 1995

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.86	159211.797	100.00
RUNOFF	16.095	58423.766	36.70
EVAPOTRANSPIRATION	15.367	55781.758	35.04
DRAINAGE COLLECTED FROM LAYER 4	11.1213	40370.363	25.36
PERC./LEAKAGE THROUGH LAYER 5	0.174698	634.155	0.40
AVG. HEAD ON TOP OF LAYER 5	0.0047		
CHANGE IN WATER STORAGE	1.102	4001.801	2.51
SOIL WATER AT START OF YEAR	53.354	193674.703	
SOIL WATER AT END OF YEAR	54.456	197676.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.043	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 1996

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.55	8.56	1.61	7.69	2.55	1.66
	0.59	0.43	1.32	5.09	6.61	11.27
RUNOFF	3.301	4.916	0.161	3.415	0.639	0.000
	0.009	0.024	0.157	1.677	2.569	5.346
EVAPOTRANSPIRATION	1.183	1.412	1.972	3.596	2.149	1.364
	0.680	0.437	1.454	1.180	1.038	0.947
LATERAL DRAINAGE COLLECTED	3.2812	2.7442	3.5724	1.0770	0.3107	0.2029
FROM LAYER 4	0.1524	0.0732	0.0121	0.0148	1.0419	1.3790
PERCOLATION/LEAKAGE THROUGH	0.0395	0.0332	0.0404	0.0163	0.0099	0.0086
LAYER 5	0.0080	0.0055	0.0010	0.0005	0.0210	0.0209

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.016	0.014	0.017	0.005	0.002	0.001
TOP OF LAYER 5	0.001	0.000	0.000	0.000	0.005	0.006
STD. DEVIATION OF DAILY	0.008	0.009	0.003	0.007	0.001	0.001
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.003	0.006

ANNUAL TOTALS FOR YEAR 1996

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.93	199395.891	100.00
RUNOFF	22.214	80637.617	40.44
EVAPOTRANSPIRATION	17.412	63205.211	31.70
DRAINAGE COLLECTED FROM LAYER 4	13.8619	50318.531	25.24
PERC./LEAKAGE THROUGH LAYER 5	0.204981	744.079	0.37
AVG. HEAD ON TOP OF LAYER 5	0.0057		
CHANGE IN WATER STORAGE	1.237	4490.543	2.25
SOIL WATER AT START OF YEAR	54.456	197676.500	
SOIL WATER AT END OF YEAR	55.693	202167.047	

SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.096	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1997

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.81	2.84	7.84	2.86	2.06	2.62
	1.43	1.22	2.78	6.20	3.52	3.33
RUNOFF	3.694	0.902	3.086	0.000	0.000	0.480
	0.373	0.101	0.502	2.254	0.721	1.367
EVAPOTRANSPIRATION	1.205	1.342	2.307	3.006	2.126	2.172
	1.630	0.489	1.936	1.756	1.137	0.978
LATERAL DRAINAGE COLLECTED	3.3941	3.6782	2.2251	2.9751	0.4304	0.0238
FROM LAYER 4	0.0332	0.0000	0.0088	0.7333	1.0230	1.3821
PERCOLATION/LEAKAGE THROUGH	0.0352	0.0392	0.0298	0.0366	0.0104	0.0011
LAYER 5	0.0017	0.0000	0.0005	0.0141	0.0195	0.0250

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.017	0.020	0.011	0.015	0.002	0.000
TOP OF LAYER 5	0.000	0.000	0.000	0.004	0.005	0.007
STD. DEVIATION OF DAILY	0.012	0.005	0.006	0.003	0.005	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.004	0.003	0.004

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ANNUAL TOTALS FOR YEAR 1997

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.51	161571.266	100.00
RUNOFF	13.479	48929.355	30.28
EVAPOTRANSPIRATION	20.084	72904.617	45.12
DRAINAGE COLLECTED FROM LAYER 4	15.9070	57742.480	35.74
PERC./LEAKAGE THROUGH LAYER 5	0.212972	773.088	0.48
AVG. HEAD ON TOP OF LAYER 5	0.0066		
CHANGE IN WATER STORAGE	-5.173	-18778.240	-11.62
SOIL WATER AT START OF YEAR	55.693	202167.047	
SOIL WATER AT END OF YEAR	50.520	183388.812	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.031	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1998

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.38	2.59	4.52	0.98	2.09	0.83
	0.94	0.00	0.24	3.53	11.21	9.17
RUNOFF	3.188	0.271	1.381	0.043	0.557	0.051
	0.000	0.000	0.000	0.079	6.380	4.502
EVAPOTRANSPIRATION	1.191	1.412	2.249	1.654	1.316	0.793
	0.778	0.242	0.205	1.297	1.107	0.953
LATERAL DRAINAGE COLLECTED	1.1726	2.4776	2.0621	1.5347	0.1375	0.1325
FROM LAYER 4	0.0513	0.0000	0.0019	0.0050	0.7894	1.7297
PERCOLATION/LEAKAGE THROUGH	0.0197	0.0306	0.0308	0.0220	0.0072	0.0076
LAYER 5	0.0032	0.0000	0.0001	0.0003	0.0157	0.0243

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.006	0.013	0.010	0.008	0.001	0.001
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.004	0.008
STD. DEVIATION OF DAILY	0.006	0.007	0.005	0.007	0.000	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.004	0.007

ANNUAL TOTALS FOR YEAR 1998

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.48	161462.453	100.00
RUNOFF	16.453	59723.922	36.99
EVAPOTRANSPIRATION	13.196	47902.012	29.67
DRAINAGE COLLECTED FROM LAYER 4	10.0944	36642.754	22.69
PERC./LEAKAGE THROUGH LAYER 5	0.161464	586.114	0.36
AVG. HEAD ON TOP OF LAYER 5	0.0043		
CHANGE IN WATER STORAGE	4.575	16607.600	10.29
SOIL WATER AT START OF YEAR	50.520	183388.812	
SOIL WATER AT END OF YEAR	55.095	199996.406	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.051	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 1999

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.62	8.31	5.03	1.53	1.84	1.78
	1.01	0.44	0.20	2.93	10.67	5.10
RUNOFF	4.203	3.510	1.333	0.094	0.246	0.633
	0.199	0.000	0.000	0.692	5.497	1.946
EVAPOTRANSPIRATION	1.216	1.344	2.371	2.102	2.061	0.582
	1.322	0.439	0.279	0.903	1.151	1.019
LATERAL DRAINAGE COLLECTED	3.4633	2.5834	3.6959	3.7254	0.2674	0.1467
FROM LAYER 4	0.0559	0.0000	0.0049	0.0057	0.2895	1.4174
PERCOLATION/LEAKAGE THROUGH	0.0388	0.0293	0.0406	0.0408	0.0092	0.0077
LAYER 5	0.0037	0.0000	0.0003	0.0004	0.0067	0.0228

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.017	0.014	0.018	0.019	0.001	0.001
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.002	0.007
STD. DEVIATION OF DAILY	0.010	0.011	0.007	0.003	0.002	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.003	0.005

ANNUAL TOTALS FOR YEAR 1999

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.46	172279.812	100.00
RUNOFF	18.353	66620.781	38.67
EVAPOTRANSPIRATION	14.791	53690.000	31.16
DRAINAGE COLLECTED FROM LAYER 4	15.6555	56829.633	32.99
PERC./LEAKAGE THROUGH LAYER 5	0.200317	727.151	0.42
AVG. HEAD ON TOP OF LAYER 5	0.0065		
CHANGE IN WATER STORAGE	-1.539	-5587.738	-3.24
SOIL WATER AT START OF YEAR	55.095	199996.406	
SOIL WATER AT END OF YEAR	53.556	194408.672	

SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.017	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2000

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.04	5.93	4.18	1.56	2.56	1.33
	0.72	0.77	0.87	3.53	3.65	2.80
RUNOFF	0.798	2.474	0.110	0.105	0.328	0.277
	0.229	0.000	0.037	0.082	1.292	0.418
EVAPOTRANSPIRATION	1.162	1.400	2.322	2.209	2.126	1.561
	0.393	0.364	0.969	1.445	1.060	0.997
LATERAL DRAINAGE COLLECTED	3.0914	2.6550	1.9743	2.0772	0.2601	0.0708
FROM LAYER 4	0.0163	0.0351	0.0206	0.0017	0.8624	1.4027
PERCOLATION/LEAKAGE THROUGH	0.0363	0.0339	0.0250	0.0298	0.0102	0.0036
LAYER 5	0.0008	0.0019	0.0012	0.0001	0.0176	0.0234

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.015	0.014	0.015	0.010	0.001	0.000
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.004	0.007
STD. DEVIATION OF DAILY	0.008	0.004	0.005	0.004	0.001	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.003	0.004

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ANNUAL TOTALS FOR YEAR 2000

	INCHES	CU. FEET	PERCENT
PRECIPITATION	31.94	115942.289	100.00
RUNOFF	6.151	22329.725	19.26
EVAPOTRANSPIRATION	16.006	58102.746	50.11
DRAINAGE COLLECTED FROM LAYER 4	12.4677	45257.590	39.03
PERC./LEAKAGE THROUGH LAYER 5	0.183862	667.419	0.58
AVG. HEAD ON TOP OF LAYER 5	0.0056		
CHANGE IN WATER STORAGE	-2.869	-10415.271	-8.98
SOIL WATER AT START OF YEAR	53.556	194408.672	
SOIL WATER AT END OF YEAR	50.687	183993.391	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.084	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2001

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.77	2.36	3.24	3.70	1.93	3.53
	0.20	2.25	0.46	3.32	10.13	6.82
RUNOFF	0.645	0.582	0.363	0.963	0.445	1.274
	0.003	0.829	0.077	0.791	5.965	2.583
EVAPOTRANSPIRATION	1.209	1.360	2.522	2.979	2.161	2.037
	0.632	1.078	0.504	0.672	1.116	1.006
LATERAL DRAINAGE COLLECTED	1.3451	1.3962	0.3703	0.1589	0.1172	0.0392
FROM LAYER 4	0.0016	0.0071	0.0008	0.0000	0.2842	1.2683
PERCOLATION/LEAKAGE THROUGH	0.0239	0.0234	0.0119	0.0069	0.0061	0.0026
LAYER 5	0.0001	0.0004	0.0001	0.0000	0.0059	0.0201

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.007	0.007	0.002	0.001	0.001	0.000
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.002	0.006
STD. DEVIATION OF DAILY	0.004	0.003	0.001	0.001	0.000	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.003	0.006

ANNUAL TOTALS FOR YEAR 2001

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.71	147777.328	100.00
RUNOFF	14.519	52702.949	35.66
EVAPOTRANSPIRATION	17.276	62713.332	42.44
DRAINAGE COLLECTED FROM LAYER 4	4.9889	18109.717	12.25
PERC./LEAKAGE THROUGH LAYER 5	0.101393	368.056	0.25
AVG. HEAD ON TOP OF LAYER 5	0.0021		
CHANGE IN WATER STORAGE	3.825	13883.257	9.39
SOIL WATER AT START OF YEAR	50.687	183993.391	
SOIL WATER AT END OF YEAR	54.511	197876.656	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.016	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 2002

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.53	3.56	4.16	3.64	1.14	1.36
	0.42	0.06	0.36	0.41	2.96	6.58
RUNOFF	0.438	1.035	1.384	1.158	0.025	0.252
	0.018	0.000	0.000	0.045	0.580	2.178
EVAPOTRANSPIRATION	1.198	1.391	2.327	2.283	1.008	0.862
	0.992	0.324	0.250	0.220	0.897	1.049
LATERAL DRAINAGE COLLECTED	3.4697	2.8812	3.1381	1.8581	0.1920	0.0923
FROM LAYER 4	0.1028	0.0727	0.0454	0.0354	0.0072	0.3111
PERCOLATION/LEAKAGE THROUGH	0.0435	0.0351	0.0374	0.0270	0.0082	0.0059
LAYER 5	0.0065	0.0056	0.0043	0.0037	0.0008	0.0087

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.016	0.015	0.015	0.009	0.001	0.000
TOP OF LAYER 5	0.001	0.000	0.000	0.000	0.000	0.002
STD. DEVIATION OF DAILY	0.008	0.005	0.005	0.006	0.001	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.000	0.002

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ANNUAL TOTALS FOR YEAR 2002

	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.18	109553.453	100.00
RUNOFF	7.114	25822.535	23.57
EVAPOTRANSPIRATION	12.800	46464.074	42.41
DRAINAGE COLLECTED FROM LAYER 4	12.2059	44307.453	40.44
PERC./LEAKAGE THROUGH LAYER 5	0.186533	677.115	0.62
AVG. HEAD ON TOP OF LAYER 5	0.0051		
CHANGE IN WATER STORAGE	-2.126	-7717.780	-7.04
SOIL WATER AT START OF YEAR	54.511	197876.656	
SOIL WATER AT END OF YEAR	52.385	190158.875	

SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.060	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2003

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.50	1.71	5.08	3.30	0.55	0.36
	0.13	0.29	0.69	8.88	6.15	4.65
RUNOFF	3.583	0.258	1.449	0.530	0.000	0.009
	0.000	0.001	0.005	5.450	2.546	1.104
EVAPOTRANSPIRATION	1.288	1.402	2.444	3.149	0.562	0.299
	0.238	0.212	0.503	1.399	1.011	1.010
LATERAL DRAINAGE COLLECTED	2.1247	2.2643	2.7572	1.0560	0.1928	0.0961
FROM LAYER 4	0.0605	0.0444	0.0338	0.2030	1.0918	1.0338
PERCOLATION/LEAKAGE THROUGH	0.0285	0.0283	0.0347	0.0195	0.0092	0.0063
LAYER 5	0.0051	0.0043	0.0035	0.0051	0.0205	0.0191

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.010	0.012	0.013	0.005	0.001	0.001
TOP OF LAYER 5	0.000	0.000	0.000	0.001	0.005	0.005
STD. DEVIATION OF DAILY	0.008	0.007	0.005	0.005	0.000	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.002	0.004	0.004

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ANNUAL TOTALS FOR YEAR 2003

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.29	146252.687	100.00
RUNOFF	14.933	54207.895	37.06
EVAPOTRANSPIRATION	13.517	49067.762	33.55
DRAINAGE COLLECTED FROM LAYER 4	10.9584	39778.965	27.20
PERC./LEAKAGE THROUGH LAYER 5	0.184325	669.101	0.46
AVG. HEAD ON TOP OF LAYER 5	0.0046		
CHANGE IN WATER STORAGE	0.697	2529.011	1.73
SOIL WATER AT START OF YEAR	52.385	190158.875	
SOIL WATER AT END OF YEAR	53.082	192687.891	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.042	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1994 THROUGH 2003

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	6.10	4.60	4.39	3.00	1.73	1.64
	0.72	0.69	1.04	4.26	7.00	6.46
STD. DEVIATIONS	2.31	2.44	1.57	1.89	0.67	0.93
	0.49	0.68	0.85	2.22	3.22	2.60
RUNOFF						
TOTALS	2.191	1.797	1.150	0.700	0.261	0.325
	0.127	0.123	0.153	1.470	3.240	2.612
STD. DEVIATIONS	1.514	1.547	0.862	1.033	0.231	0.395
	0.170	0.263	0.192	1.630	2.280	1.543
EVAPOTRANSPIRATION						

TOTALS	1.214	1.372	2.338	2.489	1.603	1.225
	0.837	0.438	0.839	1.125	1.067	0.995
STD. DEVIATIONS	0.039	0.060	0.154	0.642	0.593	0.658
	0.464	0.248	0.621	0.523	0.081	0.030

LATERAL DRAINAGE COLLECTED FROM LAYER 4

TOTALS	2.6286	2.5731	2.3381	1.7828	0.2313	0.1010
	0.0585	0.0291	0.0150	0.1007	0.6590	1.2618
STD. DEVIATIONS	0.8642	0.5864	1.0050	1.0037	0.0916	0.0521
	0.0452	0.0312	0.0144	0.2307	0.3707	0.3759

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0330	0.0316	0.0302	0.0250	0.0088	0.0056
	0.0037	0.0023	0.0013	0.0025	0.0136	0.0205
STD. DEVIATIONS	0.0073	0.0045	0.0090	0.0098	0.0014	0.0024
	0.0027	0.0025	0.0014	0.0044	0.0069	0.0046

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	0.0127	0.0137	0.0119	0.0090	0.0012	0.0005
	0.0003	0.0001	0.0001	0.0005	0.0033	0.0061
STD. DEVIATIONS	0.0041	0.0031	0.0049	0.0049	0.0005	0.0003
	0.0002	0.0002	0.0001	0.0011	0.0018	0.0018

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1994 THROUGH 2003

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.65 (7.244)	151182.3	100.00
RUNOFF	14.148 (4.8352)	51355.62	33.969
EVAPOTRANSPIRATION	15.544 (2.2453)	56424.06	37.322
LATERAL DRAINAGE COLLECTED FROM LAYER 4	11.77893 (3.13894)	42757.523	28.28210
PERCOLATION/LEAKAGE THROUGH	0.17811 (0.03128)	646.547	0.42766

LAYER 5

AVERAGE HEAD ON TOP OF LAYER 5	0.005	(0.001)		
CHANGE IN WATER STORAGE	0.000	(2.9953)	-1.50	-0.001

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PEAK DAILY VALUES FOR YEARS 1994 THROUGH 2003

	(INCHES)	(CU. FT.)
PRECIPITATION	4.20	15245.999
RUNOFF	3.674	13337.0156
DRAINAGE COLLECTED FROM LAYER 4	0.26120	948.14978
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.002907	10.55109
AVERAGE HEAD ON TOP OF LAYER 5	0.040	
MAXIMUM HEAD ON TOP OF LAYER 5	0.020	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	0.42	1516.4022

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2979
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1302

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 2003

LAYER	(INCHES)	(VOL/VOL)
1	0.0019	0.2356
2	4.3275	0.2404
3	48.7050	0.3083
4	0.0238	0.0953
5	0.0000	0.0000
SNOW WATER	0.000	

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**                                                                              **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                   **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                    **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                       **
**                    USAE WATERWAYS EXPERIMENT STATION                         **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY                  **
**                                                                              **
**                                                                              **
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PRECIPITATION DATA FILE:    C:\tlf\PRECIP.D4
TEMPERATURE DATA FILE:      C:\tLF\TEMP.D7
SOLAR RADIATION DATA FILE:  C:\tLF\SOLARRAD.D13
EVAPOTRANSPIRATION DATA:    C:\tLF\EVAPTRAN.D11
SOIL AND DESIGN DATA FILE:  C:\tLF\WSSST1R2.D10
OUTPUT DATA FILE:           C:\tLF\wssst1r2.OUT


TIME:  17: 3     DATE:   5/ 2/2005


**********************************************************************************

     TITLE:  Tacoma Landfill Central Area HELP Evaluation - W Steep SS UC

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                  LAYER  1
                                  --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   5
          THICKNESS                     =     18.00   INCHES
          POROSITY                      =      0.4570 VOL/VOL
          FIELD CAPACITY                =      0.1310 VOL/VOL
          WILTING POINT                 =      0.0580 VOL/VOL
          INITIAL SOIL WATER CONTENT    =      0.0667 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.100000005000E-02 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
                 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
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LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	460.00	INCHES
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3190	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.25	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	69.60	PERCENT
DRAINAGE LENGTH	=	50.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	4.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A
POOR STAND OF GRASS, A SURFACE SLOPE OF 2.%
AND A SLOPE LENGTH OF 50. FEET.

SCS RUNOFF CURVE NUMBER	=	79.20	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	24.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.115	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	12.252	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.506	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	147.943	INCHES
TOTAL INITIAL WATER	=	147.943	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
Tacoma WASHINGTON

STATION LATITUDE	=	47.25	DEGREES
MAXIMUM LEAF AREA INDEX	=	1.00	
START OF GROWING SEASON (JULIAN DATE)	=	126	
END OF GROWING SEASON (JULIAN DATE)	=	287	
EVAPORATIVE ZONE DEPTH	=	24.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	9.10	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	75.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	70.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	79.00	%

NOTE: PRECIPITATION DATA FOR TACOMA WA
WAS ENTERED FROM AN ASCII DATA FILE.

NOTE: TEMPERATURE DATA FOR TACOMA WA
WAS ENTERED FROM AN ASCII DATA FILE.

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SEATTLE WASHINGTON
AND STATION LATITUDE = 47.25 DEGREES

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1994

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.54	4.72	4.02	2.44	1.63	2.04
	0.27	0.36	1.82	4.52	5.24	7.52
RUNOFF	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.001	0.008	0.002
EVAPOTRANSPIRATION	1.292	1.217	1.123	1.198	0.316	0.409
	0.057	0.043	0.237	0.140	0.255	1.006
LATERAL DRAINAGE COLLECTED	3.6178	3.1748	2.1630	4.5484	3.6811	2.5007
FROM LAYER 3	3.6747	2.7871	1.2269	0.9771	1.0393	1.2445
PERCOLATION/LEAKAGE THROUGH	0.0324	0.0265	0.0206	0.0360	0.0320	0.0246
LAYER 4	0.0331	0.0275	0.0144	0.0105	0.0119	0.0127

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.001	0.000	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 1994

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.12	138375.609	100.00
RUNOFF	0.011	40.093	0.03
EVAPOTRANSPIRATION	7.291	26466.121	19.13
DRAINAGE COLLECTED FROM LAYER 3	30.6354	111206.453	80.37
PERC./LEAKAGE THROUGH LAYER 4	0.282345	1024.912	0.74
AVG. HEAD ON TOP OF LAYER 4	0.0003		

CHANGE IN WATER STORAGE	-0.100	-361.970	-0.26
SOIL WATER AT START OF YEAR	147.946	537042.312	
SOIL WATER AT END OF YEAR	147.846	536680.375	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.005	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1995

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.29	5.37	4.19	2.30	0.96	0.91
	1.49	1.12	1.70	4.23	9.90	7.40
RUNOFF	0.000	0.045	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.127	0.000
EVAPOTRANSPIRATION	1.248	1.459	0.463	0.219	0.134	0.181
	0.262	0.197	0.123	0.297	0.366	0.313
LATERAL DRAINAGE COLLECTED	3.2689	2.6637	3.0958	4.6305	4.4399	3.6059
FROM LAYER 3	3.1253	2.5487	1.9589	0.8312	1.6175	2.2962
PERCOLATION/LEAKAGE THROUGH	0.0300	0.0233	0.0268	0.0350	0.0355	0.0316
LAYER 4	0.0289	0.0266	0.0195	0.0099	0.0172	0.0188

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.001	0.001	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 1995

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.86	159211.797	100.00
RUNOFF	0.172	624.392	0.39
EVAPOTRANSPIRATION	5.262	19099.373	12.00
DRAINAGE COLLECTED FROM LAYER 3	34.0825	123719.477	77.71
PERC./LEAKAGE THROUGH LAYER 4	0.303032	1100.007	0.69
AVG. HEAD ON TOP OF LAYER 4	0.0004		
CHANGE IN WATER STORAGE	4.041	14668.555	9.21
SOIL WATER AT START OF YEAR	147.846	536680.375	
SOIL WATER AT END OF YEAR	151.887	551348.875	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.001	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1996

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.55	8.56	1.61	7.69	2.55	1.66
	0.59	0.43	1.32	5.09	6.61	11.27
RUNOFF	0.000	0.360	0.000	0.101	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.072
EVAPOTRANSPIRATION	0.342	1.298	1.320	0.893	0.413	0.702
	0.134	0.096	0.175	0.310	0.325	0.848
LATERAL DRAINAGE COLLECTED	3.0892	5.9699	7.4190	3.3533	4.9826	5.3766

FROM LAYER 3	4.5096	3.7990	2.3118	1.6093	1.2540	1.9244
PERCOLATION/LEAKAGE THROUGH	0.0258	0.0389	0.0470	0.0273	0.0351	0.0395
LAYER 4	0.0364	0.0334	0.0246	0.0160	0.0134	0.0186

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.001	0.001	0.000	0.001	0.001
TOP OF LAYER 4	0.001	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

ANNUAL TOTALS FOR YEAR 1996

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.93	199395.891	100.00
RUNOFF	0.533	1933.496	0.97
EVAPOTRANSPIRATION	6.855	24883.801	12.48
DRAINAGE COLLECTED FROM LAYER 3	45.5988	165523.516	83.01
PERC./LEAKAGE THROUGH LAYER 4	0.355845	1291.716	0.65
AVG. HEAD ON TOP OF LAYER 4	0.0005		
CHANGE IN WATER STORAGE	1.588	5763.434	2.89
SOIL WATER AT START OF YEAR	151.887	551348.875	
SOIL WATER AT END OF YEAR	153.474	557112.312	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.067	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1997

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.81	2.84	7.84	2.86	2.06	2.62
	1.43	1.22	2.78	6.20	3.52	3.33
RUNOFF	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.001	0.000	0.020
EVAPOTRANSPIRATION	1.224	1.369	2.332	2.863	2.069	1.436
	0.411	0.275	0.370	0.318	0.253	0.580
LATERAL DRAINAGE COLLECTED	3.6294	5.2035	4.1703	6.8795	5.2223	3.3749
FROM LAYER 3	2.6641	3.0741	1.3302	1.5947	1.4990	2.0056
PERCOLATION/LEAKAGE THROUGH	0.0283	0.0369	0.0311	0.0447	0.0396	0.0303
LAYER 4	0.0255	0.0292	0.0147	0.0165	0.0162	0.0221

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.001	0.001	0.001	0.001	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 1997

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.51	161571.266	100.00
RUNOFF	0.021	77.800	0.05
EVAPOTRANSPIRATION	13.500	49006.641	30.33
DRAINAGE COLLECTED FROM LAYER 3	40.6476	147550.719	91.32
PERC./LEAKAGE THROUGH LAYER 4	0.335049	1216.228	0.75
AVG. HEAD ON TOP OF LAYER 4	0.0004		

CHANGE IN WATER STORAGE	-9.995	-36280.172	-22.45
SOIL WATER AT START OF YEAR	153.474	557112.312	
SOIL WATER AT END OF YEAR	143.480	520832.156	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.055	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1998

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.38	2.59	4.52	0.98	2.09	0.83
	0.94	0.00	0.24	3.53	11.21	9.17
RUNOFF	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.221	0.000
EVAPOTRANSPIRATION	1.204	1.426	1.336	0.114	0.436	0.190
	0.711	0.021	0.030	0.198	0.315	0.316
LATERAL DRAINAGE COLLECTED	1.7433	3.6231	2.5896	4.1673	3.8383	2.8131
FROM LAYER 3	3.0695	1.6287	0.0000	0.9584	0.7288	2.5075
PERCOLATION/LEAKAGE THROUGH	0.0172	0.0300	0.0251	0.0337	0.0335	0.0269
LAYER 4	0.0303	0.0155	0.0000	0.0133	0.0085	0.0217

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.001	0.000	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 1998

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.48	161462.453	100.00
RUNOFF	0.221	803.940	0.50
EVAPOTRANSPIRATION	6.297	22856.832	14.16
DRAINAGE COLLECTED FROM LAYER 3	27.6676	100433.375	62.20
PERC./LEAKAGE THROUGH LAYER 4	0.255636	927.959	0.57
AVG. HEAD ON TOP OF LAYER 4	0.0003		
CHANGE IN WATER STORAGE	10.039	36440.246	22.57
SOIL WATER AT START OF YEAR	143.480	520832.156	
SOIL WATER AT END OF YEAR	153.519	557272.437	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.100	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1999

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.62	8.31	5.03	1.53	1.84	1.78
	1.01	0.44	0.20	2.93	10.67	5.10
RUNOFF	0.014	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.191	0.009
EVAPOTRANSPIRATION	0.389	1.359	1.846	0.369	0.285	0.252
	0.141	0.151	0.043	0.134	0.826	1.038
LATERAL DRAINAGE COLLECTED	4.0626	4.8661	6.1889	7.1372	4.8679	4.6417

FROM LAYER 3	3.5245	3.7108	3.1344	1.2860	0.6822	1.5866
PERCOLATION/LEAKAGE THROUGH	0.0301	0.0318	0.0410	0.0455	0.0371	0.0361
LAYER 4	0.0306	0.0331	0.0301	0.0144	0.0074	0.0170

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.001	0.001	0.001	0.001	0.001	0.001
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

ANNUAL TOTALS FOR YEAR 1999

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.46	172279.812	100.00
RUNOFF	0.214	777.491	0.45
EVAPOTRANSPIRATION	6.833	24803.256	14.40
DRAINAGE COLLECTED FROM LAYER 3	45.6888	165850.266	96.27
PERC./LEAKAGE THROUGH LAYER 4	0.354245	1285.910	0.75
AVG. HEAD ON TOP OF LAYER 4	0.0005		
CHANGE IN WATER STORAGE	-5.630	-20436.973	-11.86
SOIL WATER AT START OF YEAR	153.519	557272.437	
SOIL WATER AT END OF YEAR	147.889	536835.437	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.137	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2000

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.04	5.93	4.18	1.56	2.56	1.33
	0.72	0.77	0.87	3.53	3.65	2.80
RUNOFF	0.000	0.004	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	1.178	1.425	2.337	0.836	0.546	0.311
	0.200	0.586	0.094	0.194	0.800	1.021
LATERAL DRAINAGE COLLECTED	3.4374	3.1384	3.2873	3.8398	3.2118	3.1169
FROM LAYER 3	3.4600	3.0415	0.3901	1.0594	1.5352	1.8054
PERCOLATION/LEAKAGE THROUGH	0.0299	0.0270	0.0302	0.0329	0.0297	0.0286
LAYER 4	0.0316	0.0301	0.0049	0.0149	0.0170	0.0199

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.000	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 2000

	INCHES	CU. FEET	PERCENT
PRECIPITATION	31.94	115942.289	100.00
RUNOFF	0.004	14.084	0.01
EVAPOTRANSPIRATION	9.529	34588.660	29.83
DRAINAGE COLLECTED FROM LAYER 3	31.3232	113703.375	98.07
PERC./LEAKAGE THROUGH LAYER 4	0.296577	1076.574	0.93
AVG. HEAD ON TOP OF LAYER 4	0.0003		

CHANGE IN WATER STORAGE	-9.212	-33440.523	-28.84
SOIL WATER AT START OF YEAR	147.889	536835.437	
SOIL WATER AT END OF YEAR	138.676	503394.906	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.119	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2001

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.77	2.36	3.24	3.70	1.93	3.53
	0.20	2.25	0.46	3.32	10.13	6.82
RUNOFF	0.000	0.000	0.000	0.000	0.000	0.002
	0.000	0.000	0.000	0.000	0.887	0.030
EVAPOTRANSPIRATION	1.235	1.378	0.657	0.482	0.368	0.582
	0.041	0.325	0.065	0.247	0.522	1.021
LATERAL DRAINAGE COLLECTED	1.6223	1.7877	1.9439	1.3586	2.4109	2.5468
FROM LAYER 3	2.9617	2.0613	1.8343	1.2099	0.6697	1.2650
PERCOLATION/LEAKAGE THROUGH	0.0186	0.0208	0.0203	0.0147	0.0235	0.0245
LAYER 4	0.0282	0.0207	0.0187	0.0151	0.0080	0.0141

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.000	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 2001

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.71	147777.328	100.00
RUNOFF	0.919	3334.708	2.26
EVAPOTRANSPIRATION	6.922	25127.529	17.00
DRAINAGE COLLECTED FROM LAYER 3	21.6721	78669.742	53.24
PERC./LEAKAGE THROUGH LAYER 4	0.227171	824.630	0.56
AVG. HEAD ON TOP OF LAYER 4	0.0002		
CHANGE IN WATER STORAGE	10.970	39820.660	26.95
SOIL WATER AT START OF YEAR	138.676	503394.906	
SOIL WATER AT END OF YEAR	149.646	543215.562	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.051	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2002

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.53	3.56	4.16	3.64	1.14	1.36
	0.42	0.06	0.36	0.41	2.96	6.58
RUNOFF	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	1.201	1.414	2.073	0.489	0.255	0.354
	0.071	0.053	0.069	0.075	0.150	0.289
LATERAL DRAINAGE COLLECTED	3.6018	3.3811	2.8565	4.3544	4.6003	3.7751

FROM LAYER 3	2.8859	3.0930	0.1663	0.4257	0.6886	1.7633
PERCOLATION/LEAKAGE THROUGH	0.0312	0.0289	0.0256	0.0333	0.0368	0.0331
LAYER 4	0.0277	0.0295	0.0023	0.0056	0.0088	0.0176

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.001	0.001	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

ANNUAL TOTALS FOR YEAR 2002

	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.18	109553.453	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	6.493	23567.787	21.51
DRAINAGE COLLECTED FROM LAYER 3	31.5920	114678.953	104.68
PERC./LEAKAGE THROUGH LAYER 4	0.280531	1018.328	0.93
AVG. HEAD ON TOP OF LAYER 4	0.0003		
CHANGE IN WATER STORAGE	-8.185	-29711.652	-27.12
SOIL WATER AT START OF YEAR	149.646	543215.562	
SOIL WATER AT END OF YEAR	141.461	513503.937	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.037	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2003

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.50	1.71	5.08	3.30	0.55	0.36
	0.13	0.29	0.69	8.88	6.15	4.65
RUNOFF	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.549	0.000	0.000
EVAPOTRANSPIRATION	0.428	0.224	0.477	0.669	0.155	0.060
	0.023	0.062	0.121	0.747	0.267	0.280
LATERAL DRAINAGE COLLECTED	1.5113	2.8478	2.8595	3.4426	4.9194	3.9471
FROM LAYER 3	3.3422	1.2659	0.5594	0.5535	2.4958	1.9965
PERCOLATION/LEAKAGE THROUGH	0.0159	0.0250	0.0250	0.0297	0.0383	0.0336
LAYER 4	0.0316	0.0125	0.0072	0.0071	0.0235	0.0196

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.001	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 2003

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.29	146252.687	100.00
RUNOFF	0.549	1991.536	1.36
EVAPOTRANSPIRATION	3.513	12750.401	8.72
DRAINAGE COLLECTED FROM LAYER 3	29.7409	107959.391	73.82
PERC./LEAKAGE THROUGH LAYER 4	0.269143	976.990	0.67
AVG. HEAD ON TOP OF LAYER 4	0.0003		

CHANGE IN WATER STORAGE	6.219	22574.395	15.44
SOIL WATER AT START OF YEAR	141.461	513503.937	
SOIL WATER AT END OF YEAR	147.680	536078.312	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.024	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1994 THROUGH 2003

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	6.10	4.60	4.39	3.00	1.73	1.64
	0.72	0.69	1.04	4.26	7.00	6.46
STD. DEVIATIONS	2.31	2.44	1.57	1.89	0.67	0.93
	0.49	0.68	0.85	2.22	3.22	2.60
RUNOFF						
TOTALS	0.001	0.041	0.000	0.010	0.000	0.000
	0.000	0.000	0.000	0.055	0.143	0.013
STD. DEVIATIONS	0.005	0.113	0.000	0.032	0.000	0.001
	0.000	0.000	0.000	0.173	0.275	0.023
EVAPOTRANSPIRATION						
TOTALS	0.974	1.257	1.396	0.813	0.498	0.448
	0.205	0.181	0.133	0.266	0.408	0.671
STD. DEVIATIONS	0.407	0.370	0.728	0.791	0.566	0.397
	0.214	0.176	0.104	0.188	0.234	0.347
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	2.9584	3.6656	3.6574	4.3712	4.2175	3.5699
	3.3218	2.7010	1.2912	1.0505	1.2210	1.8395
STD. DEVIATIONS	0.9555	1.2874	1.7908	1.6779	0.9076	0.9192

	0.5218	0.8356	1.0255	0.3928	0.5881	0.4040

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.0259	0.0289	0.0293	0.0333	0.0341	0.0309
	0.0304	0.0258	0.0136	0.0123	0.0132	0.0182
STD. DEVIATIONS	0.0063	0.0057	0.0086	0.0087	0.0047	0.0049
	0.0031	0.0072	0.0099	0.0038	0.0053	0.0030

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0004	0.0005	0.0004	0.0005	0.0005	0.0004
	0.0004	0.0003	0.0002	0.0001	0.0002	0.0002
STD. DEVIATIONS	0.0001	0.0002	0.0002	0.0002	0.0001	0.0001
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1994 THROUGH 2003

	INCHES		CU. FEET	PERCENT
PRECIPITATION	41.65	(7.244)	151182.3	100.00
RUNOFF	0.264	(0.3082)	959.75	0.635
EVAPOTRANSPIRATION	7.249	(2.6688)	26315.04	17.406
LATERAL DRAINAGE COLLECTED FROM LAYER 3	33.86489	(7.81502)	122929.539	81.31213
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.29596	(0.04225)	1074.326	0.71062
AVERAGE HEAD ON TOP OF LAYER 4	0.000	(0.000)		
CHANGE IN WATER STORAGE	-0.027	(7.9028)	-96.40	-0.064

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PEAK DAILY VALUES FOR YEARS 1994 THROUGH 2003

	(INCHES)	(CU. FT.)
PRECIPITATION	4.20	15245.999
RUNOFF	0.887	3219.3218
DRAINAGE COLLECTED FROM LAYER 3	0.39995	1451.81433
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.001961	7.11804
AVERAGE HEAD ON TOP OF LAYER 4	0.002	
MAXIMUM HEAD ON TOP OF LAYER 4	0.023	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	0.42	1516.4022

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2196
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0879

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 2003

LAYER	(INCHES)	(VOL/VOL)
1	1.1991	0.0666
2	146.4750	0.3184
3	0.0034	0.0136
4	0.0000	0.0000
SNOW WATER	0.000	

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 **                                                                           **
 **              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                **
 **                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                 **
 **                  DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
 **                    USAE WATERWAYS EXPERIMENT STATION                      **
 **             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY               **
 **                                                                           **
 **                                                                           **
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 PRECIPITATION DATA FILE:    C:\tlf\PRECIP.D4
 TEMPERATURE DATA FILE:      C:\tLF\TEMP.D7
 SOLAR RADIATION DATA FILE:  C:\tLF\SOLARRAD.D13
 EVAPOTRANSPIRATION DATA:    C:\tLF\ET_CVR.D11
 SOIL AND DESIGN DATA FILE:  C:\tLF\WSSST2R1.D10
 OUTPUT DATA FILE:           C:\tLF\WSSST2R1.OUT

 TIME:  11: 8     DATE:   4/27/2005

 *******************************************************************************

      TITLE:  Tacoma Landfill Central Area HELP Evaluation - W Steep SS C

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      NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
               WERE SPECIFIED BY THE USER.

                                  LAYER  1
                                  --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER  45
               THICKNESS                    =      0.01   INCHES
               POROSITY                     =      0.0030 VOL/VOL
               FIELD CAPACITY               =      0.0020 VOL/VOL
               WILTING POINT                =      0.0010 VOL/VOL
               INITIAL SOIL WATER CONTENT   =      0.0030 VOL/VOL
               EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
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LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 5

THICKNESS	=	18.00	INCHES
POROSITY	=	0.4570	VOL/VOL
FIELD CAPACITY	=	0.1310	VOL/VOL
WILTING POINT	=	0.0580	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2401	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	460.00	INCHES
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2982	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 4

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.25	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	69.60	PERCENT
DRAINAGE LENGTH	=	50.0	FEET

LAYER 5

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL

INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY	=	1.00 HOLES/ACRE
FML INSTALLATION DEFECTS	=	4.00 HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #17 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 50. FEET.

SCS RUNOFF CURVE NUMBER	=	97.00	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	24.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	6.109	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	12.247	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.505	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	141.496	INCHES
TOTAL INITIAL WATER	=	141.496	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM Tacoma WASHINGTON

STATION LATITUDE	=	47.25 DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00
START OF GROWING SEASON (JULIAN DATE)	=	126
END OF GROWING SEASON (JULIAN DATE)	=	287
EVAPORATIVE ZONE DEPTH	=	24.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	9.10 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	75.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	70.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	79.00 %

NOTE: PRECIPITATION DATA FOR TACOMA WA WAS ENTERED FROM AN ASCII DATA FILE.

NOTE: TEMPERATURE DATA FOR TACOMA WA
WAS ENTERED FROM AN ASCII DATA FILE.

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SEATTLE WASHINGTON
AND STATION LATITUDE = 47.25 DEGREES

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1994

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.54	4.72	4.02	2.44	1.63	2.04
	0.27	0.36	1.82	4.52	5.24	7.52
RUNOFF	0.916	1.435	1.266	0.503	0.257	0.266
	0.001	0.005	0.362	2.167	1.705	3.575
EVAPOTRANSPIRATION	1.273	1.225	2.493	1.902	1.424	1.879
	0.405	0.278	1.595	0.575	1.005	0.992
LATERAL DRAINAGE COLLECTED	1.4044	2.5935	1.4670	2.5648	0.6554	0.0988
FROM LAYER 4	0.0946	0.0208	0.0067	0.0015	0.4770	0.9727
PERCOLATION/LEAKAGE THROUGH	0.0029	0.0042	0.0030	0.0043	0.0017	0.0008
LAYER 5	0.0008	0.0002	0.0001	0.0000	0.0014	0.0020

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.007	0.014	0.007	0.013	0.003	0.001
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.002	0.005
STD. DEVIATION OF DAILY	0.005	0.002	0.006	0.001	0.005	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.003	0.006

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ANNUAL TOTALS FOR YEAR 1994

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.12	138375.609	100.00
RUNOFF	12.458	45221.352	32.68
EVAPOTRANSPIRATION	15.046	54616.355	39.47
DRAINAGE COLLECTED FROM LAYER 4	10.3572	37596.789	27.17
PERC./LEAKAGE THROUGH LAYER 5	0.021419	77.752	0.06
AVG. HEAD ON TOP OF LAYER 5	0.0043		
CHANGE IN WATER STORAGE	0.238	863.355	0.62
SOIL WATER AT START OF YEAR	141.499	513640.562	
SOIL WATER AT END OF YEAR	141.737	514503.937	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.011	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1995

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.29	5.37	4.19	2.30	0.96	0.91
	1.49	1.12	1.70	4.23	9.90	7.40
RUNOFF	1.210	2.670	1.040	0.225	0.132	0.026
	0.448	0.293	0.383	1.505	5.265	3.235
EVAPOTRANSPIRATION	1.221	1.433	2.376	2.011	1.101	0.736
	1.120	1.016	0.524	1.809	1.145	1.000
LATERAL DRAINAGE COLLECTED	1.5844	1.6724	1.8828	2.4771	1.5047	0.1143
FROM LAYER 4	0.0273	0.0000	0.0058	0.0024	0.3927	0.5598
PERCOLATION/LEAKAGE THROUGH	0.0031	0.0031	0.0036	0.0042	0.0029	0.0009
LAYER 5	0.0003	0.0000	0.0000	0.0000	0.0012	0.0014

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.008	0.009	0.009	0.012	0.007	0.001
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.002	0.003
STD. DEVIATION OF DAILY	0.005	0.006	0.005	0.002	0.007	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.003	0.004

ANNUAL TOTALS FOR YEAR 1995

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.86	159211.797	100.00
RUNOFF	16.432	59647.617	37.46
EVAPOTRANSPIRATION	15.494	56244.359	35.33
DRAINAGE COLLECTED FROM LAYER 4	10.2238	37112.215	23.31
PERC./LEAKAGE THROUGH LAYER 5	0.020726	75.235	0.05
AVG. HEAD ON TOP OF LAYER 5	0.0042		
CHANGE IN WATER STORAGE	1.689	6132.382	3.85
SOIL WATER AT START OF YEAR	141.737	514503.937	
SOIL WATER AT END OF YEAR	143.426	520636.312	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.010	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 1996

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.55	8.56	1.61	7.69	2.55	1.66
	0.59	0.43	1.32	5.09	6.61	11.27
RUNOFF	3.370	4.979	0.171	3.459	0.659	0.000
	0.011	0.026	0.167	1.730	2.630	5.449
EVAPOTRANSPIRATION	1.183	1.412	1.972	3.643	2.149	1.376
	0.680	0.437	1.368	1.207	1.038	0.947
LATERAL DRAINAGE COLLECTED	1.7697	1.4240	3.1640	3.3685	1.9578	0.2067
FROM LAYER 4	0.1583	0.0780	0.0251	0.0106	1.0183	0.6673
PERCOLATION/LEAKAGE THROUGH	0.0034	0.0030	0.0048	0.0049	0.0034	0.0011
LAYER 5	0.0011	0.0007	0.0003	0.0000	0.0025	0.0015

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.009	0.007	0.015	0.017	0.010	0.001
TOP OF LAYER 5	0.001	0.000	0.000	0.000	0.005	0.003
STD. DEVIATION OF DAILY	0.007	0.007	0.004	0.001	0.007	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.003	0.006

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ANNUAL TOTALS FOR YEAR 1996

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.93	199395.891	100.00
RUNOFF	22.652	82227.016	41.24
EVAPOTRANSPIRATION	17.411	63200.320	31.70
DRAINAGE COLLECTED FROM LAYER 4	13.8483	50269.391	25.21
PERC./LEAKAGE THROUGH LAYER 5	0.026952	97.836	0.05
AVG. HEAD ON TOP OF LAYER 5	0.0057		
CHANGE IN WATER STORAGE	0.992	3601.419	1.81
SOIL WATER AT START OF YEAR	143.426	520636.312	
SOIL WATER AT END OF YEAR	144.418	524237.719	

SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.098	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1997

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.81	2.84	7.84	2.86	2.06	2.62
	1.43	1.22	2.78	6.20	3.52	3.33
RUNOFF	3.762	0.929	3.159	0.000	0.000	0.501
	0.385	0.107	0.525	2.306	0.753	1.391
EVAPOTRANSPIRATION	1.205	1.342	2.307	3.006	2.126	2.172
	1.630	0.489	1.944	1.756	1.137	0.978
LATERAL DRAINAGE COLLECTED	1.2712	2.3784	2.2518	2.9982	3.3215	1.0394
FROM LAYER 4	0.0340	0.0033	0.0026	0.7338	0.9253	1.2394
PERCOLATION/LEAKAGE THROUGH	0.0024	0.0038	0.0038	0.0047	0.0050	0.0017
LAYER 5	0.0002	0.0000	0.0000	0.0017	0.0025	0.0029

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.006	0.013	0.011	0.015	0.016	0.005
TOP OF LAYER 5	0.000	0.000	0.000	0.004	0.005	0.006
STD. DEVIATION OF DAILY	0.007	0.005	0.007	0.005	0.001	0.007
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.004	0.003	0.004

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ANNUAL TOTALS FOR YEAR 1997

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.51	161571.266	100.00
RUNOFF	13.819	50161.301	31.05
EVAPOTRANSPIRATION	20.093	72936.766	45.14
DRAINAGE COLLECTED FROM LAYER 4	16.1989	58802.176	36.39
PERC./LEAKAGE THROUGH LAYER 5	0.028829	104.650	0.06
AVG. HEAD ON TOP OF LAYER 5	0.0067		
CHANGE IN WATER STORAGE	-5.629	-20433.594	-12.65
SOIL WATER AT START OF YEAR	144.418	524237.719	
SOIL WATER AT END OF YEAR	138.789	503804.125	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.033	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1998

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.38	2.59	4.52	0.98	2.09	0.83
	0.94	0.00	0.24	3.53	11.21	9.17
RUNOFF	3.268	0.286	1.424	0.048	0.563	0.055
	0.000	0.000	0.000	0.088	6.463	4.584
EVAPOTRANSPIRATION	1.191	1.412	2.249	1.289	1.676	0.587
	1.038	0.244	0.206	1.245	1.107	0.953
LATERAL DRAINAGE COLLECTED FROM LAYER 4	1.0205	1.5896	1.7673	2.7299	0.3473	0.1397
	0.0820	0.0083	0.0024	0.0007	0.7207	0.6824
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0022	0.0030	0.0036	0.0045	0.0011	0.0010
	0.0007	0.0001	0.0000	0.0000	0.0017	0.0016

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.005	0.009	0.008	0.013	0.002	0.001
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.004	0.003
STD. DEVIATION OF DAILY	0.006	0.006	0.004	0.001	0.004	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.004	0.004

ANNUAL TOTALS FOR YEAR 1998

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.48	161462.453	100.00
RUNOFF	16.779	60908.508	37.72
EVAPOTRANSPIRATION	13.197	47905.121	29.67
DRAINAGE COLLECTED FROM LAYER 4	9.0908	32999.645	20.44
PERC./LEAKAGE THROUGH LAYER 5	0.019554	70.981	0.04
AVG. HEAD ON TOP OF LAYER 5	0.0038		
CHANGE IN WATER STORAGE	5.393	19578.160	12.13
SOIL WATER AT START OF YEAR	138.789	503804.125	
SOIL WATER AT END OF YEAR	144.182	523382.281	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.039	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 1999

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.62	8.31	5.03	1.53	1.84	1.78
	1.01	0.44	0.20	2.93	10.67	5.10
RUNOFF	4.280	3.588	1.375	0.100	0.258	0.645
	0.207	0.000	0.000	0.713	5.581	1.990
EVAPOTRANSPIRATION	1.216	1.344	2.371	2.102	2.061	0.582
	1.322	0.439	0.279	0.896	1.151	1.019
LATERAL DRAINAGE COLLECTED	1.8776	1.2404	2.2494	3.9668	3.4860	1.9322
FROM LAYER 4	0.0613	0.0006	0.0049	0.0070	0.2784	0.6341
PERCOLATION/LEAKAGE THROUGH	0.0032	0.0024	0.0037	0.0054	0.0051	0.0033
LAYER 5	0.0005	0.0000	0.0000	0.0001	0.0008	0.0016

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.009	0.006	0.011	0.020	0.017	0.010
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.001	0.003
STD. DEVIATION OF DAILY	0.007	0.006	0.007	0.001	0.001	0.007
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.002	0.004

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ANNUAL TOTALS FOR YEAR 1999

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.46	172279.812	100.00
RUNOFF	18.736	68012.641	39.48
EVAPOTRANSPIRATION	14.783	53663.070	31.15
DRAINAGE COLLECTED FROM LAYER 4	15.7387	57131.402	33.16
PERC./LEAKAGE THROUGH LAYER 5	0.026082	94.678	0.05
AVG. HEAD ON TOP OF LAYER 5	0.0065		
CHANGE IN WATER STORAGE	-1.824	-6621.969	-3.84
SOIL WATER AT START OF YEAR	144.182	523382.281	
SOIL WATER AT END OF YEAR	142.358	516760.312	

SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.011	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2000

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.04	5.93	4.18	1.56	2.56	1.33
	0.72	0.77	0.87	3.53	3.65	2.80
RUNOFF	0.833	2.528	0.128	0.113	0.350	0.288
	0.236	0.000	0.041	0.091	1.325	0.440
EVAPOTRANSPIRATION	1.162	1.400	2.322	2.209	2.137	1.573
	0.393	0.364	1.158	1.211	1.060	0.997
LATERAL DRAINAGE COLLECTED	1.8616	2.2000	2.0209	2.4580	2.1457	0.1015
FROM LAYER 4	0.1049	0.0587	0.0031	0.0069	0.6564	1.4603
PERCOLATION/LEAKAGE THROUGH	0.0035	0.0038	0.0069	0.0042	0.0037	0.0007
LAYER 5	0.0009	0.0006	0.0000	0.0001	0.0018	0.0031

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.009	0.012	0.008	0.012	0.010	0.001
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.003	0.007
STD. DEVIATION OF DAILY	0.006	0.004	0.006	0.002	0.006	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.003	0.004

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ANNUAL TOTALS FOR YEAR 2000

	INCHES	CU. FEET	PERCENT
PRECIPITATION	31.94	115942.289	100.00
RUNOFF	6.374	23138.107	19.96
EVAPOTRANSPIRATION	15.985	58024.941	50.05
DRAINAGE COLLECTED FROM LAYER 4	13.0779	47472.879	40.95
PERC./LEAKAGE THROUGH LAYER 5	0.029398	106.715	0.09
AVG. HEAD ON TOP OF LAYER 5	0.0052		
CHANGE IN WATER STORAGE	-3.526	-12800.491	-11.04
SOIL WATER AT START OF YEAR	142.358	516760.312	
SOIL WATER AT END OF YEAR	138.832	503959.844	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.144	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2001

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.77	2.36	3.24	3.70	1.93	3.53
	0.20	2.25	0.46	3.32	10.13	6.82
RUNOFF	0.667	0.602	0.385	1.003	0.471	1.307
	0.004	0.852	0.081	0.819	6.033	2.641
EVAPOTRANSPIRATION	1.209	1.360	2.522	2.844	2.161	2.037
	0.632	1.078	0.504	0.672	1.116	1.006
LATERAL DRAINAGE COLLECTED FROM LAYER 4	1.2154	1.5160	0.3790	0.1699	0.0649	0.0303
	0.0043	0.0124	0.0022	0.0012	0.2719	0.6421
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0028	0.0032	0.0016	0.0010	0.0004	0.0002
	0.0000	0.0001	0.0000	0.0000	0.0007	0.0014

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.006	0.008	0.002	0.001	0.000	0.000
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.002	0.003
STD. DEVIATION OF DAILY	0.004	0.003	0.001	0.001	0.000	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.002	0.004

ANNUAL TOTALS FOR YEAR 2001

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.71	147777.328	100.00
RUNOFF	14.865	53958.816	36.51
EVAPOTRANSPIRATION	17.141	62220.945	42.10
DRAINAGE COLLECTED FROM LAYER 4	4.3095	15643.472	10.59
PERC./LEAKAGE THROUGH LAYER 5	0.011506	41.768	0.03
AVG. HEAD ON TOP OF LAYER 5	0.0019		
CHANGE IN WATER STORAGE	4.384	15912.323	10.77
SOIL WATER AT START OF YEAR	138.832	503959.844	
SOIL WATER AT END OF YEAR	143.215	519872.156	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.003	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 2002

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.53	3.56	4.16	3.64	1.14	1.36
	0.42	0.06	0.36	0.41	2.96	6.58
RUNOFF	0.479	1.067	1.421	1.187	0.028	0.263
	0.020	0.000	0.000	0.048	0.603	2.237
EVAPOTRANSPIRATION	1.198	1.391	2.327	2.283	1.008	0.862
	0.992	0.324	0.250	0.220	0.897	1.049
LATERAL DRAINAGE COLLECTED	1.9842	1.4687	3.0616	2.6657	2.9244	0.0895
FROM LAYER 4	0.1009	0.0755	0.0483	0.0379	0.0078	0.2169
PERCOLATION/LEAKAGE THROUGH	0.0042	0.0030	0.0047	0.0043	0.0046	0.0008
LAYER 5	0.0008	0.0008	0.0006	0.0006	0.0001	0.0010

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.010	0.008	0.015	0.013	0.014	0.000
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.000	0.001
STD. DEVIATION OF DAILY	0.005	0.005	0.004	0.004	0.004	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.000	0.001

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ANNUAL TOTALS FOR YEAR 2002

	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.18	109553.453	100.00
RUNOFF	7.353	26692.748	24.37
EVAPOTRANSPIRATION	12.800	46464.094	42.41
DRAINAGE COLLECTED FROM LAYER 4	12.6812	46032.801	42.02
PERC./LEAKAGE THROUGH LAYER 5	0.025550	92.747	0.08
AVG. HEAD ON TOP OF LAYER 5	0.0052		
CHANGE IN WATER STORAGE	-2.680	-9728.982	-8.88
SOIL WATER AT START OF YEAR	143.215	519872.156	
SOIL WATER AT END OF YEAR	140.535	510143.156	

SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.049	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2003

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.50	1.71	5.08	3.30	0.55	0.36
	0.13	0.29	0.69	8.88	6.15	4.65
RUNOFF	3.667	0.270	1.489	0.553	0.000	0.010
	0.000	0.001	0.007	5.445	2.602	1.145
EVAPOTRANSPIRATION	1.288	1.402	2.444	3.125	0.562	0.299
	0.238	0.212	0.761	1.435	1.011	1.010
LATERAL DRAINAGE COLLECTED	1.3334	1.3224	2.8613	2.1016	0.7343	0.1010
FROM LAYER 4	0.0657	0.0487	0.0220	0.1441	0.8804	0.7054
PERCOLATION/LEAKAGE THROUGH	0.0028	0.0026	0.0046	0.0038	0.0019	0.0009
LAYER 5	0.0007	0.0006	0.0003	0.0005	0.0023	0.0020

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.006	0.007	0.014	0.010	0.004	0.001
TOP OF LAYER 5	0.000	0.000	0.000	0.001	0.004	0.003
STD. DEVIATION OF DAILY	0.006	0.005	0.003	0.004	0.005	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.002	0.003	0.003

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ANNUAL TOTALS FOR YEAR 2003

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.29	146252.687	100.00
RUNOFF	15.188	55133.957	37.70
EVAPOTRANSPIRATION	13.788	50049.437	34.22
DRAINAGE COLLECTED FROM LAYER 4	10.3201	37461.934	25.61
PERC./LEAKAGE THROUGH LAYER 5	0.022964	83.359	0.06
AVG. HEAD ON TOP OF LAYER 5	0.0042		
CHANGE IN WATER STORAGE	0.971	3523.985	2.41
SOIL WATER AT START OF YEAR	140.535	510143.156	
SOIL WATER AT END OF YEAR	141.506	513667.156	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.019	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1994 THROUGH 2003

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	6.10	4.60	4.39	3.00	1.73	1.64
	0.72	0.69	1.04	4.26	7.00	6.46
STD. DEVIATIONS	2.31	2.44	1.57	1.89	0.67	0.93
	0.49	0.68	0.85	2.22	3.22	2.60
RUNOFF						
TOTALS	2.245	1.835	1.186	0.719	0.272	0.336
	0.131	0.128	0.157	1.491	3.296	2.669
STD. DEVIATIONS	1.535	1.566	0.879	1.046	0.237	0.404
	0.175	0.271	0.196	1.629	2.302	1.567
EVAPOTRANSPIRATION						

TOTALS	1.214	1.372	2.338	2.441	1.641	1.210
	0.845	0.488	0.859	1.103	1.067	0.995
STD. DEVIATIONS	0.039	0.060	0.154	0.698	0.586	0.681
	0.449	0.308	0.619	0.513	0.081	0.030

LATERAL DRAINAGE COLLECTED FROM LAYER 4

TOTALS	1.5322	1.7405	2.1105	2.5500	1.7142	0.3853
	0.0733	0.0306	0.0123	0.0946	0.5629	0.7780
STD. DEVIATIONS	0.3295	0.4741	0.8305	0.9890	1.2537	0.6185
	0.0449	0.0314	0.0151	0.2289	0.3305	0.3566

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0031	0.0032	0.0040	0.0041	0.0030	0.0011
	0.0006	0.0003	0.0001	0.0003	0.0015	0.0019
STD. DEVIATIONS	0.0006	0.0006	0.0014	0.0012	0.0017	0.0008
	0.0003	0.0003	0.0002	0.0005	0.0008	0.0007

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	0.0074	0.0092	0.0100	0.0126	0.0083	0.0019
	0.0004	0.0001	0.0001	0.0005	0.0029	0.0038
STD. DEVIATIONS	0.0016	0.0026	0.0040	0.0049	0.0060	0.0031
	0.0002	0.0002	0.0001	0.0011	0.0017	0.0017

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1994 THROUGH 2003

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.65 (7.244)	151182.3	100.00
RUNOFF	14.466 (4.8952)	52510.21	34.733
EVAPOTRANSPIRATION	15.574 (2.2076)	56532.54	37.394
LATERAL DRAINAGE COLLECTED FROM LAYER 4	11.58465 (3.51519)	42052.270	27.81561
PERCOLATION/LEAKAGE THROUGH	0.02330 (0.00535)	84.572	0.05594

LAYER 5

AVERAGE HEAD ON TOP OF LAYER 5	0.005	(0.001)		
CHANGE IN WATER STORAGE	0.001	(3.4605)	2.66	0.002

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PEAK DAILY VALUES FOR YEARS 1994 THROUGH 2003

	(INCHES)	(CU. FT.)
PRECIPITATION	4.20	15245.999
RUNOFF	3.689	13392.0967
DRAINAGE COLLECTED FROM LAYER 4	0.18218	661.32935
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000877	3.18245
AVERAGE HEAD ON TOP OF LAYER 5	0.025	
MAXIMUM HEAD ON TOP OF LAYER 5	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	0.42	1516.4022

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2968
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1318

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 2003

LAYER	(INCHES)	(VOL/VOL)
1	0.0019	0.2349
2	4.3220	0.2401
3	137.1772	0.2982
4	0.0025	0.0100
5	0.0000	0.0000
SNOW WATER	0.000	

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**                                                                              **
**               HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                  **
**                 HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                   **
**                   DEVELOPED BY ENVIRONMENTAL LABORATORY                      **
**                     USAE WATERWAYS EXPERIMENT STATION                        **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY                 **
**                                                                              **
**                                                                              **
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PRECIPITATION DATA FILE:    C:\tlf\PRECIP.D4
TEMPERATURE DATA FILE:      C:\tLF\TEMP.D7
SOLAR RADIATION DATA FILE:  C:\tLF\SOLARRAD.D13
EVAPOTRANSPIRATION DATA:    C:\tLF\EVAPTRAN.D11
SOIL AND DESIGN DATA FILE:  C:\tLF\FLOOR1R2.D10
OUTPUT DATA FILE:           C:\tLF\floor1R2.OUT


TIME:  15:26     DATE:   5/ 3/2005



**********************************************************************************

     TITLE:  Tacoma Landfill Central Area HELP Evaluation

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.



                                  LAYER  1
                                  --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   5
          THICKNESS                     =     18.00   INCHES
          POROSITY                      =      0.4570 VOL/VOL
          FIELD CAPACITY                =      0.1310 VOL/VOL
          WILTING POINT                 =      0.0580 VOL/VOL
          INITIAL SOIL WATER CONTENT    =      0.2352 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.100000005000E-02 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
                 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
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LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	695.00	INCHES
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3048	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 50

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3200	VOL/VOL
FIELD CAPACITY	=	0.0500	VOL/VOL
WILTING POINT	=	0.0200	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0580	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.200000003000	CM/SEC
SLOPE	=	2.00	PERCENT
DRAINAGE LENGTH	=	125.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	4.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 5

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.25	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	2.00	PERCENT
DRAINAGE LENGTH	=	125.0	FEET

LAYER 6

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	4.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 125. FEET.

SCS RUNOFF CURVE NUMBER	=	78.10	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	24.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	6.062	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	12.252	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.506	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	216.768	INCHES
TOTAL INITIAL WATER	=	216.768	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
Tacoma WASHINGTON

STATION LATITUDE	=	47.25 DEGREES
MAXIMUM LEAF AREA INDEX	=	1.00
START OF GROWING SEASON (JULIAN DATE)	=	126
END OF GROWING SEASON (JULIAN DATE)	=	287
EVAPORATIVE ZONE DEPTH	=	24.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	9.10 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	75.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	70.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	79.00 %

NOTE: PRECIPITATION DATA FOR TACOMA WA
WAS ENTERED FROM AN ASCII DATA FILE.

NOTE: TEMPERATURE DATA FOR TACOMA WA
WAS ENTERED FROM AN ASCII DATA FILE.

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SEATTLE WASHINGTON
AND STATION LATITUDE = 47.25 DEGREES

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1994

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.54	4.72	4.02	2.44	1.63	2.04
	0.27	0.36	1.82	4.52	5.24	7.52
RUNOFF	0.000	0.000	0.005	0.000	0.000	0.000
	0.000	0.000	0.000	0.017	0.098	0.135
EVAPOTRANSPIRATION	1.160	1.160	2.370	2.127	1.638	2.607
	1.834	0.440	1.750	0.499	0.949	0.939
LATERAL DRAINAGE COLLECTED	0.5581	0.9365	0.6177	1.2802	1.4554	1.2151
FROM LAYER 3	1.0002	0.0000	0.0000	0.0000	0.1392	0.1524
PERCOLATION/LEAKAGE THROUGH	1.1985	1.6489	1.1239	2.0728	2.2694	2.0378

LAYER 4	1.7362	0.0000	0.0000	0.0000	0.5073	0.4119
LATERAL DRAINAGE COLLECTED	1.0569	1.4765	0.9989	1.8682	2.0506	1.8346
FROM LAYER 5	1.5593	0.0000	0.0000	0.0000	0.4282	0.3542
PERCOLATION/LEAKAGE THROUGH	0.1416	0.1725	0.1250	0.2045	0.2188	0.2032
LAYER 6	0.1769	0.0000	0.0000	0.0000	0.0791	0.0577

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.099	0.184	0.110	0.235	0.259	0.223
TOP OF LAYER 4	0.178	0.000	0.000	0.000	0.026	0.027
STD. DEVIATION OF DAILY	0.086	0.098	0.129	0.060	0.010	0.014
HEAD ON TOP OF LAYER 4	0.079	0.000	0.000	0.000	0.028	0.047
AVERAGE DAILY HEAD ON	0.006	0.009	0.005	0.010	0.011	0.010
TOP OF LAYER 6	0.008	0.000	0.000	0.000	0.003	0.002
STD. DEVIATION OF DAILY	0.003	0.003	0.005	0.001	0.000	0.000
HEAD ON TOP OF LAYER 6	0.003	0.000	0.000	0.000	0.002	0.003

ANNUAL TOTALS FOR YEAR 1994

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.12	138375.609	100.00
RUNOFF	0.255	925.348	0.67
EVAPOTRANSPIRATION	17.473	63426.762	45.84
DRAINAGE COLLECTED FROM LAYER 3	7.3548	26698.014	19.29
PERC./LEAKAGE THROUGH LAYER 4	13.006743	47214.480	34.12
AVG. HEAD ON TOP OF LAYER 4	0.1119		
DRAINAGE COLLECTED FROM LAYER 5	11.6274	42207.492	30.50
PERC./LEAKAGE THROUGH LAYER 6	1.379334	5006.983	3.62
AVG. HEAD ON TOP OF LAYER 6	0.0053		
CHANGE IN WATER STORAGE	0.031	111.056	0.08
SOIL WATER AT START OF YEAR	217.467	789403.500	

SOIL WATER AT END OF YEAR	217.497	789514.562	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.041	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1995

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.29	5.37	4.19	2.30	0.96	0.91
	1.49	1.12	1.70	4.23	9.90	7.40
RUNOFF	0.000	0.224	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.409	0.002
EVAPOTRANSPIRATION	1.127	1.339	2.264	2.355	1.286	1.041
	2.892	1.395	0.496	1.438	1.051	0.935
LATERAL DRAINAGE COLLECTED	0.5736	0.3930	0.7931	1.4302	1.6516	1.3564
FROM LAYER 3	1.1911	0.1684	0.0000	0.0046	0.1656	0.1070
PERCOLATION/LEAKAGE THROUGH	1.2367	0.8370	1.4946	2.1764	2.4187	2.1549
LAYER 4	2.0503	0.2821	0.0000	0.0392	0.5132	0.3632
LATERAL DRAINAGE COLLECTED	1.0915	0.7348	1.3274	1.9669	2.1921	1.9453
FROM LAYER 5	1.8434	0.2529	0.0000	0.0308	0.4369	0.3056
PERCOLATION/LEAKAGE THROUGH	0.1451	0.1022	0.1672	0.2096	0.2266	0.2096
LAYER 6	0.2069	0.0292	0.0000	0.0084	0.0763	0.0576

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.102	0.077	0.141	0.263	0.294	0.249
TOP OF LAYER 4	0.212	0.030	0.000	0.001	0.031	0.019
STD. DEVIATION OF DAILY	0.090	0.104	0.128	0.083	0.016	0.009
HEAD ON TOP OF LAYER 4	0.014	0.080	0.000	0.003	0.036	0.023

AVERAGE DAILY HEAD ON	0.006	0.004	0.007	0.011	0.012	0.011
TOP OF LAYER 6	0.010	0.001	0.000	0.000	0.003	0.002
STD. DEVIATION OF DAILY	0.003	0.004	0.004	0.002	0.000	0.000
HEAD ON TOP OF LAYER 6	0.000	0.003	0.000	0.001	0.002	0.002

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ANNUAL TOTALS FOR YEAR 1995

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.86	159211.797	100.00
RUNOFF	0.635	2305.986	1.45
EVAPOTRANSPIRATION	17.619	63956.289	40.17
DRAINAGE COLLECTED FROM LAYER 3	7.8348	28440.195	17.86
PERC./LEAKAGE THROUGH LAYER 4	13.566185	49245.250	30.93
AVG. HEAD ON TOP OF LAYER 4	0.1183		
DRAINAGE COLLECTED FROM LAYER 5	12.1275	44022.793	27.65
PERC./LEAKAGE THROUGH LAYER 6	1.438689	5222.441	3.28
AVG. HEAD ON TOP OF LAYER 6	0.0055		
CHANGE IN WATER STORAGE	4.205	15264.046	9.59
SOIL WATER AT START OF YEAR	217.497	789514.562	
SOIL WATER AT END OF YEAR	221.702	804778.625	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.051	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1996

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.55	8.56	1.61	7.69	2.55	1.66
	0.59	0.43	1.32	5.09	6.61	11.27
RUNOFF	0.040	0.823	0.000	0.267	0.000	0.000
	0.000	0.000	0.000	0.000	0.014	0.225
EVAPOTRANSPIRATION	1.138	1.334	2.054	3.942	2.827	1.597
	2.050	1.081	1.373	1.216	0.942	0.918
LATERAL DRAINAGE COLLECTED	0.4871	0.9444	2.2051	2.2710	1.3401	1.8510
FROM LAYER 3	1.6040	1.2956	0.7913	0.0000	0.1229	0.1398
PERCOLATION/LEAKAGE THROUGH	0.9617	1.5097	2.7409	2.7236	2.0088	2.5213
LAYER 4	2.3832	2.1382	1.3655	0.0000	0.4347	0.3935
LATERAL DRAINAGE COLLECTED	0.8473	1.3504	2.4999	2.4898	1.8114	2.2929
FROM LAYER 5	2.1584	1.9265	1.2268	0.0000	0.3647	0.3340
PERCOLATION/LEAKAGE THROUGH	0.1143	0.1593	0.2410	0.2338	0.1974	0.2284
LAYER 6	0.2248	0.2117	0.1387	0.0000	0.0700	0.0595

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.087	0.180	0.392	0.417	0.238	0.340
TOP OF LAYER 4	0.285	0.230	0.145	0.000	0.023	0.025
STD. DEVIATION OF DAILY	0.106	0.178	0.146	0.114	0.145	0.016
HEAD ON TOP OF LAYER 4	0.016	0.020	0.102	0.000	0.027	0.044
AVERAGE DAILY HEAD ON	0.005	0.008	0.013	0.014	0.010	0.013
TOP OF LAYER 6	0.011	0.010	0.007	0.000	0.002	0.002
STD. DEVIATION OF DAILY	0.004	0.005	0.003	0.003	0.004	0.000
HEAD ON TOP OF LAYER 6	0.000	0.000	0.005	0.000	0.002	0.003

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ANNUAL TOTALS FOR YEAR 1996

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.93	199395.891	100.00
RUNOFF	1.369	4967.795	2.49

EVAPOTRANSPIRATION	20.472	74312.031	37.27
DRAINAGE COLLECTED FROM LAYER 3	13.0522	47379.355	23.76
PERC./LEAKAGE THROUGH LAYER 4	19.181065	69627.266	34.92
AVG. HEAD ON TOP OF LAYER 4	0.1970		
DRAINAGE COLLECTED FROM LAYER 5	17.3021	62806.641	31.50
PERC./LEAKAGE THROUGH LAYER 6	1.878967	6820.651	3.42
AVG. HEAD ON TOP OF LAYER 6	0.0078		
CHANGE IN WATER STORAGE	0.857	3109.450	1.56
SOIL WATER AT START OF YEAR	221.702	804778.625	
SOIL WATER AT END OF YEAR	222.559	807888.062	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.038	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1997

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.81	2.84	7.84	2.86	2.06	2.62
	1.43	1.22	2.78	6.20	3.52	3.33
RUNOFF	0.064	0.000	0.011	0.000	0.000	0.000
	0.000	0.000	0.000	0.050	0.000	0.092
EVAPOTRANSPIRATION	1.132	1.239	2.217	3.114	2.154	2.856
	3.500	0.848	1.792	1.521	1.016	0.887
LATERAL DRAINAGE COLLECTED	0.4228	1.0613	0.8030	2.4300	2.3792	1.8714
FROM LAYER 3	1.5383	1.2496	0.3895	0.0420	0.2170	0.1484
PERCOLATION/LEAKAGE THROUGH	0.9477	1.6821	1.4555	2.8651	2.9087	2.5346
LAYER 4	2.3331	2.1007	0.6670	0.2175	0.5665	0.5326
LATERAL DRAINAGE COLLECTED	0.8287	1.5102	1.2949	2.6210	2.6581	2.3055

FROM LAYER 5	2.1109	1.8910	0.5987	0.1802	0.4893	0.4501
PERCOLATION/LEAKAGE THROUGH	0.1189	0.1720	0.1605	0.2441	0.2506	0.2291
LAYER 6	0.2222	0.2097	0.0683	0.0373	0.0772	0.0824

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.075	0.209	0.143	0.447	0.423	0.344
TOP OF LAYER 4	0.274	0.222	0.072	0.008	0.040	0.027
STD. DEVIATION OF DAILY	0.093	0.158	0.137	0.111	0.031	0.024
HEAD ON TOP OF LAYER 4	0.018	0.013	0.105	0.012	0.061	0.037
AVERAGE DAILY HEAD ON	0.005	0.009	0.007	0.014	0.014	0.013
TOP OF LAYER 6	0.011	0.010	0.003	0.001	0.003	0.003
STD. DEVIATION OF DAILY	0.004	0.004	0.004	0.002	0.001	0.000
HEAD ON TOP OF LAYER 6	0.000	0.000	0.005	0.001	0.003	0.002

ANNUAL TOTALS FOR YEAR 1997

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.51	161571.266	100.00
RUNOFF	0.216	784.024	0.49
EVAPOTRANSPIRATION	22.276	80861.852	50.05
DRAINAGE COLLECTED FROM LAYER 3	12.5526	45565.930	28.20
PERC./LEAKAGE THROUGH LAYER 4	18.810984	68283.867	42.26
AVG. HEAD ON TOP OF LAYER 4	0.1902		
DRAINAGE COLLECTED FROM LAYER 5	16.9387	61487.652	38.06
PERC./LEAKAGE THROUGH LAYER 6	1.872246	6796.252	4.21
AVG. HEAD ON TOP OF LAYER 6	0.0077		
CHANGE IN WATER STORAGE	-9.346	-33924.348	-21.00
SOIL WATER AT START OF YEAR	222.559	807888.062	
SOIL WATER AT END OF YEAR	213.213	773963.750	

SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.095	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1998

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.38	2.59	4.52	0.98	2.09	0.83
	0.94	0.00	0.24	3.53	11.21	9.17
RUNOFF	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.749	0.072
EVAPOTRANSPIRATION	1.147	1.368	2.200	1.521	1.606	1.054
	2.028	1.140	0.193	1.209	1.050	0.894
LATERAL DRAINAGE COLLECTED	0.2405	0.7227	0.5705	1.5058	1.4309	1.2035
FROM LAYER 3	0.7258	0.0001	0.0000	0.0000	0.0210	0.2577
PERCOLATION/LEAKAGE THROUGH	0.6189	1.3636	1.2100	2.2708	2.2501	2.0276
LAYER 4	1.3431	0.0010	0.0000	0.0000	0.0802	0.6523
LATERAL DRAINAGE COLLECTED	0.5340	1.2133	1.0657	2.0551	2.0323	1.8250
FROM LAYER 5	1.1971	0.0005	0.0000	0.0000	0.0657	0.5659
PERCOLATION/LEAKAGE THROUGH	0.0849	0.1504	0.1443	0.2157	0.2178	0.2026
LAYER 6	0.1460	0.0005	0.0000	0.0000	0.0145	0.0864

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.043	0.142	0.102	0.277	0.255	0.221
TOP OF LAYER 4	0.129	0.000	0.000	0.000	0.004	0.046
STD. DEVIATION OF DAILY	0.056	0.109	0.090	0.019	0.008	0.016
HEAD ON TOP OF LAYER 4	0.092	0.000	0.000	0.000	0.010	0.059
AVERAGE DAILY HEAD ON	0.003	0.007	0.006	0.011	0.011	0.010
TOP OF LAYER 6	0.006	0.000	0.000	0.000	0.000	0.003

STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 6	0.003	0.004	0.003	0.000	0.000	0.000
	0.004	0.000	0.000	0.000	0.001	0.003

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ANNUAL TOTALS FOR YEAR 1998

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.48	161462.453	100.00
RUNOFF	0.821	2979.741	1.85
EVAPOTRANSPIRATION	15.409	55935.789	34.64
DRAINAGE COLLECTED FROM LAYER 3	6.6785	24243.020	15.01
PERC./LEAKAGE THROUGH LAYER 4	11.817634	42898.012	26.57
AVG. HEAD ON TOP OF LAYER 4	0.1015		
DRAINAGE COLLECTED FROM LAYER 5	10.5545	38312.695	23.73
PERC./LEAKAGE THROUGH LAYER 6	1.263176	4585.328	2.84
AVG. HEAD ON TOP OF LAYER 6	0.0048		
CHANGE IN WATER STORAGE	9.754	35405.793	21.93
SOIL WATER AT START OF YEAR	213.213	773963.750	
SOIL WATER AT END OF YEAR	222.967	809369.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.087	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1999

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC

PRECIPITATION	8.62	8.31	5.03	1.53	1.84	1.78
	1.01	0.44	0.20	2.93	10.67	5.10
RUNOFF	0.114	0.010	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.537	0.099
EVAPOTRANSPIRATION	1.127	1.285	2.264	2.050	2.420	1.663
	2.426	0.967	0.123	1.044	1.072	0.927
LATERAL DRAINAGE COLLECTED	0.5528	0.7344	1.1972	3.1492	2.5770	1.9651
FROM LAYER 3	1.6787	1.3478	0.8547	0.0000	0.0423	0.1238
PERCOLATION/LEAKAGE THROUGH	1.0754	1.1912	1.8636	3.2984	3.0285	2.5985
LAYER 4	2.4382	2.1824	1.4736	0.0000	0.1394	0.4409
LATERAL DRAINAGE COLLECTED	0.9504	1.0607	1.6744	3.0340	2.7723	2.3663
FROM LAYER 5	2.2106	1.9682	1.3237	0.0000	0.1176	0.3734
PERCOLATION/LEAKAGE THROUGH	0.1250	0.1304	0.1892	0.2643	0.2562	0.2322
LAYER 6	0.2276	0.2142	0.1500	0.0000	0.0218	0.0675

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.098	0.145	0.213	0.579	0.458	0.361
TOP OF LAYER 4	0.299	0.240	0.157	0.000	0.008	0.022
STD. DEVIATION OF DAILY	0.123	0.174	0.159	0.052	0.036	0.021
HEAD ON TOP OF LAYER 4	0.021	0.015	0.097	0.000	0.019	0.025
AVERAGE DAILY HEAD ON	0.005	0.006	0.009	0.016	0.015	0.013
TOP OF LAYER 6	0.012	0.010	0.007	0.000	0.001	0.002
STD. DEVIATION OF DAILY	0.004	0.005	0.004	0.001	0.001	0.000
HEAD ON TOP OF LAYER 6	0.000	0.000	0.004	0.000	0.002	0.002

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ANNUAL TOTALS FOR YEAR 1999

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.46	172279.812	100.00
RUNOFF	0.760	2757.486	1.60
EVAPOTRANSPIRATION	17.368	63045.613	36.59
DRAINAGE COLLECTED FROM LAYER 3	14.2229	51629.121	29.97

PERC./LEAKAGE THROUGH LAYER 4	19.729986	71619.852	41.57
AVG. HEAD ON TOP OF LAYER 4	0.2150		
DRAINAGE COLLECTED FROM LAYER 5	17.8516	64801.305	37.61
PERC./LEAKAGE THROUGH LAYER 6	1.878391	6818.560	3.96
AVG. HEAD ON TOP OF LAYER 6	0.0080		
CHANGE IN WATER STORAGE	-4.620	-16772.299	-9.74
SOIL WATER AT START OF YEAR	222.967	809369.500	
SOIL WATER AT END OF YEAR	218.346	792597.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.027	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2000

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.04	5.93	4.18	1.56	2.56	1.33
	0.72	0.77	0.87	3.53	3.65	2.80
RUNOFF	0.000	0.023	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	1.088	1.303	2.266	2.278	2.764	1.947
	1.896	1.016	0.716	1.278	0.880	0.889
LATERAL DRAINAGE COLLECTED	0.6657	0.4767	0.8140	1.4464	1.5924	1.3582
FROM LAYER 3	1.1975	0.1500	0.0000	0.0000	0.0825	0.3521
PERCOLATION/LEAKAGE THROUGH	1.3287	1.0502	1.6306	2.2227	2.3747	2.1564
LAYER 4	2.0561	0.2401	0.0000	0.0000	0.3101	0.9245
LATERAL DRAINAGE COLLECTED	1.1756	0.9222	1.4498	2.0096	2.1503	1.9467
FROM LAYER 5	1.8488	0.2155	0.0000	0.0000	0.2647	0.8073
PERCOLATION/LEAKAGE THROUGH	0.1531	0.1280	0.1808	0.2131	0.2243	0.2097

LAYER 6	0.2072	0.0245	0.0000	0.0000	0.0454	0.1171

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.118	0.091	0.145	0.266	0.283	0.250
TOP OF LAYER 4	0.213	0.027	0.000	0.000	0.015	0.063
STD. DEVIATION OF DAILY	0.106	0.085	0.079	0.029	0.014	0.007
HEAD ON TOP OF LAYER 4	0.012	0.080	0.000	0.000	0.022	0.057
AVERAGE DAILY HEAD ON	0.006	0.005	0.008	0.011	0.011	0.011
TOP OF LAYER 6	0.010	0.001	0.000	0.000	0.002	0.004
STD. DEVIATION OF DAILY	0.004	0.003	0.002	0.001	0.000	0.000
HEAD ON TOP OF LAYER 6	0.000	0.003	0.000	0.000	0.002	0.003

ANNUAL TOTALS FOR YEAR 2000

	INCHES	CU. FEET	PERCENT
PRECIPITATION	31.94	115942.289	100.00
RUNOFF	0.023	85.197	0.07
EVAPOTRANSPIRATION	18.320	66502.914	57.36
DRAINAGE COLLECTED FROM LAYER 3	8.1354	29531.488	25.47
PERC./LEAKAGE THROUGH LAYER 4	14.293874	51886.762	44.75
AVG. HEAD ON TOP OF LAYER 4	0.1225		
DRAINAGE COLLECTED FROM LAYER 5	12.7906	46429.871	40.05
PERC./LEAKAGE THROUGH LAYER 6	1.503282	5456.914	4.71
AVG. HEAD ON TOP OF LAYER 6	0.0058		
CHANGE IN WATER STORAGE	-8.833	-32064.150	-27.66
SOIL WATER AT START OF YEAR	218.346	792597.250	
SOIL WATER AT END OF YEAR	209.513	760533.062	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00

ANNUAL WATER BUDGET BALANCE	0.0000	0.060	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2001

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.77	2.36	3.24	3.70	1.93	3.53
	0.20	2.25	0.46	3.32	10.13	6.82
RUNOFF	0.000	0.000	0.000	0.000	0.000	0.013
	0.000	0.000	0.000	0.000	1.435	0.071
EVAPOTRANSPIRATION	1.099	1.252	2.387	3.003	2.773	2.600
	2.377	2.084	0.774	0.914	0.991	0.925
LATERAL DRAINAGE COLLECTED	0.2929	0.3518	0.7546	0.3881	0.0570	0.0501
FROM LAYER 3	0.0349	0.0045	0.0000	0.0000	0.0324	0.0828
PERCOLATION/LEAKAGE THROUGH	0.7746	0.9679	1.6066	0.9923	0.3817	0.3162
LAYER 4	0.2366	0.0217	0.0000	0.0000	0.0920	0.2759
LATERAL DRAINAGE COLLECTED	0.6706	0.8409	1.4266	0.8621	0.3076	0.2552
FROM LAYER 5	0.1896	0.0171	0.0000	0.0000	0.0779	0.2330
PERCOLATION/LEAKAGE THROUGH	0.1040	0.1270	0.1800	0.1302	0.0742	0.0610
LAYER 6	0.0470	0.0046	0.0000	0.0000	0.0141	0.0430

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.052	0.069	0.134	0.071	0.010	0.009
TOP OF LAYER 4	0.006	0.001	0.000	0.000	0.006	0.015
STD. DEVIATION OF DAILY	0.056	0.051	0.042	0.076	0.007	0.010
HEAD ON TOP OF LAYER 4	0.008	0.003	0.000	0.000	0.020	0.026
AVERAGE DAILY HEAD ON	0.004	0.005	0.008	0.005	0.002	0.002
TOP OF LAYER 6	0.001	0.000	0.000	0.000	0.000	0.001
STD. DEVIATION OF DAILY	0.003	0.002	0.001	0.003	0.001	0.001
HEAD ON TOP OF LAYER 6	0.001	0.000	0.000	0.000	0.001	0.002

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ANNUAL TOTALS FOR YEAR 2001

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.71	147777.328	100.00
RUNOFF	1.519	5514.500	3.73
EVAPOTRANSPIRATION	21.181	76885.789	52.03
DRAINAGE COLLECTED FROM LAYER 3	2.0491	7438.061	5.03
PERC./LEAKAGE THROUGH LAYER 4	5.665551	20565.951	13.92
AVG. HEAD ON TOP OF LAYER 4	0.0312		
DRAINAGE COLLECTED FROM LAYER 5	4.8805	17716.340	11.99
PERC./LEAKAGE THROUGH LAYER 6	0.785019	2849.619	1.93
AVG. HEAD ON TOP OF LAYER 6	0.0023		
CHANGE IN WATER STORAGE	10.296	37373.004	25.29
SOIL WATER AT START OF YEAR	209.513	760533.062	
SOIL WATER AT END OF YEAR	219.809	797906.062	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.012	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2002

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.53	3.56	4.16	3.64	1.14	1.36
	0.42	0.06	0.36	0.41	2.96	6.58

RUNOFF	0.000	0.000	0.000	0.011	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	1.196	1.278	2.185	2.357	1.200	1.285
	2.181	0.644	0.215	0.552	0.748	0.969
LATERAL DRAINAGE COLLECTED	0.6949	0.5507	0.8306	1.2534	1.6999	1.5023
FROM LAYER 3	1.3514	0.9111	0.0000	0.0000	0.0000	0.0241
PERCOLATION/LEAKAGE THROUGH	1.4380	1.1769	1.4878	1.9746	2.4511	2.2682
LAYER 4	2.1857	1.5689	0.0000	0.0000	0.0000	0.0925
LATERAL DRAINAGE COLLECTED	1.2716	1.0362	1.3234	1.7779	2.2229	2.0527
FROM LAYER 5	1.9714	1.4099	0.0000	0.0000	0.0000	0.0761
PERCOLATION/LEAKAGE THROUGH	0.1664	0.1406	0.1643	0.1967	0.2282	0.2155
LAYER 6	0.2144	0.1590	0.0000	0.0000	0.0000	0.0164

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.124	0.108	0.148	0.230	0.302	0.276
TOP OF LAYER 4	0.240	0.162	0.000	0.000	0.000	0.004
STD. DEVIATION OF DAILY	0.091	0.107	0.141	0.131	0.031	0.018
HEAD ON TOP OF LAYER 4	0.012	0.094	0.000	0.000	0.000	0.013
AVERAGE DAILY HEAD ON	0.007	0.006	0.007	0.010	0.012	0.011
TOP OF LAYER 6	0.010	0.008	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.003	0.003	0.004	0.003	0.001	0.000
HEAD ON TOP OF LAYER 6	0.000	0.004	0.000	0.000	0.000	0.001

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ANNUAL TOTALS FOR YEAR 2002

	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.18	109553.453	100.00
RUNOFF	0.012	43.056	0.04
EVAPOTRANSPIRATION	14.811	53765.234	49.08
DRAINAGE COLLECTED FROM LAYER 3	8.8183	32010.273	29.22
PERC./LEAKAGE THROUGH LAYER 4	14.643708	53156.660	48.52

AVG. HEAD ON TOP OF LAYER 4	0.1330		
DRAINAGE COLLECTED FROM LAYER 5	13.1421	47705.793	43.55
PERC./LEAKAGE THROUGH LAYER 6	1.501618	5450.872	4.98
AVG. HEAD ON TOP OF LAYER 6	0.0060		
CHANGE IN WATER STORAGE	-8.105	-29421.855	-26.86
SOIL WATER AT START OF YEAR	219.809	797906.062	
SOIL WATER AT END OF YEAR	211.704	768484.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.082	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2003

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.50	1.71	5.08	3.30	0.55	0.36
	0.13	0.29	0.69	8.88	6.15	4.65
RUNOFF	0.034	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	1.233	0.003	0.000
EVAPOTRANSPIRATION	1.157	1.266	2.328	3.606	0.633	0.676
	1.803	0.429	0.687	1.105	0.905	0.956
LATERAL DRAINAGE COLLECTED	0.2681	0.5185	0.7815	1.0402	1.3887	1.1436
FROM LAYER 3	0.5165	0.0000	0.0000	0.0000	0.4264	0.1562
PERCOLATION/LEAKAGE THROUGH	0.6888	1.0532	1.3849	1.8003	2.2160	1.9767
LAYER 4	0.9204	0.0000	0.0000	0.0000	0.9877	0.4994
LATERAL DRAINAGE COLLECTED	0.5960	0.9319	1.2349	1.6134	2.0000	1.7769
FROM LAYER 5	0.8246	0.0000	0.0000	0.0000	0.8665	0.4250
PERCOLATION/LEAKAGE THROUGH	0.0928	0.1213	0.1499	0.1868	0.2160	0.1998
LAYER 6	0.0958	0.0000	0.0000	0.0000	0.1212	0.0744

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.048	0.102	0.139	0.191	0.247	0.210
TOP OF LAYER 4	0.092	0.000	0.000	0.000	0.078	0.028
STD. DEVIATION OF DAILY	0.055	0.104	0.117	0.098	0.012	0.010
HEAD ON TOP OF LAYER 4	0.103	0.000	0.000	0.000	0.078	0.034
AVERAGE DAILY HEAD ON	0.003	0.006	0.007	0.009	0.011	0.010
TOP OF LAYER 6	0.004	0.000	0.000	0.000	0.005	0.002
STD. DEVIATION OF DAILY	0.003	0.004	0.004	0.003	0.000	0.000
HEAD ON TOP OF LAYER 6	0.005	0.000	0.000	0.000	0.003	0.002

ANNUAL TOTALS FOR YEAR 2003

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.29	146252.687	100.00
RUNOFF	1.270	4610.724	3.15
EVAPOTRANSPIRATION	15.551	56449.172	38.60
DRAINAGE COLLECTED FROM LAYER 3	6.2398	22650.316	15.49
PERC./LEAKAGE THROUGH LAYER 4	11.527400	41844.461	28.61
AVG. HEAD ON TOP OF LAYER 4	0.0947		
DRAINAGE COLLECTED FROM LAYER 5	10.2692	37277.199	25.49
PERC./LEAKAGE THROUGH LAYER 6	1.258191	4567.234	3.12
AVG. HEAD ON TOP OF LAYER 6	0.0047		
CHANGE IN WATER STORAGE	5.702	20698.078	14.15
SOIL WATER AT START OF YEAR	211.704	768484.250	
SOIL WATER AT END OF YEAR	217.406	789182.312	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.037	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1994 THROUGH 2003

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	6.10	4.60	4.39	3.00	1.73	1.64
	0.72	0.69	1.04	4.26	7.00	6.46
STD. DEVIATIONS	2.31	2.44	1.57	1.89	0.67	0.93
	0.49	0.68	0.85	2.22	3.22	2.60
RUNOFF						
TOTALS	0.025	0.108	0.002	0.028	0.000	0.001
	0.000	0.000	0.000	0.130	0.324	0.070
STD. DEVIATIONS	0.039	0.261	0.004	0.084	0.000	0.004
	0.000	0.000	0.000	0.388	0.475	0.074
EVAPOTRANSPIRATION						
TOTALS	1.137	1.282	2.254	2.635	1.930	1.733
	2.299	1.004	0.812	1.078	0.960	0.924
STD. DEVIATIONS	0.031	0.060	0.098	0.756	0.769	0.753
	0.536	0.489	0.623	0.340	0.099	0.028
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.4757	0.6690	0.9367	1.6194	1.5572	1.3517
	1.0838	0.5127	0.2035	0.0047	0.1249	0.1544
STD. DEVIATIONS	0.1637	0.2492	0.4755	0.7889	0.6748	0.5474
	0.5254	0.6063	0.3487	0.0132	0.1268	0.0915
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	1.0269	1.2481	1.5998	2.2397	2.2308	2.0592
	1.7683	0.8535	0.3506	0.0257	0.3631	0.4587
STD. DEVIATIONS	0.2770	0.2913	0.4524	0.6323	0.7204	0.6531
	0.7249	1.0035	0.6011	0.0685	0.3015	0.2223
LATERAL DRAINAGE COLLECTED FROM LAYER 5						
TOTALS	0.9023	1.1077	1.4296	2.0298	2.0198	1.8601

	1.5914	0.7682	0.3149	0.0211	0.3111	0.3925
STD. DEVIATIONS	0.2505	0.2689	0.4218	0.5964	0.6698	0.6035
	0.6632	0.9043	0.5399	0.0567	0.2632	0.1958

PERCOLATION/LEAKAGE THROUGH LAYER 6

TOTALS	0.1246	0.1404	0.1702	0.2099	0.2110	0.1991
	0.1769	0.0853	0.0357	0.0046	0.0520	0.0662
STD. DEVIATIONS	0.0267	0.0229	0.0314	0.0363	0.0510	0.0499
	0.0619	0.0992	0.0611	0.0118	0.0388	0.0270

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0847	0.1308	0.1667	0.2977	0.2770	0.2485
	0.1928	0.0912	0.0374	0.0008	0.0230	0.0276
STD. DEVIATIONS	0.0291	0.0486	0.0846	0.1450	0.1200	0.1006
	0.0934	0.1079	0.0641	0.0024	0.0233	0.0163

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.0049	0.0066	0.0077	0.0111	0.0107	0.0102
	0.0085	0.0041	0.0017	0.0001	0.0018	0.0022
STD. DEVIATIONS	0.0013	0.0015	0.0022	0.0031	0.0035	0.0032
	0.0035	0.0048	0.0030	0.0003	0.0015	0.0011

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1994 THROUGH 2003

	INCHES		CU. FEET	PERCENT
PRECIPITATION	41.65	(7.244)	151182.3	100.00
RUNOFF	0.688	(0.5605)	2497.39	1.652
EVAPOTRANSPIRATION	18.048	(2.5449)	65514.14	43.335
LATERAL DRAINAGE COLLECTED FROM LAYER 3	8.69382	(3.67501)	31558.576	20.87452
PERCOLATION/LEAKAGE THROUGH LAYER 4	14.22431	(4.27308)	51634.262	34.15365

AVERAGE HEAD ON TOP OF LAYER 4	0.132 (0.055)			
LATERAL DRAINAGE COLLECTED FROM LAYER 5	12.74842 (3.92994)	46276.773	30.60992	
PERCOLATION/LEAKAGE THROUGH LAYER 6	1.47589 (0.34378)	5357.485	3.54373	
AVERAGE HEAD ON TOP OF LAYER 6	0.006 (0.002)			
CHANGE IN WATER STORAGE	-0.006 (7.4868)	-22.12	-0.015	

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PEAK DAILY VALUES FOR YEARS 1994 THROUGH 2003

	(INCHES)	(CU. FT.)
PRECIPITATION	4.20	15245.999
RUNOFF	1.406	5103.3672
DRAINAGE COLLECTED FROM LAYER 3	0.12265	445.21701
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.119104	432.34674
AVERAGE HEAD ON TOP OF LAYER 4	0.676	
MAXIMUM HEAD ON TOP OF LAYER 4	1.214	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	12.8 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.10990	398.93909
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.009203	33.40766
AVERAGE HEAD ON TOP OF LAYER 6	0.018	
MAXIMUM HEAD ON TOP OF LAYER 6	0.024	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	0.42	1516.4022

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3332
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0627

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 2003

LAYER	(INCHES)	(VOL/VOL)
1	4.2330	0.2352
2	211.8501	0.3048
3	0.6216	0.0518
4	0.0000	0.0000
5	0.0025	0.0100
6	0.0000	0.0000
SNOW WATER	0.000	

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 **              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                **
 **                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                 **
 **                  DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
 **                    USAE WATERWAYS EXPERIMENT STATION                      **
 **             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY               **
 **                                                                           **
 **                                                                           **
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 PRECIPITATION DATA FILE:    C:\tlf\PRECIP.D4
 TEMPERATURE DATA FILE:      C:\tLF\TEMP.D7
 SOLAR RADIATION DATA FILE:  C:\tLF\SOLARRAD.D13
 EVAPOTRANSPIRATION DATA:    C:\tLF\ET_CVR.D11
 SOIL AND DESIGN DATA FILE:  C:\tLF\FLOOR2R1.D10
 OUTPUT DATA FILE:           C:\tLF\FLOOR2R1.OUT

 TIME:  10: 6     DATE:   4/27/2005

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      TITLE:  Tacoma Landfill Central Area HELP Evaluation - Cover Area

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      NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
               WERE SPECIFIED BY THE USER.

                                  LAYER  1
                                  --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER  45
             THICKNESS                    =      0.01   INCHES
             POROSITY                     =      0.0030 VOL/VOL
             FIELD CAPACITY               =      0.0020 VOL/VOL
             WILTING POINT                =      0.0010 VOL/VOL
             INITIAL SOIL WATER CONTENT   =      0.0030 VOL/VOL
             EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
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LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 5

THICKNESS	=	18.00	INCHES
POROSITY	=	0.4570	VOL/VOL
FIELD CAPACITY	=	0.1310	VOL/VOL
WILTING POINT	=	0.0580	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2404	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	695.00	INCHES
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2963	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 4

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 50

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3200	VOL/VOL
FIELD CAPACITY	=	0.0500	VOL/VOL
WILTING POINT	=	0.0200	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0511	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.200000003000	CM/SEC
SLOPE	=	2.00	PERCENT
DRAINAGE LENGTH	=	125.0	FEET

LAYER 5

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL

INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	4.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 6

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.25	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	2.00	PERCENT
DRAINAGE LENGTH	=	125.0	FEET

LAYER 7

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	4.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #16 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 125. FEET.

SCS RUNOFF CURVE NUMBER	=	96.90	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	24.0	INCHES

INITIAL WATER IN EVAPORATIVE ZONE	=	6.103	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	12.247	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.505	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	210.871	INCHES
TOTAL INITIAL WATER	=	210.871	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
Tacoma WASHINGTON

STATION LATITUDE	=	47.25	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	126	
END OF GROWING SEASON (JULIAN DATE)	=	287	
EVAPORATIVE ZONE DEPTH	=	24.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	9.10	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	75.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	70.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	79.00	%

NOTE: PRECIPITATION DATA FOR TACOMA WA
WAS ENTERED FROM AN ASCII DATA FILE.

NOTE: TEMPERATURE DATA FOR TACOMA WA
WAS ENTERED FROM AN ASCII DATA FILE.

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SEATTLE WASHINGTON
AND STATION LATITUDE = 47.25 DEGREES

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1994

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC

PRECIPITATION	3.54	4.72	4.02	2.44	1.63	2.04
	0.27	0.36	1.82	4.52	5.24	7.52
RUNOFF	0.884	1.392	1.230	0.482	0.246	0.253
	0.001	0.004	0.347	2.148	1.665	3.512
EVAPOTRANSPIRATION	1.273	1.225	2.493	1.902	1.424	1.841
	0.397	0.275	1.592	0.570	1.005	0.992
LATERAL DRAINAGE COLLECTED	0.3234	0.8302	0.4153	0.8407	0.4578	0.0066
FROM LAYER 4	0.0058	0.0031	0.0006	0.0001	0.1238	0.2633
PERCOLATION/LEAKAGE THROUGH	0.9169	1.6178	0.9615	1.6912	0.9140	0.0924
LAYER 5	0.0866	0.0596	0.0117	0.0011	0.4387	0.6437
LATERAL DRAINAGE COLLECTED	0.7954	1.4445	0.8439	1.5079	0.8058	0.0630
FROM LAYER 6	0.0561	0.0360	0.0067	0.0005	0.3720	0.5579
PERCOLATION/LEAKAGE THROUGH	0.1216	0.1733	0.1175	0.1833	0.1082	0.0295
LAYER 7	0.0305	0.0236	0.0051	0.0006	0.0667	0.0858

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.058	0.164	0.074	0.155	0.081	0.001
TOP OF LAYER 5	0.001	0.001	0.000	0.000	0.023	0.047
STD. DEVIATION OF DAILY	0.044	0.031	0.073	0.015	0.092	0.001
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.028	0.069
AVERAGE DAILY HEAD ON	0.004	0.009	0.005	0.008	0.004	0.000
TOP OF LAYER 7	0.000	0.000	0.000	0.000	0.002	0.003
STD. DEVIATION OF DAILY	0.002	0.001	0.003	0.000	0.004	0.000
HEAD ON TOP OF LAYER 7	0.000	0.000	0.000	0.000	0.002	0.003

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ANNUAL TOTALS FOR YEAR 1994

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.12	138375.609	100.00
RUNOFF	12.164	44154.566	31.91
EVAPOTRANSPIRATION	14.989	54409.203	39.32
DRAINAGE COLLECTED FROM LAYER 4	3.2708	11872.844	8.58

PERC./LEAKAGE THROUGH LAYER 5	7.435317	26990.201	19.51
AVG. HEAD ON TOP OF LAYER 5	0.0504		
DRAINAGE COLLECTED FROM LAYER 6	6.4898	23557.916	17.02
PERC./LEAKAGE THROUGH LAYER 7	0.945533	3432.286	2.48
AVG. HEAD ON TOP OF LAYER 7	0.0031		
CHANGE IN WATER STORAGE	0.261	948.820	0.69
SOIL WATER AT START OF YEAR	211.487	767698.062	
SOIL WATER AT END OF YEAR	211.748	768646.875	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.026	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1995

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.29	5.37	4.19	2.30	0.96	0.91
	1.49	1.12	1.70	4.23	9.90	7.40
RUNOFF	1.171	2.627	1.002	0.209	0.126	0.024
	0.433	0.273	0.401	1.482	5.185	3.161
EVAPOTRANSPIRATION	1.221	1.433	2.376	2.011	1.101	0.736
	1.313	0.518	0.702	1.809	1.145	1.000
LATERAL DRAINAGE COLLECTED	0.4129	0.4532	0.5169	0.7705	0.8435	0.0077
FROM LAYER 4	0.0016	0.0001	0.0008	0.0005	0.1089	0.1352
PERCOLATION/LEAKAGE THROUGH	1.0164	1.0229	1.2031	1.5996	1.5960	0.1108
LAYER 5	0.0251	0.0009	0.0109	0.0084	0.4527	0.3849
LATERAL DRAINAGE COLLECTED	0.8892	0.8972	1.0565	1.4226	1.4236	0.0755
FROM LAYER 6	0.0158	0.0004	0.0071	0.0056	0.3737	0.3308
PERCOLATION/LEAKAGE THROUGH	0.1271	0.1257	0.1467	0.1770	0.1724	0.0352
LAYER 7	0.0093	0.0004	0.0038	0.0028	0.0789	0.0541

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.073	0.089	0.092	0.142	0.150	0.002
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.020	0.024
STD. DEVIATION OF DAILY	0.069	0.089	0.079	0.040	0.072	0.000
HEAD ON TOP OF LAYER 5	0.001	0.000	0.001	0.000	0.029	0.041
AVERAGE DAILY HEAD ON	0.005	0.005	0.006	0.008	0.008	0.001
TOP OF LAYER 7	0.000	0.000	0.000	0.000	0.002	0.002
STD. DEVIATION OF DAILY	0.003	0.003	0.003	0.001	0.003	0.000
HEAD ON TOP OF LAYER 7	0.000	0.000	0.000	0.000	0.002	0.003

ANNUAL TOTALS FOR YEAR 1995

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.86	159211.797	100.00
RUNOFF	16.095	58423.766	36.70
EVAPOTRANSPIRATION	15.367	55781.785	35.04
DRAINAGE COLLECTED FROM LAYER 4	3.2517	11803.685	7.41
PERC./LEAKAGE THROUGH LAYER 5	7.431584	26976.650	16.94
AVG. HEAD ON TOP OF LAYER 5	0.0494		
DRAINAGE COLLECTED FROM LAYER 6	6.4981	23587.943	14.82
PERC./LEAKAGE THROUGH LAYER 7	0.933526	3388.701	2.13
AVG. HEAD ON TOP OF LAYER 7	0.0030		
CHANGE IN WATER STORAGE	1.715	6225.880	3.91
SOIL WATER AT START OF YEAR	211.748	768646.875	
SOIL WATER AT END OF YEAR	213.464	774872.812	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00

ANNUAL WATER BUDGET BALANCE	0.0000	0.040	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1996

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.55	8.56	1.61	7.69	2.55	1.66
	0.59	0.43	1.32	5.09	6.61	11.27
RUNOFF	3.301	4.916	0.161	3.415	0.639	0.000
	0.009	0.024	0.157	1.677	2.569	5.346
EVAPOTRANSPIRATION	1.183	1.412	1.972	3.596	2.149	1.364
	0.680	0.437	1.454	1.180	1.038	0.947
LATERAL DRAINAGE COLLECTED	0.4451	0.2946	0.9728	1.2472	1.0459	0.2430
FROM LAYER 4	0.0097	0.0047	0.0007	0.0023	0.2433	0.1450
PERCOLATION/LEAKAGE THROUGH	1.0000	0.7546	1.7982	2.0650	1.9152	0.5674
LAYER 5	0.1495	0.0739	0.0124	0.0123	0.7965	0.4080
LATERAL DRAINAGE COLLECTED	0.8760	0.6554	1.6076	1.8603	1.7160	0.4871
FROM LAYER 6	0.1066	0.0470	0.0071	0.0094	0.6828	0.3470
PERCOLATION/LEAKAGE THROUGH	0.1240	0.0992	0.1906	0.2047	0.1991	0.0803
LAYER 7	0.0429	0.0269	0.0053	0.0029	0.1137	0.0610

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.079	0.056	0.173	0.229	0.186	0.045
TOP OF LAYER 5	0.002	0.001	0.000	0.000	0.045	0.026
STD. DEVIATION OF DAILY	0.078	0.068	0.072	0.012	0.029	0.079
HEAD ON TOP OF LAYER 5	0.001	0.000	0.000	0.002	0.031	0.049
AVERAGE DAILY HEAD ON	0.005	0.004	0.009	0.010	0.009	0.003
TOP OF LAYER 7	0.001	0.000	0.000	0.000	0.004	0.002
STD. DEVIATION OF DAILY	0.003	0.003	0.002	0.000	0.001	0.004
HEAD ON TOP OF LAYER 7	0.000	0.000	0.000	0.000	0.002	0.003

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ANNUAL TOTALS FOR YEAR 1996

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.93	199395.891	100.00
RUNOFF	22.214	80637.609	40.44
EVAPOTRANSPIRATION	17.412	63205.242	31.70
DRAINAGE COLLECTED FROM LAYER 4	4.6543	16895.115	8.47
PERC./LEAKAGE THROUGH LAYER 5	9.553142	34677.902	17.39
AVG. HEAD ON TOP OF LAYER 5	0.0702		
DRAINAGE COLLECTED FROM LAYER 6	8.4023	30500.521	15.30
PERC./LEAKAGE THROUGH LAYER 7	1.150797	4177.392	2.10
AVG. HEAD ON TOP OF LAYER 7	0.0039		
CHANGE IN WATER STORAGE	1.096	3980.116	2.00
SOIL WATER AT START OF YEAR	213.464	774872.812	
SOIL WATER AT END OF YEAR	214.560	778852.875	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.113	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1997

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.81	2.84	7.84	2.86	2.06	2.62
	1.43	1.22	2.78	6.20	3.52	3.33

RUNOFF	3.694	0.902	3.086	0.000	0.000	0.480
	0.373	0.101	0.502	2.254	0.721	1.367
EVAPOTRANSPIRATION	1.205	1.342	2.307	3.006	2.126	2.172
	1.630	0.489	1.936	1.756	1.137	0.978
LATERAL DRAINAGE COLLECTED	0.2912	0.6120	0.6508	0.9734	1.2690	1.0147
FROM LAYER 4	0.0019	0.0000	0.0006	0.1505	0.2702	0.2938
PERCOLATION/LEAKAGE THROUGH	0.6950	1.2888	1.3122	1.7593	2.1168	1.7666
LAYER 5	0.0330	0.0000	0.0077	0.5340	0.8360	0.8757
LATERAL DRAINAGE COLLECTED	0.6032	1.1399	1.1628	1.5742	1.9062	1.5848
FROM LAYER 6	0.0236	0.0000	0.0047	0.4564	0.7187	0.7540
PERCOLATION/LEAKAGE THROUGH	0.0918	0.1489	0.1495	0.1850	0.2106	0.1818
LAYER 7	0.0094	0.0000	0.0030	0.0776	0.1173	0.1217

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.052	0.121	0.116	0.179	0.226	0.187
TOP OF LAYER 5	0.000	0.000	0.000	0.027	0.050	0.052
STD. DEVIATION OF DAILY	0.082	0.086	0.086	0.077	0.015	0.071
HEAD ON TOP OF LAYER 5	0.001	0.000	0.000	0.031	0.045	0.055
AVERAGE DAILY HEAD ON	0.003	0.007	0.006	0.009	0.010	0.009
TOP OF LAYER 7	0.000	0.000	0.000	0.003	0.004	0.004
STD. DEVIATION OF DAILY	0.003	0.003	0.004	0.002	0.000	0.003
HEAD ON TOP OF LAYER 7	0.000	0.000	0.000	0.002	0.002	0.002

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ANNUAL TOTALS FOR YEAR 1997

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.51	161571.266	100.00
RUNOFF	13.479	48929.133	30.28
EVAPOTRANSPIRATION	20.084	72904.656	45.12
DRAINAGE COLLECTED FROM LAYER 4	5.5281	20066.873	12.42
PERC./LEAKAGE THROUGH LAYER 5	11.225141	40747.262	25.22
AVG. HEAD ON TOP OF LAYER 5	0.0841		

DRAINAGE COLLECTED FROM LAYER 6	9.9287	36041.180	22.31
PERC./LEAKAGE THROUGH LAYER 7	1.296434	4706.054	2.91
AVG. HEAD ON TOP OF LAYER 7	0.0046		
CHANGE IN WATER STORAGE	-5.806	-21076.609	-13.04
SOIL WATER AT START OF YEAR	214.560	778852.875	
SOIL WATER AT END OF YEAR	208.754	757776.312	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.019	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1998

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.38	2.59	4.52	0.98	2.09	0.83
	0.94	0.00	0.24	3.53	11.21	9.17
RUNOFF	3.188	0.271	1.381	0.043	0.557	0.051
	0.000	0.000	0.000	0.079	6.380	4.502
EVAPOTRANSPIRATION	1.191	1.412	2.249	1.654	1.316	0.793
	0.778	0.242	0.205	1.297	1.107	0.953
LATERAL DRAINAGE COLLECTED	0.2778	0.4445	0.4354	0.9067	0.3438	0.0107
FROM LAYER 4	0.0040	0.0000	0.0001	0.0004	0.1861	0.1275
PERCOLATION/LEAKAGE THROUGH	0.7225	1.0091	1.1506	1.7567	0.6859	0.1271
LAYER 5	0.0520	0.0000	0.0019	0.0050	0.5777	0.4146
LATERAL DRAINAGE COLLECTED	0.6240	0.8896	1.0037	1.5695	0.5990	0.0883
FROM LAYER 6	0.0348	0.0000	0.0011	0.0028	0.4931	0.3498
PERCOLATION/LEAKAGE THROUGH	0.0985	0.1195	0.1469	0.1872	0.0869	0.0388
LAYER 7	0.0173	0.0000	0.0008	0.0022	0.0846	0.0648

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.050	0.088	0.077	0.167	0.061	0.002
TOP OF LAYER 5	0.001	0.000	0.000	0.000	0.034	0.023
STD. DEVIATION OF DAILY	0.065	0.072	0.053	0.016	0.094	0.000
HEAD ON TOP OF LAYER 5	0.001	0.000	0.000	0.000	0.043	0.037
AVERAGE DAILY HEAD ON	0.003	0.005	0.006	0.009	0.003	0.001
TOP OF LAYER 7	0.000	0.000	0.000	0.000	0.003	0.002
STD. DEVIATION OF DAILY	0.003	0.003	0.002	0.000	0.004	0.000
HEAD ON TOP OF LAYER 7	0.000	0.000	0.000	0.000	0.003	0.002

ANNUAL TOTALS FOR YEAR 1998

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.48	161462.453	100.00
RUNOFF	16.453	59723.187	36.99
EVAPOTRANSPIRATION	13.196	47902.043	29.67
DRAINAGE COLLECTED FROM LAYER 4	2.7371	9935.675	6.15
PERC./LEAKAGE THROUGH LAYER 5	6.503251	23606.799	14.62
AVG. HEAD ON TOP OF LAYER 5	0.0419		
DRAINAGE COLLECTED FROM LAYER 6	5.6559	20530.973	12.72
PERC./LEAKAGE THROUGH LAYER 7	0.847336	3075.828	1.90
AVG. HEAD ON TOP OF LAYER 7	0.0027		
CHANGE IN WATER STORAGE	5.591	20294.678	12.57
SOIL WATER AT START OF YEAR	208.754	757776.312	
SOIL WATER AT END OF YEAR	214.345	778071.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.071	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1999

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.62	8.31	5.03	1.53	1.84	1.78
	1.01	0.44	0.20	2.93	10.67	5.10
RUNOFF	4.203	3.510	1.333	0.094	0.246	0.633
	0.199	0.000	0.000	0.692	5.497	1.946
EVAPOTRANSPIRATION	1.216	1.344	2.371	2.102	2.061	0.582
	1.322	0.439	0.279	0.903	1.151	1.019
LATERAL DRAINAGE COLLECTED	0.5235	0.2439	0.5661	1.4026	1.3359	1.0907
FROM LAYER 4	0.3460	0.0000	0.0004	0.0004	0.0519	0.1172
PERCOLATION/LEAKAGE THROUGH	1.0735	0.6483	1.2094	2.1875	2.1728	1.9303
LAYER 5	0.6310	0.0000	0.0049	0.0057	0.1928	0.3932
LATERAL DRAINAGE COLLECTED	0.9476	0.5590	1.0684	1.9763	1.9591	1.7330
FROM LAYER 6	0.5592	0.0000	0.0031	0.0034	0.1594	0.3297
PERCOLATION/LEAKAGE THROUGH	0.1259	0.0893	0.1410	0.2112	0.2136	0.1972
LAYER 7	0.0719	0.0000	0.0018	0.0023	0.0334	0.0634

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.093	0.048	0.101	0.258	0.238	0.200
TOP OF LAYER 5	0.062	0.000	0.000	0.000	0.010	0.021
STD. DEVIATION OF DAILY	0.100	0.057	0.083	0.030	0.013	0.008
HEAD ON TOP OF LAYER 5	0.097	0.000	0.000	0.000	0.019	0.034
AVERAGE DAILY HEAD ON	0.005	0.003	0.006	0.011	0.010	0.010
TOP OF LAYER 7	0.003	0.000	0.000	0.000	0.001	0.002
STD. DEVIATION OF DAILY	0.004	0.003	0.003	0.001	0.000	0.000
HEAD ON TOP OF LAYER 7	0.004	0.000	0.000	0.000	0.002	0.002

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ANNUAL TOTALS FOR YEAR 1999

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.46	172279.812	100.00
RUNOFF	18.353	66620.781	38.67
EVAPOTRANSPIRATION	14.791	53690.051	31.16
DRAINAGE COLLECTED FROM LAYER 4	5.6784	20612.771	11.96
PERC./LEAKAGE THROUGH LAYER 5	10.449306	37930.980	22.02
AVG. HEAD ON TOP OF LAYER 5	0.0859		
DRAINAGE COLLECTED FROM LAYER 6	9.2983	33752.652	19.59
PERC./LEAKAGE THROUGH LAYER 7	1.151059	4178.343	2.43
AVG. HEAD ON TOP OF LAYER 7	0.0043		
CHANGE IN WATER STORAGE	-1.811	-6574.722	-3.82
SOIL WATER AT START OF YEAR	214.345	778071.000	
SOIL WATER AT END OF YEAR	212.533	771496.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.068	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2000

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.04	5.93	4.18	1.56	2.56	1.33
	0.72	0.77	0.87	3.53	3.65	2.80
RUNOFF	0.798	2.474	0.110	0.105	0.328	0.277
	0.229	0.000	0.037	0.082	1.291	0.418

EVAPOTRANSPIRATION	1.162	1.400	2.322	2.209	2.126	1.561
	0.393	0.364	0.969	1.445	1.060	0.997
LATERAL DRAINAGE COLLECTED	0.5205	0.6022	0.5597	0.7527	1.0060	0.1639
FROM LAYER 4	0.0010	0.0023	0.0015	0.0002	0.1761	0.4167
PERCOLATION/LEAKAGE THROUGH	1.1520	1.3501	1.3460	1.5913	1.8832	0.3221
LAYER 5	0.0161	0.0347	0.0192	0.0023	0.6307	1.0792
LATERAL DRAINAGE COLLECTED	1.0139	1.1928	1.1838	1.4144	1.6858	0.2806
FROM LAYER 6	0.0112	0.0243	0.0124	0.0012	0.5370	0.9410
PERCOLATION/LEAKAGE THROUGH	0.1381	0.1574	0.1622	0.1769	0.1974	0.0415
LAYER 7	0.0049	0.0105	0.0068	0.0012	0.0936	0.1381

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.093	0.115	0.100	0.138	0.179	0.030
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.032	0.074
STD. DEVIATION OF DAILY	0.082	0.060	0.051	0.029	0.009	0.076
HEAD ON TOP OF LAYER 5	0.001	0.001	0.001	0.000	0.031	0.054
AVERAGE DAILY HEAD ON	0.006	0.007	0.006	0.008	0.009	0.002
TOP OF LAYER 7	0.000	0.000	0.000	0.000	0.003	0.005
STD. DEVIATION OF DAILY	0.003	0.002	0.002	0.001	0.000	0.003
HEAD ON TOP OF LAYER 7	0.000	0.000	0.000	0.000	0.002	0.003

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ANNUAL TOTALS FOR YEAR 2000

	INCHES	CU. FEET	PERCENT
PRECIPITATION	31.94	115942.289	100.00
RUNOFF	6.150	22324.309	19.25
EVAPOTRANSPIRATION	16.006	58102.777	50.11
DRAINAGE COLLECTED FROM LAYER 4	4.2030	15256.960	13.16
PERC./LEAKAGE THROUGH LAYER 5	9.427004	34220.023	29.51
AVG. HEAD ON TOP OF LAYER 5	0.0635		
DRAINAGE COLLECTED FROM LAYER 6	8.2984	30123.227	25.98

PERC./LEAKAGE THROUGH LAYER 7	1.128597	4096.808	3.53
AVG. HEAD ON TOP OF LAYER 7	0.0038		
CHANGE IN WATER STORAGE	-3.846	-13961.896	-12.04
SOIL WATER AT START OF YEAR	212.533	771496.250	
SOIL WATER AT END OF YEAR	208.687	757534.375	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.107	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2001

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.77	2.36	3.24	3.70	1.93	3.53
	0.20	2.25	0.46	3.32	10.13	6.82
RUNOFF	0.645	0.582	0.363	0.963	0.445	1.274
	0.003	0.829	0.077	0.791	5.965	2.583
EVAPOTRANSPIRATION	1.209	1.360	2.522	2.979	2.161	2.037
	0.632	1.078	0.504	0.672	1.116	1.006
LATERAL DRAINAGE COLLECTED	0.2944	0.4566	0.0453	0.0131	0.0074	0.0029
FROM LAYER 4	0.0001	0.0005	0.0001	0.0000	0.0542	0.1316
PERCOLATION/LEAKAGE THROUGH	0.8659	1.1697	0.3445	0.1509	0.1154	0.0399
LAYER 5	0.0016	0.0070	0.0008	0.0000	0.1990	0.3965
LATERAL DRAINAGE COLLECTED	0.7446	1.0261	0.2731	0.1110	0.0823	0.0263
FROM LAYER 6	0.0009	0.0044	0.0004	0.0000	0.1639	0.3374
PERCOLATION/LEAKAGE THROUGH	0.1213	0.1437	0.0715	0.0399	0.0332	0.0135
LAYER 7	0.0007	0.0026	0.0004	0.0000	0.0350	0.0591

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.052	0.090	0.008	0.003	0.001	0.001
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.010	0.024
STD. DEVIATION OF DAILY	0.049	0.042	0.005	0.002	0.001	0.001
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.024	0.037
AVERAGE DAILY HEAD ON	0.004	0.006	0.002	0.001	0.001	0.000
TOP OF LAYER 7	0.000	0.000	0.000	0.000	0.001	0.002
STD. DEVIATION OF DAILY	0.002	0.001	0.001	0.000	0.000	0.000
HEAD ON TOP OF LAYER 7	0.000	0.000	0.000	0.000	0.002	0.002

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ANNUAL TOTALS FOR YEAR 2001

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.71	147777.328	100.00
RUNOFF	14.519	52702.937	35.66
EVAPOTRANSPIRATION	17.276	62713.398	42.44
DRAINAGE COLLECTED FROM LAYER 4	1.0062	3652.539	2.47
PERC./LEAKAGE THROUGH LAYER 5	3.291252	11947.244	8.08
AVG. HEAD ON TOP OF LAYER 5	0.0158		
DRAINAGE COLLECTED FROM LAYER 6	2.7704	10056.590	6.81
PERC./LEAKAGE THROUGH LAYER 7	0.520840	1890.650	1.28
AVG. HEAD ON TOP OF LAYER 7	0.0014		
CHANGE IN WATER STORAGE	4.617	16761.221	11.34
SOIL WATER AT START OF YEAR	208.687	757534.375	
SOIL WATER AT END OF YEAR	213.305	774295.562	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.015	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2002

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.53	3.56	4.16	3.64	1.14	1.36
	0.42	0.06	0.36	0.41	2.96	6.58
RUNOFF	0.438	1.035	1.384	1.159	0.025	0.252
	0.018	0.000	0.000	0.045	0.580	2.178
EVAPOTRANSPIRATION	1.198	1.391	2.327	2.283	1.008	0.862
	0.992	0.324	0.250	0.220	0.897	1.049
LATERAL DRAINAGE COLLECTED	0.4791	0.2963	0.9414	0.8716	1.1233	0.4993
FROM LAYER 4	0.0078	0.0046	0.0024	0.0017	0.0003	0.0354
PERCOLATION/LEAKAGE THROUGH	1.2011	0.8288	1.7569	1.6708	1.9912	0.9245
LAYER 5	0.1020	0.0738	0.0474	0.0374	0.0077	0.2175
LATERAL DRAINAGE COLLECTED	1.0504	0.7172	1.5691	1.4907	1.7875	0.8188
FROM LAYER 6	0.0686	0.0465	0.0276	0.0205	0.0040	0.1753
PERCOLATION/LEAKAGE THROUGH	0.1507	0.1116	0.1878	0.1802	0.2036	0.1056
LAYER 7	0.0334	0.0273	0.0198	0.0169	0.0037	0.0422

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.085	0.059	0.167	0.160	0.200	0.092
TOP OF LAYER 5	0.002	0.001	0.001	0.001	0.000	0.006
STD. DEVIATION OF DAILY	0.060	0.052	0.080	0.069	0.007	0.103
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.000	0.008
AVERAGE DAILY HEAD ON	0.006	0.004	0.008	0.008	0.010	0.005
TOP OF LAYER 7	0.000	0.000	0.000	0.000	0.000	0.001
STD. DEVIATION OF DAILY	0.002	0.003	0.002	0.002	0.000	0.005
HEAD ON TOP OF LAYER 7	0.000	0.000	0.000	0.000	0.000	0.001

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ANNUAL TOTALS FOR YEAR 2002

	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.18	109553.453	100.00
RUNOFF	7.114	25823.430	23.57
EVAPOTRANSPIRATION	12.800	46464.102	42.41
DRAINAGE COLLECTED FROM LAYER 4	4.2632	15475.322	14.13
PERC./LEAKAGE THROUGH LAYER 5	8.858938	32157.945	29.35
AVG. HEAD ON TOP OF LAYER 5	0.0645		
DRAINAGE COLLECTED FROM LAYER 6	7.7761	28227.217	25.77
PERC./LEAKAGE THROUGH LAYER 7	1.082847	3930.735	3.59
AVG. HEAD ON TOP OF LAYER 7	0.0036		
CHANGE IN WATER STORAGE	-2.856	-10367.401	-9.46
SOIL WATER AT START OF YEAR	213.305	774295.562	
SOIL WATER AT END OF YEAR	210.449	763928.187	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.051	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 2003

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.50	1.71	5.08	3.30	0.55	0.36
	0.13	0.29	0.69	8.88	6.15	4.65
RUNOFF	3.583	0.258	1.449	0.530	0.000	0.009
	0.000	0.001	0.005	5.450	2.546	1.104
EVAPOTRANSPIRATION	1.288	1.402	2.444	3.149	0.562	0.299
	0.238	0.212	0.503	1.399	1.011	1.010

LATERAL DRAINAGE COLLECTED	0.3511	0.3178	0.9413	0.6373	0.4856	0.0069
FROM LAYER 4	0.0035	0.0023	0.0016	0.0393	0.2921	0.1484
PERCOLATION/LEAKAGE THROUGH	0.8758	0.8144	1.7769	1.4054	0.9768	0.0955
LAYER 5	0.0620	0.0465	0.0356	0.1674	0.8207	0.5016
LATERAL DRAINAGE COLLECTED	0.7632	0.7109	1.5873	1.2427	0.8586	0.0634
FROM LAYER 6	0.0378	0.0267	0.0199	0.1387	0.7098	0.4248
PERCOLATION/LEAKAGE THROUGH	0.1127	0.1036	0.1895	0.1627	0.1182	0.0321
LAYER 7	0.0243	0.0198	0.0157	0.0287	0.1109	0.0768

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.063	0.063	0.167	0.117	0.086	0.002
TOP OF LAYER 5	0.001	0.001	0.001	0.007	0.054	0.027
STD. DEVIATION OF DAILY	0.066	0.059	0.058	0.059	0.095	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.016	0.053	0.029
AVERAGE DAILY HEAD ON	0.004	0.004	0.009	0.007	0.005	0.000
TOP OF LAYER 7	0.000	0.000	0.000	0.001	0.004	0.002
STD. DEVIATION OF DAILY	0.003	0.003	0.002	0.002	0.004	0.000
HEAD ON TOP OF LAYER 7	0.000	0.000	0.000	0.002	0.003	0.002

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ANNUAL TOTALS FOR YEAR 2003

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.29	146252.687	100.00
RUNOFF	14.933	54207.895	37.06
EVAPOTRANSPIRATION	13.517	49067.785	33.55
DRAINAGE COLLECTED FROM LAYER 4	3.2275	11715.829	8.01
PERC./LEAKAGE THROUGH LAYER 5	7.578812	27511.086	18.81
AVG. HEAD ON TOP OF LAYER 5	0.0489		
DRAINAGE COLLECTED FROM LAYER 6	6.5839	23899.588	16.34
PERC./LEAKAGE THROUGH LAYER 7	0.994903	3611.499	2.47
AVG. HEAD ON TOP OF LAYER 7	0.0031		

CHANGE IN WATER STORAGE	1.033	3750.140	2.56
SOIL WATER AT START OF YEAR	210.449	763928.187	
SOIL WATER AT END OF YEAR	211.482	767678.312	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.047	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1994 THROUGH 2003

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	6.10	4.60	4.39	3.00	1.73	1.64
	0.72	0.69	1.04	4.26	7.00	6.46
STD. DEVIATIONS	2.31	2.44	1.57	1.89	0.67	0.93
	0.49	0.68	0.85	2.22	3.22	2.60
RUNOFF						
TOTALS	2.191	1.797	1.150	0.700	0.261	0.325
	0.127	0.123	0.153	1.470	3.240	2.612
STD. DEVIATIONS	1.514	1.547	0.862	1.033	0.231	0.395
	0.170	0.263	0.192	1.630	2.280	1.543
EVAPOTRANSPIRATION						
TOTALS	1.214	1.372	2.338	2.489	1.603	1.225
	0.837	0.438	0.839	1.125	1.067	0.995
STD. DEVIATIONS	0.039	0.060	0.154	0.642	0.593	0.658
	0.464	0.248	0.621	0.523	0.081	0.030
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	0.3919	0.4551	0.6045	0.8416	0.7918	0.3046
	0.0381	0.0018	0.0009	0.0195	0.1507	0.1814
STD. DEVIATIONS	0.0965	0.1830	0.2892	0.3716	0.4432	0.4251

	0.1082	0.0019	0.0008	0.0476	0.0994	0.1106

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.9519	1.0505	1.2859	1.5878	1.4367	0.5977
	0.1159	0.0297	0.0153	0.0774	0.4953	0.5315
STD. DEVIATIONS	0.1688	0.3054	0.4412	0.5539	0.7118	0.7152
	0.1864	0.0318	0.0151	0.1683	0.2906	0.2621

LATERAL DRAINAGE COLLECTED FROM LAYER 6

TOTALS	0.8307	0.9233	1.1356	1.4170	1.2824	0.5221
	0.0915	0.0185	0.0090	0.0639	0.4215	0.4548
STD. DEVIATIONS	0.1523	0.2780	0.4048	0.5063	0.6487	0.6496
	0.1673	0.0199	0.0087	0.1443	0.2522	0.2317

PERCOLATION/LEAKAGE THROUGH LAYER 7

TOTALS	0.1212	0.1272	0.1503	0.1708	0.1543	0.0756
	0.0244	0.0111	0.0062	0.0135	0.0738	0.0767
STD. DEVIATIONS	0.0172	0.0276	0.0367	0.0480	0.0632	0.0658
	0.0215	0.0120	0.0065	0.0243	0.0387	0.0306

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	0.0698	0.0891	0.1076	0.1547	0.1409	0.0561
	0.0069	0.0005	0.0003	0.0035	0.0278	0.0324
STD. DEVIATIONS	0.0171	0.0359	0.0514	0.0683	0.0788	0.0781
	0.0192	0.0005	0.0002	0.0085	0.0182	0.0197

DAILY AVERAGE HEAD ON TOP OF LAYER 7

AVERAGES	0.0046	0.0055	0.0062	0.0079	0.0069	0.0030
	0.0006	0.0001	0.0001	0.0004	0.0025	0.0026
STD. DEVIATIONS	0.0008	0.0016	0.0021	0.0027	0.0034	0.0035
	0.0009	0.0002	0.0001	0.0008	0.0014	0.0013

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1994 THROUGH 2003

	INCHES	CU. FEET	PERCENT

PRECIPITATION	41.65 (7.244)	151182.3	100.00
RUNOFF	14.147 (4.8354)	51354.77	33.969
EVAPOTRANSPIRATION	15.544 (2.2453)	56424.10	37.322
LATERAL DRAINAGE COLLECTED FROM LAYER 4	3.78203 (1.39291)	13728.761	9.08093
PERCOLATION/LEAKAGE THROUGH LAYER 5	8.17537 (2.27331)	29676.611	19.62969
AVERAGE HEAD ON TOP OF LAYER 5	0.057 (0.021)		
LATERAL DRAINAGE COLLECTED FROM LAYER 6	7.17019 (2.06036)	26027.781	17.21616
PERCOLATION/LEAKAGE THROUGH LAYER 7	1.00519 (0.21522)	3648.830	2.41353
AVERAGE HEAD ON TOP OF LAYER 7	0.003 (0.001)		
CHANGE IN WATER STORAGE	-0.001 (3.6179)	-1.98	-0.001

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PEAK DAILY VALUES FOR YEARS 1994 THROUGH 2003

	(INCHES)	(CU. FT.)
PRECIPITATION	4.20	15245.999
RUNOFF	3.674	13337.0156
DRAINAGE COLLECTED FROM LAYER 4	0.06204	225.20006
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.084144	305.44318
AVERAGE HEAD ON TOP OF LAYER 5	0.342	
MAXIMUM HEAD ON TOP OF LAYER 5	0.639	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	8.2 FEET	
DRAINAGE COLLECTED FROM LAYER 6	0.07652	277.78464
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.007619	27.65855
AVERAGE HEAD ON TOP OF LAYER 7	0.013	
MAXIMUM HEAD ON TOP OF LAYER 7	0.017	
LOCATION OF MAXIMUM HEAD IN LAYER 6 (DISTANCE FROM DRAIN)	1.6 FEET	
SNOW WATER	0.42	1516.4022

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2979
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1302

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 2003

LAYER	(INCHES)	(VOL/VOL)
1	0.0019	0.2356
2	4.3275	0.2404
3	205.9208	0.2963
4	0.6132	0.0511
5	0.0000	0.0000
6	0.0025	0.0100
7	0.0000	0.0000
SNOW WATER	0.000	

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**                                                                              **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                   **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                    **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                       **
**                    USAE WATERWAYS EXPERIMENT STATION                         **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY                  **
**                                                                              **
**                                                                              **
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PRECIPITATION DATA FILE:    C:\tlf\PRECIP.D4
TEMPERATURE DATA FILE:      C:\tLF\TEMP.D7
SOLAR RADIATION DATA FILE:  C:\tLF\SOLARRAD.D13
EVAPOTRANSPIRATION DATA:    C:\tLF\EVAPTRAN.D11
SOIL AND DESIGN DATA FILE:  C:\tLF\ESS1R2.D10
OUTPUT DATA FILE:           C:\tLF\ess1r2.OUT


TIME:  15:30     DATE:   5/ 3/2005


**********************************************************************************

     TITLE:  Tacoma Landfill Central Area HELP Evaluation - Eastern SS

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                  LAYER  1
                                  --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   5
          THICKNESS                     =     18.00   INCHES
          POROSITY                      =      0.4570 VOL/VOL
          FIELD CAPACITY                =      0.1310 VOL/VOL
          WILTING POINT                 =      0.0580 VOL/VOL
          INITIAL SOIL WATER CONTENT    =      0.2376 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.100000005000E-02 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
                 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
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LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	348.00	INCHES
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3161	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.25	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0235	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	20.60	PERCENT
DRAINAGE LENGTH	=	300.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	4.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A
POOR STAND OF GRASS, A SURFACE SLOPE OF 2.%
AND A SLOPE LENGTH OF 300. FEET.

SCS RUNOFF CURVE NUMBER	=	77.00	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	24.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	6.173	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	12.252	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.506	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	114.285	INCHES
TOTAL INITIAL WATER	=	114.285	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
Tacoma WASHINGTON

STATION LATITUDE	=	47.25	DEGREES
MAXIMUM LEAF AREA INDEX	=	1.00	
START OF GROWING SEASON (JULIAN DATE)	=	126	
END OF GROWING SEASON (JULIAN DATE)	=	287	
EVAPORATIVE ZONE DEPTH	=	24.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	9.10	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	75.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	70.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	79.00	%

NOTE: PRECIPITATION DATA FOR TACOMA WA
WAS ENTERED FROM AN ASCII DATA FILE.

NOTE: TEMPERATURE DATA FOR TACOMA WA
WAS ENTERED FROM AN ASCII DATA FILE.

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SEATTLE WASHINGTON
AND STATION LATITUDE = 47.25 DEGREES

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1994

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.54	4.72	4.02	2.44	1.63	2.04
	0.27	0.36	1.82	4.52	5.24	7.52
RUNOFF	0.000	0.000	0.004	0.000	0.000	0.000
	0.000	0.000	0.000	0.003	0.092	0.146
EVAPOTRANSPIRATION	1.272	1.225	2.492	2.107	1.634	1.385
	0.351	0.458	0.918	0.508	1.008	0.997
LATERAL DRAINAGE COLLECTED	2.6319	3.4640	2.3451	3.1993	3.3423	2.3711
FROM LAYER 3	1.7656	0.0017	0.5506	0.4620	0.9639	0.7650
PERCOLATION/LEAKAGE THROUGH	0.1885	0.2249	0.1633	0.2257	0.2310	0.1820
LAYER 4	0.1302	0.0004	0.0557	0.0507	0.1037	0.0665

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.002	0.003	0.002	0.003	0.003	0.002
TOP OF LAYER 4	0.002	0.000	0.000	0.000	0.001	0.001
STD. DEVIATION OF DAILY	0.001	0.001	0.002	0.001	0.001	0.001
HEAD ON TOP OF LAYER 4	0.001	0.000	0.001	0.000	0.001	0.001

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ANNUAL TOTALS FOR YEAR 1994

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.12	138375.609	100.00
RUNOFF	0.246	891.345	0.64
EVAPOTRANSPIRATION	14.355	52108.641	37.66
DRAINAGE COLLECTED FROM LAYER 3	21.8625	79360.820	57.35
PERC./LEAKAGE THROUGH LAYER 4	1.622463	5889.540	4.26
AVG. HEAD ON TOP OF LAYER 4	0.0016		

CHANGE IN WATER STORAGE	0.035	125.291	0.09
SOIL WATER AT START OF YEAR	114.291	414877.344	
SOIL WATER AT END OF YEAR	114.326	415002.625	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.025	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1995

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.29	5.37	4.19	2.30	0.96	0.91
	1.49	1.12	1.70	4.23	9.90	7.40
RUNOFF	0.000	0.221	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.327	0.002
EVAPOTRANSPIRATION	1.231	1.443	2.388	2.223	1.291	1.039
	1.984	1.147	0.576	1.663	1.104	0.972
LATERAL DRAINAGE COLLECTED	2.6597	2.0632	3.3479	4.1203	3.2984	2.7915
FROM LAYER 3	0.9596	0.0110	0.0018	0.2507	0.8137	0.8399
PERCOLATION/LEAKAGE THROUGH	0.1956	0.1550	0.2243	0.2581	0.2352	0.2114
LAYER 4	0.0760	0.0026	0.0006	0.0390	0.0806	0.0757

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.002	0.002	0.003	0.004	0.003	0.002
TOP OF LAYER 4	0.001	0.000	0.000	0.000	0.001	0.001
STD. DEVIATION OF DAILY	0.001	0.002	0.002	0.001	0.000	0.001
HEAD ON TOP OF LAYER 4	0.001	0.000	0.000	0.000	0.001	0.001

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ANNUAL TOTALS FOR YEAR 1995

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.86	159211.797	100.00
RUNOFF	0.550	1997.882	1.25
EVAPOTRANSPIRATION	17.061	61932.984	38.90
DRAINAGE COLLECTED FROM LAYER 3	21.1577	76802.602	48.24
PERC./LEAKAGE THROUGH LAYER 4	1.553954	5640.854	3.54
AVG. HEAD ON TOP OF LAYER 4	0.0016		
CHANGE IN WATER STORAGE	3.536	12837.491	8.06
SOIL WATER AT START OF YEAR	114.326	415002.625	
SOIL WATER AT END OF YEAR	117.862	427840.125	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.011	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1996

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.55	8.56	1.61	7.69	2.55	1.66
	0.59	0.43	1.32	5.09	6.61	11.27
RUNOFF	0.036	0.929	0.000	0.245	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.201
EVAPOTRANSPIRATION	1.163	1.376	2.018	4.012	2.800	1.458
	1.390	0.798	0.983	1.319	1.003	0.936
LATERAL DRAINAGE COLLECTED	2.8595	5.3090	6.7221	4.7790	2.6823	3.2378

FROM LAYER 3	2.9662	0.5507	0.0071	0.1564	1.3228	1.2221
PERCOLATION/LEAKAGE THROUGH	0.1868	0.2719	0.3363	0.2714	0.1997	0.2288
LAYER 4	0.2230	0.0390	0.0024	0.0187	0.1151	0.0988

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.002	0.005	0.006	0.004	0.002	0.003
TOP OF LAYER 4	0.003	0.000	0.000	0.000	0.001	0.001
STD. DEVIATION OF DAILY	0.002	0.003	0.001	0.001	0.001	0.000
HEAD ON TOP OF LAYER 4	0.000	0.001	0.000	0.000	0.001	0.001

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ANNUAL TOTALS FOR YEAR 1996

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.93	199395.891	100.00
RUNOFF	1.411	5120.649	2.57
EVAPOTRANSPIRATION	19.256	69899.844	35.06
DRAINAGE COLLECTED FROM LAYER 3	31.8150	115488.367	57.92
PERC./LEAKAGE THROUGH LAYER 4	1.991874	7230.504	3.63
AVG. HEAD ON TOP OF LAYER 4	0.0023		
CHANGE IN WATER STORAGE	0.456	1656.476	0.83
SOIL WATER AT START OF YEAR	117.862	427840.125	
SOIL WATER AT END OF YEAR	118.319	429496.594	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.047	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1997

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.81	2.84	7.84	2.86	2.06	2.62
	1.43	1.22	2.78	6.20	3.52	3.33
RUNOFF	0.086	0.000	0.017	0.000	0.000	0.000
	0.000	0.000	0.000	0.004	0.000	0.064
EVAPOTRANSPIRATION	1.175	1.300	2.270	3.038	2.141	2.859
	2.158	1.252	1.784	1.544	1.083	0.936
LATERAL DRAINAGE COLLECTED	2.7516	5.1323	3.4539	6.3265	4.6466	3.1178
FROM LAYER 3	1.9347	0.0001	0.1321	0.9918	1.7515	0.9879
PERCOLATION/LEAKAGE THROUGH	0.1699	0.2751	0.2147	0.3211	0.2796	0.2234
LAYER 4	0.1571	0.0001	0.0161	0.0914	0.1538	0.1054

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.002	0.005	0.003	0.006	0.004	0.003
TOP OF LAYER 4	0.002	0.000	0.000	0.001	0.002	0.001
STD. DEVIATION OF DAILY	0.002	0.002	0.002	0.001	0.000	0.001
HEAD ON TOP OF LAYER 4	0.001	0.000	0.000	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 1997

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.51	161571.266	100.00
RUNOFF	0.171	621.095	0.38
EVAPOTRANSPIRATION	21.541	78195.305	48.40
DRAINAGE COLLECTED FROM LAYER 3	31.2269	113353.570	70.16
PERC./LEAKAGE THROUGH LAYER 4	2.007699	7287.948	4.51
AVG. HEAD ON TOP OF LAYER 4	0.0023		

CHANGE IN WATER STORAGE	-10.437	-37886.574	-23.45
SOIL WATER AT START OF YEAR	118.319	429496.594	
SOIL WATER AT END OF YEAR	107.882	391610.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.080	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1998

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.38	2.59	4.52	0.98	2.09	0.83
	0.94	0.00	0.24	3.53	11.21	9.17
RUNOFF	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.611	0.094
EVAPOTRANSPIRATION	1.170	1.391	2.177	1.577	1.408	0.631
	0.865	0.154	0.070	0.662	1.112	0.959
LATERAL DRAINAGE COLLECTED	0.8137	2.6277	2.3612	3.2179	3.5235	2.3010
FROM LAYER 3	1.0609	0.0000	0.0000	0.9727	1.0520	1.3279
PERCOLATION/LEAKAGE THROUGH	0.0713	0.1891	0.1778	0.2267	0.2425	0.1802
LAYER 4	0.0972	0.0000	0.0000	0.0926	0.0976	0.1043

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.001	0.003	0.002	0.003	0.003	0.002
TOP OF LAYER 4	0.001	0.000	0.000	0.001	0.001	0.001
STD. DEVIATION OF DAILY	0.001	0.001	0.001	0.001	0.000	0.001
HEAD ON TOP OF LAYER 4	0.001	0.000	0.000	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 1998

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.48	161462.453	100.00
RUNOFF	0.704	2557.180	1.58
EVAPOTRANSPIRATION	12.174	44193.152	27.37
DRAINAGE COLLECTED FROM LAYER 3	19.2585	69908.422	43.30
PERC./LEAKAGE THROUGH LAYER 4	1.479268	5369.741	3.33
AVG. HEAD ON TOP OF LAYER 4	0.0014		
CHANGE IN WATER STORAGE	10.863	39433.879	24.42
SOIL WATER AT START OF YEAR	107.882	391610.000	
SOIL WATER AT END OF YEAR	118.745	431043.875	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.081	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1999

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.62	8.31	5.03	1.53	1.84	1.78
	1.01	0.44	0.20	2.93	10.67	5.10
RUNOFF	0.094	0.008	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.360	0.111
EVAPOTRANSPIRATION	1.226	1.351	2.384	2.128	2.330	1.655
	2.429	0.902	0.133	1.201	1.104	0.965
LATERAL DRAINAGE COLLECTED	3.1075	4.2343	6.1176	7.1185	4.6904	3.3092

FROM LAYER 3	1.0863	0.0946	0.0000	0.0000	0.3247	0.9149
PERCOLATION/LEAKAGE THROUGH	0.1982	0.2113	0.3071	0.3401	0.2809	0.2323
LAYER 4	0.0788	0.0135	0.0000	0.0000	0.0298	0.0893

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.003	0.004	0.005	0.006	0.004	0.003
TOP OF LAYER 4	0.001	0.000	0.000	0.000	0.000	0.001
STD. DEVIATION OF DAILY	0.002	0.003	0.002	0.001	0.000	0.000
HEAD ON TOP OF LAYER 4	0.001	0.000	0.000	0.000	0.001	0.001

ANNUAL TOTALS FOR YEAR 1999

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.46	172279.812	100.00
RUNOFF	0.573	2078.505	1.21
EVAPOTRANSPIRATION	17.807	64639.254	37.52
DRAINAGE COLLECTED FROM LAYER 3	30.9980	112522.641	65.31
PERC./LEAKAGE THROUGH LAYER 4	1.781291	6466.085	3.75
AVG. HEAD ON TOP OF LAYER 4	0.0023		
CHANGE IN WATER STORAGE	-3.699	-13426.724	-7.79
SOIL WATER AT START OF YEAR	118.745	431043.875	
SOIL WATER AT END OF YEAR	115.046	417617.156	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.049	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2000

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.04	5.93	4.18	1.56	2.56	1.33
	0.72	0.77	0.87	3.53	3.65	2.80
RUNOFF	0.000	0.014	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	1.116	1.340	2.286	2.296	2.533	2.291
	1.768	0.939	0.610	0.696	0.946	0.928
LATERAL DRAINAGE COLLECTED	3.1960	2.7324	3.1664	4.0423	3.5563	1.9693
FROM LAYER 3	0.0258	0.1613	0.0226	0.4394	1.6315	1.2237
PERCOLATION/LEAKAGE THROUGH	0.2191	0.1911	0.2255	0.2567	0.2447	0.1468
LAYER 4	0.0090	0.0207	0.0054	0.0432	0.1528	0.1208

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.003	0.003	0.003	0.004	0.003	0.002
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.001	0.001
STD. DEVIATION OF DAILY	0.001	0.001	0.001	0.000	0.000	0.001
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.001	0.001

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ANNUAL TOTALS FOR YEAR 2000

	INCHES	CU. FEET	PERCENT
PRECIPITATION	31.94	115942.289	100.00
RUNOFF	0.014	51.675	0.04
EVAPOTRANSPIRATION	17.750	64434.016	55.57
DRAINAGE COLLECTED FROM LAYER 3	22.1669	80465.844	69.40
PERC./LEAKAGE THROUGH LAYER 4	1.635872	5938.215	5.12
AVG. HEAD ON TOP OF LAYER 4	0.0016		

CHANGE IN WATER STORAGE	-9.627	-34947.500	-30.14
SOIL WATER AT START OF YEAR	115.046	417617.156	
SOIL WATER AT END OF YEAR	105.419	382669.656	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.045	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2001

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.77	2.36	3.24	3.70	1.93	3.53
	0.20	2.25	0.46	3.32	10.13	6.82
RUNOFF	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.761	0.060
EVAPOTRANSPIRATION	1.137	1.289	2.431	3.020	2.751	2.600
	1.793	1.732	0.686	1.027	1.050	0.963
LATERAL DRAINAGE COLLECTED	1.2430	1.3281	2.0621	0.6395	0.5520	0.1722
FROM LAYER 3	0.0948	0.0013	0.0000	0.0354	0.7345	0.5986
PERCOLATION/LEAKAGE THROUGH	0.1183	0.1320	0.1748	0.0856	0.0558	0.0252
LAYER 4	0.0110	0.0004	0.0000	0.0050	0.0703	0.0609

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.001	0.001	0.002	0.001	0.000	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.001	0.001
STD. DEVIATION OF DAILY	0.001	0.001	0.001	0.000	0.001	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.001	0.001

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ANNUAL TOTALS FOR YEAR 2001

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.71	147777.328	100.00
RUNOFF	0.821	2981.855	2.02
EVAPOTRANSPIRATION	20.480	74342.578	50.31
DRAINAGE COLLECTED FROM LAYER 3	7.4615	27085.275	18.33
PERC./LEAKAGE THROUGH LAYER 4	0.739489	2684.345	1.82
AVG. HEAD ON TOP OF LAYER 4	0.0006		
CHANGE IN WATER STORAGE	11.207	40683.211	27.53
SOIL WATER AT START OF YEAR	105.419	382669.656	
SOIL WATER AT END OF YEAR	116.626	423352.875	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.058	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2002

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.53	3.56	4.16	3.64	1.14	1.36
	0.42	0.06	0.36	0.41	2.96	6.58
RUNOFF	0.000	0.000	0.000	0.002	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	1.193	1.329	2.246	2.252	1.312	1.104
	2.411	0.590	0.204	0.313	0.842	1.010
LATERAL DRAINAGE COLLECTED	3.4787	3.1417	3.1935	3.7712	3.9630	3.0499

FROM LAYER 3	0.6175	0.0218	0.0106	0.0000	0.2822	1.3435
PERCOLATION/LEAKAGE THROUGH	0.2359	0.2129	0.2181	0.2432	0.2585	0.2230
LAYER 4	0.0471	0.0028	0.0031	0.0000	0.0349	0.1159

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.003	0.003	0.003	0.003	0.003	0.003
TOP OF LAYER 4	0.001	0.000	0.000	0.000	0.000	0.001
STD. DEVIATION OF DAILY	0.001	0.001	0.002	0.001	0.000	0.000
HEAD ON TOP OF LAYER 4	0.001	0.000	0.000	0.000	0.000	0.001

ANNUAL TOTALS FOR YEAR 2002

	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.18	109553.453	100.00
RUNOFF	0.002	6.322	0.01
EVAPOTRANSPIRATION	14.806	53746.039	49.06
DRAINAGE COLLECTED FROM LAYER 3	22.8737	83031.430	75.79
PERC./LEAKAGE THROUGH LAYER 4	1.595294	5790.916	5.29
AVG. HEAD ON TOP OF LAYER 4	0.0017		
CHANGE IN WATER STORAGE	-9.097	-33021.309	-30.14
SOIL WATER AT START OF YEAR	116.626	423352.875	
SOIL WATER AT END OF YEAR	107.529	390331.562	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.057	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2003

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.50	1.71	5.08	3.30	0.55	0.36
	0.13	0.29	0.69	8.88	6.15	4.65
RUNOFF	0.017	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.940	0.002	0.000
EVAPOTRANSPIRATION	1.225	1.336	2.387	3.614	0.615	0.671
	1.747	0.508	0.293	1.251	0.929	0.967
LATERAL DRAINAGE COLLECTED	1.8017	1.8598	2.5094	2.8764	3.1717	0.6729
FROM LAYER 3	0.0311	0.0298	0.0013	0.1465	1.5421	1.1231
PERCOLATION/LEAKAGE THROUGH	0.1425	0.1437	0.1795	0.2112	0.2312	0.0717
LAYER 4	0.0145	0.0044	0.0006	0.0146	0.1332	0.0989

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.002	0.002	0.002	0.003	0.003	0.001
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.001	0.001
STD. DEVIATION OF DAILY	0.001	0.001	0.001	0.001	0.000	0.001
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.001	0.001

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ANNUAL TOTALS FOR YEAR 2003

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.29	146252.687	100.00
RUNOFF	0.959	3480.276	2.38
EVAPOTRANSPIRATION	15.543	56420.941	38.58
DRAINAGE COLLECTED FROM LAYER 3	15.7659	57230.094	39.13
PERC./LEAKAGE THROUGH LAYER 4	1.245809	4522.285	3.09
AVG. HEAD ON TOP OF LAYER 4	0.0012		

CHANGE IN WATER STORAGE	6.777	24599.100	16.82
SOIL WATER AT START OF YEAR	107.529	390331.562	
SOIL WATER AT END OF YEAR	114.306	414930.656	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.007	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1994 THROUGH 2003

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	6.10	4.60	4.39	3.00	1.73	1.64
	0.72	0.69	1.04	4.26	7.00	6.46
STD. DEVIATIONS	2.31	2.44	1.57	1.89	0.67	0.93
	0.49	0.68	0.85	2.22	3.22	2.60
RUNOFF						
TOTALS	0.023	0.117	0.002	0.025	0.000	0.000
	0.000	0.000	0.000	0.095	0.215	0.068
STD. DEVIATIONS	0.037	0.293	0.005	0.077	0.000	0.000
	0.000	0.000	0.000	0.297	0.286	0.070
EVAPOTRANSPIRATION						
TOTALS	1.191	1.338	2.308	2.627	1.881	1.569
	1.690	0.848	0.626	1.018	1.018	0.963
STD. DEVIATIONS	0.048	0.060	0.139	0.764	0.734	0.781
	0.663	0.455	0.517	0.455	0.090	0.026
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	2.4543	3.1893	3.5279	4.0091	3.3426	2.2993
	1.0542	0.0872	0.0726	0.3455	1.0419	1.0347
STD. DEVIATIONS	0.8779	1.3524	1.6033	1.8141	1.1660	1.0883

	0.9523	0.1712	0.1727	0.3731	0.5190	0.2533

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.1726	0.2007	0.2221	0.2440	0.2259	0.1725
	0.0844	0.0084	0.0084	0.0355	0.0972	0.0937
STD. DEVIATIONS	0.0494	0.0491	0.0576	0.0692	0.0644	0.0715
	0.0701	0.0128	0.0173	0.0347	0.0439	0.0202

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0021	0.0030	0.0030	0.0036	0.0029	0.0021
	0.0009	0.0001	0.0001	0.0003	0.0009	0.0009
STD. DEVIATIONS	0.0008	0.0013	0.0014	0.0016	0.0010	0.0010
	0.0008	0.0001	0.0002	0.0003	0.0005	0.0002

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1994 THROUGH 2003

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.65 (7.244)	151182.3	100.00
RUNOFF	0.545 (0.4509)	1978.68	1.309
EVAPOTRANSPIRATION	17.077 (2.9098)	61991.28	41.004
LATERAL DRAINAGE COLLECTED FROM LAYER 3	22.45865 (7.59822)	81524.906	53.92491
PERCOLATION/LEAKAGE THROUGH LAYER 4	1.56530 (0.36894)	5682.043	3.75841
AVERAGE HEAD ON TOP OF LAYER 4	0.002 (0.001)		
CHANGE IN WATER STORAGE	0.001 (8.1671)	5.33	0.004

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PEAK DAILY VALUES FOR YEARS 1994 THROUGH 2003

	(INCHES)	(CU. FT.)
PRECIPITATION	4.20	15245.999
RUNOFF	0.908	3297.0195
DRAINAGE COLLECTED FROM LAYER 3	0.37367	1356.42151
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.014220	51.61866
AVERAGE HEAD ON TOP OF LAYER 4	0.010	
MAXIMUM HEAD ON TOP OF LAYER 4	0.092	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	0.42	1516.4022

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3592
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0627

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 2003

LAYER	(INCHES)	(VOL/VOL)
1	4.2779	0.2377
2	110.0163	0.3161
3	0.0059	0.0235
4	0.0000	0.0000
SNOW WATER	0.000	

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 **                                                                           **
 **              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                **
 **                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                 **
 **                  DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
 **                    USAE WATERWAYS EXPERIMENT STATION                      **
 **             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY               **
 **                                                                           **
 **                                                                           **
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 PRECIPITATION DATA FILE:    C:\tlf\PRECIP.D4
 TEMPERATURE DATA FILE:      C:\tLF\TEMP.D7
 SOLAR RADIATION DATA FILE:  C:\tLF\SOLARRAD.D13
 EVAPOTRANSPIRATION DATA:    C:\tLF\ET_CVR.D11
 SOIL AND DESIGN DATA FILE:  C:\tLF\ESS2R1.D10
 OUTPUT DATA FILE:           C:\tLF\ESS2R1.OUT

 TIME:  11:24     DATE:   4/27/2005

 *******************************************************************************

      TITLE:  Tacoma Landfill Central Area HELP Evaluation - Eastern SS

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      NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
               WERE SPECIFIED BY THE USER.

                                    LAYER  1
                                    --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER  45
               THICKNESS                    =      0.01   INCHES
               POROSITY                     =      0.0030 VOL/VOL
               FIELD CAPACITY               =      0.0020 VOL/VOL
               WILTING POINT                =      0.0010 VOL/VOL
               INITIAL SOIL WATER CONTENT   =      0.0030 VOL/VOL
               EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
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LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 5

THICKNESS	=	18.00	INCHES
POROSITY	=	0.4570	VOL/VOL
FIELD CAPACITY	=	0.1310	VOL/VOL
WILTING POINT	=	0.0580	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2407	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	348.00	INCHES
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3006	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 4

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.25	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0500	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	20.60	PERCENT
DRAINAGE LENGTH	=	300.0	FEET

LAYER 5

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL

INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY	=	1.00 HOLES/ACRE
FML INSTALLATION DEFECTS	=	4.00 HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #17 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 300. FEET.

SCS RUNOFF CURVE NUMBER	=	96.80	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	24.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	6.134	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	12.247	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.505	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	108.954	INCHES
TOTAL INITIAL WATER	=	108.954	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM Tacoma WASHINGTON

STATION LATITUDE	=	47.25 DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00
START OF GROWING SEASON (JULIAN DATE)	=	126
END OF GROWING SEASON (JULIAN DATE)	=	287
EVAPORATIVE ZONE DEPTH	=	24.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	9.10 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	75.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	70.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	79.00 %

NOTE: PRECIPITATION DATA FOR TACOMA WA WAS ENTERED FROM AN ASCII DATA FILE.

NOTE: TEMPERATURE DATA FOR TACOMA WA
WAS ENTERED FROM AN ASCII DATA FILE.

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SEATTLE WASHINGTON
AND STATION LATITUDE = 47.25 DEGREES

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1994

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.54	4.72	4.02	2.44	1.63	2.04
	0.27	0.36	1.82	4.52	5.24	7.52
RUNOFF	0.852	1.351	1.195	0.462	0.235	0.239
	0.000	0.002	0.327	2.107	1.627	3.451
EVAPOTRANSPIRATION	1.273	1.225	2.493	1.902	1.424	2.025
	0.405	0.278	1.494	0.570	1.005	0.992
LATERAL DRAINAGE COLLECTED	1.5305	2.7019	1.5349	2.5548	0.5372	0.0782
FROM LAYER 4	0.0921	0.0490	0.0148	0.0004	0.5674	0.9878
PERCOLATION/LEAKAGE THROUGH	0.0439	0.0600	0.0398	0.0606	0.0203	0.0089
LAYER 5	0.0112	0.0080	0.0025	0.0001	0.0232	0.0287

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.008	0.015	0.008	0.013	0.003	0.000
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.003	0.005
STD. DEVIATION OF DAILY	0.004	0.002	0.006	0.001	0.005	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.003	0.006

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ANNUAL TOTALS FOR YEAR 1994

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.12	138375.609	100.00
RUNOFF	11.849	43011.332	31.08
EVAPOTRANSPIRATION	15.086	54762.590	39.58
DRAINAGE COLLECTED FROM LAYER 4	10.6490	38655.832	27.94
PERC./LEAKAGE THROUGH LAYER 5	0.307141	1114.922	0.81
AVG. HEAD ON TOP OF LAYER 5	0.0046		
CHANGE IN WATER STORAGE	0.229	830.980	0.60
SOIL WATER AT START OF YEAR	108.966	395547.906	
SOIL WATER AT END OF YEAR	109.195	396378.875	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.048	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1995

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.29	5.37	4.19	2.30	0.96	0.91
	1.49	1.12	1.70	4.23	9.90	7.40
RUNOFF	1.134	2.586	0.966	0.190	0.121	0.020
	0.414	0.271	0.354	1.433	5.105	3.088
EVAPOTRANSPIRATION	1.221	1.433	2.376	2.006	1.246	0.732
	1.121	1.016	0.524	1.809	1.145	1.000
LATERAL DRAINAGE COLLECTED	1.7100	1.7808	1.9635	2.5346	1.2859	0.1080
FROM LAYER 4	0.0282	0.0000	0.0015	0.0013	0.5175	0.6275
PERCOLATION/LEAKAGE THROUGH	0.0453	0.0449	0.0520	0.0603	0.0361	0.0116
LAYER 5	0.0035	0.0000	0.0002	0.0002	0.0234	0.0221

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.008	0.010	0.010	0.013	0.006	0.001
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.003	0.003
STD. DEVIATION OF DAILY	0.006	0.007	0.006	0.002	0.007	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.003	0.004

ANNUAL TOTALS FOR YEAR 1995

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.86	159211.797	100.00
RUNOFF	15.684	56933.816	35.76
EVAPOTRANSPIRATION	15.630	56736.977	35.64
DRAINAGE COLLECTED FROM LAYER 4	10.5589	38328.637	24.07
PERC./LEAKAGE THROUGH LAYER 5	0.299653	1087.741	0.68
AVG. HEAD ON TOP OF LAYER 5	0.0044		
CHANGE IN WATER STORAGE	1.687	6124.656	3.85
SOIL WATER AT START OF YEAR	109.195	396378.875	
SOIL WATER AT END OF YEAR	110.883	402503.531	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.025	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 1996

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.55	8.56	1.61	7.69	2.55	1.66
	0.59	0.43	1.32	5.09	6.61	11.27
RUNOFF	3.234	4.855	0.151	3.372	0.618	0.000
	0.008	0.022	0.149	1.610	2.509	5.246
EVAPOTRANSPIRATION	1.183	1.412	1.972	3.543	2.149	1.415
	0.680	0.437	1.368	1.391	1.038	0.947
LATERAL DRAINAGE COLLECTED	2.0210	1.7655	3.4902	3.3691	1.3893	0.1975
FROM LAYER 4	0.1469	0.0683	0.0173	0.0041	0.9549	0.6945
PERCOLATION/LEAKAGE THROUGH	0.0523	0.0450	0.0717	0.0698	0.0403	0.0151
LAYER 5	0.0141	0.0093	0.0027	0.0004	0.0345	0.0243

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.010	0.009	0.017	0.017	0.007	0.001
TOP OF LAYER 5	0.001	0.000	0.000	0.000	0.005	0.003
STD. DEVIATION OF DAILY	0.007	0.008	0.004	0.001	0.006	0.001
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.003	0.004

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ANNUAL TOTALS FOR YEAR 1996

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.93	199395.891	100.00
RUNOFF	21.775	79044.430	39.64
EVAPOTRANSPIRATION	17.534	63650.152	31.92
DRAINAGE COLLECTED FROM LAYER 4	14.1187	51250.914	25.70
PERC./LEAKAGE THROUGH LAYER 5	0.379647	1378.117	0.69
AVG. HEAD ON TOP OF LAYER 5	0.0059		
CHANGE IN WATER STORAGE	1.122	4072.312	2.04
SOIL WATER AT START OF YEAR	110.883	402503.531	
SOIL WATER AT END OF YEAR	112.004	406575.844	

SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.043	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1997

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.81	2.84	7.84	2.86	2.06	2.62
	1.43	1.22	2.78	6.20	3.52	3.33
RUNOFF	3.628	0.876	3.016	0.000	0.000	0.458
	0.361	0.094	0.441	2.193	0.690	1.343
EVAPOTRANSPIRATION	1.205	1.342	2.307	3.006	2.126	2.172
	1.630	0.738	1.978	1.756	1.137	0.978
LATERAL DRAINAGE COLLECTED	1.6626	2.8104	2.3939	3.2025	3.2610	0.2511
FROM LAYER 4	0.0349	0.0000	0.0078	0.6511	0.9724	1.1918
PERCOLATION/LEAKAGE THROUGH	0.0405	0.0597	0.0544	0.0680	0.0698	0.0059
LAYER 5	0.0033	0.0000	0.0010	0.0238	0.0340	0.0402

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.008	0.016	0.012	0.016	0.016	0.001
TOP OF LAYER 5	0.000	0.000	0.000	0.003	0.005	0.006
STD. DEVIATION OF DAILY	0.007	0.006	0.007	0.004	0.001	0.005
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.003	0.003	0.004

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ANNUAL TOTALS FOR YEAR 1997

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.51	161571.266	100.00
RUNOFF	13.099	47549.555	29.43
EVAPOTRANSPIRATION	20.376	73963.227	45.78
DRAINAGE COLLECTED FROM LAYER 4	16.4394	59674.930	36.93
PERC./LEAKAGE THROUGH LAYER 5	0.400588	1454.134	0.90
AVG. HEAD ON TOP OF LAYER 5	0.0070		
CHANGE IN WATER STORAGE	-5.805	-21070.518	-13.04
SOIL WATER AT START OF YEAR	112.004	406575.844	
SOIL WATER AT END OF YEAR	106.200	385505.312	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.058	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1998

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.38	2.59	4.52	0.98	2.09	0.83
	0.94	0.00	0.24	3.53	11.21	9.17
RUNOFF	3.111	0.258	1.339	0.039	0.541	0.047
	0.000	0.000	0.000	0.067	6.299	4.421
EVAPOTRANSPIRATION	1.191	1.412	2.249	1.654	1.316	0.793
	0.769	0.242	0.205	1.350	1.107	0.953
LATERAL DRAINAGE COLLECTED	1.0117	1.7297	1.8601	2.8310	0.1973	0.1248
FROM LAYER 4	0.0924	0.0176	0.0024	0.0010	0.6984	0.8144
PERCOLATION/LEAKAGE THROUGH	0.0322	0.0440	0.0521	0.0641	0.0142	0.0127
LAYER 5	0.0107	0.0025	0.0003	0.0002	0.0245	0.0274

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.005	0.010	0.009	0.014	0.001	0.001
TOP OF LAYER 5	0.001	0.000	0.000	0.000	0.004	0.004
STD. DEVIATION OF DAILY	0.006	0.006	0.004	0.001	0.002	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.004	0.004

ANNUAL TOTALS FOR YEAR 1998

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.48	161462.453	100.00
RUNOFF	16.124	58531.812	36.25
EVAPOTRANSPIRATION	13.240	48062.336	29.77
DRAINAGE COLLECTED FROM LAYER 4	9.3806	34051.680	21.09
PERC./LEAKAGE THROUGH LAYER 5	0.284933	1034.306	0.64
AVG. HEAD ON TOP OF LAYER 5	0.0040		
CHANGE IN WATER STORAGE	5.450	19782.270	12.25
SOIL WATER AT START OF YEAR	106.200	385505.312	
SOIL WATER AT END OF YEAR	111.649	405287.594	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.053	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 1999

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.62	8.31	5.03	1.53	1.84	1.78
	1.01	0.44	0.20	2.93	10.67	5.10
RUNOFF	4.129	3.434	1.292	0.088	0.235	0.620
	0.171	0.000	0.000	0.690	5.419	1.903
EVAPOTRANSPIRATION	1.216	1.344	2.371	2.102	2.061	1.034
	0.725	0.322	0.239	1.220	1.151	1.019
LATERAL DRAINAGE COLLECTED	2.1413	1.5506	2.8067	4.2289	3.3651	0.8938
FROM LAYER 4	0.0103	0.0021	0.0121	0.0059	0.2274	0.7329
PERCOLATION/LEAKAGE THROUGH	0.0505	0.0389	0.0621	0.0783	0.0708	0.0259
LAYER 5	0.0011	0.0002	0.0013	0.0007	0.0085	0.0262

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.010	0.008	0.014	0.021	0.017	0.005
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.001	0.004
STD. DEVIATION OF DAILY	0.008	0.007	0.007	0.002	0.001	0.007
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.003	0.004

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ANNUAL TOTALS FOR YEAR 1999

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.46	172279.812	100.00
RUNOFF	17.981	65270.770	37.89
EVAPOTRANSPIRATION	14.803	53736.457	31.19
DRAINAGE COLLECTED FROM LAYER 4	15.9771	57996.715	33.66
PERC./LEAKAGE THROUGH LAYER 5	0.364325	1322.501	0.77
AVG. HEAD ON TOP OF LAYER 5	0.0067		
CHANGE IN WATER STORAGE	-1.666	-6046.640	-3.51
SOIL WATER AT START OF YEAR	111.649	405287.594	
SOIL WATER AT END OF YEAR	109.984	399240.969	

SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.007	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2000

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.04	5.93	4.18	1.56	2.56	1.33
	0.72	0.77	0.87	3.53	3.65	2.80
RUNOFF	0.764	2.422	0.094	0.099	0.313	0.273
	0.223	0.000	0.037	0.073	1.260	0.396
EVAPOTRANSPIRATION	1.162	1.400	2.322	2.209	2.126	1.545
	0.393	0.509	0.596	1.643	1.060	0.997
LATERAL DRAINAGE COLLECTED	2.1333	2.3872	2.0682	2.5435	1.8245	0.0669
FROM LAYER 4	0.0273	0.0898	0.0402	0.0036	0.7916	1.4929
PERCOLATION/LEAKAGE THROUGH	0.0527	0.0578	0.0582	0.0605	0.0461	0.0061
LAYER 5	0.0024	0.0107	0.0060	0.0008	0.0289	0.0436

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.010	0.012	0.012	0.013	0.009	0.000
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.004	0.007
STD. DEVIATION OF DAILY	0.006	0.004	0.006	0.002	0.007	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.004	0.004

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ANNUAL TOTALS FOR YEAR 2000

	INCHES	CU. FEET	PERCENT
PRECIPITATION	31.94	115942.289	100.00
RUNOFF	5.953	21610.219	18.64
EVAPOTRANSPIRATION	15.961	57937.008	49.97
DRAINAGE COLLECTED FROM LAYER 4	13.4690	48892.375	42.17
PERC./LEAKAGE THROUGH LAYER 5	0.373655	1356.366	1.17
AVG. HEAD ON TOP OF LAYER 5	0.0058		
CHANGE IN WATER STORAGE	-3.816	-13853.776	-11.95
SOIL WATER AT START OF YEAR	109.984	399240.969	
SOIL WATER AT END OF YEAR	106.167	385387.187	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.098	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2001

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.77	2.36	3.24	3.70	1.93	3.53
	0.20	2.25	0.46	3.32	10.13	6.82
RUNOFF	0.623	0.562	0.341	0.934	0.431	1.254
	0.002	0.812	0.070	0.755	5.899	2.525
EVAPOTRANSPIRATION	1.209	1.360	2.522	2.979	2.161	2.037
	0.632	1.219	0.520	0.674	1.116	1.006
LATERAL DRAINAGE COLLECTED FROM LAYER 4	1.1876	1.5613	0.3651	0.1549	0.1131	0.0331
	0.0044	0.0073	0.0017	0.0017	0.2327	0.6971
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0387	0.0449	0.0213	0.0118	0.0105	0.0042
	0.0005	0.0008	0.0002	0.0002	0.0097	0.0213

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.006	0.009	0.002	0.001	0.001	0.000
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.001	0.004
STD. DEVIATION OF DAILY	0.004	0.003	0.001	0.001	0.000	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.002	0.005

ANNUAL TOTALS FOR YEAR 2001

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.71	147777.328	100.00
RUNOFF	14.210	51580.637	34.90
EVAPOTRANSPIRATION	17.435	63288.008	42.83
DRAINAGE COLLECTED FROM LAYER 4	4.3599	15826.496	10.71
PERC./LEAKAGE THROUGH LAYER 5	0.164038	595.460	0.40
AVG. HEAD ON TOP OF LAYER 5	0.0019		
CHANGE IN WATER STORAGE	4.542	16486.711	11.16
SOIL WATER AT START OF YEAR	106.167	385387.187	
SOIL WATER AT END OF YEAR	110.709	401873.875	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.013	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 2002

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.53	3.56	4.16	3.64	1.14	1.36
	0.42	0.06	0.36	0.41	2.96	6.58
RUNOFF	0.400	1.004	1.348	1.131	0.023	0.241
	0.017	0.000	0.000	0.042	0.558	2.121
EVAPOTRANSPIRATION	1.198	1.391	2.327	2.283	1.008	0.862
	0.992	0.324	0.250	0.220	0.897	1.049
LATERAL DRAINAGE COLLECTED	2.2415	1.7927	3.2498	2.7177	2.2267	0.1001
FROM LAYER 4	0.1062	0.0716	0.0434	0.0331	0.0072	0.3026
PERCOLATION/LEAKAGE THROUGH	0.0580	0.0462	0.0689	0.0619	0.0517	0.0109
LAYER 5	0.0116	0.0098	0.0074	0.0067	0.0016	0.0154

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.010	0.010	0.016	0.014	0.011	0.001
TOP OF LAYER 5	0.001	0.000	0.000	0.000	0.000	0.002
STD. DEVIATION OF DAILY	0.006	0.005	0.005	0.004	0.007	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.000	0.002

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ANNUAL TOTALS FOR YEAR 2002

	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.18	109553.453	100.00
RUNOFF	6.884	24988.342	22.81
EVAPOTRANSPIRATION	12.800	46464.082	42.41
DRAINAGE COLLECTED FROM LAYER 4	12.8926	46800.020	42.72
PERC./LEAKAGE THROUGH LAYER 5	0.350280	1271.517	1.16
AVG. HEAD ON TOP OF LAYER 5	0.0054		
CHANGE IN WATER STORAGE	-2.747	-9970.563	-9.10
SOIL WATER AT START OF YEAR	110.709	401873.875	
SOIL WATER AT END OF YEAR	107.962	391903.312	

SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.057	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2003

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.50	1.71	5.08	3.30	0.55	0.36
	0.13	0.29	0.69	8.88	6.15	4.65
RUNOFF	3.501	0.247	1.411	0.496	0.000	0.007
	0.000	0.000	0.004	5.333	2.490	1.064
EVAPOTRANSPIRATION	1.288	1.402	2.444	3.232	0.562	0.299
	0.238	0.212	0.816	1.333	1.011	1.010
LATERAL DRAINAGE COLLECTED	1.4262	1.5199	2.8706	2.1191	0.5953	0.0870
FROM LAYER 4	0.0577	0.0426	0.0220	0.1466	0.9765	0.7143
PERCOLATION/LEAKAGE THROUGH	0.0412	0.0395	0.0631	0.0550	0.0228	0.0107
LAYER 5	0.0087	0.0075	0.0047	0.0070	0.0335	0.0246

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.007	0.008	0.015	0.011	0.003	0.000
TOP OF LAYER 5	0.000	0.000	0.000	0.001	0.005	0.004
STD. DEVIATION OF DAILY	0.006	0.006	0.005	0.004	0.005	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.002	0.004	0.003

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ANNUAL TOTALS FOR YEAR 2003

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.29	146252.687	100.00
RUNOFF	14.553	52828.691	36.12
EVAPOTRANSPIRATION	13.848	50267.539	34.37
DRAINAGE COLLECTED FROM LAYER 4	10.5778	38397.543	26.25
PERC./LEAKAGE THROUGH LAYER 5	0.318076	1154.617	0.79
AVG. HEAD ON TOP OF LAYER 5	0.0045		
CHANGE IN WATER STORAGE	0.993	3604.299	2.46
SOIL WATER AT START OF YEAR	107.962	391903.312	
SOIL WATER AT END OF YEAR	108.955	395507.625	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.001	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1994 THROUGH 2003

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	6.10	4.60	4.39	3.00	1.73	1.64
	0.72	0.69	1.04	4.26	7.00	6.46
STD. DEVIATIONS	2.31	2.44	1.57	1.89	0.67	0.93
	0.49	0.68	0.85	2.22	3.22	2.60
RUNOFF						
TOTALS	2.138	1.759	1.115	0.681	0.252	0.316
	0.120	0.120	0.138	1.430	3.186	2.556
STD. DEVIATIONS	1.493	1.528	0.846	1.022	0.224	0.389
	0.163	0.258	0.171	1.596	2.259	1.520
EVAPOTRANSPIRATION						

TOTALS	1.214	1.372	2.338	2.492	1.618	1.291
	0.758	0.530	0.799	1.197	1.067	0.995
STD. DEVIATIONS	0.039	0.060	0.154	0.643	0.581	0.645
	0.408	0.349	0.611	0.536	0.081	0.030

LATERAL DRAINAGE COLLECTED FROM LAYER 4

TOTALS	1.7066	1.9600	2.2603	2.6256	1.4795	0.1940
	0.0600	0.0348	0.0163	0.0849	0.5946	0.8256
STD. DEVIATIONS	0.4242	0.4862	0.9180	1.0482	1.1848	0.2541
	0.0472	0.0338	0.0151	0.2040	0.3473	0.3288

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0455	0.0481	0.0544	0.0590	0.0383	0.0112
	0.0067	0.0049	0.0026	0.0040	0.0222	0.0274
STD. DEVIATIONS	0.0078	0.0080	0.0148	0.0178	0.0216	0.0062
	0.0051	0.0045	0.0026	0.0074	0.0117	0.0085

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	0.0084	0.0106	0.0114	0.0133	0.0073	0.0010
	0.0003	0.0002	0.0001	0.0004	0.0031	0.0040
STD. DEVIATIONS	0.0019	0.0027	0.0045	0.0053	0.0058	0.0013
	0.0002	0.0002	0.0001	0.0010	0.0018	0.0016

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1994 THROUGH 2003

	INCHES		CU. FEET	PERCENT
PRECIPITATION	41.65	(7.244)	151182.3	100.00
RUNOFF	13.811	(4.7665)	50134.96	33.162
EVAPOTRANSPIRATION	15.671	(2.2942)	56886.84	37.628
LATERAL DRAINAGE COLLECTED FROM LAYER 4	11.84229	(3.55710)	42987.516	28.43423
PERCOLATION/LEAKAGE THROUGH	0.32423	(0.06813)	1176.968	0.77851

LAYER 5

AVERAGE HEAD ON TOP OF LAYER 5	0.005	(0.001)		
CHANGE IN WATER STORAGE	-0.001	(3.5598)	-4.03	-0.003

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PEAK DAILY VALUES FOR YEARS 1994 THROUGH 2003

	(INCHES)	(CU. FT.)
PRECIPITATION	4.20	15245.999
RUNOFF	3.659	13281.9512
DRAINAGE COLLECTED FROM LAYER 4	0.19844	720.32935
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.004629	16.80188
AVERAGE HEAD ON TOP OF LAYER 5	0.029	
MAXIMUM HEAD ON TOP OF LAYER 5	0.048	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	0.42	1516.4022

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2992
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1334

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 2003

LAYER	(INCHES)	(VOL/VOL)
1	0.0019	0.2362
2	4.3322	0.2407
3	104.5961	0.3006
4	0.0125	0.0500
5	0.0000	0.0000
SNOW WATER	0.000	

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City of Tacoma
Public Works Department
Environmental Services
Science and Engineering Division

Technical Memorandum

TO: Kris Flint, EPA
Chris Maurer, Ecology

FROM: Karen Bartlett, LEED AP
Calvin Taylor, LHG CDT

CC: Dave Bosch, TPCHD
Craig Francis, PE, City of Tacoma

SUBJECT: Tacoma Landfill – Water Balance for the Central Area

DATE: December 12, 2008

Purpose

This memorandum provides a discussion of the water balance in the Central Area of the Tacoma Landfill using leachate collection, leachate detection, and surface runoff data collected between May 1, 2007 and April 30, 2008. Based on our analysis, there is not a significant issue with regard to the water balance for the Central Area.

Discussion

Flow Pathways

Rainfall that falls on the Central Area generally leaves the area via the following pathways:

#1. Leachate Collection System: The leachate collection system pipe is located at the bottom of the lined refuse cell. It collects water that passes through the refuse. These flows are discharged into the leachate collection manhole at the north end of the Central Area.

#2. Leachate Detection System: The leachate detection system pipe is located beneath the primary liner. It collects leachate that passes through the primary liner and is collected by the secondary liner (i.e., serves as leak detection for the leachate collection system). These flows are discharged into the leachate detection manhole at the north end of the Central Area.

#3. Surface Runoff – Majority of Central Area: Surface runoff from the majority of the Central Area is collected in a combination of ditches and pipes. These flows are discharged into the leachate collection manhole.

#4. Surface Runoff – Southern Tarped Portion: A portion of the surface runoff from the southern 7.9 tarped acres drains south and enters the adjacent capped landfill area's stormwater collection system. These flows do not enter either the leachate collection or detection manholes.

#5. Evapo-transpiration: Evapo-transpiration of the water occurs on the surface of the landfill. This water is returned directly to the atmosphere.

The landfill currently has flow meters monitoring the leachate collection system (#1), the leachate detection system (#2), and the surface runoff system for the majority of the Central Area (#3). The two unknown variables are evapo-transpiration and surface runoff from a portion of the southern tarped area.

Water Balance

Between May 1, 2007 and April 30, 2008, approximately 35.0 inches of rainfall fell on the Central Area based on measurements taken at the Central Treatment Plant (2201 Portland Ave., Tacoma, WA 98421). This equates to approximately 30.9 million gallons of precipitation landing over the 32.45 acre Central Area. During the same time period, 20.8 million gallons were observed passing through the leachate collection, leachate detection, and surface runoff meter systems. This results in approximately 10.1 million gallons of water that were not accounted for in the flow meters.

A portion of the water is accounted for by evapo-transpiration. We calculated the water loss due to evapo-transpiration using a 23% evapo-transpiration rate (Curtis Hinman, WSU Pierce County Extension, Personal Communication). For the 24.55 acres (everything except the southern tarped area), this equates to approximately 5.4 million gallons of evapo-transpiration between May 1, 2007 and April 30, 2008. Based on survey data, approximately 7.04 acres of the 7.9 acre southern tarped area drains to the south and is not collected in the Central Area surface runoff collection system. Assuming that 75% of this water makes it to the surface collection system or evaporates (the rest passes through holes in the tarped system and is collected by the leachate collection system), this accounts for an additional 5.03 million gallons per year.

Given these two variables, it suggests that there is not a significant issue with regard to the water balance for the Central Area. The fact that the analysis suggested that slightly more (< 1% of total) water is leaving the Central Area than is coming in between May 1, 2007 and April 30, 2008, is likely due to the evapo-transpiration value used. This percentage number has many variables (e.g., weather patterns, yearly rainfall, depth of soil, type of soil) some of which may vary significantly from year to year. Even a small change in the evapo-transpiration percentage would have a significant impact on the water balance for the Central Area.

End of Plume Residual Plume Characterization Report
Tacoma Landfill – North Area & South Area
Tacoma, Washington

February 1, 2006

Prepared for

City of Tacoma, Public Works Dept.

LANDAU ASSOCIATES
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1.0 INTRODUCTION

This edge of plume (EOP) residual plume characterization project was initiated to characterize the nature and extent of volatile organic compound (VOC) groundwater contamination in two offsite areas west of the Tacoma Landfill. In these two areas, persistent VOC concentrations have been detected during regular monitoring (City of Tacoma and Pacific Groundwater Group 2004). For the purpose of this project, these two areas have been defined as the north area and the south area. The north area is centered along Emerson Street (also shown on maps as South 40th Street); the south area is centered along 46th Street West. The landfill location is shown on the vicinity map on Figure 1. The north area and the south area locations are shown on the site plan on Figure 2.

The scope of services for this project was established as Task 11 under Landau Associates geotechnical engineering services on-call contract (G-258-3) for the City of Tacoma, Public Works Department. The scope of work is defined in the *Landfill Plume Work Plan* (Landau Associates 2005). The work plan preparation was authorized as Task 10 under Landau Associates geotechnical engineering services on-call contract.

1.1 BACKGROUND

The City of Tacoma (City) Solid Waste Management Division operates the Tacoma Landfill (landfill) at 3510 South Mullen Street in Tacoma, Washington. The landfill area is approximately 210 acres. It began accepting garbage and municipal waste in 1960. The landfill is part of the Commencement Bay, South Tacoma Channel Superfund site. A remedial investigation was completed by the City in 1987. A record of decision (ROD) was issued by the U.S. Environmental Protection Agency (EPA) in 1988. The ROD specified various cleanup actions to address contaminated air, soil and groundwater. A groundwater extraction and treatment system (GETS) was implemented in 1992 to address groundwater contamination flowing from the western boundary of the landfill towards Leach Creek. The GETS combined with landfill capping and gas extraction have been effective in reducing the offsite impact to groundwater. Two small areas of groundwater contamination remain between the landfill boundary and Leach Creek. The landfill boundary, GETS wells, and landfill monitoring wells are shown on Figure 2. A detailed explanation of wells used in the landfill extraction system and groundwater monitoring network was presented in *Tacoma Landfill Consent Decree 2004 Annual Report* (City of Tacoma and Pacific Groundwater Group 2004).

The final remedy for the landfill established groundwater performance standards (GWPSs) set at the Federal maximum contaminant level (MCL) and Health Based Criteria, in the Consent Decree. The remedy also established the point of compliance (POC) as the landfill boundary. The GETS goal is to

remediate groundwater at the point of compliance and within the existing plume to drinking water standards or health based criteria specified in the Consent Decree, then the system will be shut down.

1.2 SCOPE

The scope of work for this project consisted of advancing a series of Waterloo Profiler[tm] (profiler) boreholes to collect multiple vertically spaced groundwater samples and groundwater parameters in each borehole. The profiler data provides a vertical water quality profile over discrete intervals. The profiler, combined with an onsite laboratory, also provides same day borehole water quality assessment. Profiler technology was typically advanced through a conductor casing installed to the water table. The conductor casing was advanced with a hollow-stem auger or sonic drilling technology.

A Waterloo Profiler[tm] description was presented in detail in the *Landfill Plume Work Plan* (Landau Associates 2005). The work plan also presents a detailed scope for field explorations.

1.3 OBJECTIVES

The primary purpose of this project is to determine the concentration and distribution of VOCs associated with the north and south area offsite groundwater plumes through an approach known as adaptive site characterization. Adaptive site characterization facilitates vertical and horizontal groundwater plume characterization based on rapidly available groundwater analytical and hydrostratigraphic data. Additional data collected during this project will be used to:

- Evaluate whether VOC groundwater contamination in the north and south areas are residual plumes from previous more extensive groundwater plumes or whether there is an ongoing source of contamination leaking through the point of compliance GETS wells along the western landfill boundary

- Determine what GETS modifications would be appropriate based on monitoring and site characterization data

- Provide necessary information to evaluate the potential for additional remedial actions to address remaining offsite groundwater contamination.

2.0 FIELD WORK

The EOP characterization field work was conducted in accordance with the work plan (Landau Associates 2005). Several alternatives were presented in the work plan to accommodate potential difficulties during data collection. The preferred approach was to drill a pilot boring to groundwater using hollow stem auger or sonic drilling methods. Boart Longyear was the drilling subcontractor and provided the direct-push drill rig[1], hollow stem auger, and sonic drilling operator and equipment. Boart Longyear was subcontracted directly to General Mechanical, a general contractor under contract with the City of Tacoma. Once groundwater was encountered, the Waterloo™ Profiler (profiler) was installed through the pilot borehole conductor casing and pushed into undisturbed soil using direct-push drilling methods.

Stone Environmental, Inc. provided the Waterloo™ Profiler and mobile laboratory services. Stone Environmental was subcontracted directly to Landau Associates Stone Environmental produced VOC analytical data, field parameter data, and index of hydraulic conductivity (I_K) data. Continuous index of hydraulic conductivity (I_K) was measured in each profiled borehole. The I_K is a unitless relative measure of the aquifer hydraulic conductivity. The primary purpose of this measurement was to select permeable portions of the aquifer to collect groundwater quality samples. These data were summarized in a separate data package submitted by Stone Environmental. This data package is reproduced in Appendix A

The first groundwater sample at each profile was collected within the top 5 ft of the water table. As the profiler was advanced, an index of hydraulic conductivity (*k*) and rate of penetration were recorded electronically and observed in real time. Groundwater samples were generally collected in zones of higher *k*, or at a pre-determined depth of 5 to 8 ft, if *k* remained constant. If the profiler could no longer be advanced prior to reaching the target depth, the pilot boring was drilled deeper, and the profiler was pushed further into the formation. Table 1 lists the number of samples per boring and their depth.

Groundwater samples were analyzed for VOCs by EPA Method 8260 at a mobile laboratory located at the landfill. Analytical results were received in the field allowing real time decisions to continue or discontinue profiling, and help determine the location of future profiles. Table 2 presents a summary of profiler analytical data analyzed at the mobile laboratory.

Twelve profiles were pushed, eight in the north area and four in the south area. In the north area, boreholes were generally aligned parallel to the direction of groundwater flow between extraction well W-14 and well TL-07 (See Figure 3). In the south area, boreholes were placed upgradient and

[1] The direct push drill rig was a Geoprobe Model 6600. More detailed specifications for drilling rigs are presented in the work plan (Landau Associates 2005).

downgradient of monitoring wells TL-26A and TL-26B (See Figure 4). Borehole locations were initially selected based on historical plume distribution and equipment and property accessibility; locations were adjusted during the project in response to profiler analytical data. Borehole locations in the north area are shown on Figure 3; locations in the south area are shown on Figure 4.

Profile samples in the north area were collected between 18 ft below ground surface (bgs) and 71 ft bgs. Samples in the south area were collected between 89 ft bgs and 150 ft bgs. In boreholes where groundwater was encountered above the suction limit (i.e., approximately 25 ft bgs), a peristaltic pump was attached to the stainless steel profiler tubing to pump the water to in-line sample containers. When groundwater samples were collected below the suction limit, a nitrogen drive pump was used to pump groundwater to the surface. Field pH measurements, specific conductivity (SC), turbidity, dissolved oxygen (DO), temperature, and oxidation/reduction potential (ORP) were measured using a closed flow cell. The sample lines were purged and field parameters were stabilized prior to the collection of groundwater samples. Field parameter data are summarized in Appendix A.

The field investigation began on May 17, 2005 and was completed on Tuesday, June 8, 2005. Due to sonic drill rig breakdowns, a planned fifth profile (e.g., SA-05) was not completed in the south area. However data from SA-01 through SA-04 were deemed sufficient to meet the project objectives.

3.0 RESULTS

Landfill hydrogeology and groundwater quality have been characterized through numerous well installations and periodic water quality and water level monitoring. As part of this EOP characterization project, site hydrogeology and contaminant plume trends were evaluated. An initial assessment was summarized in the work plan based on review of boring logs and water level data (Landau Associates 2005). Based on additional data collected during this project, refinements to the site conceptual models of geology, groundwater flow, and water quality were developed.

3.1 GEOLOGY

The landfill geology consists primarily of Vashon age glacial deposits that overlay older pre-Vashon deposits. The basic landfill stratigraphy was developed during the initial landfill remedial investigation (RI) (Black and Veatch 1987) and was refined in the *Tacoma Landfill 1995 Annual Report* (Pacific Groundwater Group 1996). This report uses RI geologic unit terminology but includes an updated interpretation of the geology as a basis for an updated hydrogeologic conceptual model.

Primary geologic deposits encountered beneath and west of the landfill were summarized into five geologic units consisting of Vashon glacial deposits, older glacial or interglacial deposits, and older silt deposits. These stratigraphic units are described below:

- Qvr: Vashon recessional deposits that consist of unconsolidated (stiff to very stiff or medium dense to dense) silt, sand and gravel. These deposits include ablation till or ice contact deposits in the valley bottom along Leach Creek. These valley bottom deposits in particular are distinguished from lodgment till (basal glacial deposit overridden by an ice sheet) based on appreciably lower density (i.e., see well logs for north area boring TL-7C and south area boring P-3/4).

- Qvt: Vashon glacial till or lodgment till deposits that consist of consolidated (very dense) silt, sand and gravel. These deposits mantle the west-facing slope of the landfill and are typically 15 to 20 ft thick. Qvt deposits pinch out in the north area west of well W-42, and in the south area west of well W-32.

- Qva: Vashon advance outwash deposits that consist of consolidated (dense to very dense) gravelly sand and sand. The Qva includes both the previously described (Black and Veatch 1987) sandy gravel advance outwash deposits and the underling sandy Colvos Sand deposit. The Qva represents a fining downward sequence where the grain size is coarsest at the top of the sequence beneath the glacial till and becomes finer toward the bottom of the sequence at about elevation[2] 200 ft.

[2] Elevations in this report are presented in ft, mean sea level (MSL) equal to NGVD 1929. Previous reports have typically presented elevations in City of Tacoma datum. City of Tacoma datum is 14 ft higher than NGVD 1929.

- Qog: Directly beneath the Qva deposit is a dense to very dense gravel deposit that appears to be stratified glacial drift or interglacial deposit associated with an older glacial episode that predates both the Vashon glaciation and the Olympia interglacial period. These deposits are termed Qog and represent pre-Olympia older gravels, older till and older outwash.

- Qol: Fine grained silt deposits underlie the pre-Olympia older gravels. These deposits are termed Qol and represent pre-Olympia lacustrine deposits. Qol deposits were previously encountered throughout the north area and in the eastern portion of the south area. In the south area, borings in the vicinity of Leach Creek were not deep enough to encounter this layer.

Cross sections were developed through the north and south areas that describe stratigraphic relationships. Cross section geology is based on a review of boring logs and the preliminary surficial geologic map of the Steilacoom quadrangle (Troost et al. 2005). Cross section locations are shown on Figures 3 and 4 for the north and south areas respectively. Cross sections are presented on Figures 5 and 6 for the north and south areas respectively[3].

3.2 GROUNDWATER FLOW

The relatively permeable Qva and Qog deposits represent a single aquifer unit (the Qva/Qog aquifer) in the vicinity of the landfill. This aquifer also includes saturated Qvr deposits in the vicinity of Leach Creek. The upper portion of the aquifer has been previously termed the Colvos Sand aquifer (City of Tacoma and Pacific Groundwater Group 2004). The lower portion of this aquifer is in the Qog older gravel deposits. Where multiple completion screens are installed at a single well location (e.g. TL-10A, TL-10B and TL-10C), the "A" designation represents the shallowest screen (typically at the water table), and the "C" or "D" designation represents the deepest screen (near the base of the Qog). The underlying Qol silt is an aquitard that represents the base of this unit.

Recharge to the aquifer beneath the landfill occurs from the Fircrest Upland north of the landfill and the South Tacoma Channel east of the landfill (City of Tacoma and Pacific Groundwater Group 2004). Some limited recharge from rainfall infiltration also likely occurs west of the landfill where the lodgment till is absent. The primary discharge sink for groundwater flowing beneath the landfill is Leach Creek. Based on recharge and discharge patterns, groundwater flow is southward and westward beneath the landfill towards Leach Creek. Horizontal groundwater flow patterns based on water level contours are shown on Figure 7 for water levels collected during the first quarter of 2003 (City of Tacoma and Pacific

[3] These cross sections are similar to cross sections presented in the work plan (Landau Associates 2005) however the topography and unit contacts have been refined. Additionally, the geology in the vicinity of Leach Creek in the south area has been reinterpreted to include ablation till or ice contact deposits based in part on geology by Troost et.al., 2005.

Groundwater Group 2003). Groundwater flow patterns shown on this figure are consistent with identified recharge and discharge areas.

No significant recharge occurs beneath the landfill since most of the facility is capped. Consequently, vertical gradients are expected to be low beneath the landfill and directly west of the landfill (where lodgment till is present) reflecting generally horizontal flow in this area, while vertical gradients are expected to be upward only near Leach Creek. Actual measured vertical gradients along the west side of the landfill are somewhat variable. This is attributed to pumping from GETS extraction wells which are sometimes screened near the top of the aquifer (i.e., well W-15) and other times screened near the bottom of the aquifer (i.e., well W-36). Figure 8 presents a plan view map of vertical gradients at various monitoring well clusters along the west side of the landfill. Vertical gradients at select well clusters are summarized in Table 3.

The I_K measurements also provided a qualitative assessment of the variability in aquifer hydraulic conductivity of the upper portion (Colvos Sand portion) of Qva/Qog aquifer. I_K measurements indicated quite a bit of variability in aquifer hydraulic conductivity at individual borings over the range of a few feet. However, there was no obvious trend in I_K measurements within boreholes or between boreholes. I_K readings are presented in Appendix A.

3.3 GROUNDWATER QUALITY

VOC groundwater plumes were historically associated with the west side of the landfill. Concentrations of tetrachloroethene (PCE), trichloroethene (TCE), 1,2-dichloroethene (1,2-DCA), and vinyl chloride exceeded GWPSs. Since remedy implementation beginning in 1992, VOC concentrations have declined significantly. Currently, the only well locations where VOCs exceed the GWPS beyond the POC are vinyl chloride in the north area at wells TL-07A and W-36 and 1,2-dichlorethane (1,2-DCA) in the south area at well TL-26A (City of Tacoma and Pacific Groundwater Group 2004).

Additional data collected during this project helped define the degree and extent of contamination in these two areas. In the north area, 44 groundwater samples were collected from 8 profiled boreholes (See Figure 3). Chloroethane; cis-1,2-dichlorethene (cis-1,2-DCE); PCE; toluene, trans-1,2-DCE; TCE and vinyl chloride were detected at least once. Cis-1,2-DCE and vinyl chloride were the only two compounds detected in more than 7 percent of the samples. The maximum cis-1,2-DCE concentration was 8.2 µg/L, well below the GWPS of 70 µg/L. The maximum vinyl chloride concentration was 4.3 µg/L, above the GWPS of 2 µg/L. Vinyl chloride was the only compound detected above the GWPS during profiling in the north area, this is consistent with monitoring well data presented in the *Tacoma Landfill Consent Decree 2003 Annual Report* (City of Tacoma and Pacific Groundwater Group 2004).

Vinyl chloride is the only compound of concern for north area groundwater. A statistical summary of profiled VOC results in the north area is presented in Table 4.

In the south area, 24 groundwater samples were collected from four profiled boreholes (see Figure 4). 1,1,1-trichloroethane (TCA), 1,1-dichloroethane (1,1-DCA); 1,2-DCA; cis-1,2-DCE; PCE; toluene, trans-1,2-DCE; TCE and vinyl chloride were compounds that were detected at least once. 1,1-DCA; 1,2-DCA; and cis-1,2-DCE were the most frequently detected compounds. The maximum cis-1,2-DCE concentration was 36 µg/L, below the GWPS of 70 µg/L. The maximum 1,1-DCA concentration was 16 µg/L, below the GWPS of 20 µg/L. The maximum 1,2-DCA concentration was 13 µg/L, above the GWPS of 5 µg/L. 1,2-DCA was the only compound that was detected above the GWPS during profiling in the south area, this is consistent with monitoring well data presented in the *Tacoma Landfill Consent Decree 2004 Annual Report* (City of Tacoma and Pacific Groundwater Group 2005). Consequently, for this evaluation 1,2-DCA is the only compound of concern for south area groundwater. A statistical summary of profiler VOC results in the south area is presented in Table 5.

During collection of profiler VOC samples, general groundwater quality parameters were collected at each profile sample interval. General groundwater quality parameters are specific conductance, dissolved oxygen, pH, and oxygen-reduction potential (ORP)[4]. ORP and pH readings were similar in the north and south areas. ORP varied from 156 to -328 mV; pH varied between 6 and 8. These readings are not unusual for shallow groundwater systems and do not appear to be indicative of an impact from landfill operations. Dissolved oxygen and specific conductance showed different trends between the north area and south area. Specifically, in the south area, dissolved oxygen and specific conductance are lower than in the north area. A summary of general groundwater quality parameter profiler data is presented in Table 6. A graphical presentation of specific conductance versus dissolved oxygen profiler data for the north and south areas is presented on Figure 9. General groundwater quality data is also presented in graphs by profiled borehole in Appendix A.

In the north area, specific conductance ranged from 184 to 1,159 µs/cm. At locations NA-01, NA-02 and NA-08 specific conductance values were all above 600 µs/cm (i.e., above values typical for shallow aquifer systems) while at other north area locations and all south area locations, specific conductance values were all below 610 µs/cm. The three locations where specific conductance is elevated (i.e., above 600 µs/cm) all occur in the north area just east of Leach Creek at the base of the westward sloping hill. The occurrence of high specific conductance at these locations near the creek could be due to a number of factors. Spatially, the occurrence of elevated specific conductance roughly correlates with elevated vinyl chloride concentrations (see discussion below) and may be related to a

[4] ORP is a measurement of the ability of the solution to oxidize a contaminant.

residual plume from the landfill. Alternatively, the occurrence of elevated specific conductance could be related to infiltration of surface water runoff. A graphical presentation of north area profiler specific conductance data by location is presented on Figure 10.

Dissolved oxygen in infiltrating rainwater is about 10 ppm. Typical values of dissolved oxygen in shallow groundwater are typically less than 10 ppm due to biochemical oxygen demand associated with the aquifer substrate. Biochemical oxygen demand from landfill contaminants can also cause dissolved oxygen to be depleted. Dissolved oxygen concentrations (between 0 and 3 ppm) in the south area are relatively low compared to the north area (see Figure 9). However, it is not clear whether these low levels are associated with impacts from the landfill. Note that specific conductance is not particularly elevated in south area samples.

3.3.1 NORTH AREA VINYL CHLORIDE

The north area was selected for evaluation because groundwater vinyl chloride concentrations persist above groundwater performance standards in wells directly east of Leach Creek. VOC data is maintained by the City of Tacoma in a database. Data for some wells extend back as far as 1988, while other wells were installed after preparation of the ROD in 1992 and subsequent remedy implementation. The database was queried to determine the maximum value of vinyl chloride at each well location to give an assessment of the maximum extent of the north area groundwater plume. These data indicated a vinyl chloride groundwater plume above the GWPS that extended from the west end of the landfill to Leach Creek. The plume axis was centered approximately on 40th Street West. The highest concentrations occurred just west of the landfill boundary at well TL-10B. Maximum historical north area vinyl chloride concentrations are summarized in Table 7. Maximum vinyl chloride plume concentrations and plan view contours are shown on Figure 11. Though the entire thickness of the aquifer appears to have been contaminated, the highest concentrations occur near or at the surface. Maximum historical vinyl chloride plume concentrations and contours are shown in cross section view on Figure 12.

Remedy implementation caused concentrations within the north area plume to decline significantly resulting in a residual plume near Leach Creek. A plot (Figure 13) of vinyl chloride concentrations over time at select north area wells demonstrates this decreasing trend. The residual vinyl chloride plume extent was delineated using borehole profile data. The data were combined with the most recent analytical data from north area wells to get an estimate of current groundwater impacts. Recent vinyl chloride concentrations are summarized in Table 8. The data indicate a residual vinyl chloride plume in the vicinity of Leach Creek. This residual plume likely represents the remnants of a contamination slug shown on Figure 11 that migrated toward Leach Creek and the edge of plume (EOP) extraction wells. Recent vinyl chloride concentrations and contours are shown on Figure 14; comparison

of Figures 11 and 14 demonstrates the reduction in plume extent over time. The residual vinyl chloride plume no longer occurs in the lower portions of the aquifer except at extraction well W-36. Recent vinyl chloride concentrations and contours are shown in cross section view on Figure 15.

The north area vinyl chloride plume eventually discharges to Leach Creek. The City collects quarterly water quality samples from Leach Creek at location LC-01 (upgradient of the north area plume) and LC-02 (downgradient of the north area plume) (Figure 2). Vinyl chloride has not been detected at either of these locations.

3.3.2 SOUTH AREA 1,2-DICHLOROETHANE

The City of Tacoma water quality database was queried to determine the maximum 1,2-DCA concentration at each well location to give an assessment of the south area groundwater plume maximum historical extent. The data indicate an area where 1,2-DCA groundwater concentrations were above the GWPS from the west end of the landfill to Leach Creek. The plume axis was centered approximately on 46th Street West. The highest concentrations occurred at the west boundary of the landfill at monitoring well TL-11A and extraction well W-05. Maximum south area 1,2-DCA concentrations are summarized in Table 9. Maximum historical 1,2-DCA plume concentrations and plan view contours are shown on Figure 16. The highest concentrations occurred near or at the water table surface however contamination impacts did extend into the Qog gravel. Maximum 1,2-DCA plume concentrations are shown in cross section view on Figure 17.

Similar to the north area, remediation has greatly reduced the plume extent in the south area. The highest remaining south area plume 1,2 DCA concentrations are in monitoring well TL-26A. At well TL-26A, 1,2-DCA concentrations continue to decrease from a peak concentration of 18 µg/L in 2000. Downgradient wells, such as well TL-09B have shown a more rapid decreasing concentration trend. Figure 18 shows 1,2-DCA concentration trends for representative south area wells.

The residual 1,2-DCA plume extent was delineated using borehole profile data. Additionally, the City collected groundwater samples from POC extraction wells W-2 to W-4 during November 2005 to determine VOC concentrations upgradient from the residual 1,2 DCA plume at the point of compliance. The data were combined with the most recent analytical data from north area wells to get an estimate of current groundwater impacts. The data from profiled boreholes SA-02 and SA-03 determined the vertical and horizontal 1,2 DCA plume extent immediately downgradient from TL-26A The data show that residual plume concentrations associated with the TL-26 well pair decrease to less than the GWPS a short distance downgradient and have limited vertical extent. Data from profiled boreholes SA-01 and SA-04, located upgradient of well TL-26A indicate 1,2-DCA concentrations above the GWPS extend upgradient toward the landfill boundary. However, recent data from POC wells W-2, W-3 and W-4 indicate that

1,2-DCA concentrations are less than the GWPS at the landfill boundary directly upgradient of TL-26A. Recent 1,2-DCA concentrations are summarized in Table 8. The residual 1,2-DCA plume is shown in plan and cross section views on Figures 19 and 20 respectively.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Borehole profile data collected with the Waterloo Profiler™ has helped determine the extent of residual groundwater plumes west of the landfill in the north and south areas. Historically, relatively extensive VOC groundwater plumes extended from the west boundary of the landfill, westward to Leach Creek. A vinyl chloride plume existed in the north area and a 1,2-dichloroethane plume existed in the south area. Landfill remedial actions combined with natural attenuation of the plume have reduced the horizontal and vertical extent of both plumes. Currently, only relatively minor residual groundwater plumes remain; maximum contaminant concentrations in these plumes are only slightly above the GWPS.

In the north area there was a relatively extensive historical groundwater plume originating from the landfill. Groundwater quality data collected during this study indicate there is now a much smaller residual plume characterized by vinyl chloride concentrations that slightly exceed GWPS. These data indicate the plume source was effectively eliminated by landfill remedial actions including soil gas removal, elimination of infiltration, and POC extraction well pumping. Since the plume source was effectively eliminated, the offsite plume has decreased due to edge of plume (EOP) groundwater extraction well pumping and treatment and natural attenuation. The decrease in the extent of the north area plume is evident in comparison of Figures 11 and 14.

In the north area, vinyl chloride concentrations above the GWPS remain in a small area in the vicinity of monitoring well TL-7A and extraction well W-36, near Leach Creek. These concentrations represent a residual slug of contamination from the historical plume. Elevated specific conductance data in this area may also represent a residual slug of contamination from the historical plume. Based on concentration profiles at locations NA-01 and NA-02 it appears that well W-36 groundwater extraction is drawing a portion of the plume downward (Figure 15), resulting in the slight GWPS exceedence in this well. Ceasing groundwater extraction at W-36 will allow groundwater contamination to naturally attenuate through biodegradation and discharge to Leach Creek. Concentrations are low enough that impacts to Leach Creek are very unlikely, especially since historical sampling has not detected VOCs in the creek. Because concentrations are low and the extent of contamination is limited, it is expected that vinyl chloride concentrations will decline to below the GWPS within a relatively limited time frame (i.e., approximately 5 years).

In the south area there was also a relatively extensive historical groundwater plume originating from the landfill. There is now a residual plume characterized by 1,2-dichloroethane concentrations that slightly exceed the GWPS. Concentration trends indicate the plume source was also effectively eliminated by remedial actions. Since the plume source was effectively eliminated, the extent of the

offsite plume has decreased significantly through EOP pumping and natural attenuation. The decrease in the extent of the south area plume is evident in comparison of Figures 18 and 20.

The residual south area groundwater plume is located in the vicinity of monitor well TL-26A, relatively close to the west boundary of the landfill. Groundwater quality data collected during this study indicate the plume is limited in horizontal and vertical extent (Figures 19 and 20). The occurrence of the residual plume relatively near the landfill boundary (as opposed to near Leach Creek like the north area plume) may result from the occurrence of a slow groundwater velocity zone or stagnation zone. This type of groundwater flow pattern can occur directly downgradient of pumping wells such as the nearby POC extraction wells. Minor leakage through the POC extraction wells could be a contributing factor to the plumes occurrence, however data from the existing POC wells suggests significant leakage is unlikely. Based on the relatively limited extent of the plume, relatively low concentrations and concentration trends at well TL-26A (Figure 18) it is likely that the concentrations in the south area plume will continue to decline to below the 1,2-dichloroethane GWPS within a relatively limited time frame (i.e., 5 to 10 years).

Based on the decline in the extent and concentration of the north and south area plumes, it is appropriate to reevaluate current remedial action practices. The following recommendations focus on scaling back on offsite (EOP) pumping and adjusting current monitoring to address the remaining residual groundwater contamination:

- Shutdown north area extraction well W-36. Continue to monitor wells W-36 and TL-7A semiannually for VOCs and field parameters to document decreasing vinyl chloride concentration trends

- Move the location of Leach Creek surface water quality monitoring station LC-1 from upgradient of the north area plume to directly downgradient (within 50 ft) of well TL-7A. The purpose of sampling Leach Creek at this location is to provide a more representative monitoring location to verify that north area plume discharge is not affecting the creek. Samples should be collected for VOCs and field parameters. Sampling frequency should be quarterly for the first year and then semiannually until north area plume concentrations meet the GWPS.

- Shut down all EOP north area extraction wells that meet groundwater performance standards

- Continue to monitor the south area plume at well TL-26A on a quarterly basis. Concentrations trends at this well should be the basis for further action. Should an increasing concentration trend develop, consider installing an additional POC extraction well.

- Shut down all EOP south area extraction wells that meet groundwater performance standards

- Continued sampling north and south area monitoring wells and selected EOP extraction wells for VOCs. A semi-annual sampling frequency should be sufficient to determine that groundwater continues to meet VOC groundwater protection standards.

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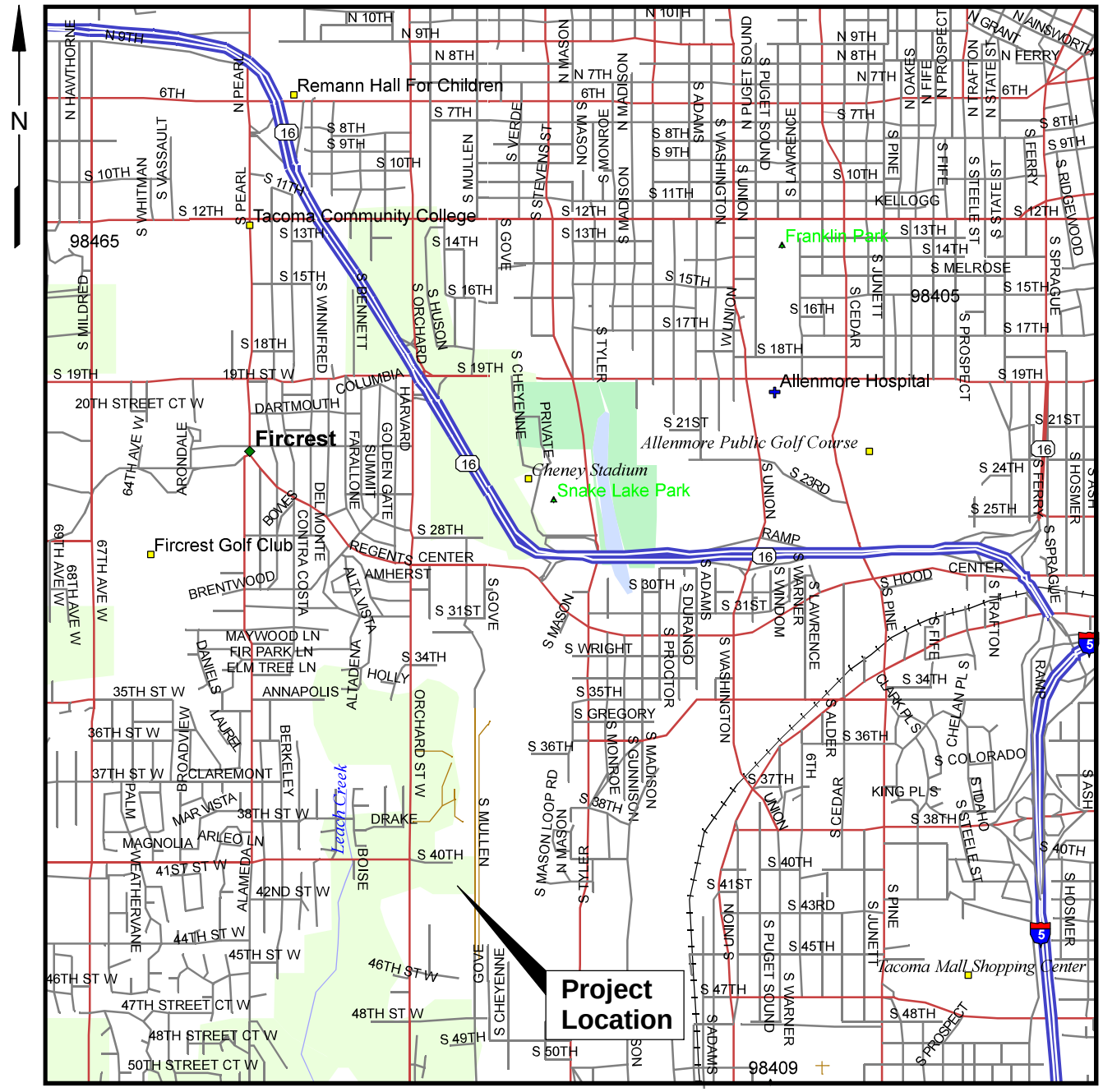


Map from DeLorme Street Atlas USA, 2002

City of Tacoma\Landfill Plume | T:\094\0150\10\Work Plan\Fig1.cdr 4/6/2005

LANDAU ASSOCIATES

Landfill Plume City of Tacoma Tacoma, Washington	**Vicinity Map**	Figure 1

N

GETS TREATMENT PLANT

North Area

South Area

Leach Creek

S. Orchard St.

S. Huson St.

W. 40th St.

46th St. W.

TL-17b
TL-17a
FL-1a
FL-1b
TL-16
TL-2a,c
W-22
TL-1a
TL-b,c
TL-3a,c
W-21
TL-18a,c
TL-4
W-20
W-19
W-18
LC-01
L-5a,c, d
TL-15b,c
TL-15a
W-17
MW-16-2
MW-16-3
TL-14
W-38
P-9
W-43
W-37
W-16
W-15
TL-10c,d
TL-7a
P-8
W-36
W-42
W-14
W-13
W-12
TL-10a,b
P-7
W-11
W-10
W-35
TL-8a
TL-8b,c
TL-25a
TL-25b
W-9
W-8
P-6
W-7
TL-13a,c
W-34
W-6
TL-12
P-5
W-33
W-5
P-10
TL-19a
W-4
P-3/4
TL-19c
TL-9a,b
W-3
W-32
TL-26a
W-2
TL-26b
W-31
W-1
P-2
TL-11a
TL-20a,c
TL-11b,d
W-30
TL-22
TL-23
W-41
TL-28
Pw-1
W-40
TL-27b
TL-27a
P-11
TL-24
89.5
TL-21
LC-02

Legend

- TL-10a,b — Tacoma Landfill Monitoring Well (multiple completion in one borehole)
- TL-12 / TL-1a — Tacoma Landfill Monitoring Well (single completion)
- W-34 — GETS Extraction Well
- P-3/4 — GETS Performance Monitoring Well
- LC-01 — Leach Creek Sampling Location
- Landfill Boundary
- Investigation Area

Base map source: City of Tacoma 2004

0 700 1400

Scale in Feet

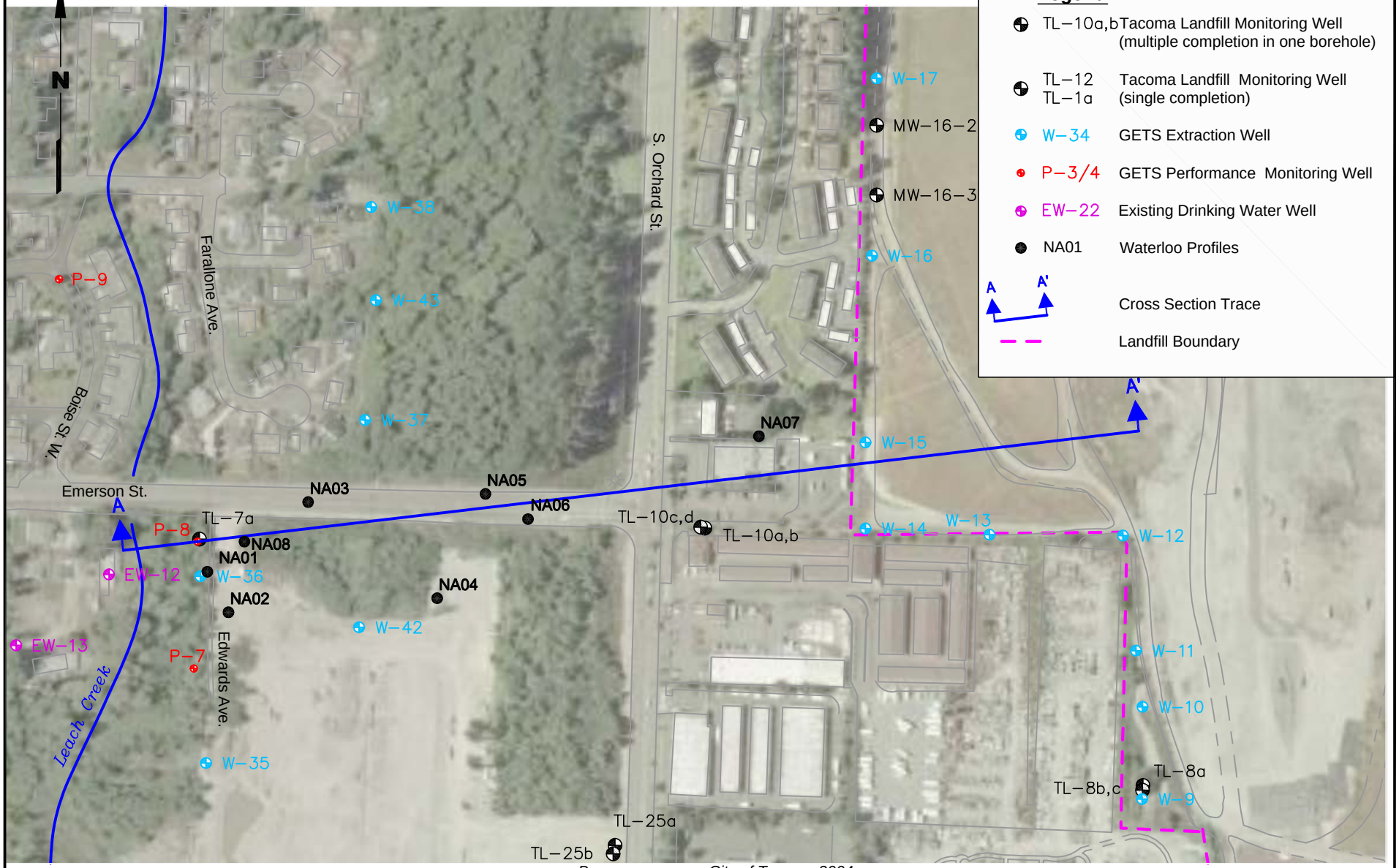
LANDAU ASSOCIATES

Landfill Plume
City of Tacoma
Tacoma, Washington

Site Plan

Figure 2

City of Tacoma\Landfill Plume | I:\094\015.020\Report\Fig3_4.dwg (A) "Figure 3" 8/08/2005



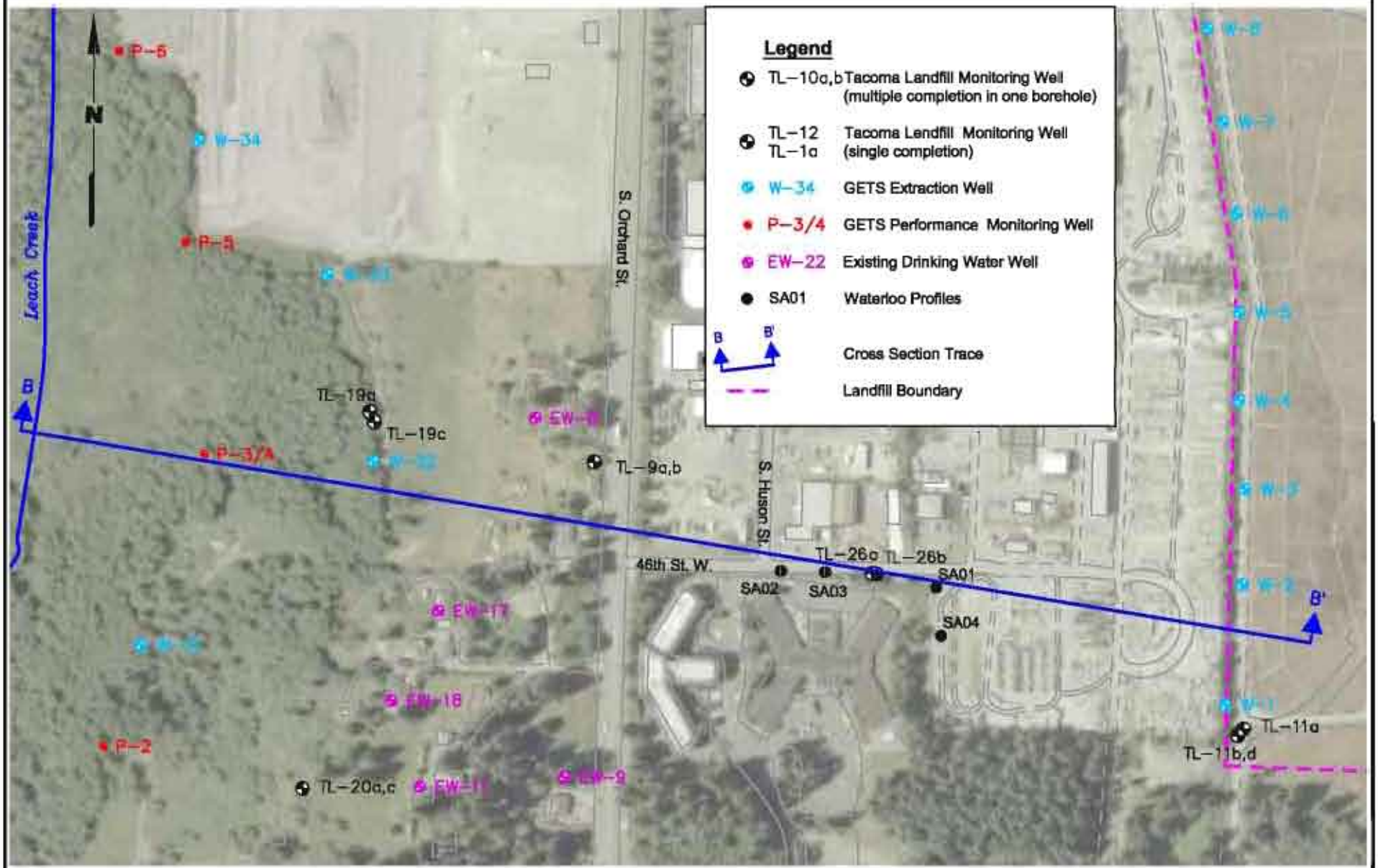
Base map source: City of Tacoma 2004

LANDAU ASSOCIATES

Landfill Plume
City of Tacoma
Tacoma, Washington

North Investigation Area

Figure
3



0 300 600
Scale in Feet

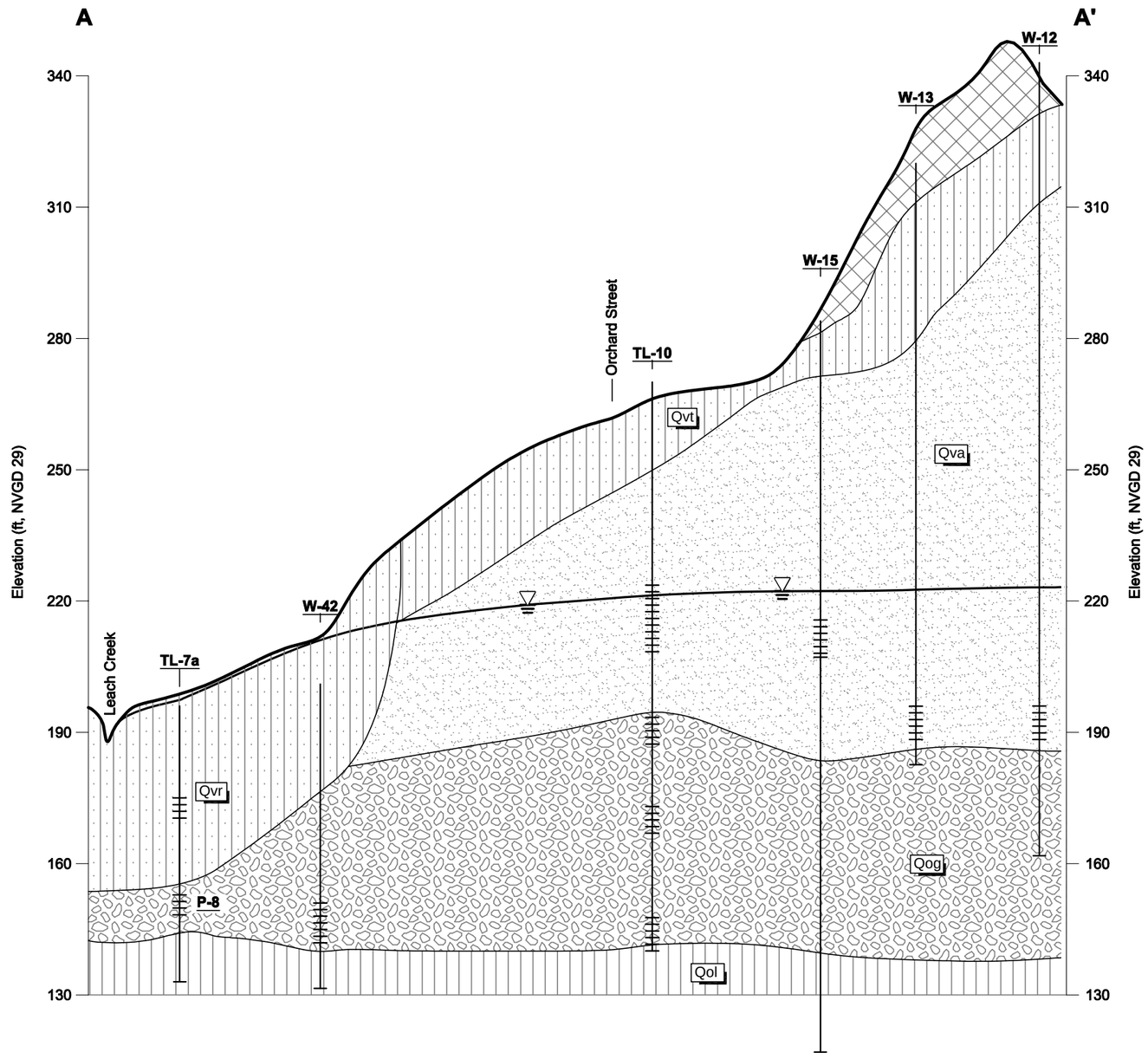
Base map source: City of Tacoma 2004

LANDAU ASSOCIATES

Landfill Plume
City of Tacoma
Tacoma, Washington

South Investigation Area

Figure
4



0 300 600

Scale in Feet
Vertical Exaggeration 10X

Legend

- Qvr — Vashon Recessional Deposit
- Qvt — Vashon Glacial Till
- Qva — Vashon Advance Outwash
- Qog — Pre-Olympia Gravel
- Qol — Pre-Olympia Lacustrine
- Screened Interval
- Approximate Water Level Elevation
- Fill
- Silty Sand (SM)
- Poorly Graded Sand (SP)
- Poorly Graded Gravel (GP)
- Silt (ML)

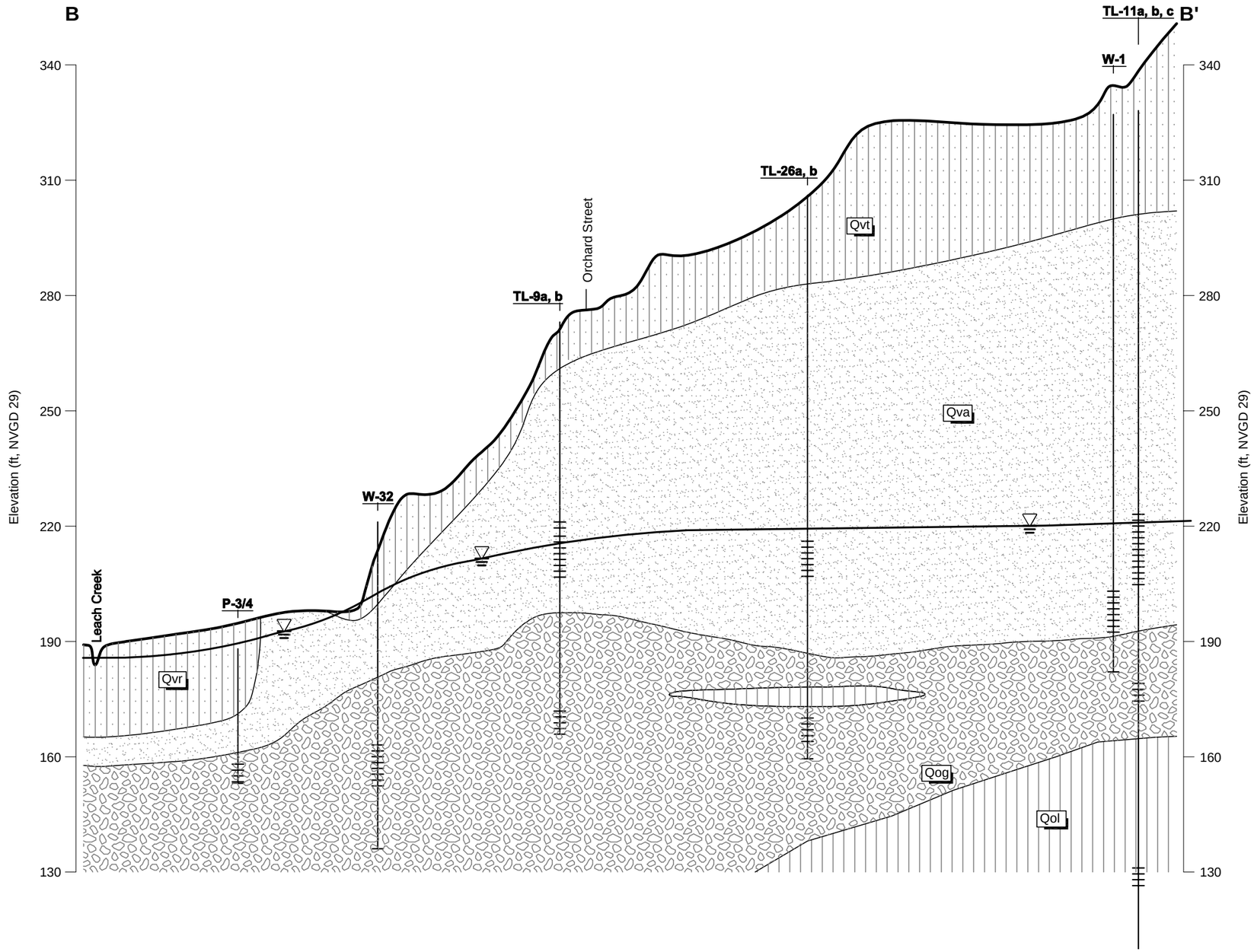
Note

1. This cross-section has been interpreted and generalized from field data collected by Landau Associates and others. Variations between this cross-section and actual conditions may exist.

City of Tacoma\Landfill Plume | I:\0944\015.020\Report\Figures5.dwg (A) "Figure 5" 8/08/2005

LANDAU ASSOCIATES

Landfill Plume City of Tacoma Tacoma, Washington	**North Investigation Area Cross Section A-A'**	Figure **5**



Legend

- Qvr — Vashon Recessional Deposit
- Qvt — Vashon Glacial Till
- Qva — Vashon Advance Outwash
- Qog — Pre-Olympia Gravel
- Qol — Pre-Olympia Lacustrine
- Screened Interval
- Approximate Water Level Elevation

- Silty Sand (SM)
- Poorly Graded Sand (SP)
- Poorly Graded Gravel (GP)
- Silt (ML)

Note

1. This cross-section has been interpreted and generalized from field data collected by Landau Associates and others. Variations between this cross-section and actual conditions may exist.

0 300 600

Scale in Feet
Vertical Exaggeration 10X

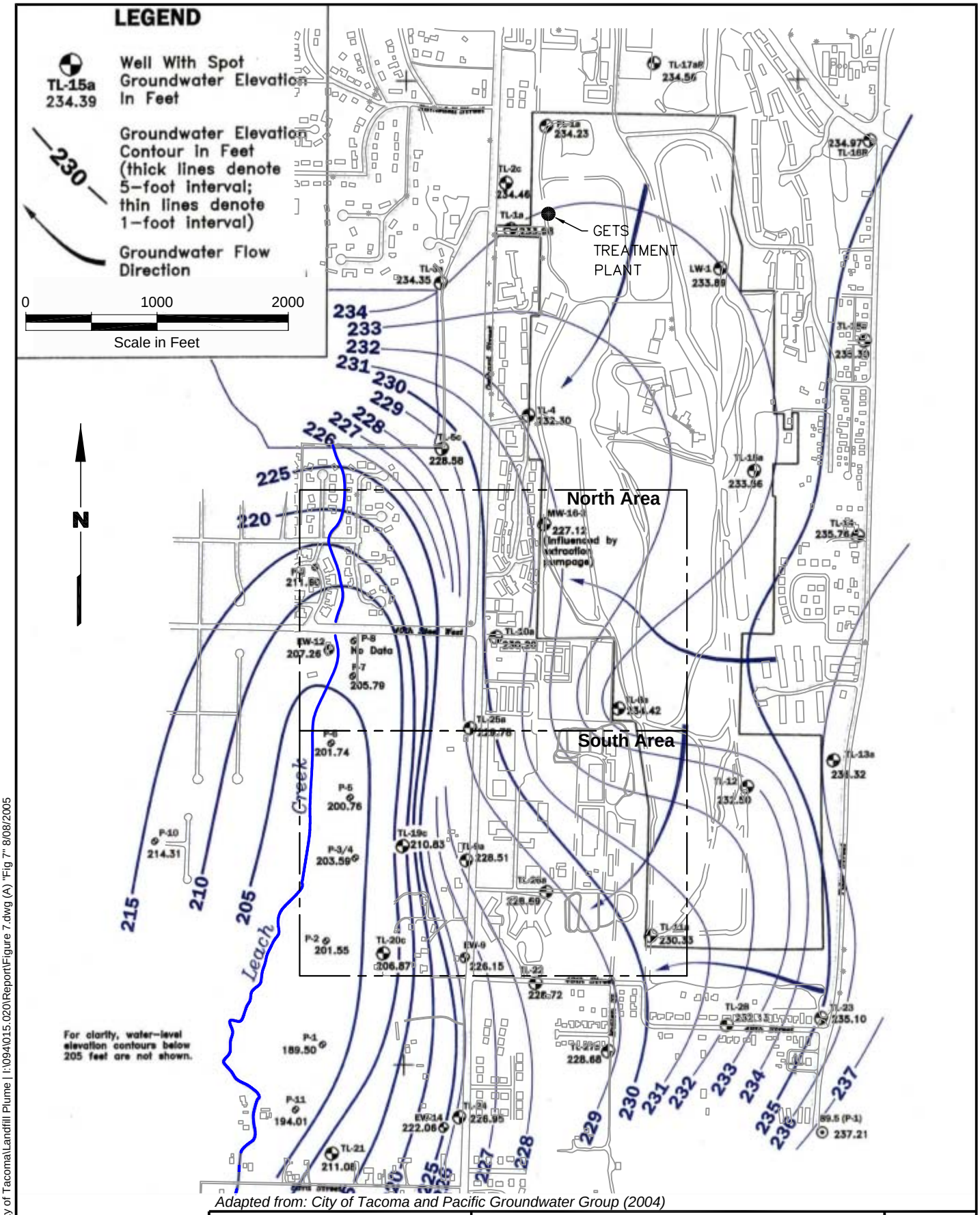
LANDAU ASSOCIATES

Landfill Plume
City of Tacoma
Tacoma, Washington

South Investigation Area
Cross Section B-B'

Figure
6

City of Tacoma\Landfill Plume I:\0940\015.020\Figure 6.dwg (A) "Figure 6" 8/08/2005

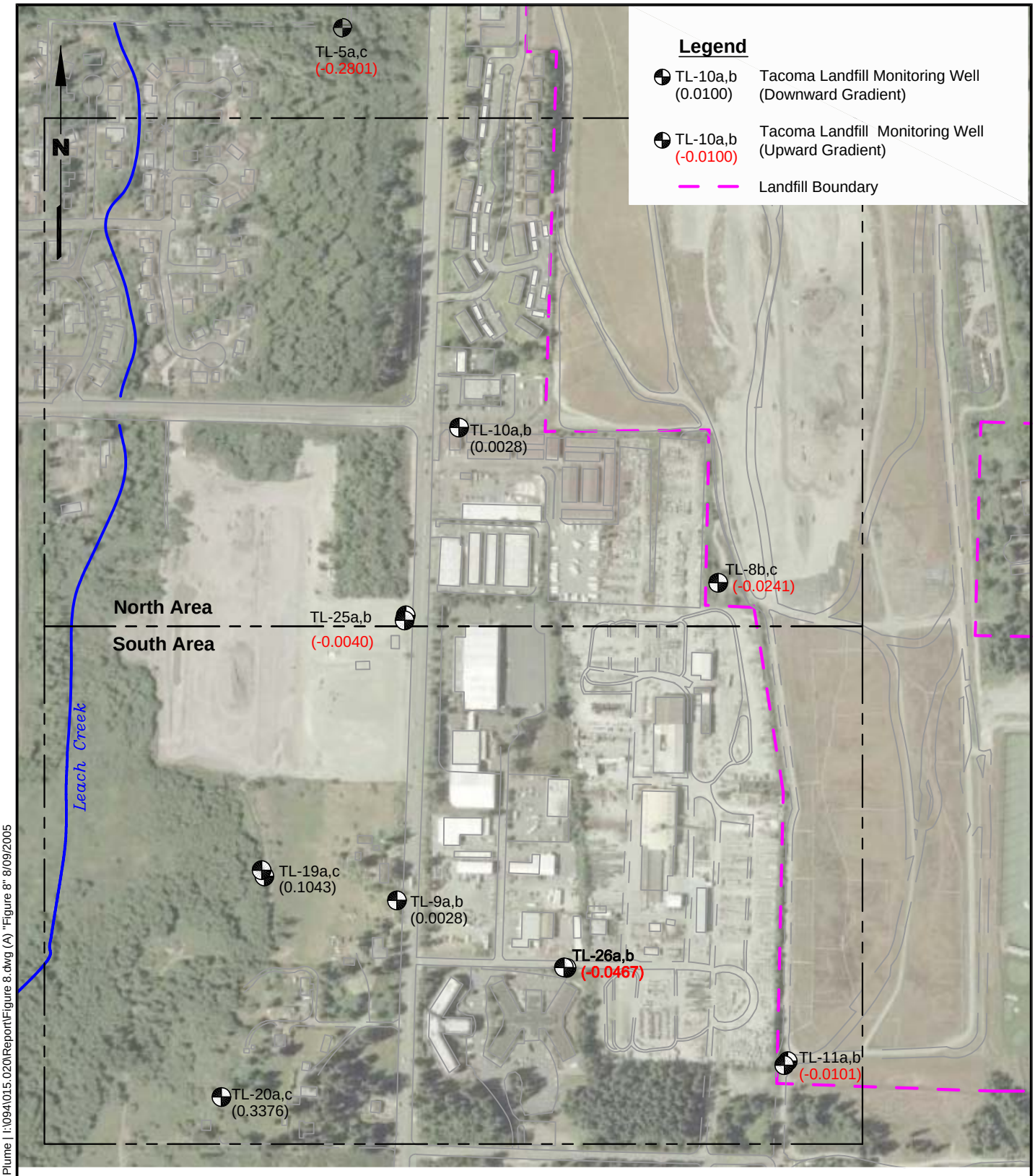


Adapted from: City of Tacoma and Pacific Groundwater Group (2004)

City of Tacoma\Landfill Plume I:\0941\015.020\Report\Figure 7.dwg (A) "Fig 7" 8/08/2005

LANDAU ASSOCIATES

Landfill Plume City of Tacoma Tacoma, Washington	**Groundwater Flow First Quarter 2003**	Figure **7**



0 500 1000

Scale in Feet

Base map source: City of Tacoma 2004

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

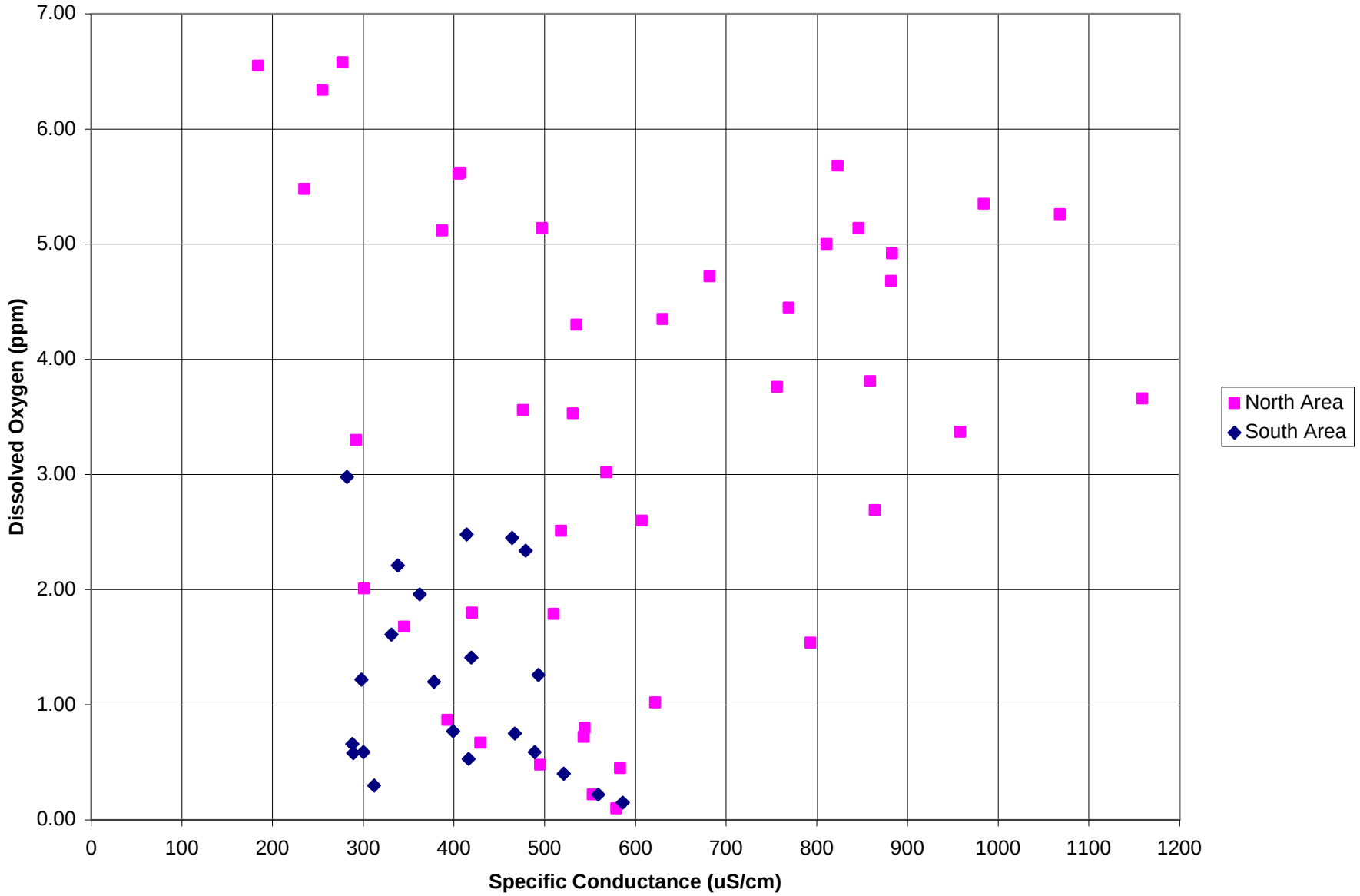
City of Tacoma\Landfill Plume I:\094\015.020\Report\Figure 8.dwg (A) "Figure 8" 8/09/2005

LANDAU ASSOCIATES

Landfill Plume
City of Tacoma
Tacoma, Washington

Groundwater Vertical Gradients

Figure 8

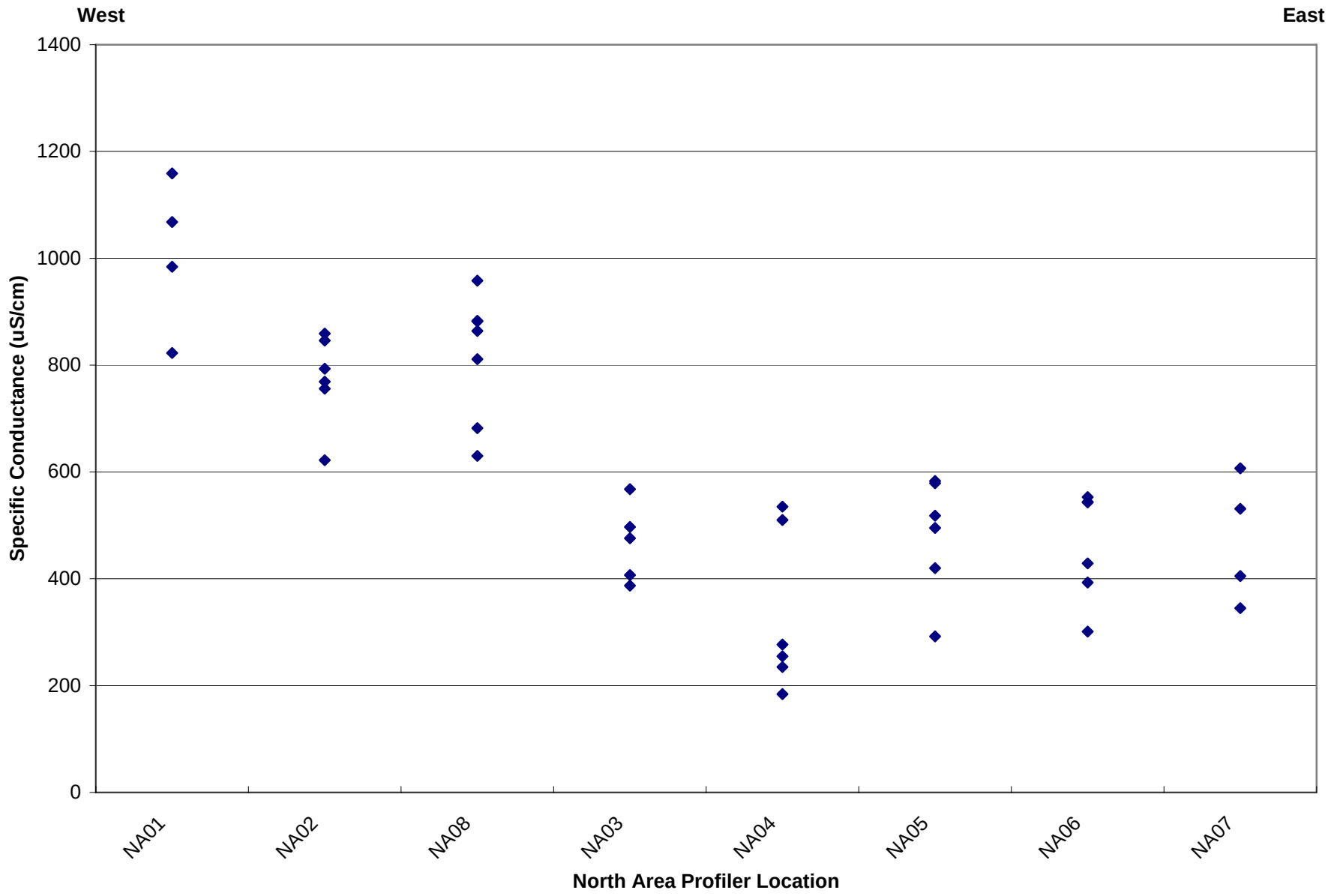


LANDAU ASSOCIATES

Landfill Plume
City of Tacoma
Tacoma, Washington

Specific Conductance versus Dissolved Oxygen Concentrations

Figure
9

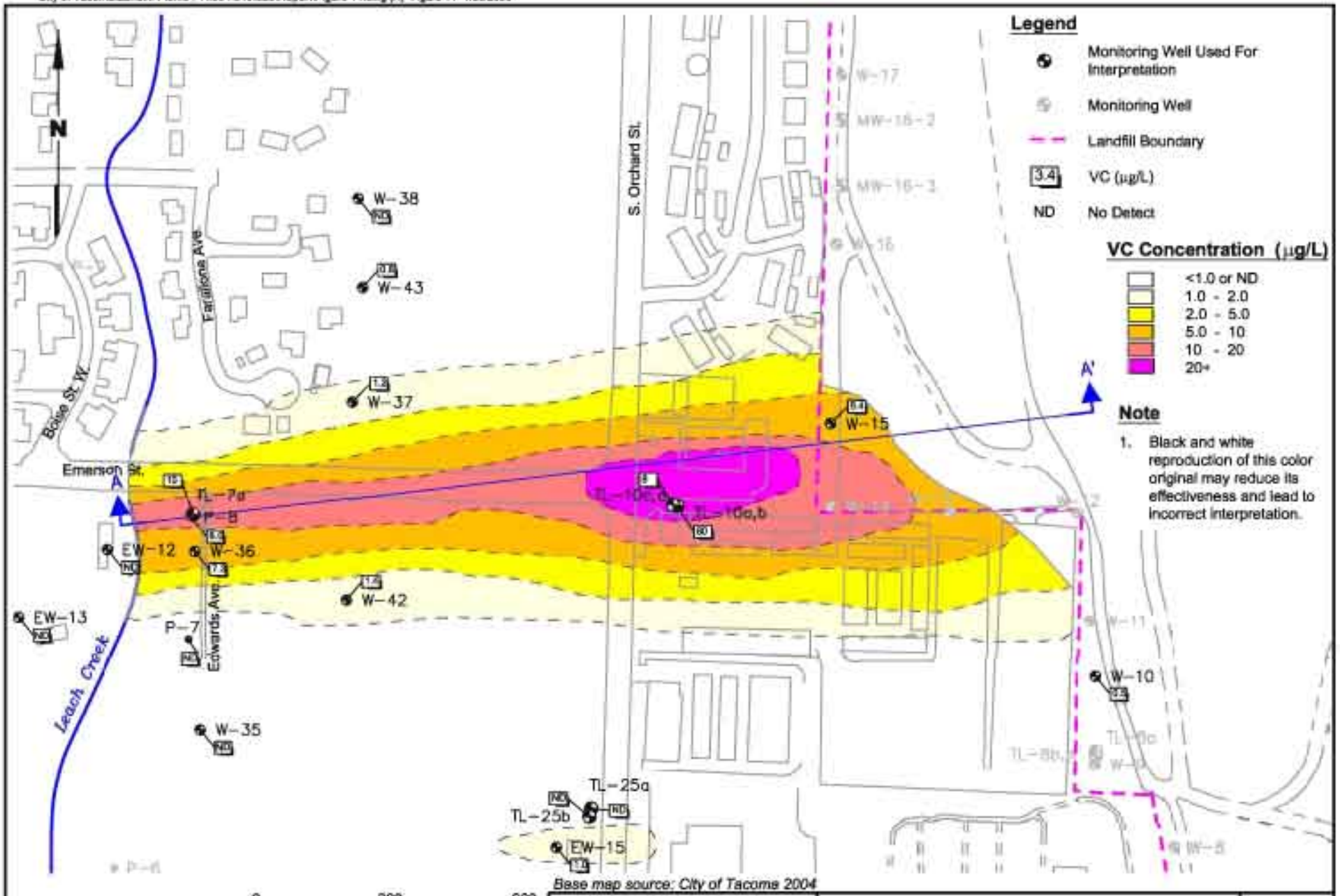


LANDAU ASSOCIATES

Landfill Plume
City of Tacoma
Tacoma, Washington

North Area Specific Conductance Data by Profiler Location

Figure
10



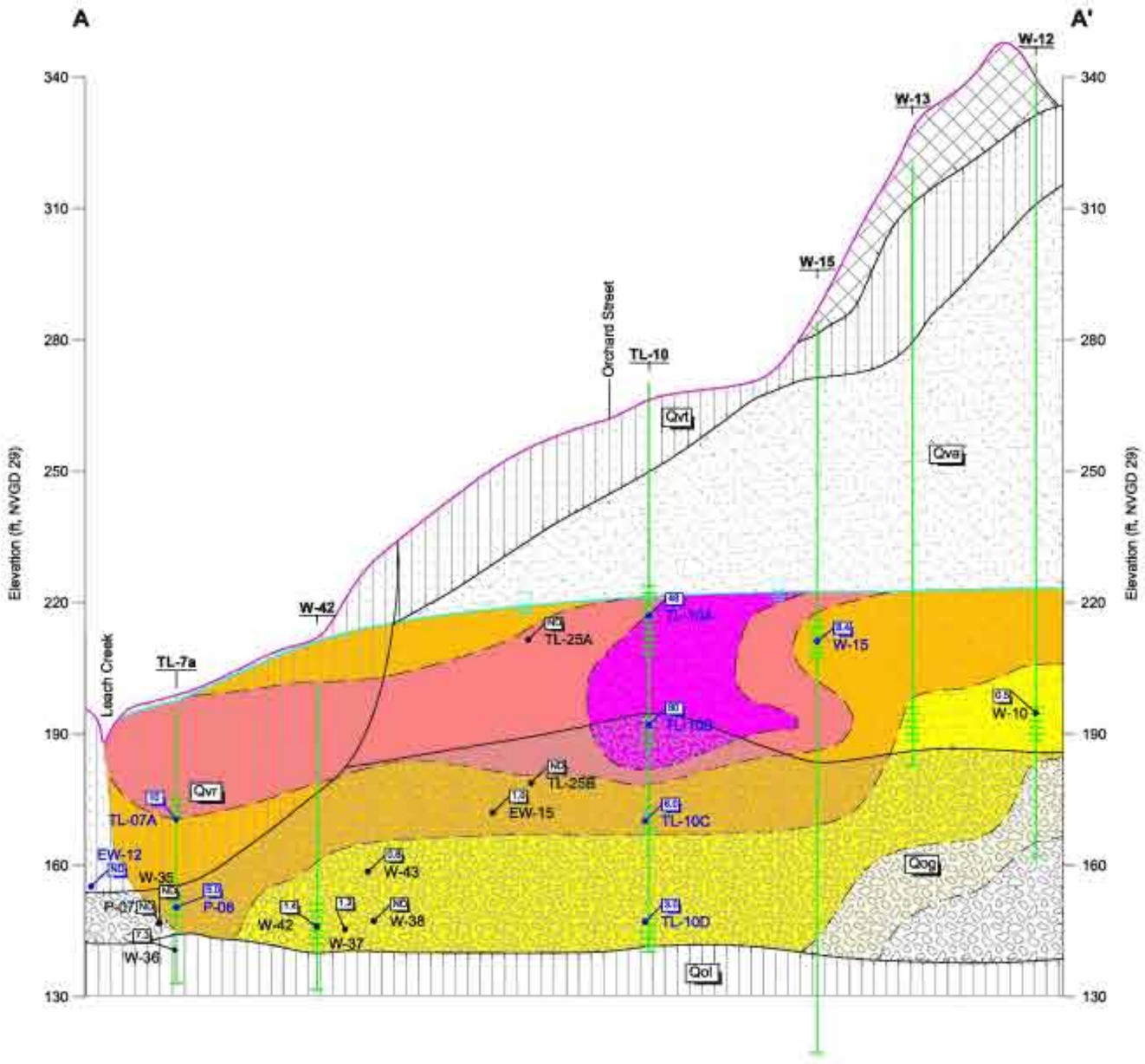
Base map source: City of Tacoma 2004

LANDAU ASSOCIATES

Landfill Plume
City of Tacoma
Tacoma, Washington

Historical Maximum Vinyl Chloride Concentrations: North Area Plan View

Figure 11



0 300 600

Scale in Feet
Vertical Exaggeration 10X

Legend

- Qvr — Vashon Recessional Deposit
- Qvt — Vashon Glacial Till
- Qva — Vashon Advance Outwash
- Qog — Pre-Olympia Gravel
- Qol — Pre-Olympia Lacustrine
- Screened Interval
- Approximate Water Level Elevation
- 3.4 — VC (µg/L)
- ND — No Detect
- Data Point
- Data Point Used For Contours

- Fill
- Silty Sand (SM)
- Poorly Graded Sand (SP)
- Poorly Graded Gravel (GP)
- Silt (ML)

VC Concentration (µg/L)

- <1.0 or ND
- 1.0 - 2.0
- 2.0 - 5.0
- 5.0 - 10
- 10 - 20
- 20+

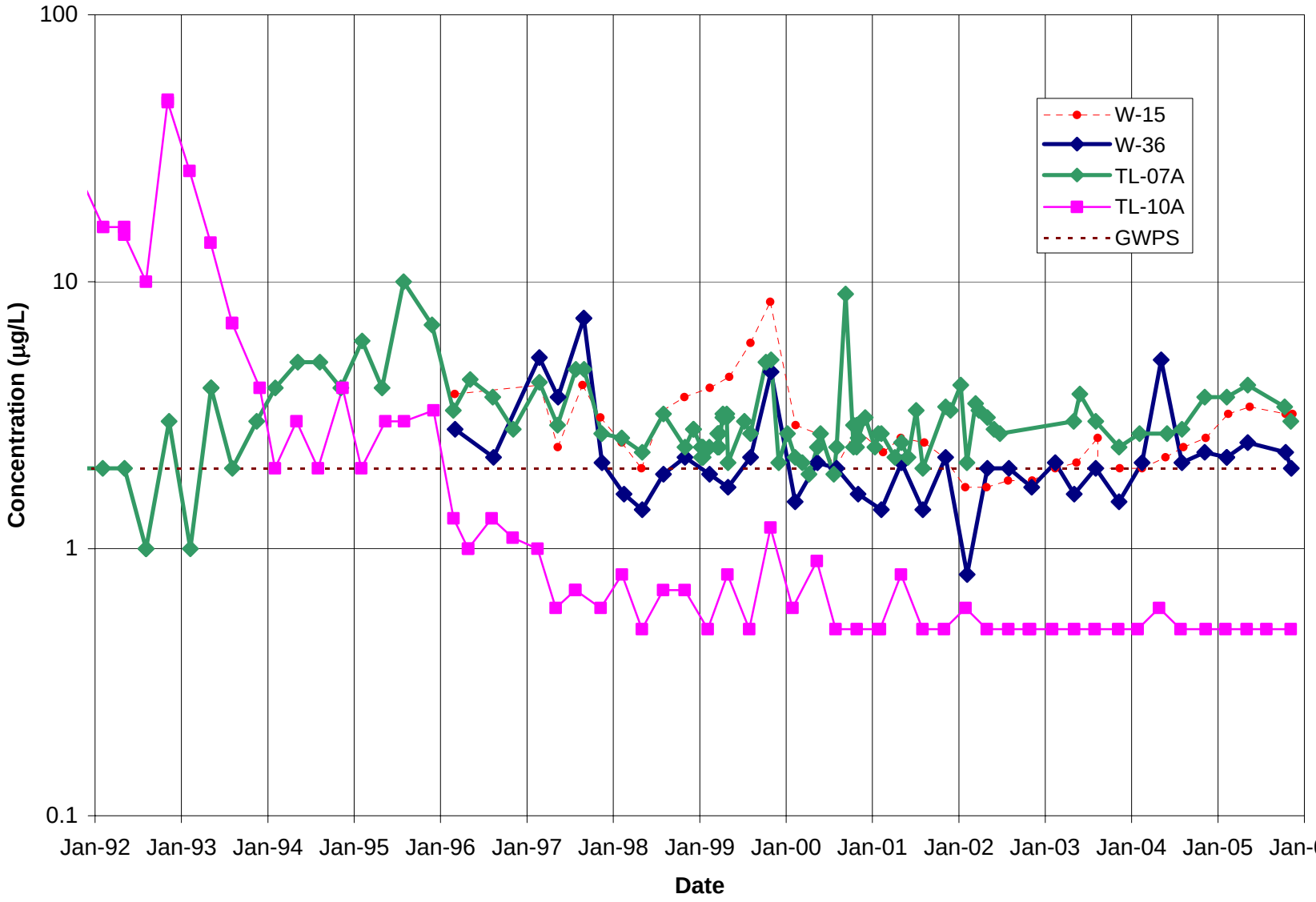
Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.
2. This cross-section has been interpreted and generalized from field data collected by Landau Associates and others. Variations between this cross-section and actual conditions may exist.

LANDAU ASSOCIATES

Landfill Plume City of Tacoma Tacoma, Washington	**Historical Maximum Vinyl Chloride Concentration: North Area Cross Section View**	Figure 12

City of Tacoma\Landfill Plume | Y:\0946\015.020\Report\Figure 12.dwg (A) "Figure 12" 1/31/2008



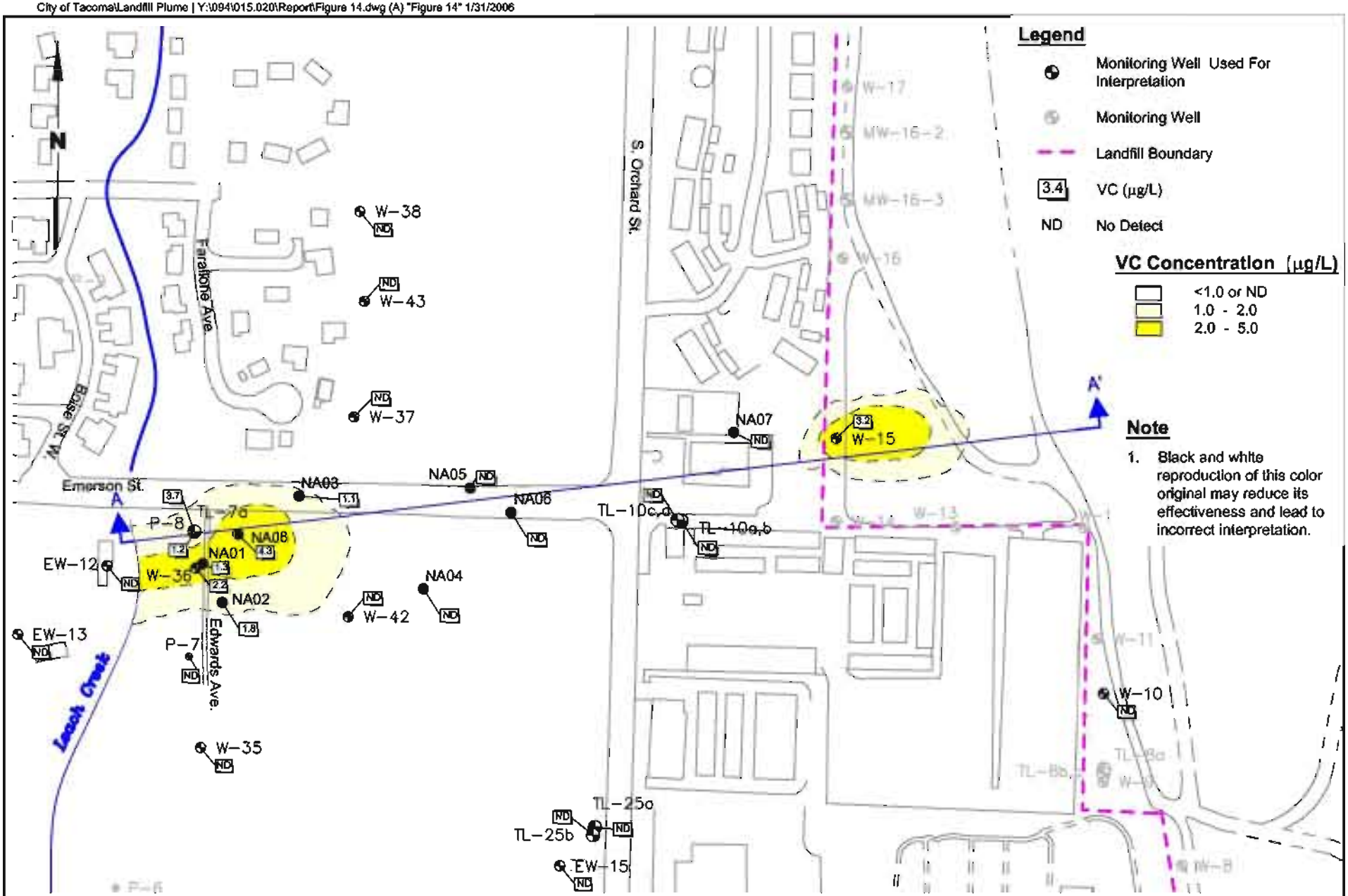
LANDAU ASSOCIATES

Landfill Plume
City of Tacoma
Tacoma, Washington

Vinyl Chloride Concentrations: North Area

Figure
13

City of Tacoma\Landfill Plume | Y:\094\015.020\Report\Figure 14.dwg (A) "Figure 14" 1/31/2006

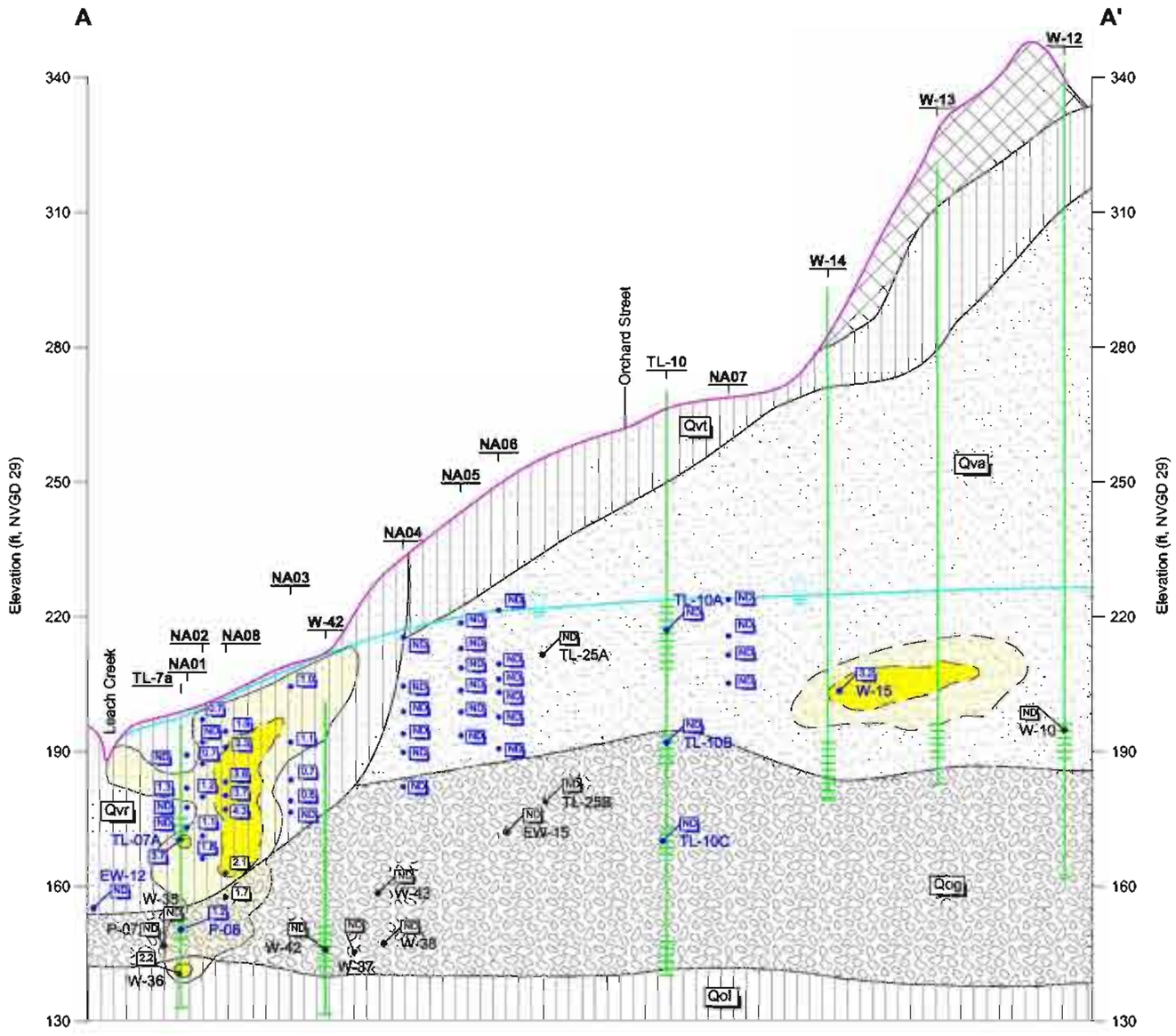


LANDAU ASSOCIATES

Landfill Plume
City of Tacoma
Tacoma, Washington

Recent Vinyl Chloride Concentrations: North Area Plan View

Figure 14



Legend

- Qvr — Vashon Recessional Deposit
- Qvt — Vashon Glacial Till
- Qva — Vashon Advance Outwash
- Qog — Pre-Olympia Gravel
- Qol — Pre-Olympia Lacustrine
- Screened Interval
- Approximate Water Level Elevation
- 3.4 — VC (µg/L)
- ND — No Detect
- Data Point
- Data Point Used For Contours

- Fill
- Silty Sand (SM)
- Poorly Graded Sand (SP)
- Poorly Graded Gravel (GP)
- Silt (ML)

VC Concentration (µg/L)

- <1.0 or ND
- 1.0 - 2.0
- 2.0 - 5.0

Note

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2. This cross-section has been interpreted and generalized from field data collected by Landau Associates and others. Variations between this cross-section and actual conditions may exist.

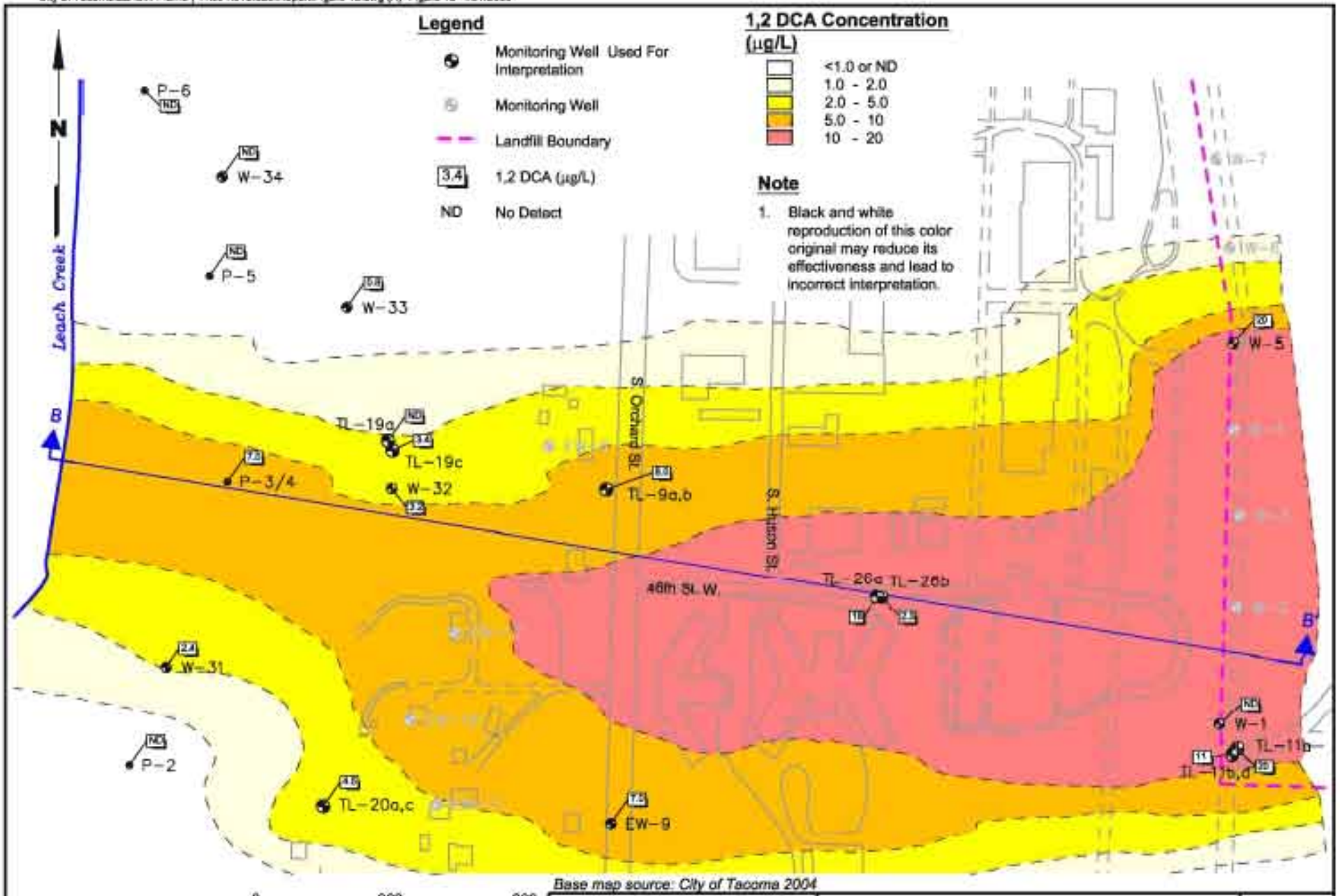
0 300 600
Scale in Feet
Vertical Exaggeration 10X

LANDAU ASSOCIATES

Landfill Plume City of Tacoma Tacoma, Washington	**Recent Vinyl Chloride Concentration: North Area Cross Section View**	Figure 15

City of Tacoma\Landfill Plume | Y:\094\015.020\Report\Figure 15.dwg (A) *Figure 15* 1/31/2006

City of Tacoma\Landfill Plume | Y:\094\015.020\Report\Figure 16.dwg (A) "Figure 16" 1/31/2006



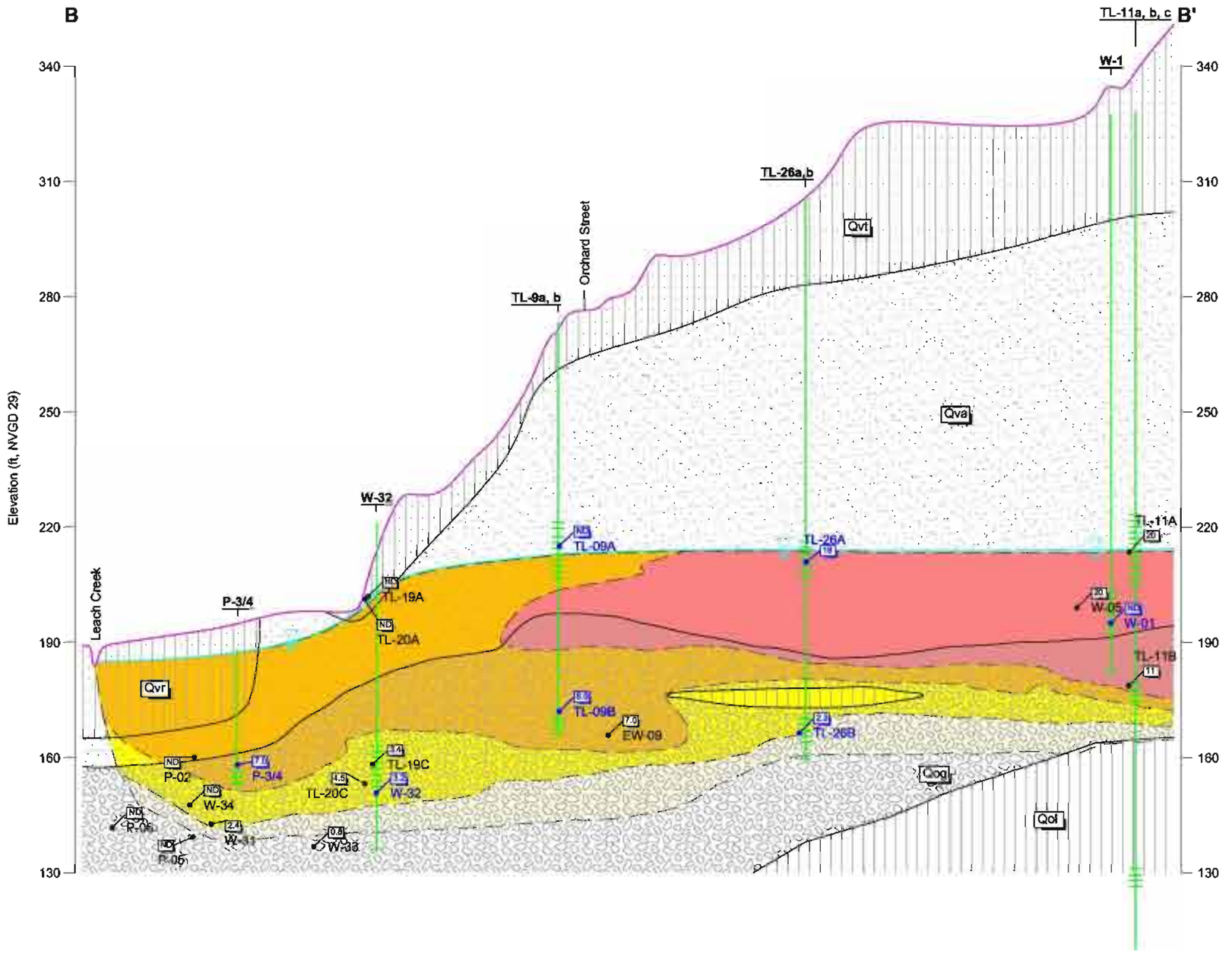
Base map source: City of Tacoma 2004

LANDAU ASSOCIATES

Landfill Plume
City of Tacoma
Tacoma, Washington

Historical Maximum 1,2 DCA Concentrations: South Area Plan View

Figure 16



Legend

- Qvr — Vashon Recessional Deposit
- Qvt — Vashon Glacial Till
- Qva — Vashon Advance Outwash
- Qog — Pre-Olympia Gravel
- Qol — Pre-Olympia Lacustrine
- Screened Interval
- Approximate Water Level Elevation
- 3.4 — 1,2 DCA (µg/L)
- ND — No Detect
- Data Point
- Data Point Used For Contours

- Silty Sand (SM)
- Poorly Graded Sand (SP)
- Poorly Graded Gravel (GP)
- Silt (ML)

1,2 DCA Concentration (µg/L)

- <1.0 or ND
- 1.0 - 2.0
- 2.0 - 5.0
- 5.0 - 10
- 10 - 20

Note

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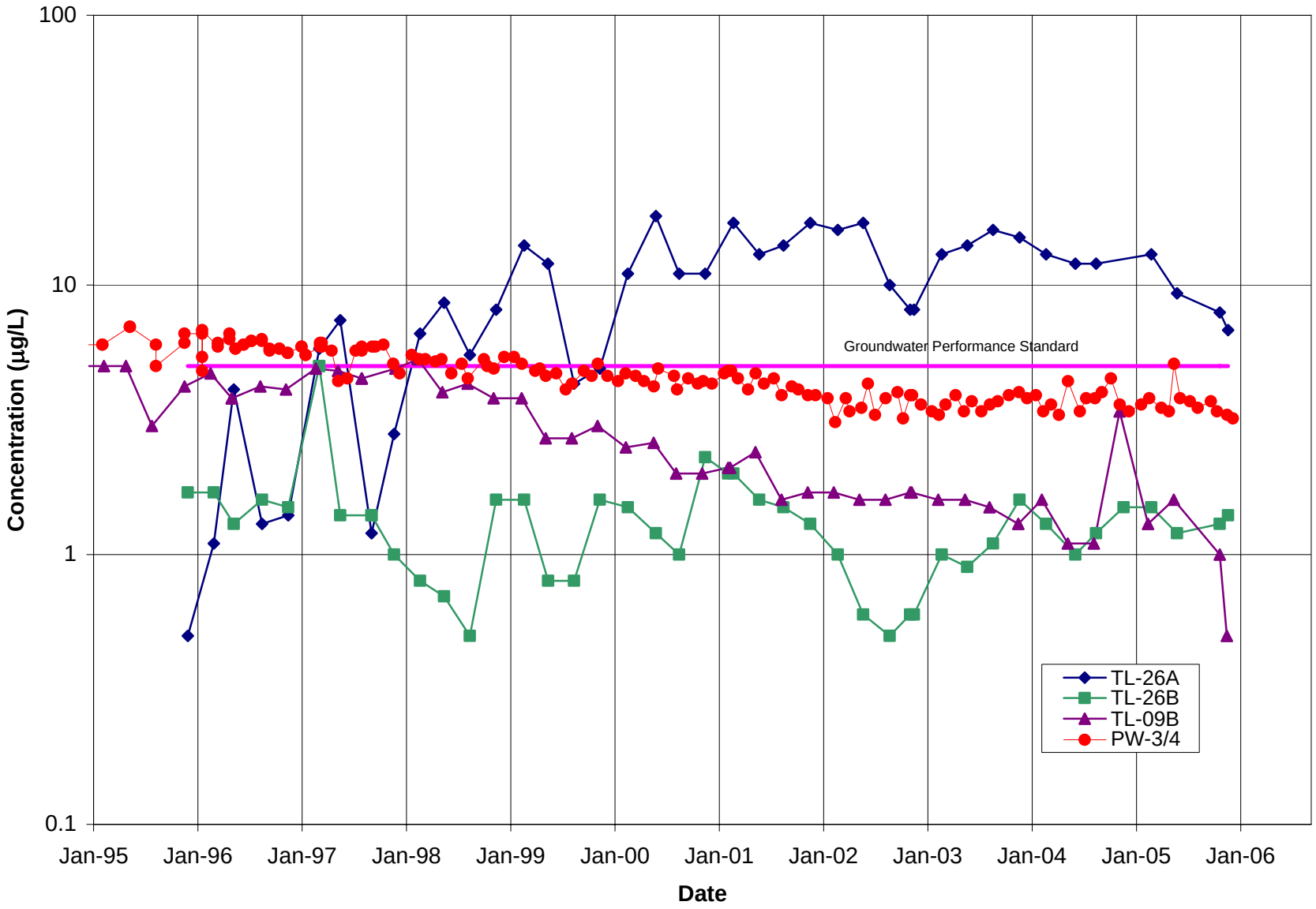
0 300 600
Scale in Feet
Vertical Exaggeration 10X

LANDAU ASSOCIATES

Landfill Plume City of Tacoma Tacoma, Washington	**Historical Maximum 1,2 DCA Concentration: South Area Cross Section View**	Figure 17

City of Tacoma\Landfill Plume | Y:\094\015.020\Report\Figure 17.dwg (A) "Figure 17" 1/31/2006

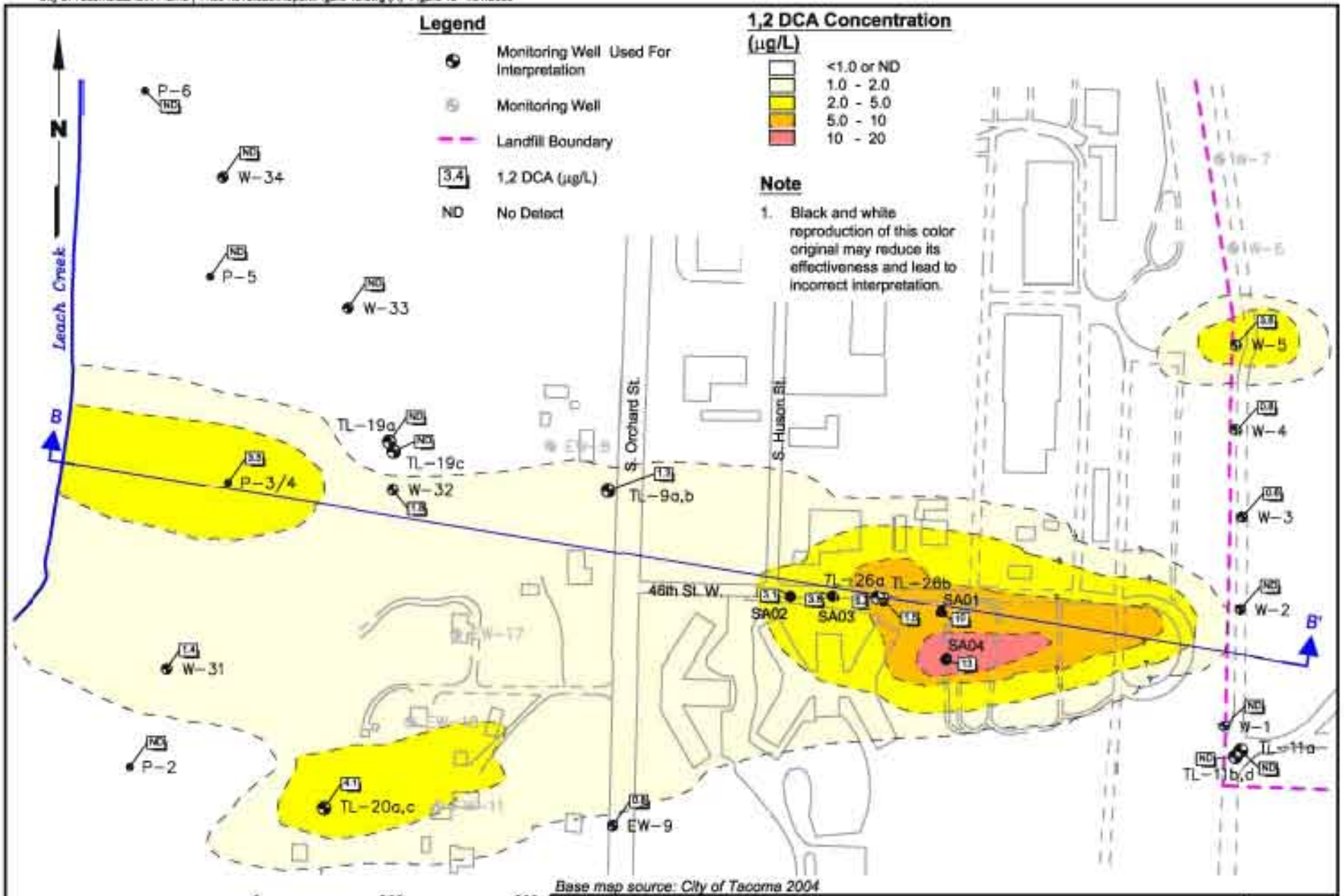


LANDAU ASSOCIATES

Landfill Plume
City of Tacoma
Tacoma, Washington

1,2-Dichloroethane Concentrations: South Area

Figure
18



Base map source: City of Tacoma 2004

LANDAU ASSOCIATES

Landfill Plume
City of Tacoma
Tacoma, Washington

Recent 1,2 DCA Concentrations: South Area Plan View

Figure 19

B

B'

Elevation (ft, NVGD 29)

340
310
280
250
220
190
160
130

TL-11a, b, c
W-1
SA01
SA04
TL-26a,b
SA03
SA02
Orchard Street
TL-9a,b
Qvt
Qva
W-32
SA02
SA03
SA01
SA04
TL-11A
TL-09A
TL-25A
W-03
W-02
TL-19A
TL-20A
P-3/4
Leach Creek
W-05
W-01
TL-11B
W-04
Qvr
TL-09B
EW-09
TL-26B
TL-19C
P-02
P-3/4
TL-20C
W-32
Qog
W-34
P-06
W-31
W-33
P-05
Qol

0 300 600
Scale in Feet
Vertical Exaggeration 10X

Legend

- Qvr — Vashon Recessional Deposit
- Qvt — Vashon Glacial Till
- Qva — Vashon Advance Outwash
- Qog — Pre-Olympia Gravel
- Qol — Pre-Olympia Lacustrine
- Screened Interval
- Approximate Water Level Elevation
- 3.4 — 1,2 DCA (µg/L)
- ND — No Detect
- Data Point
- Data Point Used For Contours

- Silty Sand (SM)
- Poorly Graded Sand (SP)
- Poorly Graded Gravel (GP)
- Silt (ML)

1,2 DCA Concentration (µg/L)

- <1.0 or ND
- 1.0 - 2.0
- 2.0 - 5.0
- 5.0 - 10

Note

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City of Tacoma\Landfill Plume | Y:\0940\015.020\Report\Figure 20.dwg (A) "Figure 20" 1/31/2006

LANDAU ASSOCIATES

Landfill Plume City of Tacoma Tacoma, Washington	**Recent 1,2 DCA Concentration: South Area Cross Section View**	Figure 20

TABLE 1
PROFILER SAMPLE DEPTHS
TACOMA LANDFILL

Profiler Location	NA01	NA02	NA03	NA04	NA05	NA06	NA07	NA08	SA01	SA02	SA03	SA04
Sample Depth Below Ground Surface (ft)	18.76	17.16	22.68	15.66	38.29	42.29	52.18	19.79	120.97	89.34	93.04	120.21
	26.09	22.14	35.07	26.55	43.96	54.22	60.29	23.25	125.95	95.95	100.04	125.52
	30.43	26.95	43.44	32.19	48.26	57.61	64.50	31.04	129.38	103.37	107.82	129.95
	34.86	34.33	48.10	37.14	53.25	60.54	70.82	34.02	134.31	109.56	115.05	137.13
		43.03	50.66	41.25	58.10	66.04		37.14	139.54	112.35	123.03	
		48.01		48.89	63.25	73.09		51.16	144.47		125.97	
								56.58	149.06			

TABLE 2
GROUNDWATER ANALYTICAL RESULTS
CITY OF TACOMA

	Groundwater Performance Standards	NA01-18.76 5/17/2005	NA01-26.09 5/17/2005	NA01-30.43 5/17/2005	NA01-34.86 5/17/2005	NA02-17.16 5/17/2005	NA02-22.14 5/17/2005	NA02-26.95 5/18/2005	NA02-34.33 5/18/2005	NA02-43.03 5/19/2005	NA02-48.01 5/19/2005
VOLATILES (µg/L)											
Method 8260B											
1,1,1-Trichloroethane	200	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethane	20	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Benzene	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroethane	20	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	70	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Ethylbenzene	320	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylene Chloride	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	175	2 U	2 U	2.2	2 U	2 U	2 U	2 U	2 U	2 U	2 U
trans-1,2-Dichloroethene	70	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Trichloroethene	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl Chloride	2	0.5 U	1.3	0.5 U	0.5 U	0.7	0.5 U	0.7	1.2	1.1	1.8
Xylenes (Total)	10	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U

TABLE 2
GROUNDWATER ANALYTICAL RESULTS
CITY OF TACOMA

	Groundwater Performance Standards	NA03-22.68 5/18/2005	NA03-35.07 5/18/2005	NA03-43.44 5/18/2005	NA03-48.10 5/19/2005	NA03-50.66 5/19/2005	NA04-15.66 5/19/2005	NA04-26.55 5/20/2005	NA04-32.19 5/20/2005	NA04-37.14 5/20/2005	NA04-41.25 5/20/2005	NA04-48.89 5/20/2005
VOLATILES (µg/L)												
Method 8260B												
1,1,1-Trichloroethane	200	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethane	20	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Benzene	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroethane	20	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	70	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Ethylbenzene	320	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylene Chloride	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene	5	0.5 U	0.6	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	175	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
trans-1,2-Dichloroethene	70	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Trichloroethene	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl Chloride	2	1	1.1	0.7	0.6	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Xylenes (Total)	10	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U

TABLE 2
GROUNDWATER ANALYTICAL RESULTS
CITY OF TACOMA

	Groundwater Performance Standards	NA05-38.29 5/23/2005	NA05-43.96 5/23/2005	NA05-48.26 5/23/2005	NA05-53.25 5/24/2005	NA05-58.10 5/24/2005	NA05-63.25 5/24/2005	NA06-42.29 5/24/2005	NA06-54.22 5/24/2005	NA06-57.61 5/25/2005	NA06-60.54 5/25/2005	NA06-66.04 5/25/2005	NA06-73.09 5/25/2005
VOLATILES (µg/L)													
Method 8260B													
1,1,1-Trichloroethane	200	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethane	20	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Benzene	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroethane	20	0.5 U	0.8	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5	0.8	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	70	0.5 U	0.5 U	0.5 U	0.6	0.6	0.6	0.5 U	0.5 U	0.5 U	0.5 U	1	0.5
Ethylbenzene	320	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylene Chloride	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	175	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
trans-1,2-Dichloroethene	70	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Trichloroethene	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl Chloride	2	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Xylenes (Total)	10	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U

TABLE 2
GROUNDWATER ANALYTICAL RESULTS
CITY OF TACOMA

	Groundwater Performance Standards	NA07-52.18 5/25/2005	NA07-60.29 5/26/2005	NA07-64.50 5/26/2005	NA07-70.82 5/26/2005	NA08-19.79 6/1/2005	NA08-23.25 6/1/2005	NA08-31.04 6/1/2005	NA08-34.02 6/2/2005	NA08-37.14 6/2/2005	NA08-51.16 6/2/2005	NA08-56.58 6/2/2005
VOLATILES (µg/L)												
Method 8260B												
1,1,1-Trichloroethane	200	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethane	20	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Benzene	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroethane	20	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	70	7.8	8.2	1.3	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Ethylbenzene	320	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylene Chloride	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene	5	0.5 U	0.8	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	175	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
trans-1,2-Dichloroethene	70	3.8	5.5	1.5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	0.5 U	0.5 U
Trichloroethene	5	0.5 U	0.9	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl Chloride	2	0.5 U	0.5 U	0.5 U	0.5 U	1.9	**3.3**	**3.8**	**3.7**	**4.3**	**2.1**	1.7
Xylenes (Total)	10	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U

TABLE 2
GROUNDWATER ANALYTICAL RESULTS
CITY OF TACOMA

	Groundwater Performance Standards	SA01-120.97 5/31/2005	SA01-125.95 5/31/2005	SA01-129.38 5/31/2005	SA01-134.31 5/31/2005	SA01-139.54 6/1/2005	SA01-139.54 6/1/2005	SA01-144.47 6/1/2005	SA01-149.06 6/1/2005	SA02-103.37 5/27/2005	SA02-109.56 5/27/2005	SA02-112.35 5/27/2005	SA02-89.34 5/27/2005	SA02-95.95 5/27/2005
VOLATILES (µg/L)														
Method 8260B														
1,1,1-Trichloroethane	200	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.1	0.5 U	0.5 U	1.4	5.4
1,1-Dichloroethane	20	8.4	7	5.7	2.4	1.2	1.2	0.6	1.5	11	5.4	6.7	8.2	16
1,2-Dichloroethane	5	**9.7**	**10**	4.7	1.5	0.6	0.6	0.5 U	0.5 U	1.4	3.1	1.3	0.5 U	0.5 U
Benzene	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroethane	20	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	70	36	23	10	3.3	1.8	1.8	0.5 U	0.5 U	1.2	3	3.6	0.5 U	0.5 U
Ethylbenzene	320	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylene Chloride	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5	0.5 U
Toluene	175	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
trans-1,2-Dichloroethene	70	0.8	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Trichloroethene	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl Chloride	2	0.5 U	0.5 U	0.8	0.6	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Xylenes (Total)	10	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U

TABLE 2
GROUNDWATER ANALYTICAL RESULTS
CITY OF TACOMA

	Groundwater Performance Standards	SA03-100.04 6/3/2005	SA03-107.82 6/3/2005	SA03-115.05 6/3/2005	SA03-123.03 6/3/2005	SA03-125.97 6/3/2005	SA03-93.04 6/3/2005	SA04-120.21 6/7/2005	SA04-125.52 6/7/2005	SA04-129.95 6/7/2005	SA04-137.13 6/7/2005
VOLATILES (µg/L)											
Method 8260B											
1,1,1-Trichloroethane	200	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethane	20	12	8.5	3.9	2.4	0.5 U	6.4	7.1	6.5	6.5	1.8
1,2-Dichloroethane	5	2.8	3.8	2.2	1.2	0.5 U	1.4	**13**	**7.9**	**7.3**	1.7
Benzene	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroethane	20	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	70	5.4	6.1	2.1	0.8	0.5 U	0.6	25	12	12	5.3
Ethylbenzene	320	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylene Chloride	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	175	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
trans-1,2-Dichloroethene	70	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Trichloroethene	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.6	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl Chloride	2	0.7	1.1	0.7	0.6	0.5 U	0.5 U	0.6	0.5 U	0.5 U	0.5 U
Xylenes (Total)	10	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U

U = Indicates the compound was undetected at the reported concentration.

Boxed and bolded value indicates exceedance of performance criteria.

TABLE 3
GROUNDWATER VERTICAL GRADIENTS
TACOMA LANDFILL

Well Pair	Measuring Point Elevation		Well Depth (ft)	Depth to Water (ft)			Water Level Elevation (ft, NGVD)			Depth of Screened Interval (ft, bgs)		Depth to Screen Center (ft)[d]	Vertical Gradient[c]		
	CTD[a]	NGVD[b]		14-Jul-05	05Q2	05Q1	14-Jul-05	05Q2	05Q1	Top	Bottom		14-Jul-05	05Q2	05Q1
TL-05A	220.22	206.22	19	-1.60	-1.42	-1.04	207.82	207.64	207.26	14	19	189.72			
TL-05C	220.01	206.01	38	-7.33	-6.92	-6.38	213.34	212.93	212.39	34	38	170.01	-0.280	-0.268	-0.260
TL-08B	342.60	328.60	152	113.88	114.34	115.30	214.72	214.26	213.30	140	145	186.1			
TL-08C	342.57	328.57	182	113.15	114.57	115.34	215.42	214.00	213.23	169	174	157.07	-0.024	0.009	0.002
TL-09A	287.56	273.56	73	61.00	61.55	62.33	212.56	212.01	211.23	52	67	214.06			
TL-09B	287.46	273.46	105	61.02	61.62	62.45	212.44	211.84	211.01	100	105	170.96	0.003	0.004	0.005
TL-10A	283.55	269.55	63	55.24	55.75	56.60	214.31	213.80	212.95	46	61	216.05			
TL-10B	283.52	269.52	83	55.28	55.77	56.58	214.24	213.75	212.94	76	81	191.02	0.003	0.002	0.000
TL-11A	344.09	330.09	124	115.95	115.00	117.34	214.14	215.09	212.75	105	124	215.59			
TL-11B	346.37	332.37	154	117.88	118.47	119.43	214.49	213.90	212.94	149	154	180.87	-0.010	0.034	-0.005
TL-19A	233.09	219.09	27	19.24	15.78	17.11	199.85	203.31	201.98	11	25	201.09			
TL-19C	232.49	218.49	66	23.24	23.37	23.71	195.25	195.12	194.78	59	64	156.99	0.104	0.186	0.163
TL-20A	241.21	227.21	33	19.79	19.69	20.82	207.42	207.52	206.39	18	33	201.71			
TL-20C	241.18	227.18	77	36.48	36.49	36.82	190.70	190.69	190.36	73	77	152.18	0.338	0.340	0.324
TL-25A	288.85	274.85	69	60.83	61.40	62.21	214.02	213.45	212.64	59	69	210.85			
TL-25B	288.73	274.73	100	60.58	61.26	62.10	214.15	213.47	212.63	94	99	178.23	-0.004	-0.001	0.000
TL-26A	318.36	304.36	100	92.07	92.64	93.50	212.29	211.72	210.86	90	100	209.36			
TL-26B	319.28	305.28	141	91.00	91.65	92.46	214.28	213.63	212.82	136	141	166.78	-0.047	-0.045	-0.046

(a) CTD denotes "old City of Tacoma datum

(b) NGVD 1929 = CTD -14 ft

(c) Positive gradient value is downwards

(d) Ground surface elevation assumed to be the same for each well within a pair

TABLE 4
NORTH AREA
WATERLOO PROFILER STATISTICS IN NORTH AREA
TACOMA LANDFILL

	1,1,1-Trichloroethane	1,1-Dichloroethane	1,2-Dichloroethane	Benzene	Chloroethane	cis-1,2-Dichloroethene	Ethylbenzene
Groundwater Performance Standards (ug/L)	200	20	5	5	20	70	320
Number of Samples:	44	44	44	44	44	44	44
Number of Detects:	0	0	0	0	3	8	0
Frequency of Detection:	0%	0%	0%	0%	7%	18%	0%
Minimum Reporting Limit:	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Maximum Reporting Limit:	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Detection:	No Detects	No Detects	No Detects	No Detects	0.5	0.6	No Detects
Maximum Detection:	No Detects	No Detects	No Detects	No Detects	0.8	8.2	No Detects
# of detects above GW performance standard:	0	0	0	0	0	0	0
% detects above GW performance standard:	0	0	0	0	0	0	0

	Methylene Chloride	Tetrachloroethene	Toluene	trans-1,2-Dichloroethene	Trichloroethene	Vinyl Chloride	Xylenes (Total)
Groundwater Performance Standards (ug/L)	5	5	175	70	5	2	10
Number of Samples:	44	44	44	44	44	44	44
Number of Detects:	0	2	1	3	1	17	0
Frequency of Detection:	0%	5%	2%	7%	2%	39%	0%
Minimum Reporting Limit:	0.5	0.5	2	0.5	0.5	0.5	2
Maximum Reporting Limit:	0.5	0.5	2	1	0.5	0.5	2
Minimum Detection:	No Detects	0.6	2.2	1.5	0.9	0.6	No Detects
Maximum Detection:	No Detects	0.8	2.2	5.5	0.9	4.3	No Detects
# of detects above GW performance standard:	0	0	0	0	0	**5**	0
% detects above GW performance standard:	0	0	0	0	0	**29%**	0

TABLE 5
SOUTH AREA
WATERLOO PROFILER STATISTICS IN SOUTH AREA
TACOMA LANDFILL

	1,1,1-Trichloroethane	1,1-Dichloroethane	1,2-Dichloroethane	Benzene	Chloroethane	cis-1,2-Dichloroethene	Ethylbenzene
Groundwater Performance Standards (ug/L)	200	20	5	5	20	70	320
Number of Samples:	24	24	24	24	24	24	24
Number of Detects:	3	22	18	0	0	18	0
Frequency of Detection:	13%	92%	75%	0%	0%	75%	0%
Minimum Reporting Limit:	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Maximum Reporting Limit:	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Detection:	1.4	0.6	0.6	No Detects	No Detects	0.6	No Detects
Maximum Detection:	5.4	16	13	No Detects	No Detects	36	No Detects
# of detects above GW performance standard:	0	0	**5**	0	0	0	0
% detects above GW performance standard:	0	0	**28%**	0	0	0	0

	Methylene Chloride	Tetrachloroethene	Toluene	trans-1,2-Dichloroethene	Trichloroethene	Vinyl Chloride	Xylenes (Total)
Groundwater Performance Standards (ug/L)	5	5	175	70	5	2	10
Number of Samples:	24	24	24	24	24	24	24
Number of Detects:	0	1	0	1	1	7	0
Frequency of Detection:	0%	4%	0%	4%	4%	29%	0%
Minimum Reporting Limit:	0.5	0.5	2	0.5	0.5	0.5	2
Maximum Reporting Limit:	0.5	0.5	2	0.5	0.5	0.5	2
Minimum Detection:	No Detects	0.5	No Detects	0.8	0.6	0.6	No Detects
Maximum Detection:	No Detects	0.5	No Detects	0.8	0.6	1.1	No Detects
# of detects above GW performance standard:	0	0	0	0	0	0	0
% detects above GW performance standard:	0	0	0	0	0	0	0

TABLE 6
GENERAL GROUNDWATER QUALITY DATA
TACOMA LANDFILL

Profiler Location	Sample Depth (ft)	SC (µS/cm)	DO (PPM)	pH	ORP (mV)
North Area					
NA01	18.76	984	5.35	6.84	-40
NA01	26.09	823	5.68	6.86	-24
NA01	30.43	1068	5.26	6.77	-11
NA01	34.86	1159	3.66	6.71	-46
NA02	17.16	622	1.02	6.39	-52
NA02	22.14	793	1.54	6.20	-7
NA02	26.95	859	3.81	6.67	-30
NA02	34.33	846	5.14	6.88	4
NA02	43.03	756	3.76	7.55	15
NA02	48.01	769	4.45	7.44	34
NA03	22.68	476	3.56	6.75	-30
NA03	35.07	407	5.62	6.99	15
NA03	43.44	497	5.14	7.29	20
NA03	48.10	568	3.02	7.03	3
NA03	50.66	387	5.12	7.32	20
NA04	15.66	277	6.58	7.87	63
NA04	26.55	184	6.55	7.99	35
NA04	32.19	255	6.34	7.60	63
NA04	37.14	235	5.48	7.29	67
NA04	41.25	510	1.79	6.48	97
NA04	48.89	535	4.30	6.66	92
NA05	38.29	292	3.30	5.96	108
NA05	43.96	495	0.48	6.07	55
NA05	48.26	518	2.51	6.65	46
NA05	53.25	420	1.80	6.97	-162
NA05	58.10	579	0.10	6.79	-255
NA05	63.25	583	0.45	6.56	-214
NA06	42.29	301	2.01	6.16	-122
NA06	54.22	393	0.87	6.40	-183
NA06	57.61	553	0.22	6.45	-179
NA06	60.54	429	0.67	6.67	-158
NA06	66.04	543	0.72	6.56	-135
NA06	73.09	544	0.80	6.69	-158
NA07	52.18	345	1.68	6.62	-131
NA07	60.29	607	2.60	6.92	-117
NA07	64.50	405	5.61	7.25	-81
NA07	70.82	531	3.53	6.91	-104
NA08	19.79	630	4.35	6.56	1
NA08	23.25	682	4.72	6.92	-41
NA08	31.04	883	4.92	7.55	64
NA08	34.02	882	4.68	7.91	61
NA08	37.14	864	2.69	7.41	6
NA08	51.16	811	5.00	7.50	87
NA08	56.58	958	3.37	7.42	86

TABLE 6
GENERAL GROUNDWATER QUALITY DATA
TACOMA LANDFILL

Profiler Location	Sample Depth (ft)	SC (µS/cm)	DO (PPM)	pH	ORP (mV)
South Area					
SA01	120.97	521	0.40	NA	-328
SA01	125.95	559	0.22	NA	-139
SA01	129.38	586	0.15	NA	-235
SA01	134.31	362	1.96	NA	-83
SA01	139.54	331	1.61	NA	-115
SA01	144.47	289	0.58	7.24	156
SA01	149.06	489	0.59	6.91	75
SA02	89.34	464	2.45	6.41	-98
SA02	95.95	467	0.75	6.25	-137
SA02	103.37	493	1.26	6.60	-121
SA02	109.56	298	1.22	7.25	-147
SA02	112.35	378	1.20	6.98	-134
SA03	93.04	479	2.34	6.54	81
SA03	100.04	416	0.53	6.52	84
SA03	107.82	419	1.41	6.63	99
SA03	115.05	399	0.77	6.78	103
SA03	123.03	414	2.48	7.08	98
SA03	125.97	282	2.98	7.92	82
SA04	120.21	338	2.21	6.93	97
SA04	125.52	300	0.59	6.83	152
SA04	129.95	312	0.30	7.16	57
SA04	137.13	288	0.66	7.24	116

TABLE 7
MAXIMUM HISTORICAL VINYL CHLORIDE CONCENTRATIONS
TACOMA LANDFILL

	Well	Concentration (μg/L)	Sample Date
Private Wells	EW-12	ND	6/19/1985
	EW-13	ND	6/19/1985
	EW-15	1.0	3/7/1989
TLF Monitoring and Performance Wells	P-07	ND	2/8/1993
	P-08 (TL-07C)	5.0	6/17/1987
	TL-10A	48.0	11/9/1988
	TL-10B	80.0	3/6/1987
	TL-10C	6.0	11/6/1991
	TL-10D	3.0	11/4/1992
	TL-25A	ND	11/28/1995
	TL-25B	ND	11/28/1995
	TL-7A	10.0	7/31/1995
POC Extraction Wells	W-10	0.5	3/4/1996
	W-15	8.4	11/1/1999
	W-35	ND	3/5/1996
	W-36	7.3	9/2/1997
	W-37	1.2	3/4/1996
	W-38	ND	11/18/2003
	W-42	1.4	3/4/1997
	W-43	0.8	9/3/1997

Note: ND = Not Detect

TABLE 8
RECENT VINYL CHLORIDE CONCENTRATIONS
TACOMA LANDFILL

	Well	Sample Depth Below Ground Surface (ft)	Concentration (μg/L)	Sample Date
Private Wells	EW-12	NA	ND	1/31/2005
	EW-13	NA	ND	1/31/2005
	EW-15	NA	ND	5/6/1992
TLF Monitoring and Performance Wells	P-07	NA	ND	2/16/2005
	P-08 (TL-07C)	NA	1.20	2/16/2005
	TL-10A	NA	ND	2/11/2005
	TL-10B	NA	ND	2/11/2005
	TL-10C	NA	ND	2/11/2005
	TL-10D	NA	1.30	2/28/1996
	TL-25A	NA	ND	2/14/2005
	TL-25B	NA	ND	2/14/2005
	TL-7A	NA	3.70	2/16/2005
POC Extraction Wells	W-10	NA	ND	2/23/2005
	W-15	NA	3.20	2/23/2005
	W-35	NA	ND	8/15/1996
	W-36	NA	2.20	2/16/2005
	W-37	NA	ND	2/14/2005
	W-38	NA	ND	2/14/2005
	W-42	NA	ND	2/16/2005
	W-43	NA	0.70	2/14/2005
EOP Characterization Profiled Boreholes - North Area	NA01	18.76	ND	5/17/2005
	NA01	26.09	1.30	5/17/2005
	NA01	30.43	ND	5/17/2005
	NA01	34.86	ND	5/17/2005
	NA02	17.16	0.70	5/19/2005
	NA02	22.14	ND	5/19/2005
	NA02	26.95	0.70	5/19/2005
	NA02	34.33	1.20	5/19/2005
	NA02	43.03	1.10	5/19/2005
	NA02	48.01	1.80	5/19/2005
	NA03	22.68	1.00	5/19/2005
	NA03	35.07	1.10	5/19/2005
	NA03	43.44	0.70	5/19/2005
	NA03	48.10	0.60	5/19/2005
	NA03	50.66	ND	5/19/2005
	NA04	15.66	ND	5/20/2005
	NA04	26.55	ND	5/20/2005
	NA04	32.19	ND	5/20/2005
	NA04	37.14	ND	5/20/2005
	NA04	41.25	ND	5/20/2005
	NA04	48.89	ND	5/20/2005

TABLE 8
RECENT VINYL CHLORIDE CONCENTRATIONS
TACOMA LANDFILL

	Well	Sample Depth Below Ground Surface (ft)	Concentration (μg/L)	Sample Date
EOP Characterization Profiled Boreholes - North Area	NA05	38.29	ND	5/24/2005
	NA05	43.96	ND	5/24/2005
	NA05	48.26	ND	5/24/2005
	NA05	53.25	ND	5/24/2005
	NA05	58.10	ND	5/24/2005
	NA05	63.25	ND	5/24/2005
	NA06	42.29	ND	5/25/2005
	NA06	54.22	ND	5/25/2005
	NA06	57.61	ND	5/25/2005
	NA06	60.54	ND	5/25/2005
	NA06	66.04	ND	5/25/2005
	NA06	73.09	ND	5/25/2005
	NA07	52.18	ND	5/26/2005
	NA07	60.29	ND	5/26/2005
	NA07	64.50	ND	5/26/2005
	NA07	70.82	ND	5/26/2005
	NA08	19.79	1.90	6/2/2005
	NA08	23.25	3.30	6/2/2005
	NA08	31.04	3.80	6/2/2005
	NA08	34.02	3.70	6/2/2005
	NA08	37.14	4.30	6/2/2005
	NA08	51.16	2.10	6/2/2005
	NA08	56.58	1.70	6/2/2005

Note: ND = Not Detect

NA: Not applicable, depths provided for profiler samples only.

TABLE 9
SOUTH AREA
MAXIMUM HISTORICAL 1,2- DICHLOROETHANE CONCENTRATIONS
TACOMA LANDFILL

	Well	Concentration (µg/L)	Sample Date
Private Well	EW-09	7.00	11/2/1992
TLF Monitoring and Performance Wells	P-02	ND	2/10/1993
	P-05	ND	2/8/1993
	P-06	ND	2/8/1993
	P-3/4	7.00	5/10/1994
	TL-09A	ND	10/23/1986
	TL-09B	8.00	2/10/1993
	TL-11A	20.00	9/25/1987
	TL-11B	11.00	8/27/1991
	TL-11D	ND	9/25/1987
	TL-19A	ND	11/30/1989
	TL-19C	3.40	3/6/1997
	TL-20A	ND	12/13/1989
	TL-20C	4.50	2/10/2004
	TL-25A	ND	11/28/1995
	TL-25B	ND	11/28/1995
	TL-26A	18.00	5/24/2000
	TL-26B	2.30	11/13/2000
POC Extraction Wells	W-01	ND	3/4/1996
	W-05	20.00	3/4/1996
	W-31	2.40	2/17/1998
	W-32	3.20	9/2/1997
	W-33	0.80	8/15/1996
	W-34	ND	3/5/1996

Note: ND = Not Detect

TABLE 10
RECENT 1,2-DICHLOROETHANE CONCENTRATIONS
TACOMA LANDFILL

	Well	Sample Depth Below Ground Surface (ft)	Concentration (μg/L)	Sample Date
Private Well	EW-09	NA	0.80	2/23/2005
Performance Monitoring Wells	P-02	NA	ND	3/30/2005
	P-05	NA	ND	2/16/2005
	P-06	NA	ND	2/16/2005
	P-3/4	NA	3.50	3/30/2005
TLF Monitoring and Performance Wells	TL-09A	NA	ND	2/11/2005
	TL-09B	NA	1.30	2/11/2005
	TL-11A	NA	ND	2/17/2005
	TL-11B	NA	ND	2/17/2005
	TL-11D	NA	ND	11/30/1995
	TL-19A	NA	ND	2/16/2005
	TL-19C	NA	ND	2/16/2005
	TL-20A	NA	ND	2/26/1996
	TL-20C	NA	4.10	2/15/2005
	TL-25A	NA	ND	2/14/2005
	TL-25B	NA	ND	2/14/2005
	TL-26A	NA	9.30	2/22/2005
	TL-26B	NA	1.50	2/22/2005
POC Extraction Wells	W-01	NA	ND	2/23/2005
	W-02	NA	ND	11/8/2005
	W-03	NA	0.60	11/8/2005
	W-04	NA	0.80	11/8/2005
	W-05	NA	3.60	2/23/2005
	W-31	NA	1.40	2/15/2005
	W-32	NA	1.80	2/16/2005
	W-33	NA	ND	2/16/2005
	W-34	NA	ND	8/15/1996
EOP Characterization Profiled Boreholes - South Area	SA01	120.97	9.70	6/1/2005
	SA01	125.95	10.00	6/1/2005
	SA01	129.38	4.70	6/1/2005
	SA01	134.31	1.50	6/1/2005
	SA01	139.54	0.60	6/1/2005
	SA01	144.47	ND	6/1/2005
	SA01	149.06	ND	6/1/2005
	SA02	89.34	ND	5/27/2005
	SA02	95.95	ND	5/27/2005
	SA02	103.37	1.40	5/27/2005
	SA02	109.56	3.10	5/27/2005
	SA02	112.35	1.30	5/27/2005
	SA03	93.04	1.40	6/3/2005
	SA03	100.04	2.80	6/3/2005
	SA03	107.82	3.80	6/3/2005
	SA03	115.05	2.20	6/3/2005
	SA03	123.03	1.20	6/3/2005
	SA03	125.97	ND	6/3/2005
	SA04	120.21	13.00	6/7/2005
	SA04	125.52	7.90	6/7/2005
	SA04	129.95	7.30	6/7/2005
	SA04	137.13	1.70	6/7/2005

Note: ND = Not Detect
NA = Not applicable, depths provided for profiler samples only.

APPENDIX A

Stone Environmental, Inc.
Waterloo Profiler^{tm} Data Presentation

VOC Data

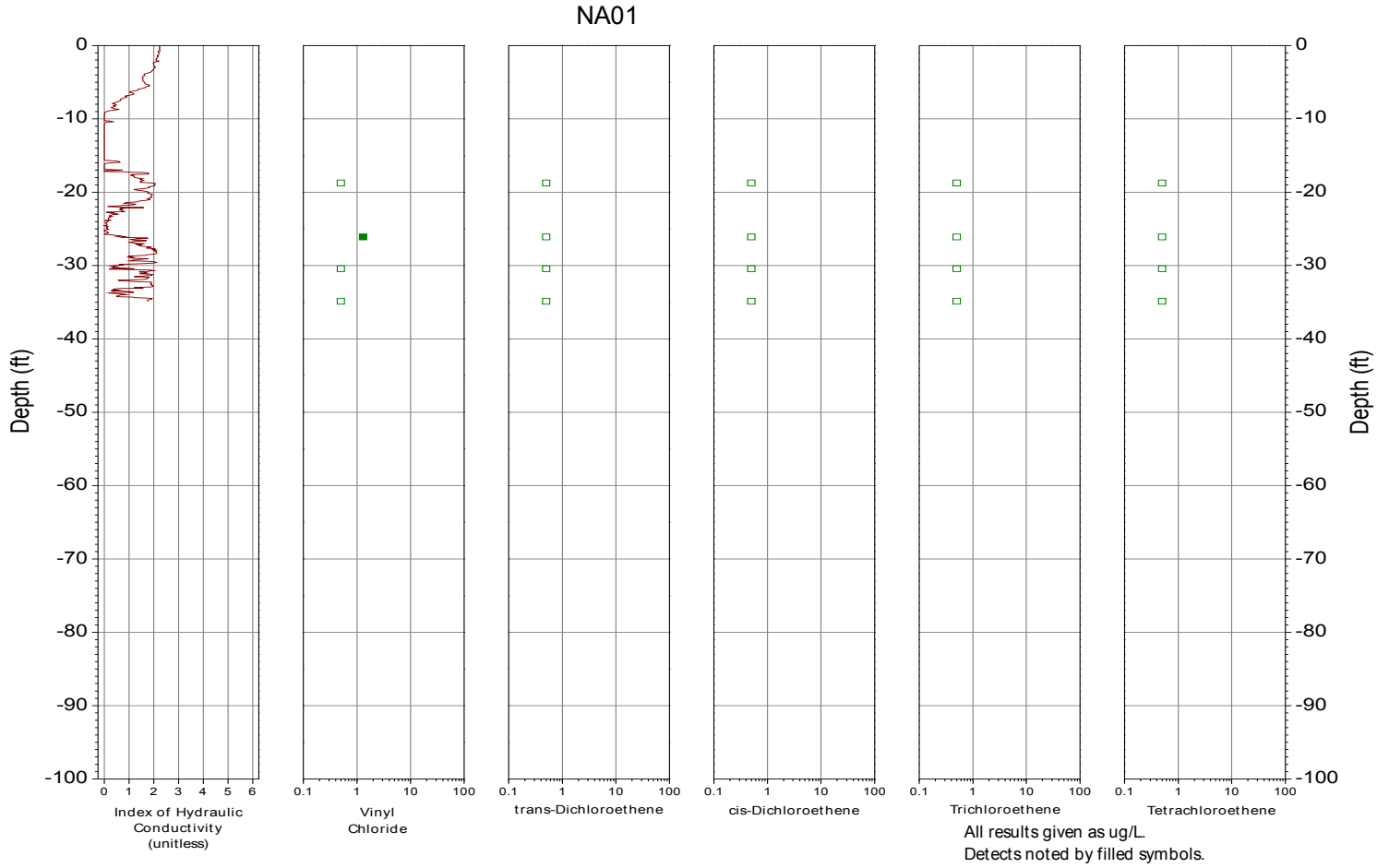


FIGURE NA01, I_K RECORD AND SELECT VOC DATA

Dates Sampled : 05/17/05

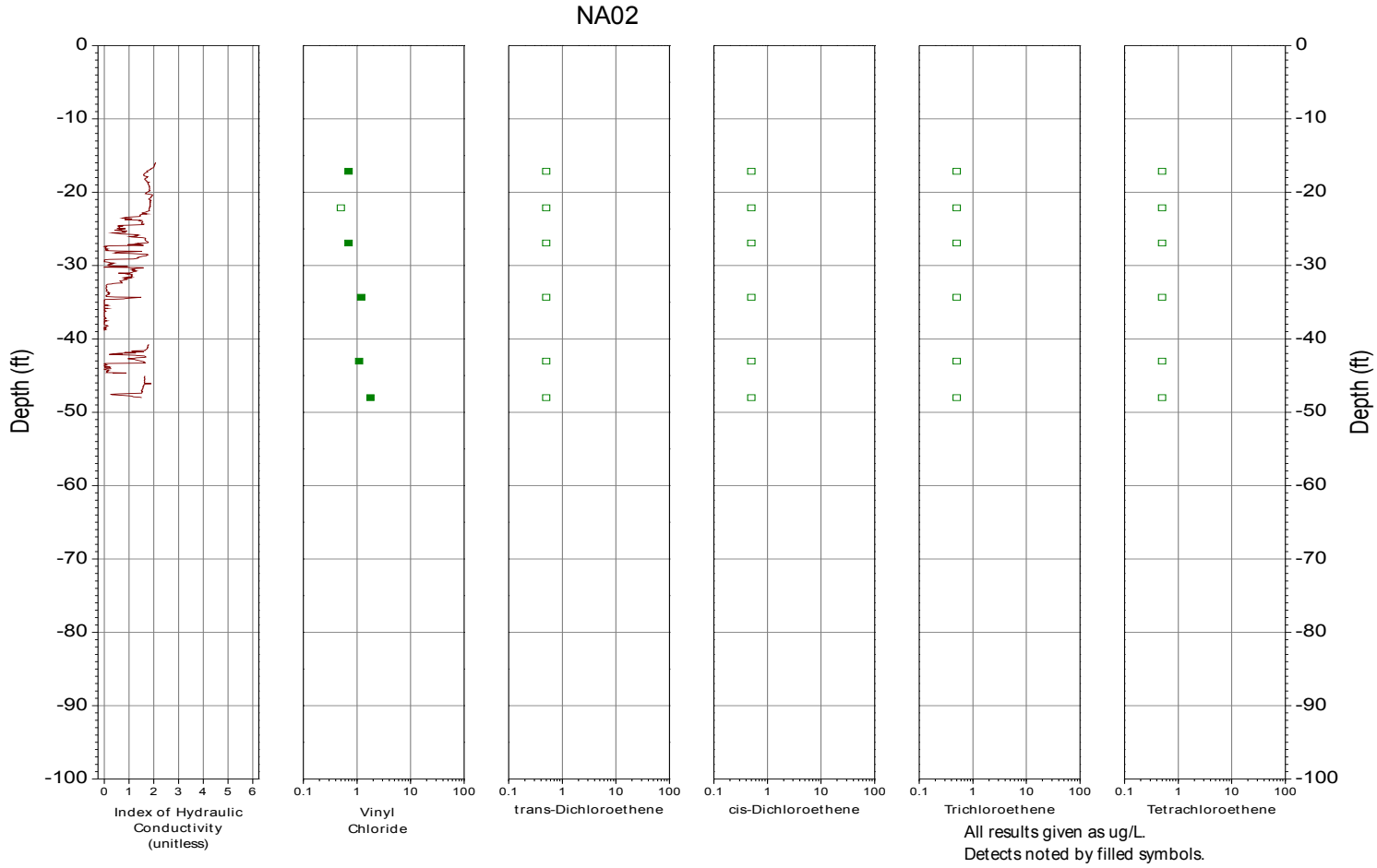
Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data

Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\Analytical\Origin\VOCChem_NA01.opj

Date: 6/28/05 acg

STONE ENVIRONMENTAL



All results given as ug/L.
Detects noted by filled symbols.
Non-detects are noted by open symbols at the detection limit.

FIGURE NA02, I_K RECORD AND SELECT VOC DATA

Dates Sampled : 5/17/2005 - 5/19/2005

Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data
Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\Analytical\Origin\VOCChem_NA02.opj
Date: 6/28/05 acg

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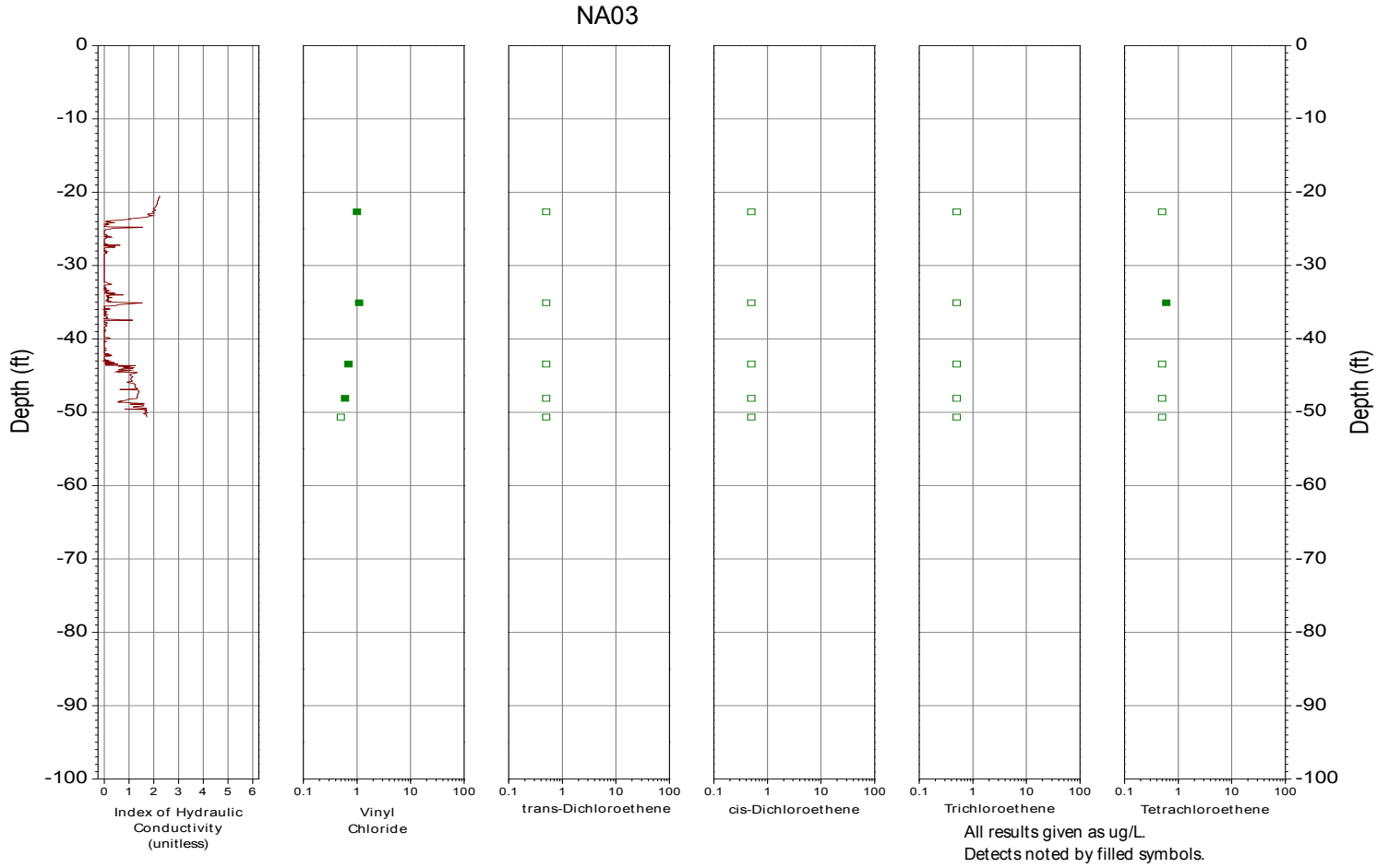


FIGURE NA03, I_K RECORD AND SELECT VOC DATA

Dates Sampled : 5/18/2005 - 5/19/2005

Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data

Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\Analytical\Origin\VOCChem_NA03.opj

Date: 6/28/05 acg

STONE ENVIRONMENTAL

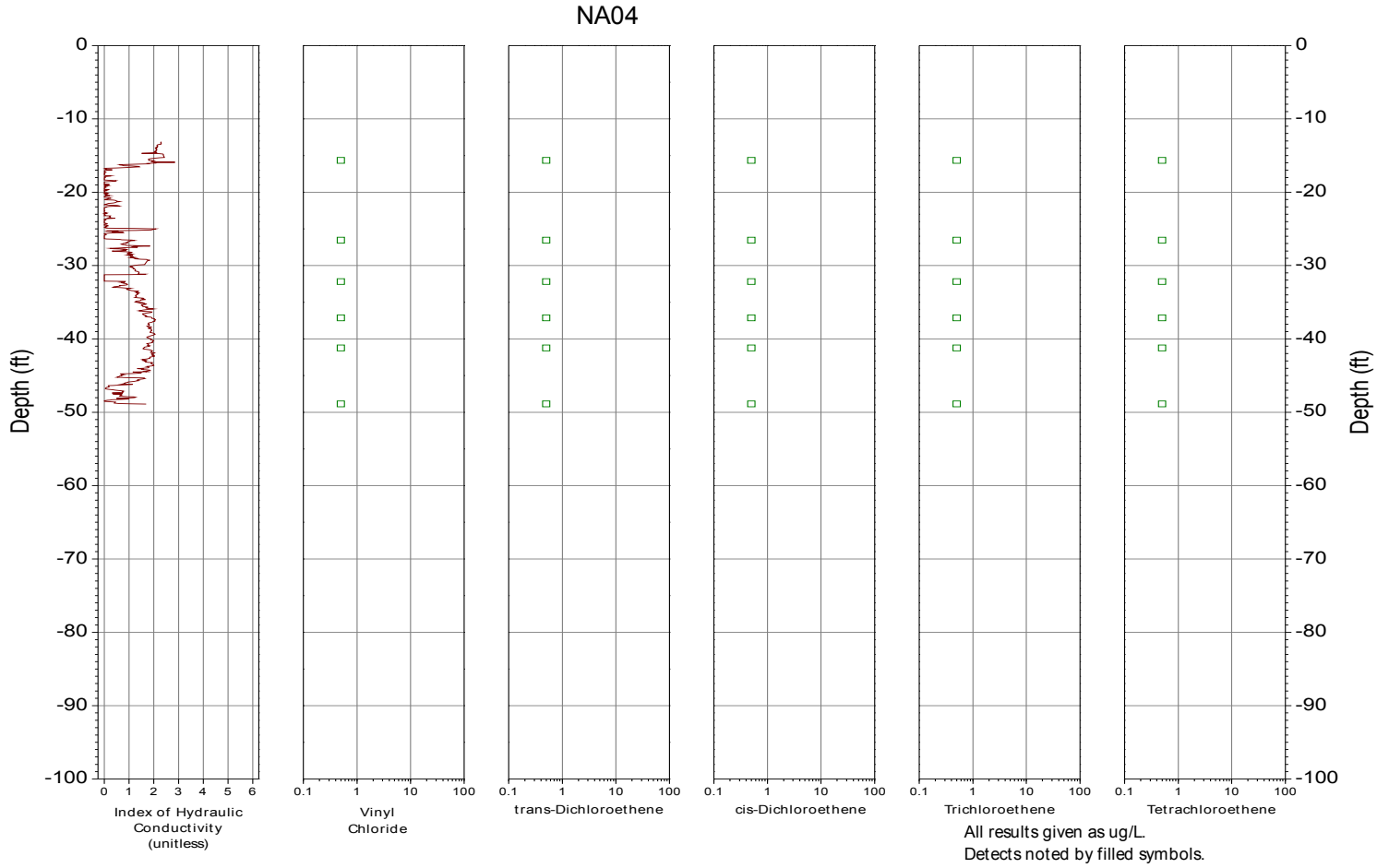


FIGURE NA04, I_K RECORD AND SELECT VOC DATA

Dates Sampled : 5/19/2005 - 5/23/2005

Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data

Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\Analytical\Origin\VOCChem_NA04.opj

Date: 6/28/05 acg

STONE ENVIRONMENTAL

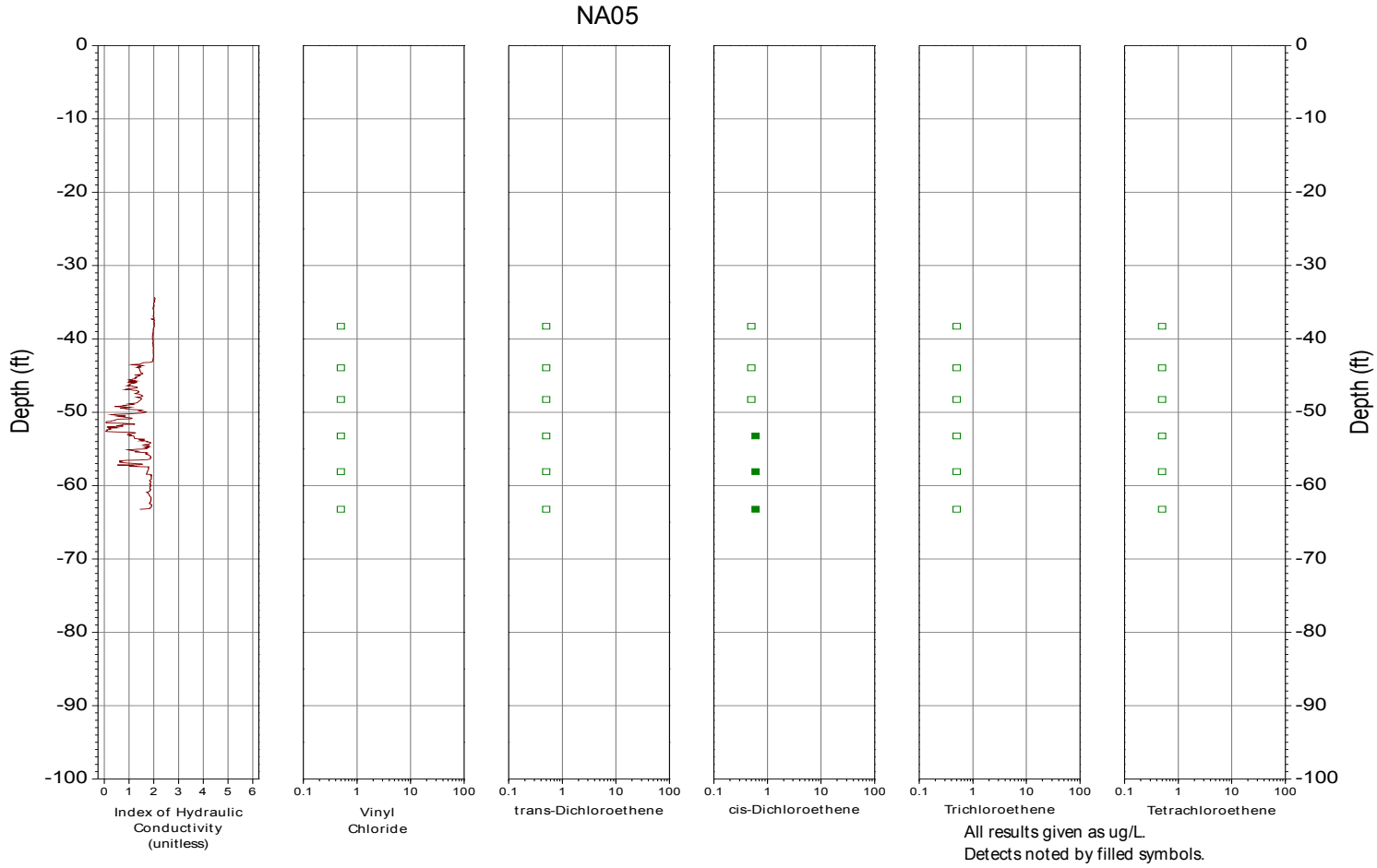


FIGURE NA05, I_K RECORD AND SELECT VOC DATA

Dates Sampled : 5/23/2005 - 5/24/2005

Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data

Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\Analytical\Origin\VOCChem_NA05.opj

Date: 6/28/05 acg

STONE ENVIRONMENTAL

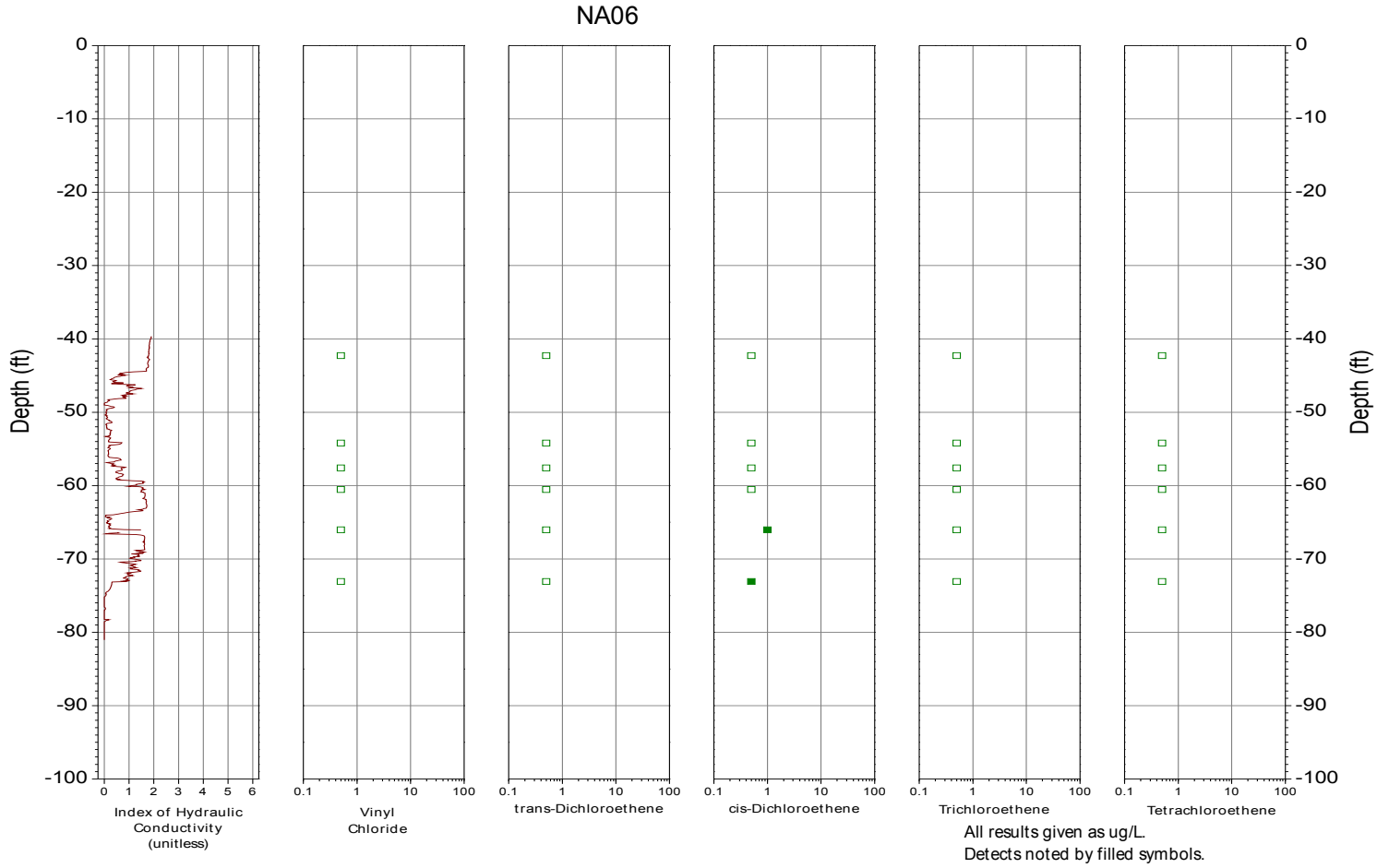


FIGURE NA06, I_K RECORD AND SELECT VOC DATA

Dates Sampled : 5/24/2005 - 5/25/2005

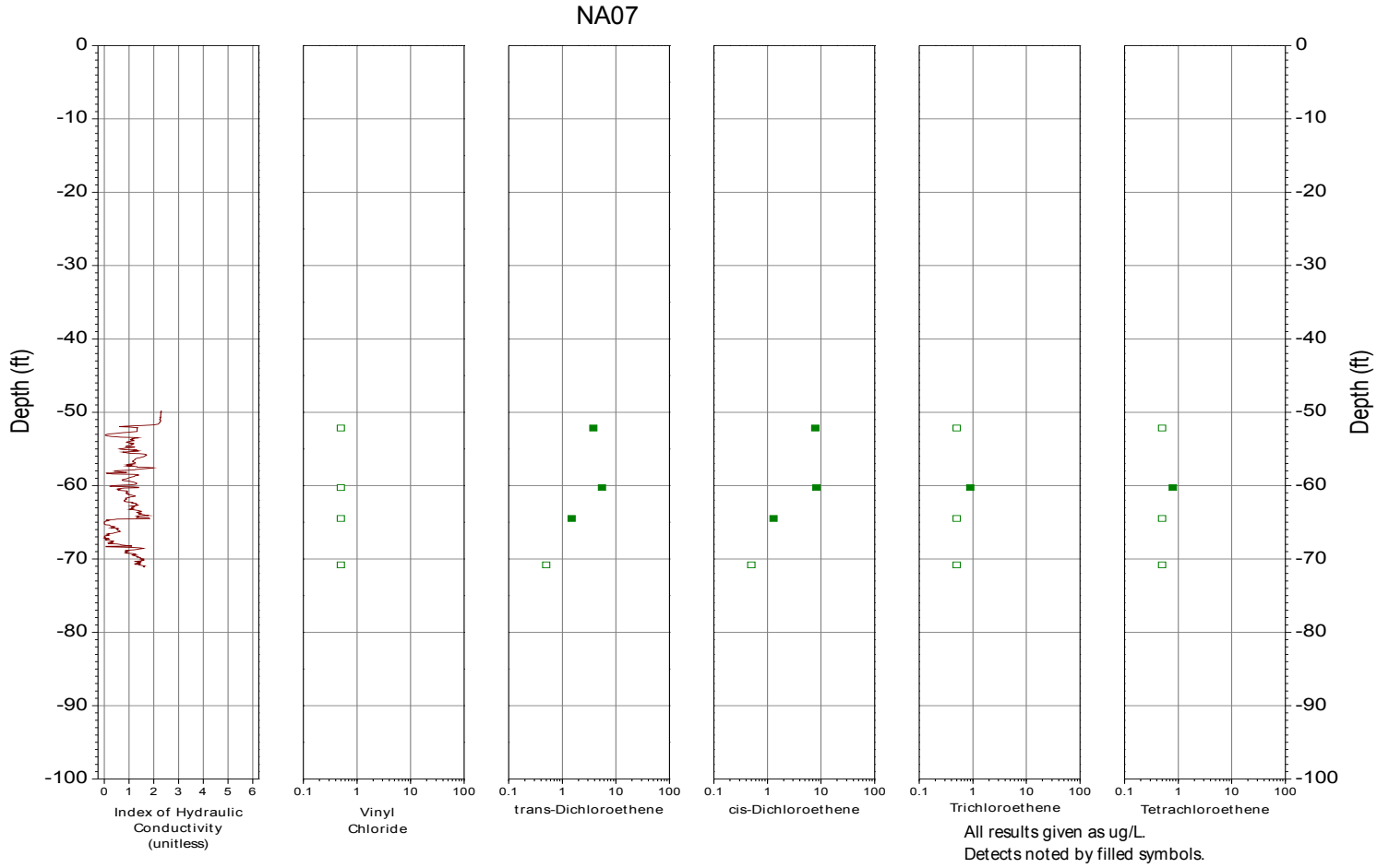
Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data

Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\Analytical\Origin\VOCChem_NA06.opj

Date: 6/28/05 acg

STONE ENVIRONMENTAL



All results given as ug/L.
Detects noted by filled symbols.
Non-detects are noted by open symbols at the detection limit.

FIGURE NA07, I_K RECORD AND SELECT VOC DATA

Dates Sampled : 5/25/2005 - 5/26/2005

Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data
Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\Analytical\Origin\VOCChem_NA07.opj
Date: 6/28/05 acg

STONE ENVIRONMENTAL

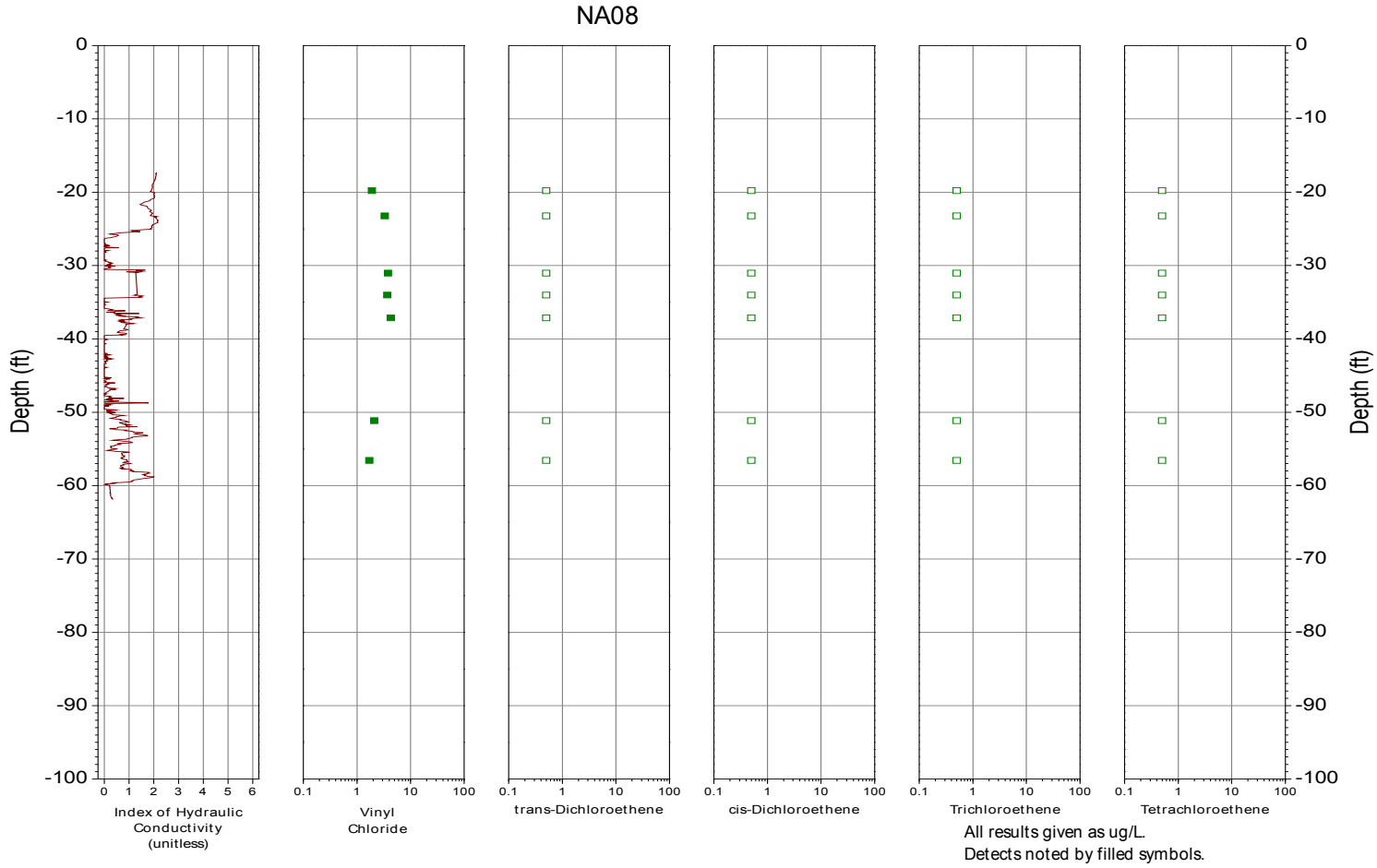


FIGURE NA08, I_K RECORD AND SELECT VOC DATA

Dates Sampled : 6/1/2005 - 6/2/2005

Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data

Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\Analytical\Origin\VOCChem_NA08.opj

Date: 6/28/05 acg

STONE ENVIRONMENTAL

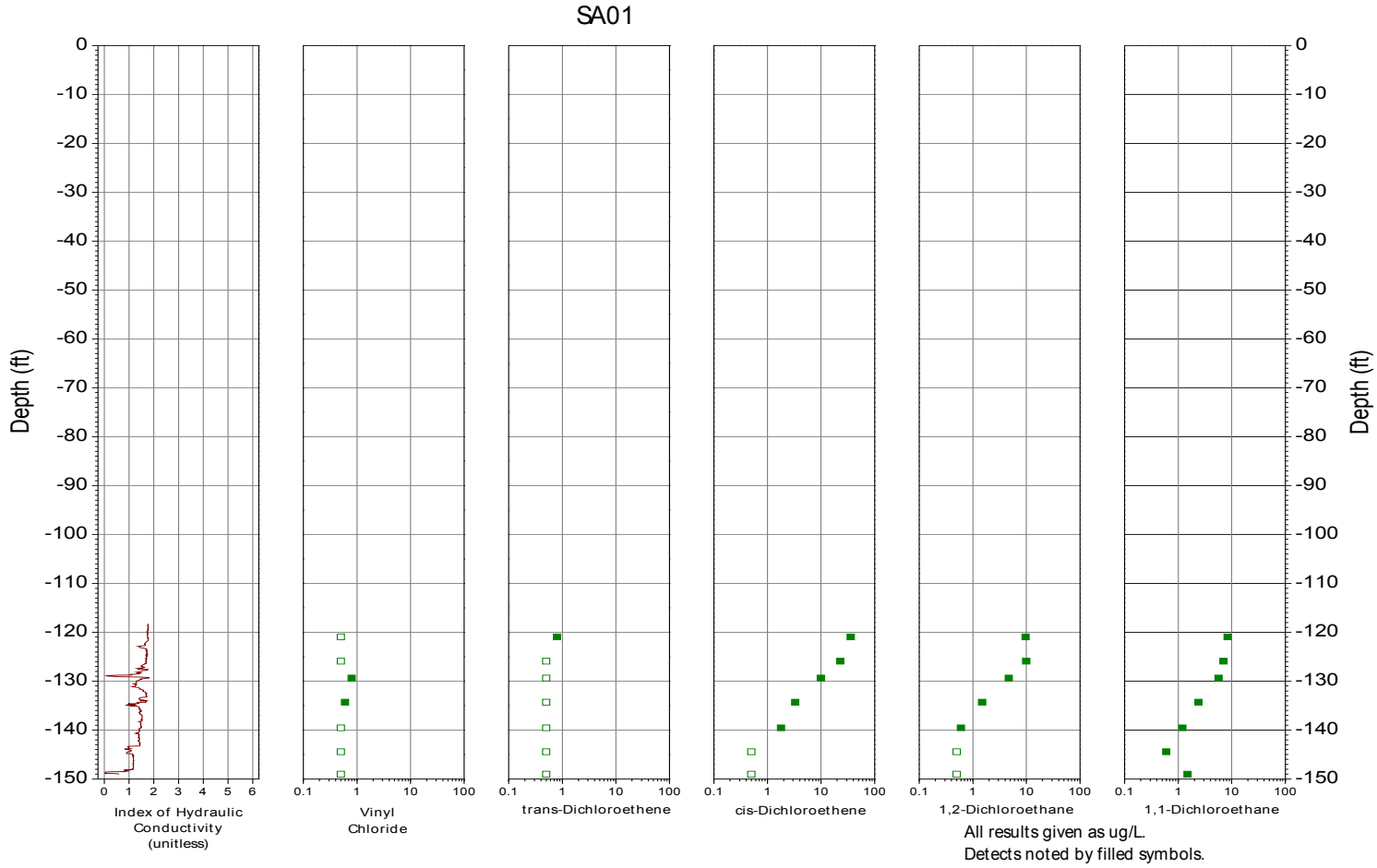


FIGURE SA01, I_K RECORD AND SELECT VOC DATA

Dates Sampled : 5/31/2005 - 6/1/2005

Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data

Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\Analytical\Origin\VOCChem_SA01.opj

Date: 6/28/05 acg

STONE ENVIRONMENTAL

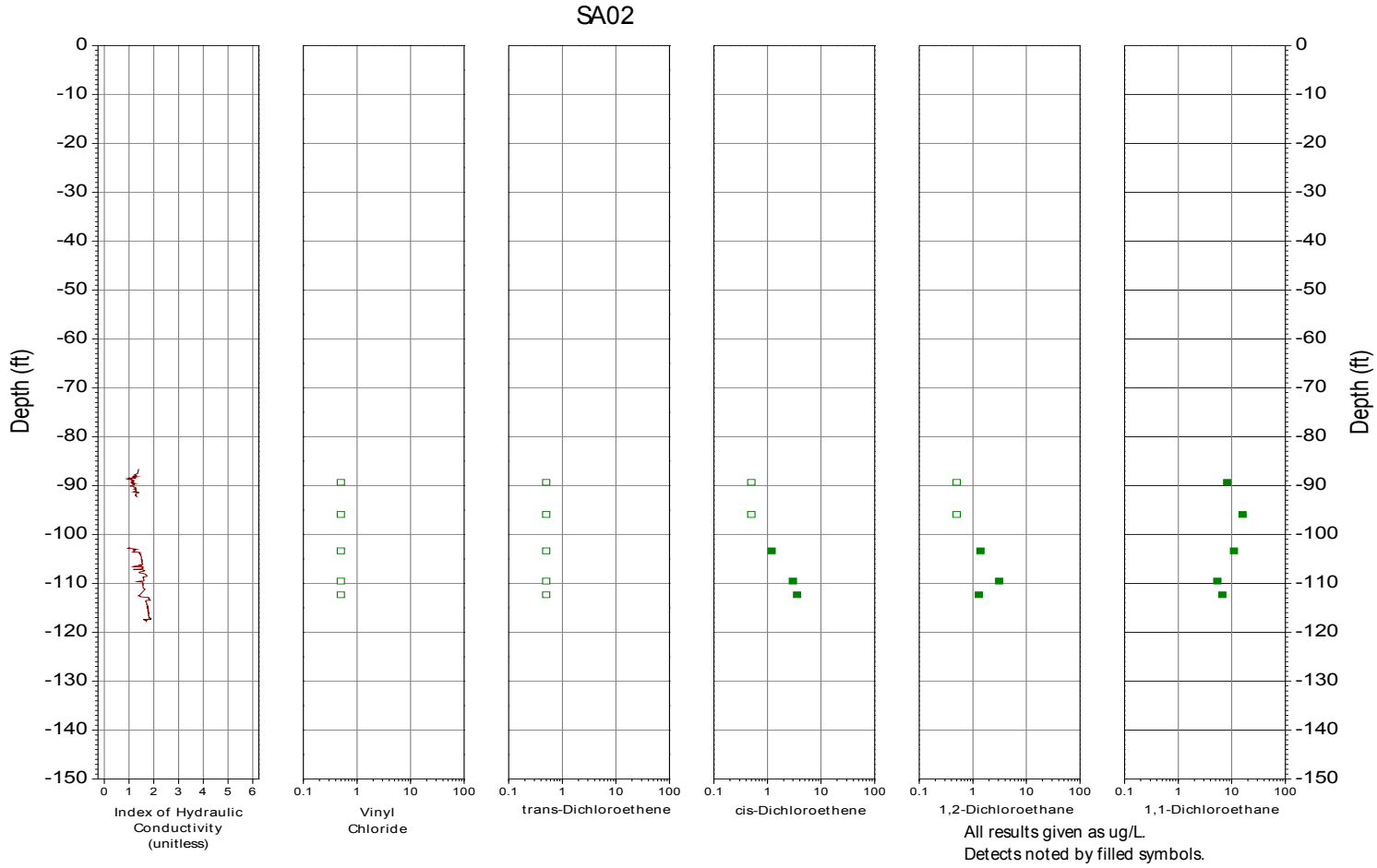


FIGURE SA02, I_K RECORD AND SELECT VOC DATA

Dates Sampled : 5/26/2005 - 5/27/2005

Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data

Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\Analytical\Origin\VOCChem_SA02.opj

Date: 6/28/05 acg

STONE ENVIRONMENTAL

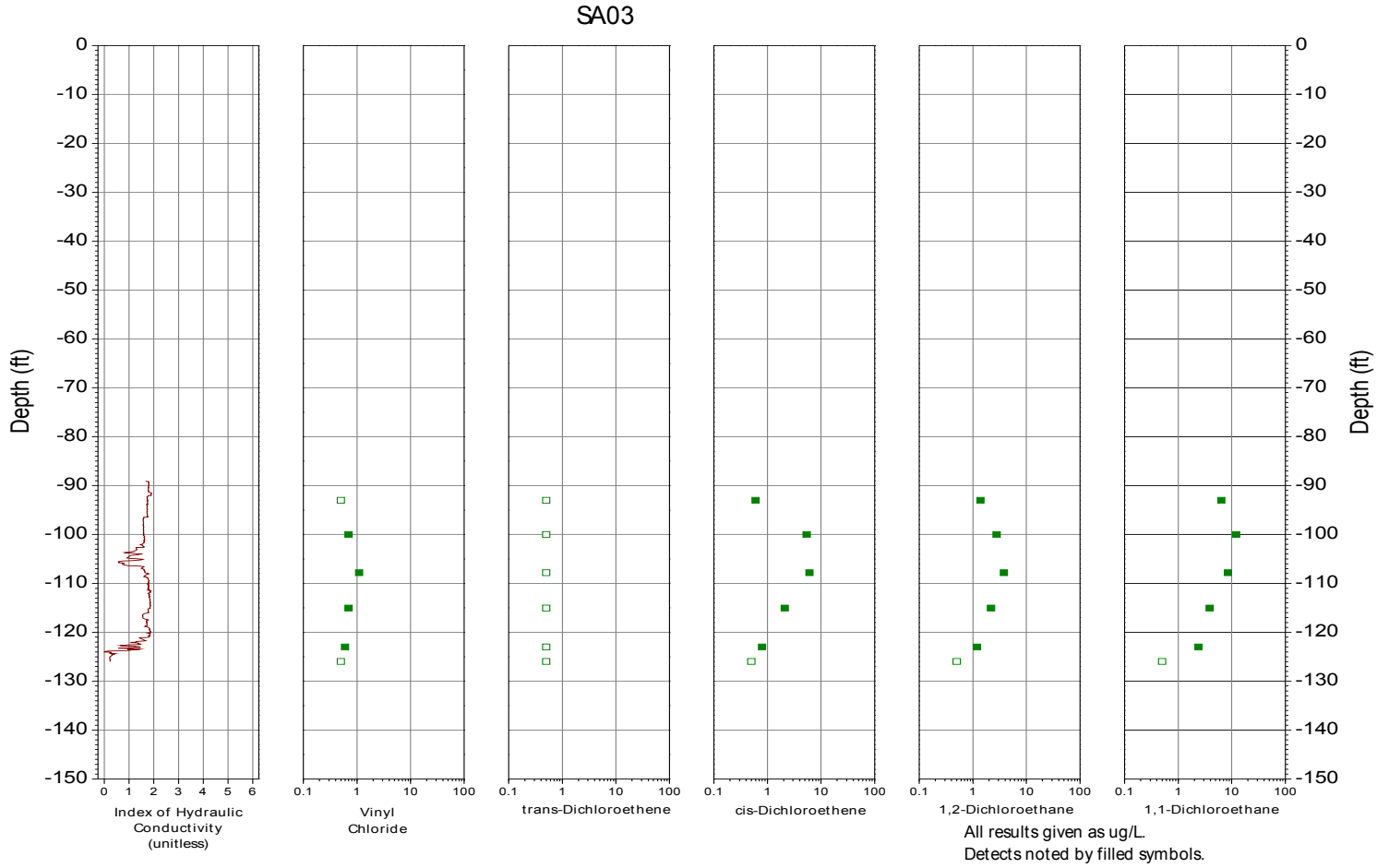


FIGURE SA03, I_K RECORD AND SELECT VOC DATA

Dates Sampled : 06/03/05

Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data

Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\Analytical\Origin\VOCChem_SA03.opj

Date: 6/28/05 acg

STONE ENVIRONMENTAL

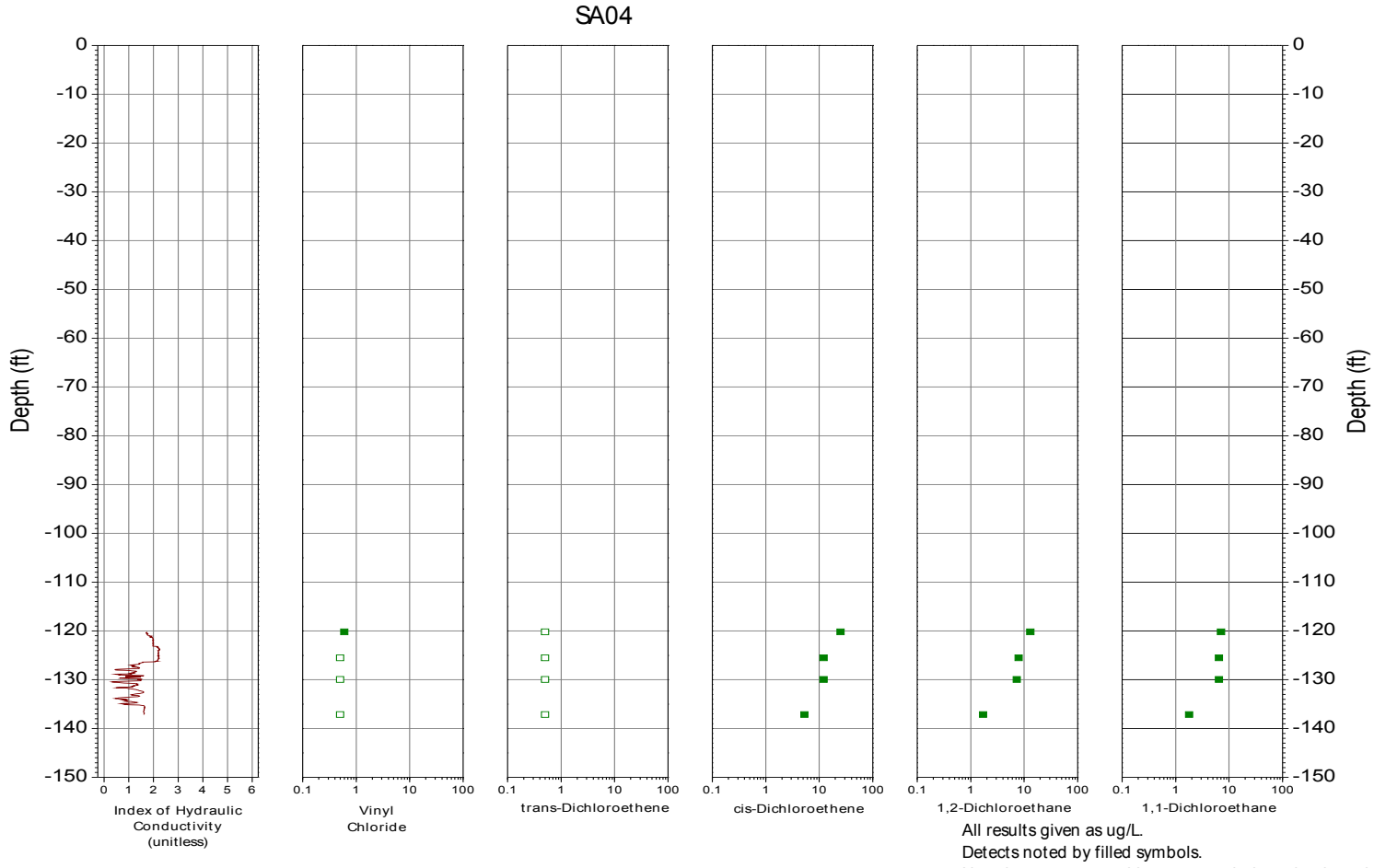


FIGURE SA04, I_K RECORD AND SELECT VOC DATA

Dates Sampled : 6/6/2005 - 6/7/2005

Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data

Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\Analytical\Origin\VOCChem_SA04.opj

Date: 6/28/05 acg

STONE ENVIRONMENTAL

Physical-Chemical Parameters

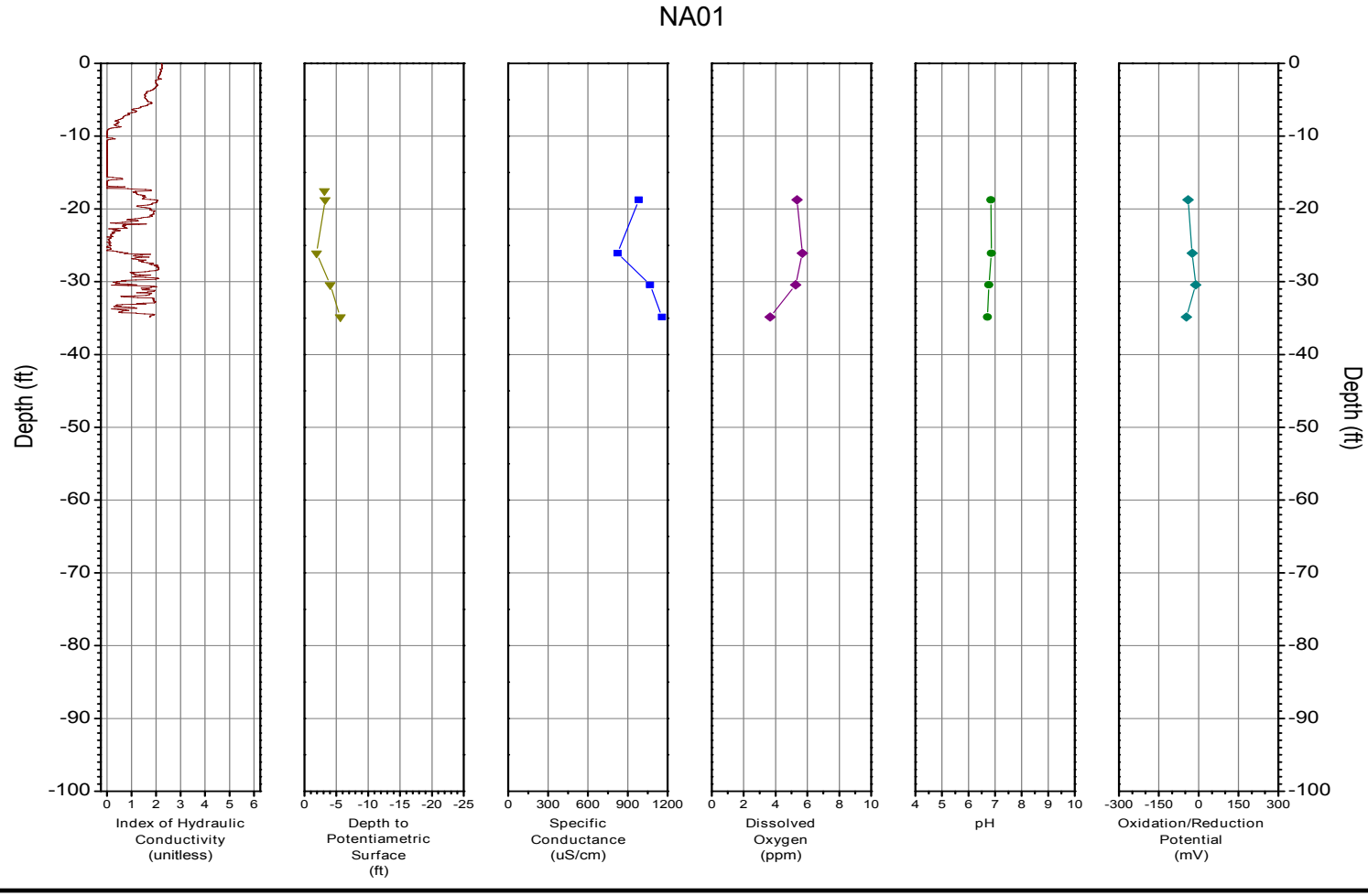


FIGURE NA01, I_K RECORD AND PHYSICO-CHEMICAL PARAMETERS

Dates Sampled : 5/17/2005

Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data

Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\profiling\orign plots\PhysChem NA01.opj

Date: 5/17/05 djl

STONE EN

I

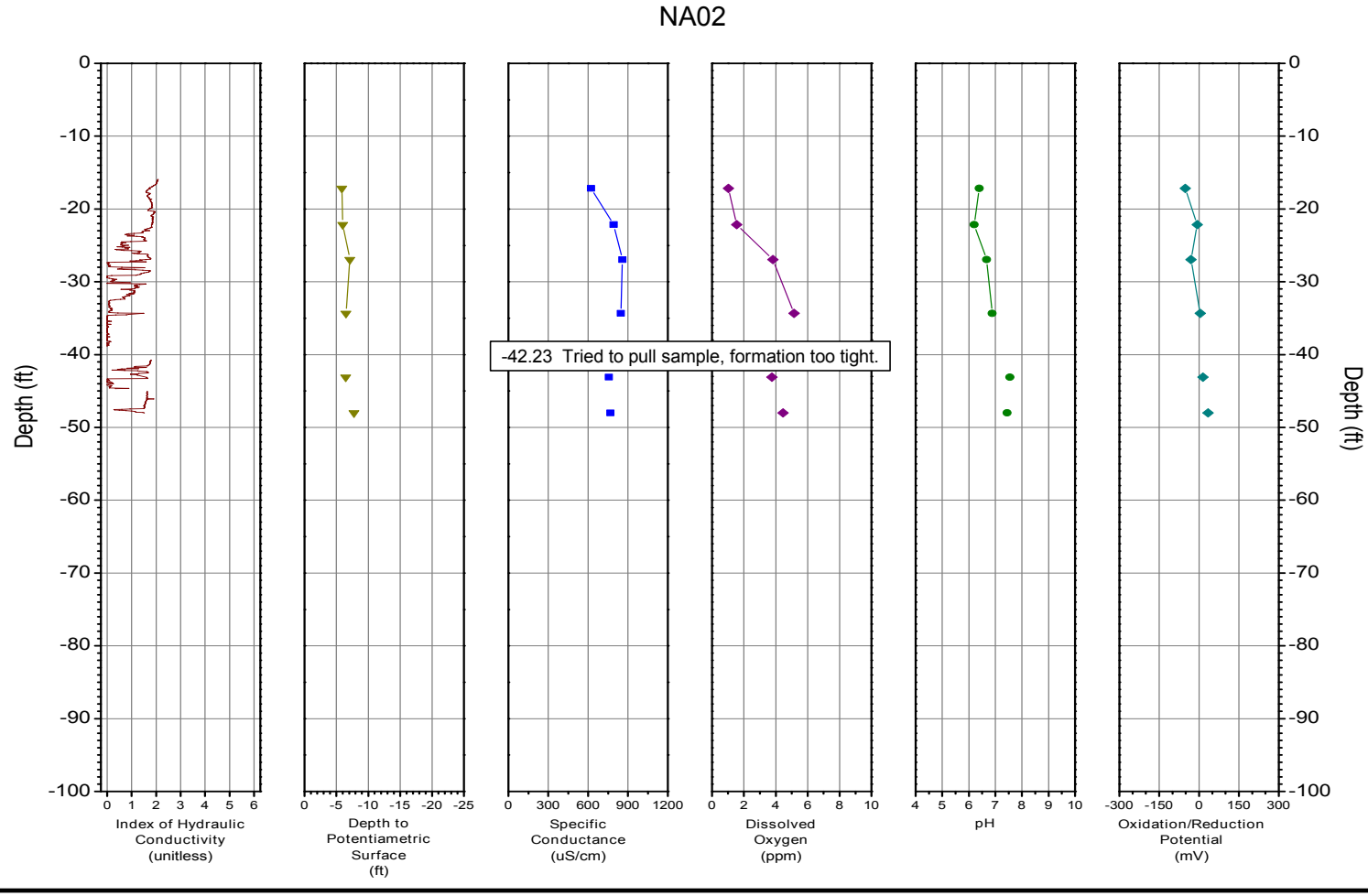


FIGURE NA02, I_K RECORD AND PHYSICO-CHEMICAL PARAMETERS

Dates Sampled : 5/17/2005-5/19/2005

Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data

Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\profiling\orign plots\PhysChem NA02.opj

Date: 5/23/05 djl

STONE ENVIRONMENTAL

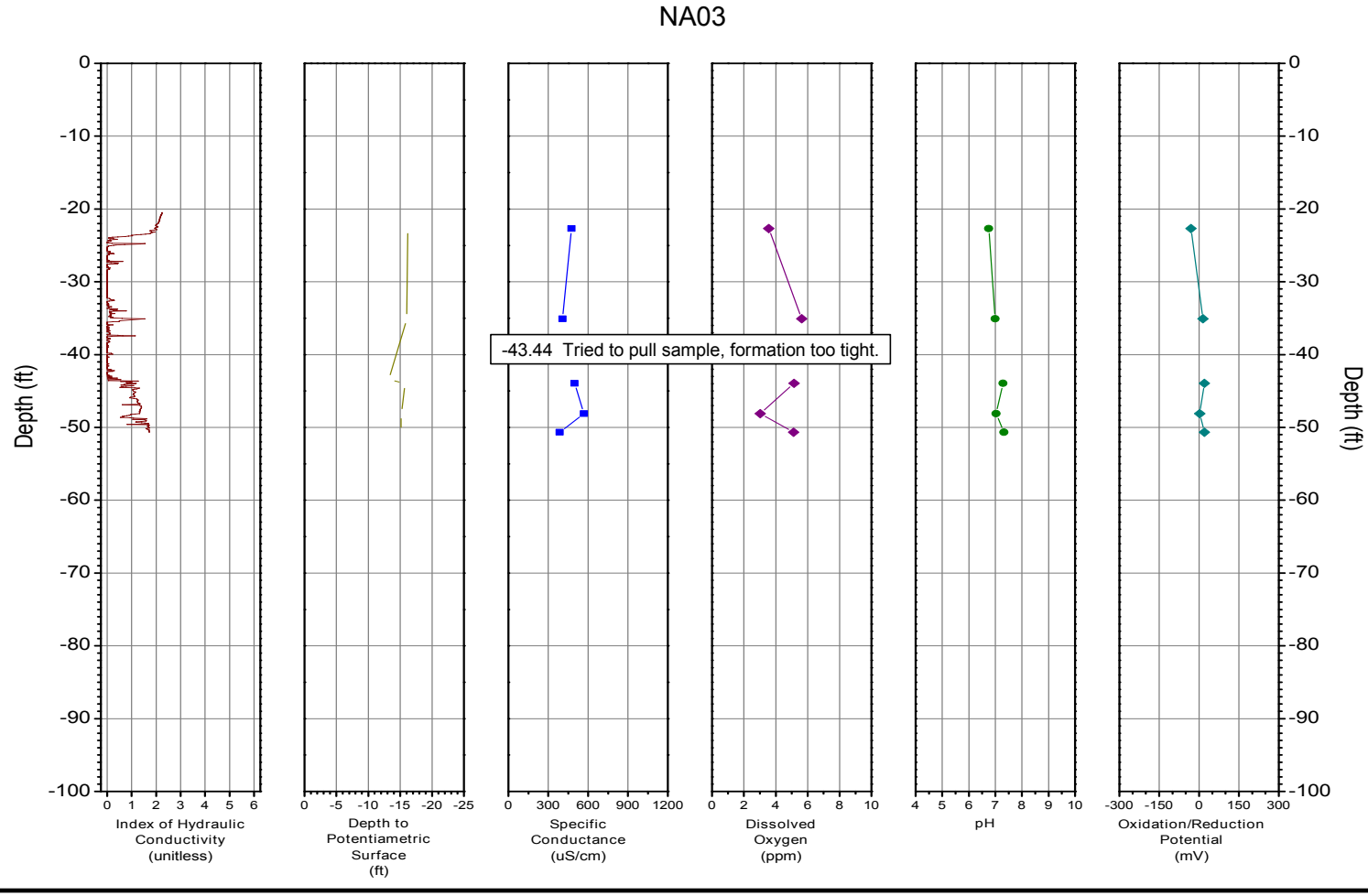


FIGURE NA03, I_K RECORD AND PHYSICO-CHEMICAL PARAMETERS

Dates Sampled : 5/18/2005-5/19/2005

Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data

Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\profiling\orign plots\PhysChem NA03.opj

Date: 5/17/05 djl

STONE ENVIRONMENTAL

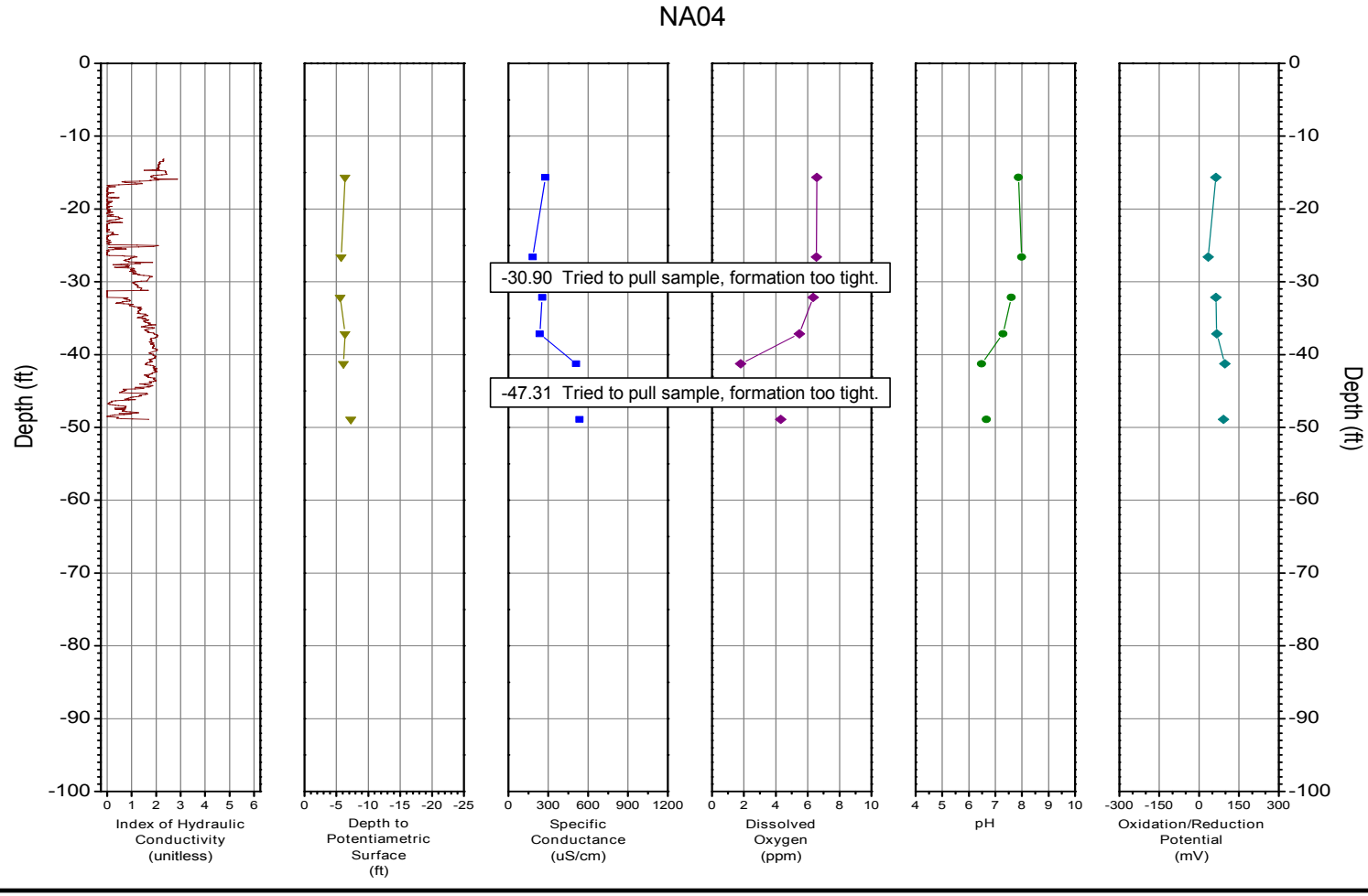


FIGURE NA04, I_K RECORD AND PHYSICO-CHEMICAL PARAMETERS

Dates Sampled : 5/19/2005-5/20/2005

Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data

Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\profiling\orign plots\PhysChem NA04.opj

Date: 5/20/05 djl

STONE ENVIRONMENTAL

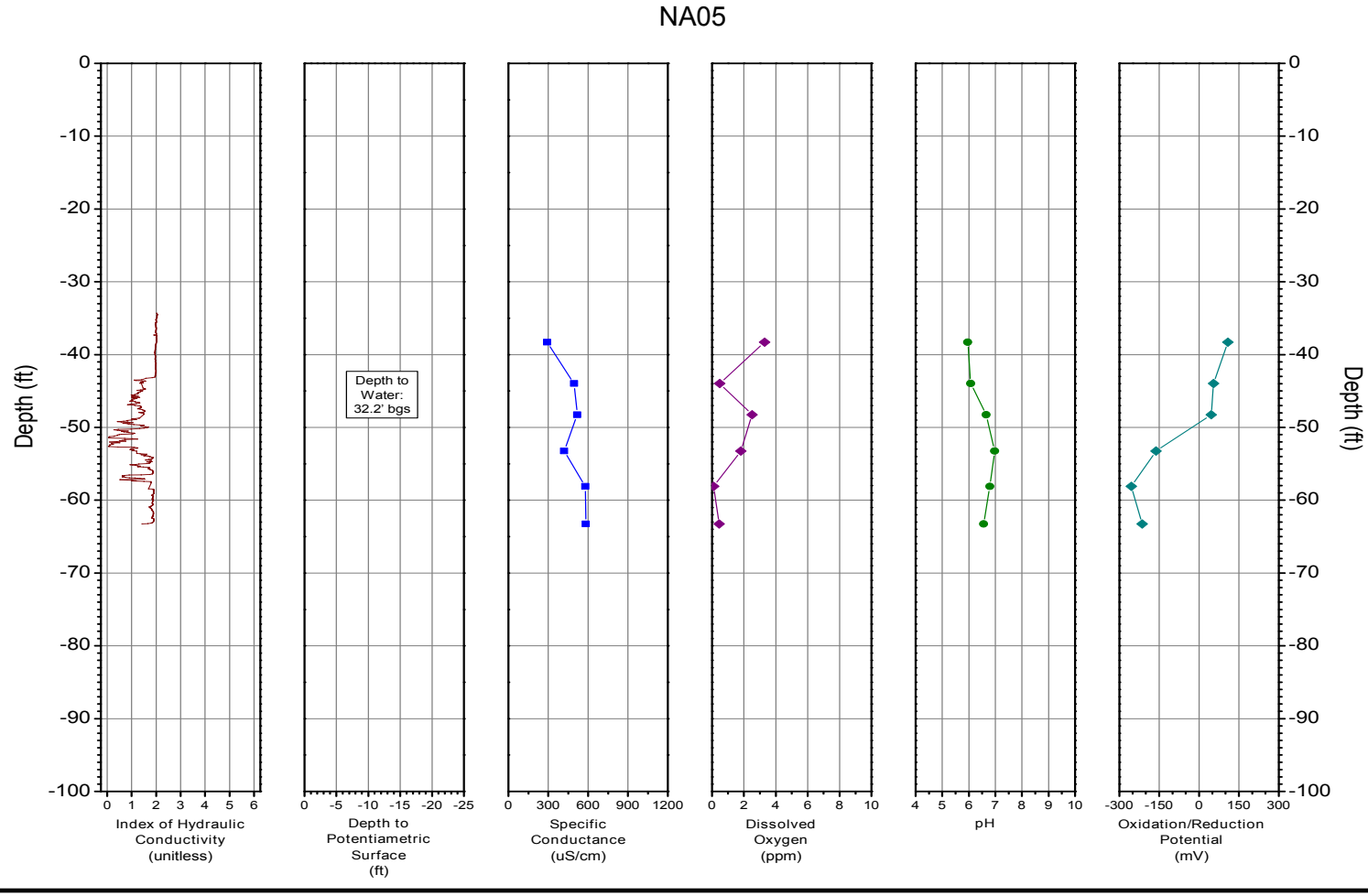


FIGURE NA05, I_K RECORD AND PHYSICO-CHEMICAL PARAMETERS

Dates Sampled : 5/23/2005-5/24/2005

Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data

Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\profiling\orign plots\PhysChem NA05.opj

Date: 5/24/05 djl

STONE ENVIRONMENTAL

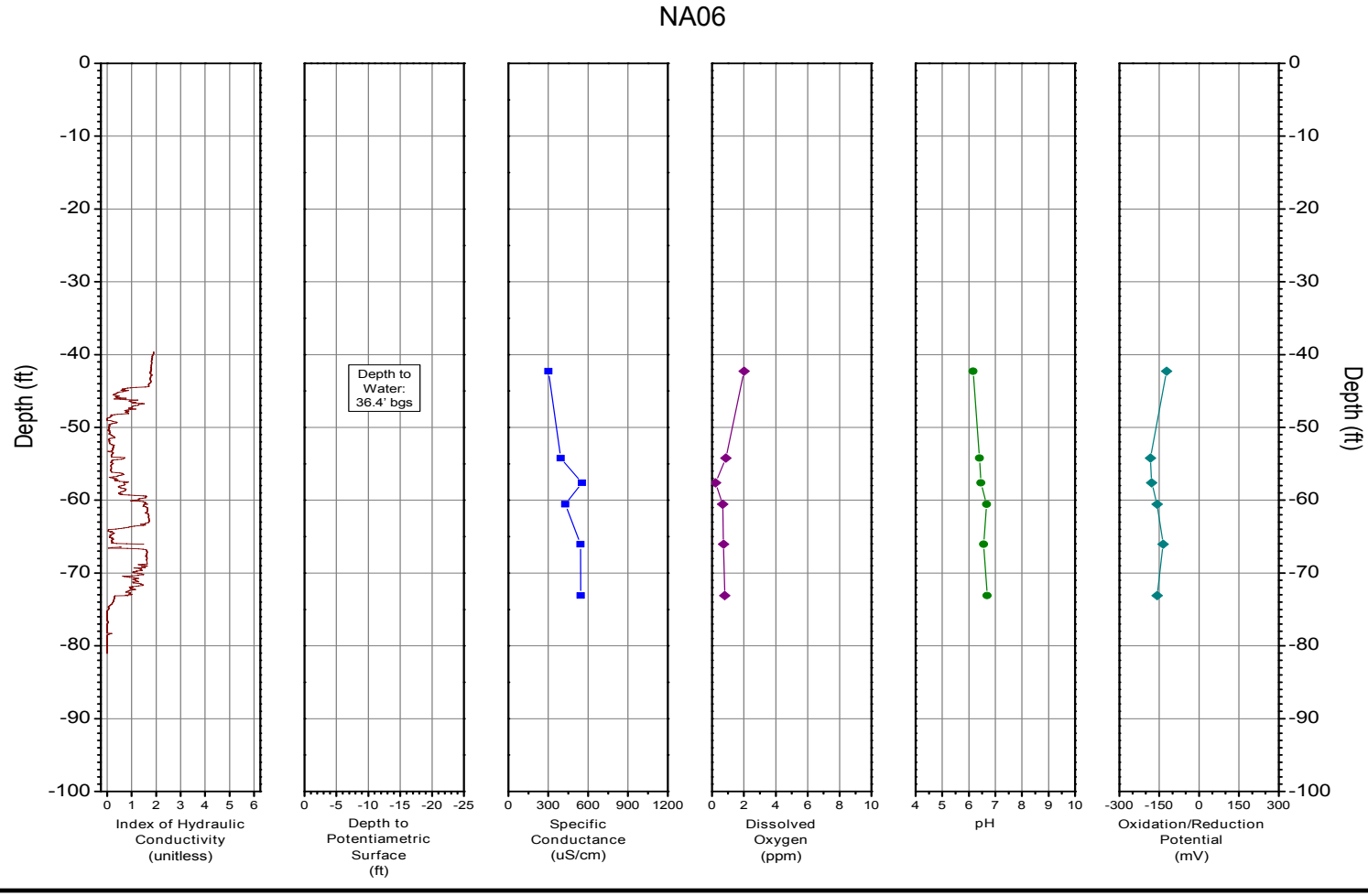


FIGURE NA06, I_K RECORD AND PHYSICO-CHEMICAL PARAMETERS

Dates Sampled : 5/24/2005-5/25/2005

Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data

Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\profiling\orign plots\PhysChem NA06.opj

Date: 5/25/05 djl

STONE ENVIRONMENTAL

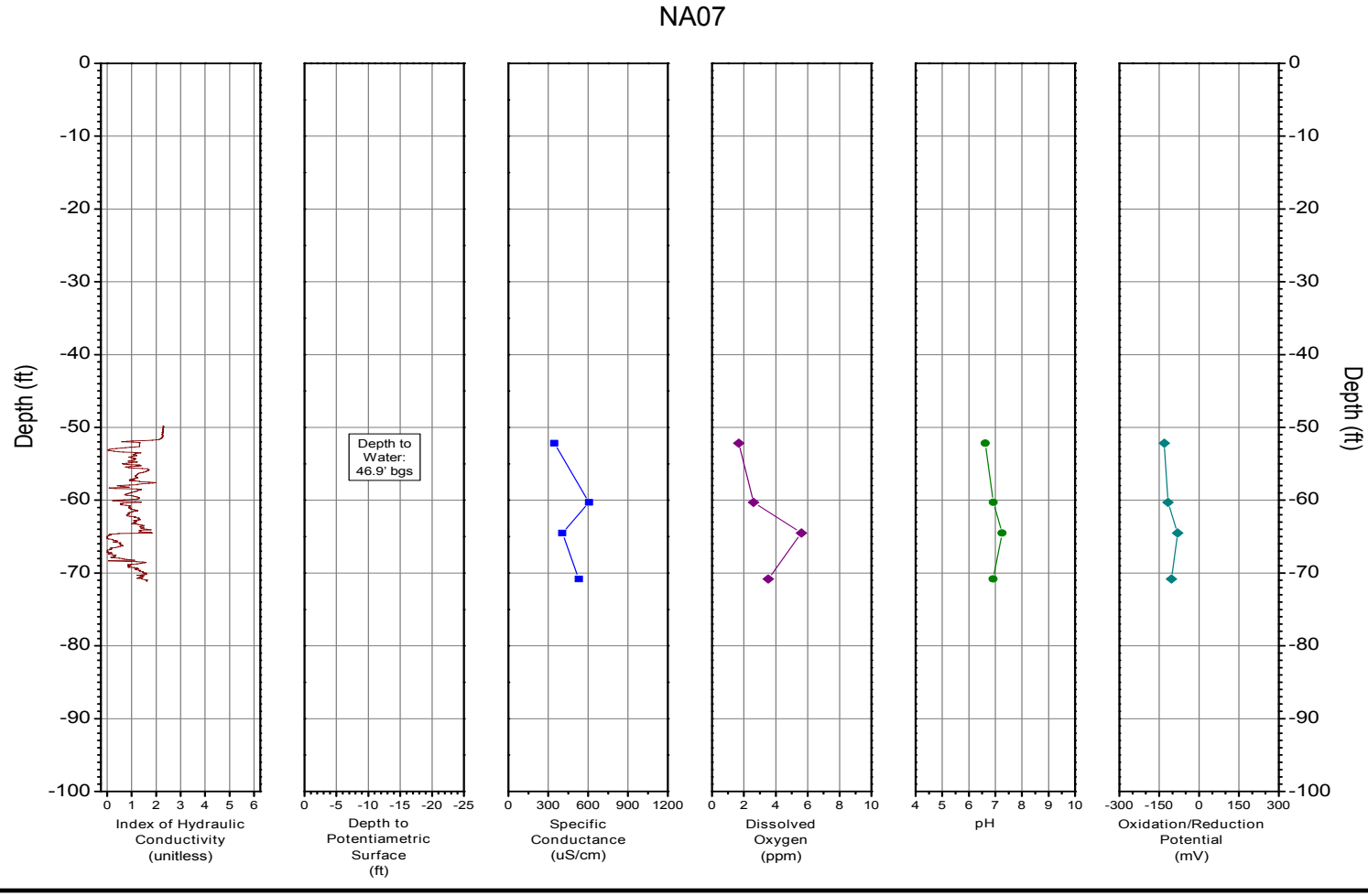


FIGURE NA07, I_K RECORD AND PHYSICO-CHEMICAL PARAMETERS

Dates Sampled : 5/25/2005-5/26/2005

Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data

Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\profiling\orign plots\PhysChem NA07.opj

Date: 5/26/05 djl

STONE ENVIRONMENTAL

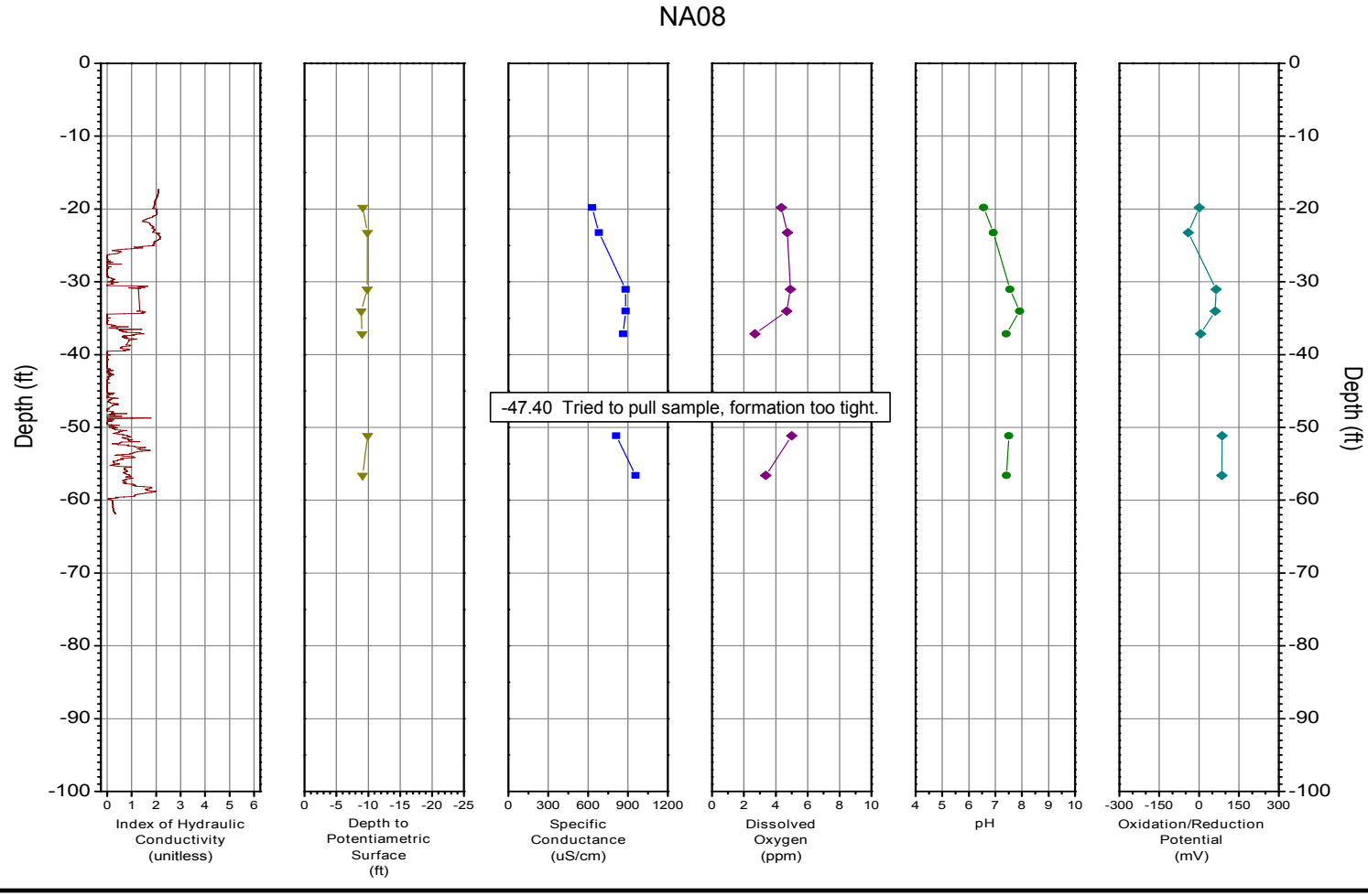


FIGURE NA08, I_K RECORD AND PHYSICO-CHEMICAL PARAMETERS

Dates Sampled : 6/1/2005-6/2/2005

Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data

Path: O:\Proj-05\1617-R Landau - Tacoma WA\Data\profiling\orign plots\PhysChem NA08.opj

Date: 6/2//05 djl

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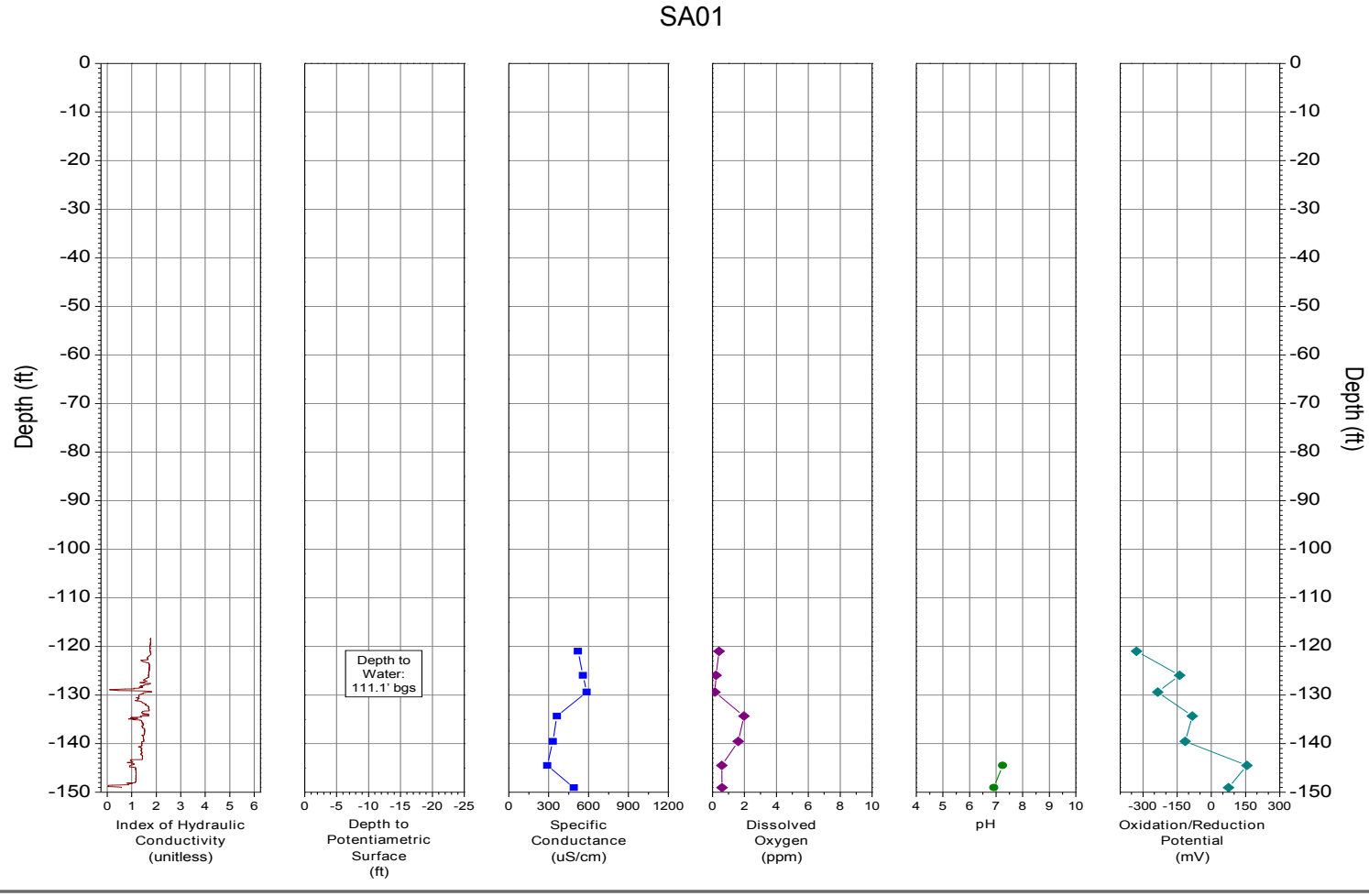

FIGURE SA01, I_K RECORD AND PHYSICO-CHEMICAL PARAMETERS

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Landau Associates / Tacoma, WA

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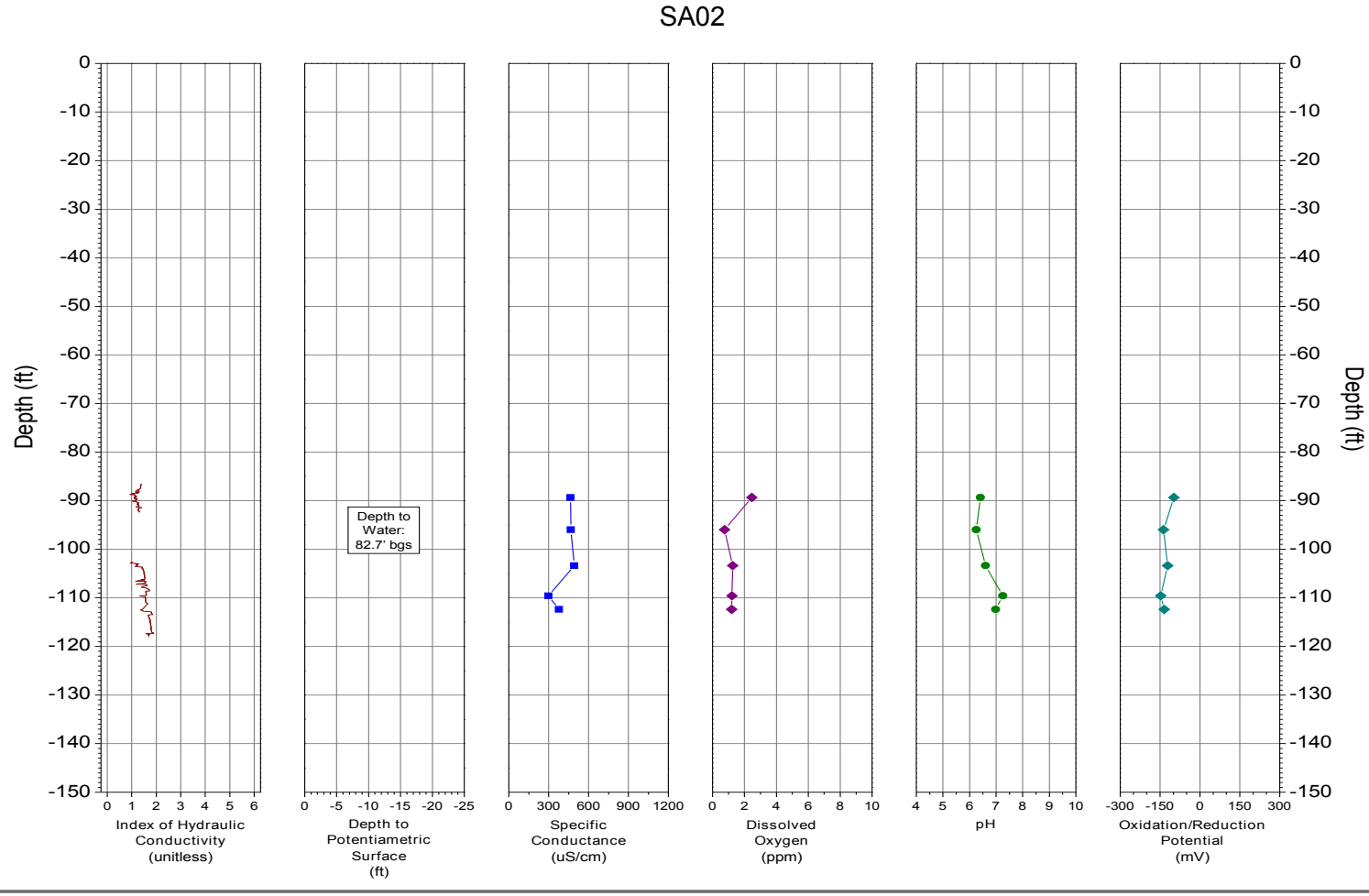

FIGURE SA02, I_K RECORD AND PHYSICO-CHEMICAL PARAMETERS

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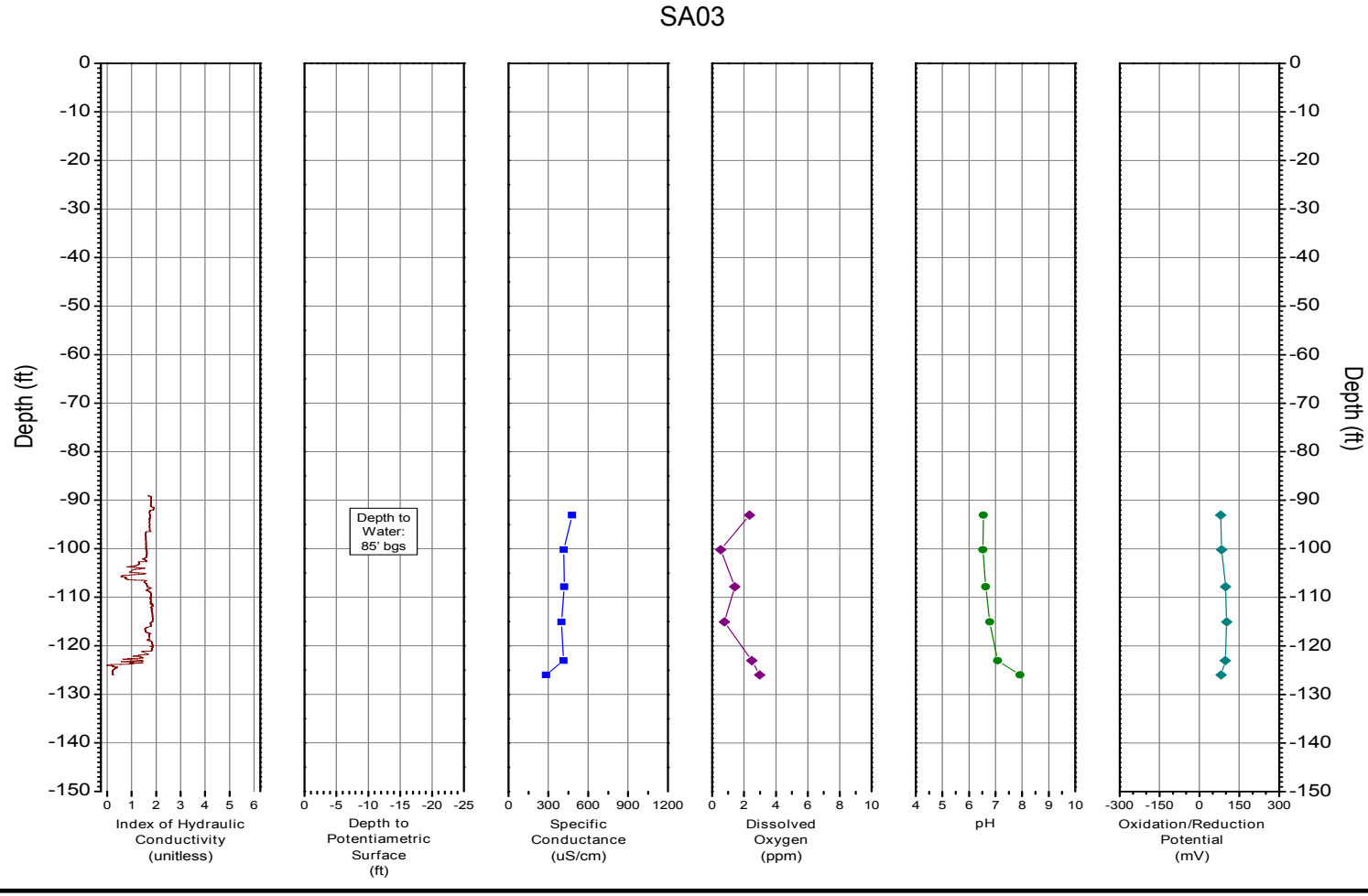

FIGURE SA03, I_K RECORD AND PHYSICO-CHEMICAL PARAMETERS

Dates Sampled : 6/3/2005

Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data

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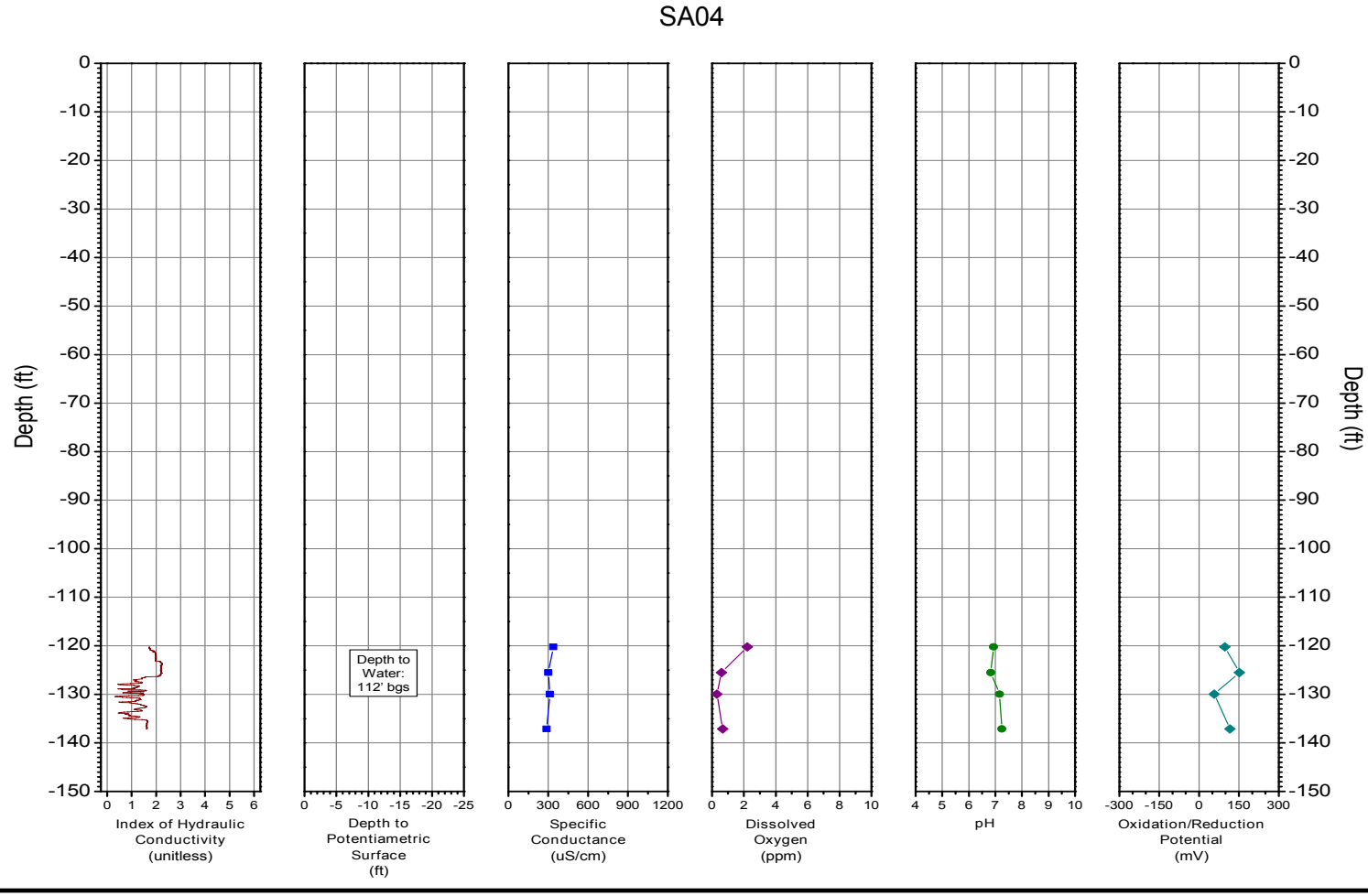

FIGURE SA04, I_K RECORD AND PHYSICO-CHEMICAL PARAMETERS

Dates Sampled : 6/7/2005

Landau Associates / Tacoma, WA

Source: SEI groundwater quality profiling data

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Date: 6/8/05 djl

STONE ENVIRONMENTAL

PLANNING FOR NATURAL DISASTER DEBRIS

March 2008

Checklist of Standard Elements for Significant Guidance Documents

- **Title** *Planning for Natural Disaster Debris Guidance*

- **Document ID Number** *EPA530-K-08-001*

- **Issuing Office or Offices** *Office of Solid Waste and Emergency Response/Office of Solid Waste*

- **Applicable Activity(ties)** *EPA's goal is to update the previous 1995 Planning document "Planning for Disaster Debris" with current information (e.g., consistent with FEMA and States) and to stress more environmental protectiveness. This guidance document, based on experience of communities, discusses the management of debris from natural disasters, such as hurricanes, earthquakes, tornados, floods, wildfires, and winter storms. This document is intended to help a planner in the beginning stages of the planning process or to assist a planner in revising an existing disaster debris management plan. It provides planners with more awareness for environmental protectiveness when it comes to dealing with disaster debris.*

- **Affected Entities or Persons** *Local communities (including cities, counties, tribes, etc.); local governments (emergency responders); states (solid waste, agricultural and public health agencies); other federal agencies responding to natural disasters; EPA regions; solid waste management industry; and the general public.*

- **Applicable Statute or Regulation** *Resource Conservation and Recovery Act (RCRA); 40 CFR parts 257 and 258*

- **Disclaimer** *This document is not a regulation. It does not change or substitute for any legal requirement. This document is not a rule, is not legally enforceable, and does not confer legal rights or impose legal requirements upon any member of the public, States, or any other Federal agency. The word "should" in this manual does not connote a requirement, but rather indicates EPA's recommended approach.*

- **Issuance date and use** *March 2008*

About This Document

- This document is an update of "Planning for Disaster Debris" published by the U.S. Environmental Protection Agency (EPA) in 1995 (document EPA530-K-95-010).
- This document is designed for local communities (including cities, counties, tribes, etc.) who are encouraged to create disaster debris management plans. Information is included on:
    - Recommended components of a disaster debris management plan.
    - Management options for various debris streams that might be found after a natural disaster.
    - A collection of case studies that highlights how several communities prepared for and managed debris generated by recent natural disasters.
    - Federal, state, and local resources to consult in planning for natural disasters.
- This document discusses the management of debris from natural disasters, such as hurricanes, earthquakes, tornadoes, volcanoes, floods, wildfires, and winter storms. It does not discuss the management of debris from deliberate or planned incidents of national significance.
- This document does not, however, provide all the information a planner will need to write a debris management plan. To do so, communities will need input from neighboring communities, state officials, local contractors, and a variety of local agencies. In general, only federal regulations are discussed in this document, where applicable. State and local governments may have more stringent regulatory requirements. State and local officials should be consulted to ensure compliance with those regulations. The information in this document is subject to change as federal regulations and recommendations change as new information becomes available.
- Additional resources:
    - EPA's Disaster Debris website: http://www.epa.gov/epaoswer/non-hw/debris-new/disaster.htm.
    - EPA regional offices and state environmental agencies can provide additional guidance. Contact information can be found at: http://www.epa.gov/epahome/whereyoulive.htm.
    - The Federal Emergency Management Agency's (FEMA) "Public Assistance: Debris Management Guide" (publication 325) was updated in July 2007. It should be consulted, especially to help ensure a debris management plan will be eligible for public assistance from the federal government, when applicable. This guide can be found on FEMA's website at: http://www.fema.gov/pdf/government/grant/pa/demagde.pdf.
    - FEMA has the same regional designations as EPA; their contact information can be found at: http://www.fema.gov/about/regions/index.shtm.
    - FEMA's Emergency Management Institute (EMI) has several courses on debris management, incident command, recovery operations, mitigation, and other topics of interest. A complete listing of EMI's training courses can be found at: http://training.fema.gov.

"Every disaster is different, but a plan will give you a place to start." – Marc Bruner, Solid Waste Authority of Palm Beach County

"Disasters are come-as-you-are battles. Having a plan will make you more prepared when the battle comes." – John Rogers, Louisiana Department of Environmental Quality

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This document references non-EPA web sites. These external links provide additional information that may be useful or interesting and are being provided consistent with the intended purpose of this document. However, EPA cannot attest to the accuracy of information provided by these links. Providing links to non-EPA web sites does not constitute an endorsement by EPA or any of its employees of the sponsors of the sites or the information or products presented on the sites.

Cover photographs (from the top): debris field in Greensburg, Kansas after the 2007 tornado; metal separated for recycling in Mississippi after Hurricane Katrina (courtesy of the Department of Environmental Engineering Sciences at the University of Florida); vegetative debris mulching operation in Louisiana after Hurricane Katrina (also courtesy of the Department of Environmental Engineering Sciences at the University of Florida).

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Steel Recycling Institute
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Acronyms

ACI	Air curtain incinerator
ACM	Asbestos-containing material
APHIS	U.S. Department of Agriculture's Animal and Plant Health Inspection Service
ASTSWMO	Association of State and Territorial Solid Waste Management Officials
BMRA	Building Materials Reuse Association
C&D	Construction and demolition
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CPD	Collection, processing, and disposal/reuse
DHS	U.S. Department of Homeland Security
DMD DST	Debris Management and Disposal Decision Support Tool
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
DOT	U.S. Department of Transportation
ECP	Emergency Conservation Program
EPA	U.S. Environmental Protection Agency
EMAC	Emergency Management Assistance Compact
EMI	Emergency Management Institute
EPCRA	Emergency Planning and Community Right-to-Know Act
ESF	Emergency support function
EWP	Emergency Watershed Protection Program
FEMA	U.S. Dept. of Homeland Security's Federal Emergency Management Agency
FHWA	U.S. Dept. of Transportation's Federal Highway Administration
FSA	U.S. Dept. of Agriculture's Farm Service Agency
GIS	Geographic information system
GPS	Global positioning system
H_2S	Hydrogen sulfide
HAZUS-MH	Hazards U.S. Multi-Hazard program
HHW	Household hazardous waste
HSPD	Homeland Security Presidential Directive
ICS	Incident Command System
LBP	Lead-based paint
LDEQ	Louisiana Department of Environmental Quality
LEPC	Local Emergency Planning Committee
MDEQ	Mississippi Department of Environmental Quality

Acronyms (cont.)

MOU	Memorandum of understanding
MSW	Municipal solid waste
NCP	National Contingency Plan
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NIBS	National Institute of Building Sciences
NIMS	National Incident Management System
NRF	National Response Framework
NRC	National Response Center
NRCS	Natural Resources Conservation Service
OPPT	Office of Pollution Prevention and Toxics
ORD	U.S. Environmental Protection Agency's Office of Research and Development
OSHA	U.S. Department of Labor's Occupational Safety and Health Administration
OSW	U.S. Environmental Protection Agency's Office of Solid Waste
PA	Public assistance
PCB	Polychlorinated biphenyl
RCA	Refrigerant-containing appliance
RCRA	Resource Conservation and Recovery Act
READ	Recycling Electronics and Asset Disposition
RFP	Request for Proposals
SIP	State Implementation Plan
SWA	Solid Waste Authority of Palm Beach County, Florida
SWANA	Solid Waste Association of North America
TRAGIS	Transportation Routing Analysis Geographic Information System
TSCA	Toxic Substances Control Act
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
WBUG	Woody Biomass Utilization Group

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1 Introduction

Each year, natural disasters, such as wildfires, floods, earthquakes, hurricanes, tornadoes, and winter storms, challenge American communities. The National Science and Technology Council estimates that these disasters cost the United States $52 billion per year in the form of lives lost and property destroyed (2005). Natural disasters have generated large amounts of debris, causing considerable challenges for public officials. Debris is the waste stream resulting from a natural disaster and often includes building materials, sediments, vegetative debris, personal property, and other materials. Cleaning up this debris can be time-consuming and costly (FEMA, 2007). As with other federal agencies, EPA's response pursuant to a disaster declared by the President is facilitated through the National Response Framework (NRF). Under the NRF, the U.S. Army Corps of Engineers (USACE) is the coordinator and primary agency for Emergency Support Function (ESF) # 3, which encompasses among other responsibilities, the management of debris. EPA is a support agency to the USACE for ESF #3. Like other responding agencies, EPA receives mission assignments from the Federal Emergency Management Agency (FEMA) to carry out activities in support of state and local governments. (See section 4.1 for further detail on the NRF and ESFs).

After a disaster occurs, communities are faced with the dilemma of how to use their existing capacity for recycling, composting, combustion, and disposal of natural disaster debris. Relying on only one of these debris management options may not be sufficient to handle the overwhelming amount of debris generated by a disaster. Communities may need to develop additional staging and storage areas to store, separate, or process the debris before it is sent to a recycling, composting, combustion, or disposal facility. A disaster debris management plan will aid communities in determining the appropriate management options in advance of a disaster to avoid rushed or, ultimately, poor decisions. Although the recovery process may take a long time, perhaps even years, careful planning can significantly minimize costly mistakes, speed recovery, protect human health and the environment, and prevent the generation of additional waste. A plan identifying cost-effective debris management options and resources can save money. It also will increase control over debris management and improve administrative efficiency. The plan also may serve as a resource document in negotiating technical and financial assistance with FEMA and other agencies. Having a sound disaster debris management plan will expedite removal of debris—an important sign of recovery that residents will see. Expedited removal also will reduce dangers of fire, personal injury, and disease vectors.

Any of the following communities may benefit from the advice presented in this document:

- Communities at risk of significant damage from a natural disaster.
- Communities currently without a disaster debris management plan.
- Communities with emergency response plans that overlook disaster debris cleanup or rely on a number of very limited management options.
- Communities with existing disaster debris management plans that have not been updated to include any new community debris management options or that do not reflect management capacity reductions.

This document, based on experiences of communities, recommends some helpful planning considerations when drafting or revising a disaster debris management plan. It describes steps a community can take to prepare for dealing with the debris created by natural disasters to speed recovery. It also describes ways that communities can reduce the burden on their solid waste management systems in the event of a natural disaster. As evidenced by Hurricane Katrina in 2005, natural disasters can cause incredible destruction. All community officials that contributed to this document recognize that even the best disaster debris management plan is likely to have its shortcomings. Having a plan, however, is important because it lays the groundwork for a community's preparedness and response to a natural disaster, particularly if it is large-scale. Since it is impossible to predict the future, communities are encouraged to plan for both large and small natural disasters.

This document does not provide all the information a planner will need to write a debris management plan, however. The development of a disaster debris management plan usually requires input from neighboring communities, state officials, local contractors, and a variety of local agencies. This document is intended to help a planner in the beginning stages of the planning process or to assist a planner in revising an existing disaster debris management plan. This document, however, is not a regulation. It does not change or substitute for any legal requirement. This document is not a rule, is not legally enforceable, and does not confer legal rights or impose legal requirements upon any member of the public, States, or any other Federal agency. This manual uses the word "should" to describe EPA recommendations or suggestions; it does not connote a requirement. This document references non-EPA web sites. These external links provide additional information that may be useful or interesting and are being provided consistent with the intended purpose of this document. However, EPA cannot attest to the accuracy of information provided by these links. Providing links to non-EPA web sites does not constitute an endorsement by EPA or any of its employees of the sponsors of the sites or the information or products presented on the sites.

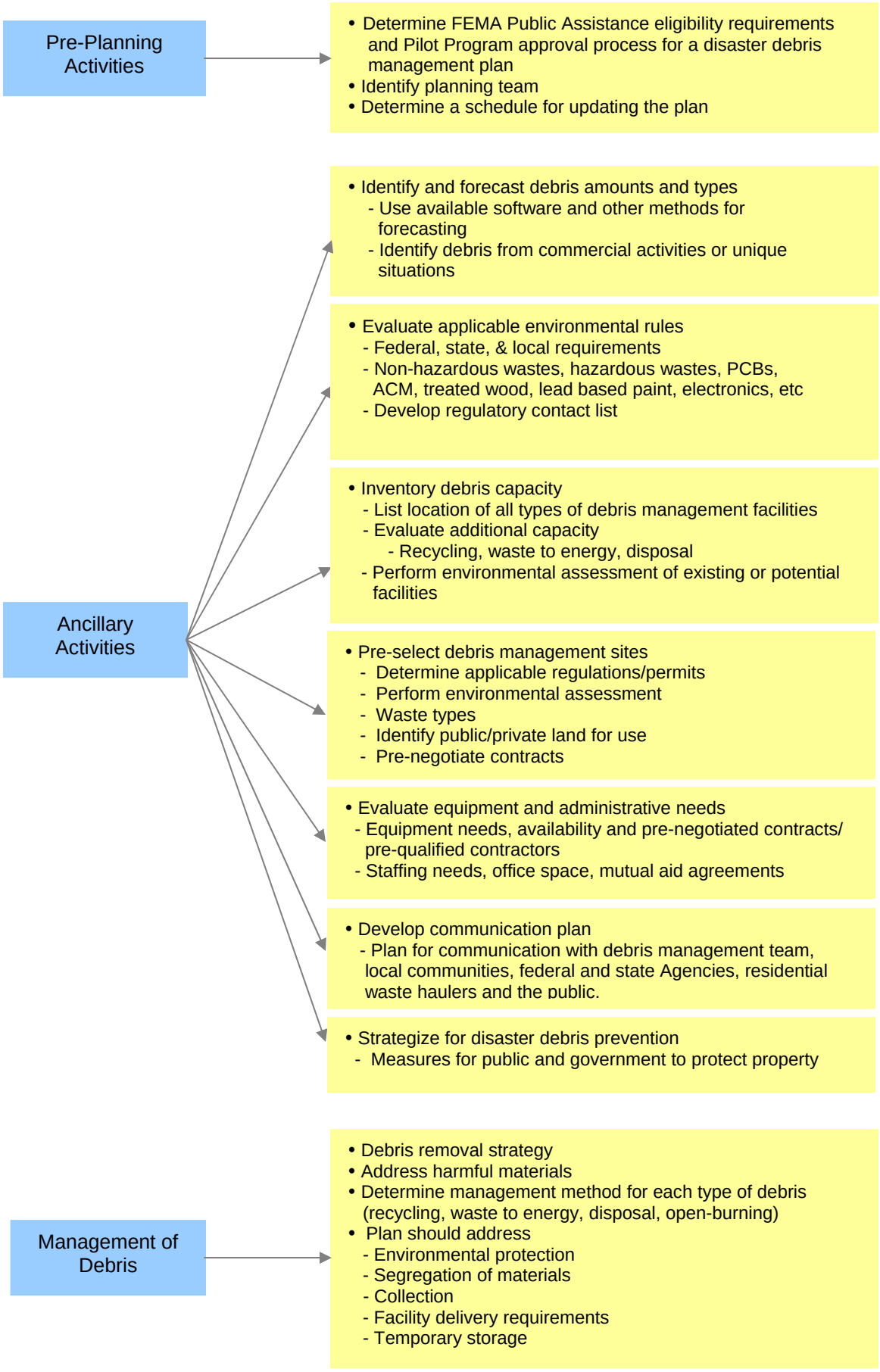
2 Components of a Disaster Debris Management Plan

Natural disasters can generate tremendous quantities of debris; communities should plan for disasters they may face. An effective disaster debris management plan addresses issues beyond initial removal, prioritizes debris management options, and also includes a strategy for recycling and reuse of materials (including mulching/composting) to reduce the burden of volume on disposal facilities. There are many different possible components of a disaster debris management plan. Recommendations presented here are based on insights from community officials who have conducted debris clean-up after a natural disaster. A disaster debris management plan could include the following components:

1. Pre-planning activities
2. Ancillary activities
    a. Identify likely debris types and forecast amounts
    b. List applicable federal, state, and local environmental regulations
    c. Inventory current capacity for debris management and determine debris tracking mechanisms
    d. Pre-select temporary debris storage sites
    e. Identify equipment and administrative needs (including pre-negotiated contracts)
    f. Develop communication plan
    g. Create a disaster debris prevention strategy
3. Create a debris removal strategy
4. Harmful materials identification and handling recommendations
5. Recycling options
6. Waste-to-energy options
7. Disposal options
8. Open burning options

A flowchart describing the process of creating a debris management plan is presented in Figure 1. This section includes recommendations that may aid in drafting language for a community's disaster debris management plan.

Figure 1. Flowchart of disaster debris management planning activities.



2.1 PRE-PLANNING ACTIVITIES

There are three activities that we recommend before starting the disaster debris management plan. The first step is to understand FEMA's requirements for public assistance eligibility and the approval process under their Public Assistance Pilot Program. FEMA has produced a guide for debris management plans (publication 325) that discusses eligibility for Public Assistance that can be found at: (http://www.fema.gov/pdf/government/grant/pa/demagde.pdf). FEMA also provides workshops throughout the country on creating plans. While not all disaster recovery efforts will qualify for federal funding from FEMA, it is important that the plan meet FEMA's requirements in the event that the disaster is severe enough to qualify for federal funding. More about FEMA's Debris Management Plan Public Assistance program can be found at: (http://www.fema.gov/government/grant/pa/) and in section 4.2 of this document. In 2007, FEMA also began a Public Assistance Pilot Program. This program encourages and provides incentives for the development of a plan that includes recycling. Plans voluntarily submitted to FEMA for approval and subsequently approved under this program are eligible for increased federal cost share during a disaster recovery. More information about the Public Assistance Pilot Program can be found at: http://www.fema.gov/government/policy/papilot.shtm and in section 4.2 of this document. FEMA's regional office contact information can be found at: (http://www.fema.gov/about/regions/index.shtm).

Second, a team should be identified for the plan's creation. This team may include planning officials, emergency management officials, environmental officials, and first responders. The team may also include officials from other communities that have experienced disasters in the past. The team should establish how the plan will be created and who, beyond the team, should review it, such as neighboring communities or state and federal officials.

Last, it is recommended that a schedule for updating the plan be established. Updating a community's disaster debris management plan is important to ensure that it reflects current practices and policies. The plan could be reviewed once a year and revised as needed. For example, outdated forms, such as time sheets and materials tracking forms, might need to be revised. If reuse and recycling practices are expanded, they could be added to the plan. New developments may change the collection strategy and may contribute to larger debris amounts. Should a disaster occur, supporting agencies will find the plan most useful if it is up-to-date and describes current practices and policies, as well as the types, locations, and capacities of existing solid waste management facilities.

2.2 ANCILLARY ACTIVITIES

A variety of ancillary activities could be addressed in the disaster debris management plan. These are tasks that do not directly involve the management of the disaster debris, but are important to an effective response program. Ancillary activities help communities understand the possible scope of a debris problem and how their community can address it given the resources and facilities that they currently have or have access to.

2.2.1 Identify Debris Types and Forecast Amounts

The types of materials that will make up the disaster debris stream should be assessed. Some types of debris result more frequently from certain types of natural disasters. Planners on the Atlantic and Gulf Coasts faced with responding to hurricanes need to plan for different debris streams, volumes of debris, and collection circumstances than planners in the West, who are confronted with, for example, earthquakes. Hurricanes, earthquakes, tornadoes, volcanoes, floods, winter snow and ice storms and wildfires can cause damage to buildings, roads, bridges, and other structures, causing construction and demolition (C&D) materials generation. These disasters can generate large quantities of treated wood, including downed utility poles, fencing, and decks. Damaged vehicles and structures are sources of large quantities of mixed metals. If buildings are severely damaged, the debris stream could include furniture and other personal property, electronic waste, white goods, household hazardous wastes (HHW) (i.e., leftover household products that contain corrosive, toxic, ignitable, or reactive ingredients), and putrescible wastes.

Since the characteristics and features of a community are diverse, each community should identify the waste types that are likely to be generated and will need to be managed. Planners may also evaluate whether their area will face special waste management issues unique to their area, such as quarantines for vegetation that is diseased or contains pests. Communities could also assess the major types of industries and commercial enterprises in the area to determine the types of debris that may be generated and dispersed. For instance, storm surge from a hurricane may move materials from an industrial complex several miles away. Communities may want to work with these businesses to determine how they will work with the community in ensuring the management of this debris.

HURRICANES have three primary sources of destruction: powerful winds, storm surge, and rain. The storm surge causes flooding along coast lines, causing much of the damage and resulting debris, including C&D materials, damaged automobiles and boats, furniture, and other debris. Winds cause destruction that can extend many miles inland, resulting in fallen trees and flying debris. Vegetative debris is usually the most voluminous debris stream generated by most hurricanes. Major hurricanes can also leave behind large amounts of displaced sediments.

EARTHQUAKES are caused by a sudden movement of the earth's crust. Generally, most destruction is closest to the epicenter, radiating damage outward, although this is not always the case. Resulting debris can include C&D materials, automobiles, furniture, and other debris.

TORNADOES inflict damage on structures and infrastructure from high winds and resulting projectile materials, putting C&D materials, automobiles, vegetative debris, furniture, and other materials into the waste stream.

FLOODS occur when an overflow of water submerges land. High waters destroy structures and personal property; uproot trees; and displace sand, soil, and sediment. Floods can also destroy roads and bridges, isolating communities and impacting a community's ability to clean up debris. As soon as flood waters recede, people begin to dispose flood-damaged household items. Mud, sediment, sandbags, and other reinforcing materials also add to the volume of

debris needing management, as do C&D materials and mixed metals from demolished and dismantled houses and automobiles.

WILDFIRES typically leave less debris than other types of disasters, but they can generate large amounts of mixed debris, ash and charred wood waste, mixed metals, C&D materials, fire-damaged cars, furniture and other home contents, and scorched soil. In addition, large-scale loss of plants serving as ground cover can lead to mud slides, increasing the debris stream.

WINTER STORMS create large amounts of vegetative debris. Heavy snow and ice accumulations coat tree branches to the point of breaking. They can also collapse roof structures, causing the generation of C&D materials. In addition, icy road conditions can impede the debris removal process.

VOLCANOES create ash and molten rock debris. A landslide or debris avalanche can result in additional debris, including, damaged structures, charred wood waste, downed trees, mixed metals and C&D materials.

Forecasts of the amount and types of debris generated during different types and sizes of natural disasters help the planner understand the scope of debris likely to require handling. These estimates can be based on previous experience or can be made using forecast tools. Due to the unpredictable nature of natural disasters, however, no estimation tool will provide a completely accurate number. These tools are meant to generate estimates that will help a community understand the possible types and amounts of debris that may be generated. Past disasters in other areas can also give planners an idea of the amount and types of debris that are likely to be generated. A description of debris management activities from several recent disasters is presented in Appendix A.

Of the two tools available from federal agencies, the Hazards U.S. Multi-Hazard (HAZUS-MH) program is a nationally applicable standardized methodology and software program that estimates potential losses from earthquakes, hurricane winds, and floods. HAZUS-MH was developed by FEMA under contract with the National Institute of Building Sciences (NIBS). HAZUS-MH uses state-of-the-art Geographic Information Systems (GIS) software to map and display hazard data and the results of damage and economic loss estimates for buildings and infrastructure. It also allows users to estimate the impacts of earthquakes, hurricane winds, and floods on populations. More information and ordering instructions for HAZUS-MH can be found at FEMA's website (http://www.fema.gov/plan/prevent/hazus/index.shtm).

Other debris estimates are available from the USACE. Prior to a forecasted hurricane landfall, the USACE uses geospatial tools to provide estimates of possible debris volumes, needs for water and ice commodities, number of people and households likely within the area impacted by hurricane force winds, and possible temporary roofing and temporary housing needs. Model estimates are developed and posted on a website (http://www.englink.usace.army.mil). The first model runs are made approximately three days before landfall; the last model runs may be days after landfall and may be a reduced suite of model runs and model outputs. The USACE developed a set of equations to calculate possible amounts of debris from hurricanes making landfall along the Gulf and East Coasts of the continental United States. The debris equations consider five primary factors: number of households, vegetation density factor, commercial

density factor (non-residential debris), storm wind intensity, and rainfall intensity. The equations were developed to provide a +/- 30% estimate of possible debris volumes that may be generated by various storms.

The accuracy of the USACE model is improved by calculating debris volumes at census-tract level but the model results need to be viewed with three key considerations. First, the volume estimated is a total amount of debris from a storm from residential sources and a limited consideration of non-residential sources. Second, the model cannot take into account (particularly before landfall) minor, yet significant, variations in storm intensity. Third, the model does not account for debris that might result from flooding caused by storm-related rainfall. The present model is a planning model best viewed as a good indicator of the approximate volume of debris from a storm event. Any community can visit the USACE website (www.englink.usace.army.mil; under debris management) and use the model to produce debris estimates specific to their community. There are also equations that will help compute the number and size of temporary disposal sites required for a known debris quantity. Contact the number listed on the website for additional help.

USACE Hurricane Debris Prediction Model

Q = H (C) (V) (B) (S)

Q = estimated debris total generated in cubic yards
Note: The predicted accuracy of the model is ±30%

H = number of households, or population/3 (household = population divided by 3)
C = hurricane category factor (cat1 = 2, cat2 = 8, cat3 = 26, cat 4 = 50, cat5 = 80)
V = density of vegetation (1.1 for light, 1.3 for medium, 1.5 for heavy)
B = percentage of commercial structures (1.0 for light, 1.2 for medium, 1.3 for heavy)
S = precipitation factor (1.0 for none to light, 1.3 for medium to heavy)

There are also estimation tools available from private companies. Some communities have tailored tools to their specific area. As building codes, age, and styles differ among geographical regions, models specific to a region may produce more accurate results. The Broward County Emergency Management Agency (Florida) produced HurDET, which models hurricane debris specific to South Florida (http://gis2.esri.com/library/userconf/proc05/papers/pap2200.pdf). The Solid Waste Authority (SWA) of Palm Beach County, Florida utilized GIS-based hurricane debris prediction software as part of its disaster debris management plan. Palm Beach County found the model to be invaluable in the few days preceding and following the landfall of Hurricane Frances. "Our first meeting with FEMA to assess the damage of Hurricane Frances lasted mere minutes," Marc Bruner of SWA said. "Knowing how much debris you are going to receive helps you prepare for it." They estimated that SWA would receive more than three million cubic yards of vegetation and mixed debris. The estimate was within 20% of the actual debris processed. Additional information may be found at SWA's website (www.swa.org/pdf/2004_annual_report.pdf).

2.2.2 List Applicable Federal, State, and Local Environmental Regulations

Communities need to understand before a disaster how all waste types must be managed according to federal, state, and local regulations. Once a disaster strikes, there will not be time to do extensive research. An effective disaster debris management plan includes a listing of all regulations and how each debris type must be managed according to those regulations. It is recommended that the plan also include an updated contact list of pertinent federal, state, and local environmental officials whom a community can reach in the event that guidance on the regulations is needed during clean-up. This contact list should include contacts beyond environmental officials, such as those from FEMA and USACE. Contacts at EPA's regional offices and state environmental agencies can also be found on EPA's website (http://www.epa.gov/epahome/whereyoulive.htm). FEMA has the same regional designations as EPA and their contact information can be found on FEMA's website (http://www.fema.gov/about/regions/index.shtm).

2.2.3 Inventory Current Capacity for Debris Management and Determine Debris Tracking Mechanisms

After the amount and type of debris are estimated, planners need to assess the region's capacity to manage the debris. Solid waste management facilities, including disposal, recycling and reuse, and combustion facilities need to be inventoried, along with their daily and permitted capacity to receive different types of debris. Each facility's ability to manage additional debris beyond their normal or permitted daily load should be evaluated. It is recommended that contacts for all solid waste facilities are listed for quick reference along with the facilities' physical locations, including latitude/longitude coordinates, global positioning system (GPS) coordinates, and/or road maps. Lists of any other necessary service providers (such as demolition contractors, refrigerant removers, electronics processors, etc.) could also be compiled.

Natural disasters can impact major transportation routes. Therefore, a community should evaluate all options for moving debris to preferred facilities. Consider other forms of transportation beyond trucks, such as rail and boats. The U.S. Department of Energy's (DOE) Transportation Routing Analysis Geographic Information System (TRAGIS) can be consulted to determine transportation routes (https://tragis.ornl.gov). Depending on the expected amount of debris, transportation needs for the debris are also very important to consider. Section 2.2.5 discusses the potential need for additional vehicles to transport the debris, as well as fuel requirements.

If there is not sufficient capacity to manage the predicted amount of debris, additional waste management facilities outside of the immediate area or suitable areas that could be developed into a solid waste management facility should also be identified. Identifying these areas in advance allows time for any necessary environmental assessments required by state or local environmental agencies. Communities also could establish mutual aid agreements with neighboring communities in advance of a natural disaster to help ensure that additional debris management capacity is available in surrounding areas in an emergency. This may allow a community to handle debris locally without needing to establish new debris management sites.

To help planners determine debris management options, EPA's Office of Research and Development's (ORD) National Homeland Security Research Center developed the Debris Management and Disposal Decision Support Tool (DMD DST). While the DMD DST does not direct the user how to dispose of debris, it provides options for disposal of various types of debris. The DMD DST contains several databases of disposal facilities including: MSW landfills, C&D materials landfills, MSW combustion facilities, hazardous waste combustion facilities, medical waste incinerators, industrial wood-fired boilers, electric arc furnaces, aluminum and copper recyclers/smelters, and hazardous waste treatment, storage, and disposal facilities. Basic facility details and contact information are provided to help users determine which facility or facilities might be best suited to accept the particular type of debris. All of the facility databases in the tool are sortable by state and EPA region to help users identify the closest facilities. Users also may enter the latitude and longitude coordinates of the center of the possible incident area to search for all the disposal facilities within a user-defined radius (based on straight-line distances). Anyone interested in accessing this online tool may request a user name and password at: http://www2.ergweb.com/bdrtool/login.asp.

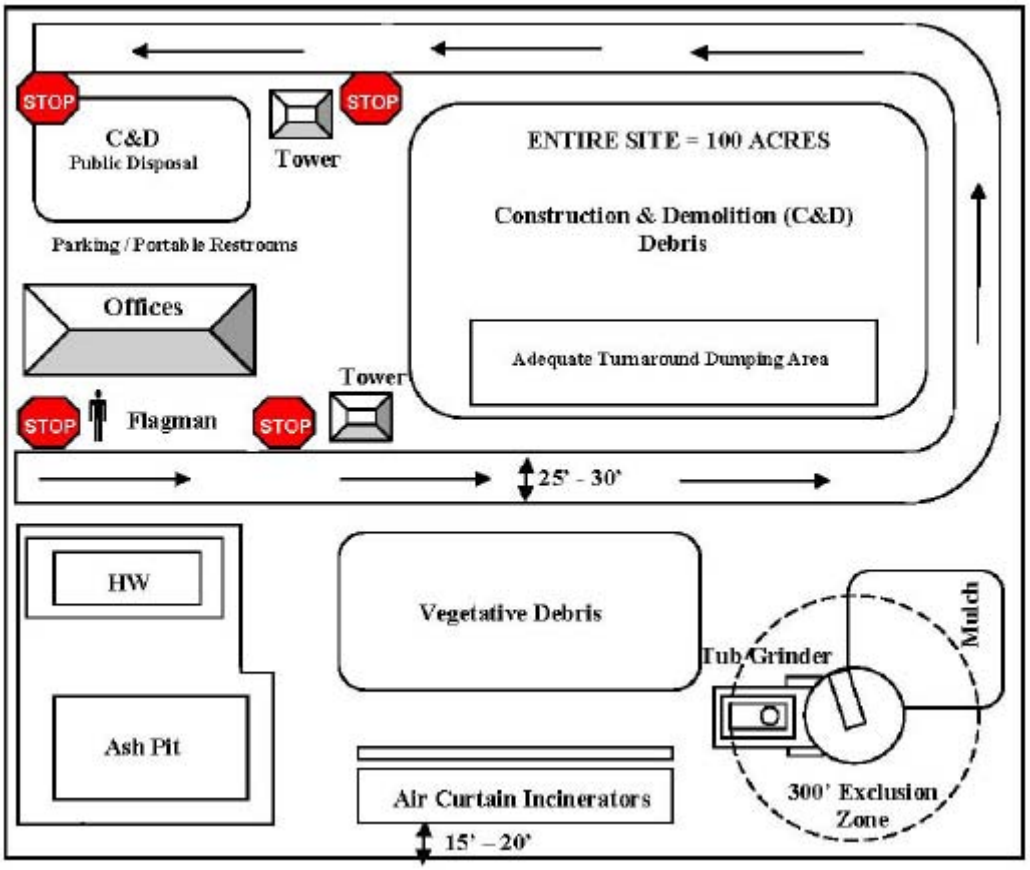
The EPA recommends that communities determine how debris can be tracked during clean-up. Tracking information is important to determine the amount of capacity used and available at various debris management locations, to pay debris haulers, and to determine the total amount managed from the disaster. FEMA also has tracking requirements for reimbursement. As contract debris haulers generally are paid on the basis of volume of debris hauled, provisions in the disaster debris management plan could be made for measuring truck carrying capacity and assigning each truck a number before the truck is allowed to collect debris. The assigned truck number allows for tracking debris amounts by individual truck. Each truck would be monitored at the receiving facility for the volume that they carry. The hauler receives payment based on the sum of these volume amounts. Haulers should be advised that vegetative debris be laid flat in the truck bed. FEMA's Debris Management Guide provides examples of tracking forms (http://www.fema.gov/pdf/government/grant/pa/demagde.pdf).

2.2.4 Pre-select Debris Management Sites

One of the most common suggestions for better debris management from communities that have experienced natural disasters is to pre-select temporary sites that can be used for the storing, sorting, and processing of debris. Hurricanes or ice storms, for example, can generate much more vegetative debris than a municipality typically manages annually. Identifying ample space to stage, store, and process debris can be a challenge. Sites selected in the past have included disposal facilities, local parks, or closed industrial/military facilities. These sites can be used to temporarily store debris before transferring it to another facility, or they can be used to process debris on site. Conveniently located sites can reduce travel time when transferring debris to processing or management facilities and result in expedited debris clean-up. Communities also can use these sites to distribute reusable or recycled products (such as free mulch or wood) to the public. According to FEMA, experience has shown that 100 acres of land are needed to process one million cubic yards of debris. Figure 2 depicts an example of a 100-acre debris management site that primarily manages nonhazardous debris. The site also includes a location for any hazardous materials (marked "HW"). Hazardous materials may be delivered to this location by mistake or included with other non-hazardous materials, which is

likely to occur as affected citizens may be confused about how to categorize their waste or where they should take it. Information about a hazardous waste bulking site used in Louisiana after Hurricane Katrina can be found in Appendix B.

Figure 2. Example of a Debris Management Site



Source: FEMA, 2007

Select a site considering its planned activities, such as storing, sorting, or processing of debris. Consider access by heavy equipment, protection of environmentally sensitive areas, and logistical efficiency. Investigate possible impacts on adjacent housing, because sites can attract vectors such as rodents and other pests, produce noise and odors at levels deemed unacceptable by residents, or put a large burden on normal traffic patterns.

Protect Human Health and the Environment When Selecting Temporary Debris Management Sites

Sites should:

- Be sufficient in size with appropriate topography and soil type (work with state/local environmental agencies to determine appropriate topography and soil type).
- Be located an appropriate distance from potable water wells and rivers, lakes, and streams (work with state/local environmental agencies to determine appropriate setback distances).
- Not be located in a floodplain or wetland.
- Have controls in place to mitigate storm water runoff, erosion, fires and dust.
- Be free from obstructions, such as power lines and pipelines.
- Have limited access with only certain areas open to the public, such as areas to drop off debris.
- Be located close to the impacted area, but far enough away from residences, infrastructure, and businesses that could be affected by site operations.
- Preferably be on public lands because approval for this use is generally easier to obtain, but could also be located on private lands. Private lands may be convenient and logistically necessary for temporary debris storage sites. Consider potential agreements with private land owners in advance to ensure the use of these needed areas.

The condition of these temporary sites could be evaluated and documented prior to use. Depending on the debris that is to be staged there, it may be advisable to assess the soil, groundwater and/or surface water at a proposed staging area prior to receiving debris to establish pre-existing conditions. Communities need to work with state officials to ensure that the staging sites do not affect drinking water sources, such as groundwater or surface water reservoirs. The government agencies involved may be responsible for returning these sites to their original condition. Therefore, guidelines could be established for the return of property to the owners. General environmental, safety, and logistical considerations include:

- Environmental monitoring. Areas that were used to stage vegetative debris do not typically require groundwater monitoring, but should be monitored for fires. Areas used to stage mixed, C&D, or hazardous wastes may need more extensive monitoring. Consult with state officials for recommendations.
- Removal of debris from the site in a timely manner. Putrescible, mixed, harmful, and hazardous wastes should not be stored for extended periods of time. These types of debris should be removed daily or as soon as practical to prevent odors, vectors, human health hazards, and/or environmental releases.
- Limiting site access to ensure that the site is secure. Some wastes that present higher levels of concern should have additional storage controls and security measures.

- Evaluating traffic logistics on and around the storage site.
- Minimizing noise disruptions to acceptable hours.

Consider the following safeguards for hazardous waste bulking sites:

- Area to be used should be covered with two layers of plastic sheeting, tarps, or a concrete pad.
- Fence off area with T-posts and orange barricade fencing.
- Surround fenced off area with absorbent booms (to absorb any potential leaks) or sandbags (to prevent spills from seeping into the ground).
- Use (wooden) pallets to raise collection bins off the ground (to ascertain potential leaks).
- Provide adequate space for walking/carrying items between pallets.
- Segregate containerized gases, liquids, or solids by material type (e.g. corrosive wastes, reactive wastes), place each material type in a separate bin or barrel, and label the bin or barrel appropriately.
- Cover collection bins or barrels with plastic liners/lids or cover the entire hazardous waste collection site with a tent to prevent water collecting in bins.
- Cylinders containing compressed gas should be placed upright with cap on and secured in place.
- Provide sufficient fire extinguishers for the site in case fire breaks out; four fire extinguishers per 10,000 square feet are recommended, placed at the corners or in easily accessible locations.

If residents will be asked to bring debris to collection sites, a community should identify those locations in its pre-incident communication plan. This information needs to be immediately available to the public, especially when electrical outages impede direct communication. Also, plan for sufficient staffing for these sites and consider establishing hours of operation that accommodate the residents. Many communities have found that much residential debris cleanup takes place on weekends or after normal business hours.

2.2.5 Identify Equipment and Administrative Needs

When drafting a disaster management plan, a planner should identify in advance the types of equipment and supplies needed to implement the plan. This means equipment for administrative staff as well as debris collectors. A list of possible equipment needs is provided below. If a large number of vehicles and fuel-dependent equipment is needed, consider possible implications from a fuel shortage due to the disaster. Potable water supplies should be well stocked during hurricane or flood season. The Occupational Safety and Health Administration (OSHA) produced a Hurricane eMatrix (http://www.osha.gov/SLTC/etools/hurricane/index.html) to provide recommendations on how to keep workers safe during the management of disaster debris. The eMatrix identifies types of necessary personal protective equipment and operational considerations. While the Hurricane eMatrix was designed for use after a hurricane, much of the recommendations can apply to the management of debris generated from other natural disasters.

Example Equipment Needs

Equipment needs can be separated into three priorities:

Primary – needed for initial response:

- Safety items/personal protective equipment (first aid kits, safety vests, work gloves, etc.)
- Barrier tape or fencing
- Chainsaws
- Debris/earth moving equipment, such as skid-steer loaders, front loaders, and excavators
- Dump trucks and roll-off trucks
- Flares
- Flags, small and brightly colored
- Flashlights
- Fuel
- Generators
- Handheld GPS units to record locations of materials such as hazardous wastes
- Handheld radios, cell phones, satellite phones, and/or wireless handheld devices
- Batteries
- Notebooks and cameras
- Road signs to direct debris hauler traffic
- Vehicle repair equipment

Secondary – may be needed to begin debris processing:

- Air monitoring equipment
- Cranes with cables and magnets
- Dumpsters and hoppers
- Forklifts
- Knuckle boom pickers (elevated work platforms)
- Jack hammers
- Jaw crushers and/or compactors
- Pallets
- Plastic sheeting
- Sealable plastic drums
- Wood grinders

Tertiary – sometimes needed to process large volumes:

- Air curtain incinerators
- Conveyors
- Vibrating screen sorters

In the aftermath of a natural disaster, communities need to be ready to handle an increased number of telephone calls and requests concerning debris removal and management. Communities also might need more staff to train and monitor debris collection contractors and

help troubleshoot problems. Debris management sites may require additional staff to ensure that wastes are being managed appropriately. Therefore, communities could consider cross-training their existing staff to carry out several responsibilities related to disaster response and identify sources of temporary labor. Staffing that is needed in order to meet recordkeeping requirements for reimbursement of disaster debris management costs should be considered. Some states reimburse some costs even if the disaster does not qualify for federal reimbursement funds. Discuss recordkeeping requirements with the state emergency planning agency. Recordkeeping is often required from the very beginning until the end of debris removal and disposition. A community, particularly if it is small, might benefit from identifying, in advance, people or other communities who have experience in obtaining reimbursement.

A community might consider using pre-negotiated contracts for additional services that the community does not have the capacity to provide for itself. Solicitations could include services for debris removal, storage, sorting, recycling, processing, marketing, and disposal. Pre-negotiated contracts may help get better prices than what might be offered after the natural disaster has occurred. They may also allow for any legal issues to be addressed in advance. Additionally, debris management can commence more quickly than if contract negotiations are necessary after the natural disaster. Back-up copies of the documentation should be kept in an alternate location in case one location is destroyed in the disaster. If pre-negotiated contracts are not feasible, consider including in the disaster debris management plan a list of pre-qualified contractors to solicit bids from directly after the disaster. Contractors excluded from federal contracts are listed at the U.S. General Services Administration's Excluded Parties List System website (http://www.epls.gov). FEMA reimbursement policies should be reviewed to ensure that the terms of the solicitation meet FEMA and state requirements in the event that the disaster qualifies for federal or state reimbursement. FEMA requires pre-event contracts and pre-qualification of contractors. For more information of FEMA's Public Assistance Grant Program, visit FEMA's website (http://www.fema.gov/government/grant/pa/index.shtm).

Plans could also be made for the quick procurement of staffing and equipment needs through mutual aid agreements. Mutual aid agreements may allow the equipment, services, and expense burden to be shared. As other communities may have equipment that they are willing to share, consider contacting other local governments in advance for equipment mutual aid agreements. Also consider contacting relevant state agencies to discuss their resources and available financial aid.

2.2.6 Develop a Communication Plan

A communication plan is recommended as part of the disaster debris management plan. During recovery, a community will have to communicate with the debris management team, other governmental agencies, local major commercial and industrial enterprises, residential waste haulers, and the general public regarding the debris removal process. The EPA suggests that a communication plan discuss what information will need to be provided and how such communication should happen effectively.

The debris management team could consist of administrative personnel in charge of debris clean-up, fleet managers, contractors who have been hired to carry out the collection efforts, and debris management facility operators. As with all teams, there should be clear descriptions

about how decisions will be made and by whom. The chain-of-command, as well as how decisions will be communicated through the chain, need to be clearly articulated. Instructions should be communicated in all languages that the debris team uses to ensure proper debris management. The disaster debris management plan should be distributed to the team to ensure that the plan can be implemented quickly and smoothly. Hardcopies might be distributed in addition to electronic versions in the event computers are not accessible after the disaster. To the extent possible, the debris management team should be familiar with the disaster debris management plan ahead of the disaster. In order to communicate events and problems that may arise, frequent meetings should be held after the disaster to discuss how to overcome problems and prevent similar ones from occurring. Other communication methods should be addressed, such as cell phones, satellite phones, and hand-held radios.

It is advisable that there be an effective communication mechanism with other pertinent government agencies about debris removal. That is, establish a reliable method to communicate with police, health officials, and other emergency responders to make sure that debris is collected in a manner protective of public safety. In addition to local agencies, it is suggested that the disaster debris management plan be filed with the state. Especially when regional solid waste services or facilities are involved, a copy should also be provided to neighboring communities. Sharing the plan with other communities and the state will ensure that the plan is readily accessible post-disaster and that all affected communities can coordinate in the clean-up process.

It is also advisable to establish a communication strategy with major industrial and commercial enterprises in the area that may generate large amounts of wastes. This communication strategy could include contact information, physical location, and a list of hazardous and non-hazardous wastes that could be generated. These companies should have an established disaster response plan, including how they will communicate any issues with the local government and/or the general public.

Informing the public about debris management before disaster strikes should make dealing with the aftermath easier. Many communities that have experienced disasters commented that residents typically want debris to be removed as quickly as possible. Some residents may resort to illegal burning, dumping, and other improper management methods. Providing public education before and after the disaster can curb this response. It is recommended that government officials inform the community when, where, and how debris collection will commence, when normal collection is likely to resume, and provide special instructions for reporting and separating disaster debris at the curb. As part of their emergency plans, some communities have prepared:

- radio and television announcements,
- flyers and door hangers,
- telephone hotlines, and
- websites.

To be as useful as possible, all communication should be timely, consistent, updated, and use language that is not overly technical. Discuss the use of free public service advertising with

local media companies to communicate instructions in the event of a natural disaster. Depending on the type and severity of the natural disaster, however, a community might lose electricity, telephone service, radio broadcasting capability, or newspaper service. Communities, therefore, are encouraged to prepare more than one method of communication. Examples of flyers used following Hurricane Katrina are presented in Appendix B.

Communicating with the Public

Marc Bruner, the Director of Environmental Programs for SWA in Palm Beach County, Florida, has a great deal of experience in managing disaster debris. He believes that properly informing the community is one of the most important elements to planning for disaster debris. "Everyone wanted their streets cleared as soon as possible," Bruner said after Hurricanes Frances and Jeanne. "But our message was consistent; be patient and our crews will be there."

Mark Triplett, the Acting Director of Solid Waste Management for Escambia County, Florida, stated that the lack of a public awareness campaign was an obvious flaw in the county's preparation. Of the clean-up process during Hurricane Ivan, he said, "One of the biggest problems that the County faced was the public outcry for debris to be picked up sooner rather than later because citizens did not fully understand the clean-up process."

Consider placing the disaster debris management plan on the internet and seeking public comment. Allowing the public to review the document and understand how debris management will occur before a natural disaster can provide time for discussion and revisions to the plan based on public concerns. Public opposition may be mitigated if citizens understand where and how the debris will be managed ahead of time. An internet site that addresses disaster debris management may also provide direction on how and where the debris will be collected. As an example, the City of St. Petersburg, Florida provides debris collection information on their website: (http://www.stpete.org/hurricane/hurricanedebris.htm). Additionally, Charlotte County, Florida provides debris preventative advice and instructions on their website: (http://www.charlottecountyfl.com/EnvironmentalServices/solidwaste/pdf/hurricaneInfo.pdf).

2.2.7 Create a Disaster Debris Prevention Strategy

Disaster debris prevention should be considered in a disaster debris management plan. While total prevention may not be possible, some measures can be taken to help reduce the generation of disaster debris. These strategies include an education outreach program to educate the public on how they may decrease the amount of damage that their property might suffer in a natural disaster. A building code and planning evaluation may be prudent by local officials to determine if the current codes and planning maps will allow the community to withstand disasters prone to that area.

Many states and communities have compiled Hazard Mitigation Plans that discuss preventative measures aimed at reducing the generation of disaster debris. These plans have been developed as a result of planning actions and working partnerships between all levels of government within a state. The result of these mitigation plans is an understanding of the risks communities face from natural and manmade hazards and the best ways to reduce or eliminate the potential for loss of life, property damage, and disruption of economic activities. Mitigation activities can be short-term or long-term actions designed to reduce or prevent the generation of debris that may arise as a result of a natural or manmade hazard. Examples of actions these mitigation plans identify are 1) educating home owners about how to strengthen their homes to resist damage from hurricane-force winds and 2) constructing large scale public works projects, such as a levee that limits the extent of flooding. As of May 31, 2007, all 50 States, the District of Columbia, 7 Territories and 36 Tribal governments had approved State Mitigation Plans, and over 14,000 local jurisdictions currently had approved (or approvals pending adoption) Local Mitigation Plans that cover approximately 59% of the nation's population. More information about hazard mitigation plans can be found at FEMA's website (http://www.fema.gov/plan/mitplanning).

Hurricanes often generate a large amount of vegetative debris that can cause additional damage. Falling branches, uprooted trees, and flying vegetation can cause destruction to homes, buildings, power lines, pipelines, and other infrastructure. Residents could be advised to trim back trees on their property and remove dead or diseased trees. Likewise, utility crews could trim back vegetation around power lines and remove trees that may interfere with important power and pipe lines. Outdoor belongings, such as patio furniture and grills, can become projectiles and should be brought inside or secured outside using ground anchors or straps. The State of Florida has produced guidance (http://www.floridadisaster.org) to help the public prepare their homes for hurricanes. Advice is given on what to do for roofs, windows and doors, screen enclosures, attic vents and other openings, home structure, the surrounding environment, and other features of a house. FEMA has also produced a homeowner's checklist for avoiding hurricane damage (http://www.fema.gov/pdf/plan/prevent/nhp/hurdam.pdf).

Earthquakes can shake buildings and attachments to the point that they become structurally unsound. Some measures can be taken to prevent some of the damage and resulting debris. California recommends that houses be anchored to their foundations to help prevent them from moving, which otherwise could result in lifting and placing the houses back on their foundation or the total demolition of the houses. Bracing hot water heaters can prevent them from toppling and rupturing gas lines, causing fire damage. Strengthening weak walls, foundations and chimneys can prevent horizontal movement of homes and subsequent damage. The State of California produced guides for the public, *Homeowner's Guide to Earthquake Safety* and *Commercial Property Owner's Guide to Earthquake Safety*. These guides and other localized recommendations can be found at the California Seismic Safety Commission's website (http://www.seismic.ca.gov). FEMA has produced several publications about preventing destruction to buildings, such as *Homebuilder's Guide to Earthquake Resistant Design and Construction* and *Earthquake Safety Guide for Homeowners* (http://www.fema.gov/plan/prevent/earthquake/homeowners.shtm).

Flood waters and the objects they displace and transport can cause a great amount of damage. Outdoor belongings, such as patio furniture and grills, could be brought inside or secured outside using ground anchors or straps. Debris from culverts, streams and channels could be removed to allow floodwaters to flow freely. FEMA and the American Red Cross have produced flyers for flood damage prevention. These can be found at http://redcross.tallytown.com/library/AvoidingFloodDamage.pdf, http://www.redcross.org/pubs/dspubs/cde.html, and http://www.fema.gov/hazard/flood/fl_before.shtm.

Wildfires can destroy homes and property. Fire-safe landscaping, protective shutters, fire resistant roof materials, such as metal roofs, and regular maintenance to remove built-up vegetative matter from buildings and surrounding landscaping can help minimize damage from a wildfire. Public information sheets are available on FEMA's website (http://www.fema.gov/news/newsrelease.fema?id=7533) and on the American Red Cross' website (http://www.redcross.org/static/file_cont258_lang0_123.pdf).

Winter Snow and Ice Storms can cause a great amount of damage. Trimming back trees and removing dead trees and branches can reduce the amount of vegetative debris generated and help reduce power outages. FEMA provides advice on their website (http://www.fema.gov/hazard/winter/wi_before.shtm).

Volcanoes create ash and molten lava debris. Working with local governments to support land-use and building ordinances that restrict construction in volcanic areas can help to reduce debris generated as a result of a volcano.

2.3 Create a Debris Removal Strategy

It is recommended that debris removal begin as soon as it is safe for personnel to be out in the community. An initial activity will likely be the clearing of roadways and ensuring that emergency vehicles can travel effectively. Following the initial clearing, there should be a plan for collection priorities. The debris removal strategy should discuss how each type of debris should be segregated (where applicable), collected, and managed. Debris that may pose an immediate threat to human health and the environment should be a first priority in collection. Following that, the strategy should discuss materials that are priorities for recycling or reuse. While recycling should be pursued to the extent possible, it is likely that many materials will be disposed. Ensuring that the debris is removed in a timely fashion is important to protect the safety of the community and to return the community back to normal.

2.4 Harmful Materials Identification and Handling Recommendations

During the course of a natural disaster, materials are generated that have the potential to harm human health or the environment. Examples of materials gathered during previous natural disasters and handled as hazardous wastes include automotive/marine batteries, pesticide containers, explosives, automotive oils, fuels and fluids, solvents, paint thinners and strippers, and compressed gas containers. Separating these materials into appropriate categories prevents incompatible materials from reacting. A plan for controlling and diverting hazardous

materials from the debris stream, including handling procedures, helps avoid the release of hazardous constituents into the environment. Waste handlers should be trained to minimize releases. At a hazardous waste bulking site, safeguards should be implemented to prevent releases (see Section 2.2.4). An example of a household hazardous waste bulking center used during the Hurricane Katrina clean-up in Orleans Parish is included in Appendix B. Federal or state officials should be contacted to determine if there are requirements for obtaining an emergency hazardous waste storage permit or other facility requirements. All state and federally-regulated hazardous wastes should be managed in an appropriate hazardous waste treatment or disposal facility that complies with federal, state and local regulations.

If a release does occur, minimize dispersion and control the release as best as possible. Then call the state environmental agency and the National Response Center (NRC). The NRC, located at U.S. Coast Guard (USCG) Headquarters, is the national communications center continuously manned for handling activities related to response actions. The NRC acts as a single point of contact for all pollution incident reporting and as the National Response Team communications center. The center is available 24 hours a day, 365 days a year at (800) 424-8802. For more information on the federal regulations that apply to hazardous waste management, please visit (http://www.epa.gov/osw).

Household items that display one or more of the following characteristics - ignitability, corrosivity, reactivity, or toxicity - are known as **household hazardous wastes (HHW)**. Examples include motor oil, automobile batteries, paints and solvents, household cleaners and drain openers, swimming pool chemicals, pesticides, and compressed gas tanks (such as propane and oxygen). EPA advises that these types of debris be segregated for special handling. For example, residents could be directed to bring HHW to a specified location or collection event. Additionally, residents could be informed to set HHW at the curb for special collections of these materials. Residents should be advised not to commingle HHW with other debris or dispose of these substances with their normal MSW collection. A sample flyer that was used to inform the public of HHW handling after Hurricane Katrina in Louisiana is included in Appendix B.

Asbestos-containing material (ACM), such as asbestos pipe wrap, siding, ceiling tiles, and other building materials, may be found in structures. Planners should be aware that there are regulations that govern the removal (where necessary) and management of ACM from structures affected by a natural disaster. These regulations may affect the demolition/deconstruction of buildings and subsequent debris removal. Planners should consider, as part of their planning activities, how to handle such situations and how to best advise the public. To the extent that demolition or renovation activities are necessary in connection with any such facility, the requirements of the asbestos regulations under the National Emissions Standards for Hazardous Air Pollutants (NESHAP) may be applicable (40 Code of Federal Regulations (CFR) part 61, Subpart M). This document does not address in detail the asbestos NESHAP requirements that apply to buildings/residences that remain standing or are partially standing and require further demolition. It also does not address debris management from renovations of buildings/residences. Regulated asbestos containing material must be removed prior to demolition under the supervision of a person trained in accordance with the regulations. The material must be adequately wetted throughout the

process and disposed of properly, which includes labeling, transportation requirements, tracking the waste, recordkeeping, and disposal in a landfill that meets specific NESHAP requirements for disposal. In some instances, individual states have promulgated their own asbestos regulations and are authorized to take the lead in implementing and enforcing them. To the extent that an entity is dealing with debris from structures already demolished by a natural disaster (as opposed to human demolition), the requirements of the asbestos NESHAP (or the state equivalent) may not be applicable. If there is any question as to the applicability of the asbestos regulations, contact and coordinate with the appropriate local, state, and federal authorities. No materials suspected to contain asbestos should be ground or incinerated at debris management sites (40 CFR 61.145(c)(10)). The material can be disposed and many MSW and C&D landfills have handling procedures for these materials. Contact the state or landfill for guidance. Additional information, including EPA and state contacts, can be found at: (http://www.epa.gov/asbestos/ and http://www.epa.gov/asbestos/pubs/regioncontact.html). Planners should also be aware that in past disaster recovery efforts, communities were able to secure "No Action Assurance (NAA)" letters from the EPA to allow for more regulatory flexibility in removing damaged structures that may contain asbestos in times of extreme hardship. These NAA letters allow the demolition of entire structures without first removing ACM, but the entire structure must then be managed as ACM. Planners should assess the possibility of hardship due to the amount of ACM that could be produced from a natural disaster in their area and determine the steps that would be needed to secure an NAA letter quickly. Examples of NAA letters issued during the Hurricane Katrina recovery can be found at (http://cfpub.epa.gov/compliance/resources/policies/civil/caa/katrina/#944). Guidance given by the EPA regarding asbestos management during that recovery effort can be found at: (http://www.epa.gov/katrina).

PCBs may be located in transformers attached to downed utility poles. Debris management personnel should notify the local electric utility if a downed pole is encountered. If a transformer appears to be leaking and does not have a sticker declaring that it is PCB-free, personnel should immediately notify the regional EPA office and the electric utility, as well as, restrict public access to the area using temporary fencing or barrier tape. In the absence of identifying information, it is best to assume a transformer contains PCBs. PCB clean-up is subject to the Toxic Substances Control Act (TSCA) regulations (40 CFR 700-789). Information about the management of PCB wastes can be found on EPA's website (http://www.epa.gov/pcb). This website features lists of facilities that can both store and dispose PCB wastes.

Storage tanks, both those above ground and underground, potentially could release petroleum or hazardous substances and pose significant risk to health, safety, and the environment. Storage tanks always should be addressed with care. If, for example, gasoline pumps or vent pipes are present near a damaged building, or if an unknown tank or cylinder is discovered, debris collection activities should be stopped, the area sealed off, and the state environmental agency should be contacted for assistance. Additional information can be found from the EPA's Office of Underground Storage Tanks website (http://www.epa.gov/oust).

Firearms and ammunition kept in the home can be part of the disaster debris stream if homes are affected. Prompt collection of these items is important to ensure the safety of the

public. Coordination with local and state law enforcement is important to determine what entity will collect this debris, how it will be collected, and how it will be managed.

2.5 RECYCLING OPTIONS

EPA recommends that any disaster debris management plan include a strategy for reuse, recycling, and mulching/composting. Due to the potentially large volumes of material produced in a natural disaster, recycling and reuse will lessen the burden on disposal facilities, cut costs, and provide a valuable material resource. Recycling conserves natural resources by replacing them with recovered products that perform the same function. Reuse and recycling (including mulching/composting), coupled with efficient processing and transportation, not only conserves natural resources but also helps reduce the amount of greenhouse gas emissions and saves landfill space.

EPA also recommends that disaster debris management plans set priorities for reusing and recycling disaster debris materials. Innovative reuse options can be identified in advance rather than trying to find appropriate options after the disaster occurs. These priorities and options should be detailed in a community's disaster debris management plan and pre-negotiated contracts. It is advisable to coordinate with FEMA on these priorities during the planning stage before a disaster to help ensure reimbursement.

Implementing a plan for reuse and recycling disaster debris is much easier if a community already has a reuse and recycling program in place. Many of the permitting, compliance, collection, processing, and marketing issues will have been largely resolved before the disaster strikes. With a recycling program in place, the community will need only to expand current recycling practices after the disaster, rather than design and implement new practices. This is not to suggest that recycling opportunities cannot be created. For example, San Diego County, California created several recycling operations after the 2003 wildfires (see Appendix A). Processing may be necessary to turn the material into a usable product. Processing can occur at a recycling facility or a debris management site. Certain materials should not be ground or burned, however, and should be removed from the waste stream before doing so.

Many of the materials generated by natural disasters are recyclable and can be utilized. Local governments should identify available recycling markets for debris materials. Inventories of existing local recyclers of scrap metal, white goods, mixed C&D materials, land clearing debris, concrete, asphalt pavement, hazardous waste, HHW, and electronics could be made. Arrangements to use their services should be in place in the event of a disaster and be described in the disaster debris management plan. EPA also recommends that planners identify the sites where recycling will occur, any equipment needed, how to process the material according to market specifications, as well as consider transportation distances. Transporting some materials long distances may make recycling too costly, both economically and environmentally. The further a material must be moved, the more it will cost and the more fuel will be burned to move it there. Due to the large amounts of debris produced after major natural disasters, provisions may be needed for storing the material for an extended time before transport and recycling can occur. For some debris materials (e.g. HHW), however, regulations may restrict how long such materials can be stored. Check with state environmental representatives for such restrictions. Planners should also check with state

representatives to understand if there are any additional requirements pertaining to the reuse of building materials.

Building materials, normally part of the C&D materials stream, are generated by the total or partial destruction of structures during disasters and can represent a large portion of disaster debris. Re-building following a natural disaster also can lead to a surge in generation of discarded building materials. These materials often include bulky, heavy materials that include masonry materials, such as bricks and blocks, and concrete which can be crushed into aggregate and reused in road reconstruction or as fill. Additional information about recycling concrete can be found at http://www.concreterecycling.org. Lumber and other wood products can be directly reused or ground and used for boiler fuel, mulch, and engineered lumber. Care should be taken to separate lead-based paint coated wood and chemically-treated lumber from other "clean" wood for recycling markets, to the extent possible. Pests, such as Formosan termites, Asian Borers, or Ash Borers, may restrict the shipment of wood materials to other geographical areas. Consult with the state agricultural department for guidance on pests of concern in a specific geographical area. **Lead-based paint (LBP)** should be removed from wood meant to be recycled as mulch or composted. Lead-based paint was banned from housing in 1978, but may continue to exist in older housing. Asphalt shingles can be recycled into new asphalt pavement mixes. They also can serve two purposes at a cement kiln: combustion of the shingles provides energy in the kiln and the remaining mineral components, containing the limestone granules, serve as a raw material for cement. Information about recycling asphalt shingles can be found at http://www.shinglerecycling.org. Gypsum drywall can be recycled into new drywall, cement, and agricultural uses. More information about recycling drywall can be found at http://www.drywallrecycling.org. Metal is almost always recycled back into other metal products and recycling opportunities are available in virtually every area around the country. More information can be found at the Institute of Scrap Recycling Industries' website (http://www.isri.org) or the Steel Recycling Institute's website (http://www.recycle-steel.org). Lists of C&D materials recyclers and reuse stores can be found at the Construction Materials Recycling Association's website (http://www.cdrecycling.org/), the Building Materials Reuse Association's (BMRA) website (http://buildingreuse.org), and the Whole Building Design Guide website (http://www.wbdg.org/tools/cwm.php). Many state and community environmental protection agencies also keep lists of C&D materials recyclers. The Association of State and Territorial Solid Waste Management Officials (ASTSWMO) keeps a webpage that links to the state solid waste websites (http://www.astswmo.org/resources_stateagencylinks.htm). The Construction Industry Compliance Assistance Center also provides information on C&D materials recycling in various states (http://www.cicacenter.org). Deconstruction techniques can be considered for standing buildings to help ensure that the materials will be segregated and in proper condition for reuse or recycling. More information about deconstruction can be found at the BMRA website and the National Demolition Association's website (http://www.demolitionassociation.com). The C&D materials recycling field has witnessed several recent technological advances that make debris sorting and recycling more feasible. For example, portable hydraulic grinders are now available that can handle wooden framing material, gypsum drywall, block, and brick at the job site. New screening systems also have been developed to facilitate and expedite sorting. Slow-speed, high-torque shredders that reduce noise, dust, and vibration are being utilized to shred

mixed bulky materials. More information about C&D materials recycling can be found at the EPA's C&D materials website (http://www.epa.gov/cdmaterials).

Road and bridge materials, also normally part of the C&D materials stream, can be generated when roads and bridges are washed out or collapsed during disasters. Road and bridge materials typically consist of large amounts of asphalt pavement, concrete, and steel. All of these materials are frequently recycled in normal settings and recycling opportunities can usually be readily found. As discussed in the building materials section, lists of C&D materials recyclers can be found on many websites. The Asphalt Recycling and Reclaiming Association can also provide information (http://www.arra.org). More information about C&D materials recycling can be found at the EPA's C&D materials website. The U.S. Department of Transportation's (DOT) Federal Highway Adminstration (FHWA) can also provide assistance (http://www.fhwa.dot.gov/pavement/recycling).

Vegetative debris (or green waste) consists of uprooted trees, broken tree limbs, stumps, brush, and leaves. This debris can be ground and used as mulch for residential, commercial, or agricultural areas, for producing compost, as landfill cover, and for boiler fuel. Whole trees, from both rural and urban areas, could also be used as a timber resource. Trees could be de-limbed at storage sites prior to transporting them to end-users, such as sawmills, veneer or panel makers, pulp and paper mills, wood pellet mills, furniture makers, specialty wood companies, and engineered wood companies. Pre-negotiated contracts may provide some revenue or cost-free labor for the community where wood companies are able to recover large amounts of undamaged logs or specialty companies are capable of recovering large diameter or high value logs. Vegetative debris typically can be ground into mulch and reused. If the quantity of mulch exceeds typical usage, local planners may be able to identify large-scale landscaping opportunities that may be able to use the material, such as landscaping in parks and recreation areas, along roadsides or railways, amusement parks, military installations, in efforts to reclaim brownfields, or at temporary debris storage sites. Visit EPA's GreenScapes website for information on large-scale landscaping opportunities (http://www.epa.gov/greenscapes). Additional information on the management of and the potential end uses of vegetative debris are available from the US Composting Council (http://www.compostingcouncil.org). It is important to keep vegetative debris segregated from other debris because contamination with other materials limits the ways in which this debris can be managed. Contamination can be limited by using proper handling techniques. Pests, such as Formosan termites or citrus canker, may restrict the shipment of these materials to other geographical areas. Consult with the state agricultural department for guidance on pests of concern in a specific geographical area.

Treated wood should be handled separately from vegetative debris being recycled. Besides wooden utility poles, other lumber that may be chemically-treated includes decks, fences, landscaping materials, wood bridges, and railroad ties. Treated wood contains chemical preservatives that can contaminate recycled wood products. These woods can be combusted in waste-to-energy facilities, provided the facilities comply with existing federal, state and local requirements, but they should not be "open burned" in piles, in order to prevent adverse impacts to human health from inhalation and to the environment. More information about treated wood can be found at: http://www.ccaresearch.org.

Automobiles and Boats may be ruined by many types of disasters. They are typically recycled under normal circumstances, so recycling opportunities are likely to exist. Vehicles may have title and ownership issues before they can be scrapped. All fluids should be drained and managed appropriately. Batteries, tires, gas tanks, airbags, and mercury switches should be removed and managed appropriately. More information can be found from the Automotive Recyclers Association (http://www.a-r-a.org).

White goods are household appliances such as stoves, refrigerators, washers and dryers, and hot water heaters. These items can be segregated for recycling. Refrigerators and freezers require special attention because they may contain putrescible wastes, refrigerants, and capacitors containing PCBs. Refrigerant-containing appliances (RCAs), including refrigerators, freezers, and window air conditioner units, should be handled by EPA-certified refrigeration technicians or recycling centers to prevent releases. The recycler must certify to EPA that certain standards are being met. Verify that the recyclers are meeting these requirements by asking them to provide a copy of the certification they have sent to EPA. EPA maintains a current list of approved refrigerant recyclers. Confirm the approval status of an RCA recycler by contacting EPA's Ozone Protection Hotline (800-296-1996) or by accessing EPA's Office of Air and Radiation Stratospheric Protection Division web page (http://www.epa.gov/ozone/title6/608/reclamation/reclist.html). More information about safe federal disposal procedures for household appliances that use refrigerants can be found at: (http://www.epa.gov/ozone/snap/emissions/downloads/SafeDisposalBrochure.pdf).

Putrescible wastes (including animal carcasses) rot or decay quickly and should be segregated accordingly and quickly managed. This debris category includes fruits, vegetables, meats, dairy products and other produce from grocery stores, restaurants, schools, hospitals, and residences. It can also include animal carcasses. Some putrescible wastes can be composted or rendered. More information about composting food and other putrescible wastes can be found at the EPA's Food Waste Recovery Hierarchy website (http://www.epa.gov/epaoswer/non-hw/organics/fd-hier.htm). Information on rendering can be found on the National Renderers Association website (http://www.renderers.org). For additional help on proper management of animal carcasses after a disaster, consult the state's department of agriculture or the U.S. Department of Agriculture (USDA). The USDA provides leadership, technical expertise, and assistance for the management of animal carcasses. The USDA has produced "Disaster Planning," technical assistance on how to prepare for a disaster (http://www.nal.usda.gov/awic/pubs/IACUC/dis.htm). Kansas State University, Purdue University, and Texas A&M University produced "Carcass Disposal: A Comprehensive Review" for USDA's Animal and Plant Health Inspection Service (APHIS) (http://fss.k-state.edu/index.php?option=com_content&task=view&id=17&Itemid=37). APHIS also maintains the National Animal Health Emergency Management System Guidelines, which provide information that may be integrated into the preparedness plans of other Federal, State and local agencies, Tribes, and additional groups involved in animal health emergency management activities (http://emrs.aphis.usda.gov/nahems.html). More information about USDA's assistance programs can be found in Chapter 4. The National Association of State Departments of Agriculture can provide contacts and links to state agriculture departments (http://www.nasda.org/).

Sediment accumulations occur when wind or water displaces sand, silt, or soils that could be removed as part of the cleanup. Sediments suspected to be contaminated should be tested for contaminants and screened to remove other debris. If not contaminated, they can be returned to their original location, used as fill in reconstruction projects, or used as cover material in landfills.

Electronics waste can be generated by any type of natural disaster and include televisions, desktop and laptop computers, computer attachments, stereo equipment, and cell phones. Computer monitors and older TV picture tubes contain an average of four pounds of lead and may require special handling. Some states have specific regulations for handling TVs and monitors. In addition to lead, electronics can contain chromium, cadmium, mercury, beryllium, nickel, zinc, and brominated flame retardants. Many organizations accept electronics for reuse. Electronics that are too damaged to be repaired and reused should be recycled. The Electronic Industries Alliance has a database of electronics recyclers on its website (http://www.eiae.org).

Disaster Debris Recycling In Action

EARTHQUAKE Spurred by the Northridge earthquake in 1994, Los Angeles officials declared recycling as a priority and expanded the City's recycling capability with the support of FEMA and local businesses. C&D materials made up a large fraction of the debris. The City developed contracts with existing businesses, provided them with source-separated materials, and piloted a project to recycle mixed debris. After only one year, Los Angeles created more than 10,000 tons per day of privately operated processing capacity for C&D materials. By the end of the cleanup, the City recycled 56% of all of the materials collected since the earthquake for less than the cost of disposal in landfills.

FLOOD In October 2005, the western part of the State of New Hampshire was subjected to intense flooding and damage. The Town of Alstead received approximately 12 inches of rainfall in a 30-hour period. After the flooding, materials were sorted into separate piles of tires, wood, cars, metal, and trees. Trees were shredded into wood chips and topsoil was recovered by screening some of the woody debris.

HURRICANE In the aftermath of the 2004 hurricane season, Seminole County, Florida, processed more vegetative debris than the total amount processed over the entire previous decade. Most of the vegetative debris was wood waste, which the County ground into mulch. The County used 360 tons of the ground mulch to establish temporary debris storage and processing site. The mulch was used as a good road base for heavy machinery and vehicles because the ground was saturated.

TORNADO On May 3, 1999, 51 tornadoes struck 18 Oklahoma counties generating an estimated 1.6 million cubic yards of debris, or enough to fill a football field five stories high. USACE and Oklahoma state officials estimated that every one million cubic yards of debris would reduce a landfill's life by five years. In response, Oklahoma designated recycling as a priority in the management of the debris and sorted it into recyclables, mixed debris, vegetative debris, and HHW. Only the mixed debris and HHW were disposed. EPA assisted in managing HHW and selecting the appropriate landfills for its disposal.

WILDFIRE Los Alamos County, New Mexico, endured the Cerro Grande wildfire in May 2000. The fire consumed more than 47,000 acres and destroyed more than 400 residential and commercial structures. Of the 162,000 cubic yards of debris generated, approximately 95% of it was reused or recycled. Solid waste officials excavated and crushed building foundations and retaining walls into a reusable aggregate and stockpiled it for use on future road construction projects. They also chipped burned trees and other vegetative waste for use as mulch at a local golf course that was under construction. The County also segregated all metal and delivered it to local scrap yards.

WINTER STORM In October 1997, the City of Lincoln, Nebraska processed more than 350,000 cubic yards of debris generated from a severe snow and ice storm—seven times the average annual volume of vegetative debris typically managed by the City. This debris was chipped into mulch and stockpiled for future use in City landscaping operations. City officials also contacted a number of nurseries, landscapers, and cattle operations, which used some of the material for mulch or animal bedding.

2.6 WASTE-TO-ENERGY OPTIONS

Natural disaster debris may be sent to a waste-to-energy facility, depending on the types and amounts of debris present. Typical non-hazardous waste-to-energy facilities can handle many types of debris, including vegetative debris, C&D materials, furniture and other home contents, and putrescible wastes. Additional storage capacity may be necessary for this material as natural disasters often produce more material than a typical combustor can handle. Since these facilities often are equipped with air pollution controls, contamination that can pose a problem to recycling and composting operations (such as treated wood) may not be a problem here. Some waste-to-energy facilities require that the debris be ground prior to receiving it and this could be addressed in any pre-negotiated contracts. The Integrated Waste Services Association can provide additional information and assistance locating a waste-to-energy facility (http://www.wte.org).

Natural disasters can create large amounts of vegetative debris (the primary biomass produced from many natural disasters) that could be used as a fuel or energy source. Using biomass to create energy instead of disposing it via open burning or in landfills has both environmental and economic benefits. Environmental benefits include saving landfill capacity and reducing air emissions (Western Governors' Association 2006; Jambeck et al. 2007). The Council of Industrial Boilers can provide additional information and assist in locating an industrial boiler that can take biomass generated from a disaster (http://www.cibo.org).

Woody biomass is a product of natural disasters, such as hurricanes and tornadoes. Most of this material is left to decay, burned in place or hauled to landfills. This woody biomass represents a potential source of raw material to produce small wood products, energy in the forms of heat, fuel or electricity and other useful products such as mulch or erosion control products. Using woody biomass, instead of wasting or burning it, has numerous economic and environmental benefits. A Federal interagency woody biomass utilization group (WBUG), composed of technical specialists, has a mission of encouraging the use of woody biomass. Their website (http://www.forestsandrangelands.gov/Woody_Biomass/wbug.shtml) provides tools and resources that communities may use to help address biomass utilization.

Power plants that accept biomass may exist near communities affected by disasters, so delivering the materials to power generators instead of landfills may require little extra effort or cost. Identifying facilities that can accept vegetative debris can be mutually beneficial to all parties involved. One obstacle that may exist is that the volume of debris may be much more than the facility can handle. Several different methods of materials management might be needed to effectively deal with very large quantities of material in a timely manner.

One way to evaluate potential biomass markets is to involve the state forestry or natural resources agency. Some states plan to actively inventory available biomass in forest areas and strategically manage standing timber to limit vegetative debris in the event of a natural disaster. These actions can be performed via GIS systems, satellite imagery, and aerial photography. Using such techniques can allow planners to develop risk maps and scenarios for natural disaster response. For more information on how biomass can be used to produce energy, visit http://www1.eere.energy.gov/biomass.

Recent Biomass Successes

Florida – Nearly half of the vegetative debris generated by Hurricanes Charley, Frances, and Jeanne in Polk County was used to generate electricity by Progress Energy. The company's Ridge Generating Station received about 800,000 cubic yards of debris. County officials stated that this was not only the most environmentally preferable option, but also the most cost effective.

Louisiana and Mississippi – Green Energy Resources, a company that provides renewable energy, purchased one million tons of vegetative debris from Louisiana and Mississippi in September 2005, after Hurricane Katrina. The debris was sent to the United Kingdom to fulfill an annual contract for more than five million tons of wood chips. The company later purchased another one million tons for use in power plants in the northeastern United States.

Texas – American Biorefining, an alternative power company in Nacogdoches salvaged millions of tons of shattered trees, branches, and other forest debris left behind by Hurricane Rita in 2005. The vegetative debris was shredded into biomass fuel and shipped to various European countries to be used for power generation.

2.7 Disposal Options

Once reuse, recycling, and waste-to-energy opportunities are exhausted for debris generated by natural disasters, either due to economics or otherwise not practicable, the remaining debris should be disposed properly and safely. Most of the debris generated from natural disasters is not hazardous and can be disposed, as appropriate, in a C&D landfill, MSW landfill, or non-hazardous solid waste combustor regulated by a state agency. States are the lead for implementing and permitting non-hazardous waste disposal options. MSW landfills have waste acceptance criteria, siting criteria, operational requirements, design standards, groundwater monitoring/clean air regulations, and closure/post-closure standards which ensure protection of

human health and the environment. C&D landfills also have waste acceptance criteria, siting criteria, operational requirements, and design standards. C&D landfill requirements tend to be less stringent than MSW landfill standards given that the type of debris received by C&D landfills generally is considered more inert. It is important to check with state/local environmental agencies to determine appropriate C&D landfill requirements and to ensure/prepare for compliance of those requirements when landfill capacity is needed expeditiously after a disaster.

Monitoring incoming disaster debris is important at disposal facilities due to the large volumes of debris and the potential for contamination from hazardous wastes and other debris of concern. Thus, it is recommended that when a truck enters the staging or disposal areas, spotters check the load for volume and contaminants not allowed at that site. Spotters also are appropriate where the truck tips its load at the disposal site and in the field where debris is being collected and sorted. Once any contaminants are removed, some of the non-hazardous debris can be ground to reduce its volume and thereby preserve landfill capacity.

Processing may be necessary to reduce the volume prior to disposal. This can be done at the landfill or at a temporary debris management site. Volume reduction can be performed by grinding the material or burning it. Volume reduction not only lessens the burden on landfill capacity, but also means that fewer trucks will be needed to move the material if the material is taken to a temporary debris management site or transfer station. Certain materials should not be ground or burned, however, and should be removed from the waste stream before doing so. These materials are discussed in detail in the previous and following sections.

Mixed debris typically includes a mixture of all types of debris. Due to its diversity, this debris stream is sometimes too mixed for cost-effective segregation. Hazardous wastes should be removed prior to disposal so that all the waste need not be managed as hazardous. Putrescible wastes should be segregated accordingly and disposed in a MSW landfill. Major components of mixed debris are usually building materials, vegetative debris, HHW, and home contents, such as furniture and personal property. Building materials, normally considered part of the C&D materials stream, can be disposed in a C&D landfill. In many states, vegetative debris and home furnishings are also allowed to be disposed in a C&D landfill. These materials generally are not considered hazardous wastes under federal law and, therefore, are not required to be disposed as such. Similarly, C&D wastes are not considered MSW. C&D landfills are subject to federal criteria under 40 CFR 257, but many states have additional requirements. One main component of C&D materials is drywall (also known as sheetrock or wallboard). Drywall consists of a gypsum core sandwiched between two sheets of paper. Placing drywall in a landfill may lead to potential **hydrogen sulfide** (H_2S) generation-related concerns. Under anaerobic conditions that exist in landfills and in contact with moisture, drywall decomposition has been shown to result in H_2S generation. Hydrogen sulfide may pose an odor problem and, in very large concentrations, may pose a health risk to landfill workers and nearby residents. A memo that discusses best management practices at a C&D landfill that generated H_2S can be found at (http://www.epa.state.oh.us/dsiwm/document/newsPDFs/cdd_h2s_bmps.pdf). Drywall can be recycled and such opportunities should be investigated pre-disaster. Where drywall cannot be recycled, odor mitigation at landfills can be performed by using various cover materials, such as sand, crushed concrete fines, lime, or mulch.

2.8 OPEN BURNING

Open burning includes both burning debris in an open pit and burning debris in an air curtain incinerator (ACI). The air curtain burning method incorporates a pit constructed by digging below grade or building above grade (if there is a shallow groundwater table) and a blower. The blower and pit make up an engineered system which must be precisely configured to properly function. The blower must have adequate air velocity to provide a "curtain effect" to hold smoke in and to feed air to the fire below. The pit configuration must have a precise width, depth and length to compliment the blower. Some incinerators are portable and utilize a pre-manufactured pit in lieu of an onsite constructed earth/limestone pit. Portable ACIs are the most efficient burning systems available. This is due to the pre-manufactured pit which is engineered to precise dimensions to complement the blower system. The pre-manufactured pit requires little or no maintenance as compared to earth or stone constructed pits which are susceptible to erosion and sluffing. Portable ACI units are more suitable for areas with shallow groundwater tables, sandy soils, and where opacity (smoke) must be kept to a minimum.

Open burning often is subject to significant public concern, but state/local officials may allow it when needed if storage is lacking and debris amounts are large. All open burning should be conducted in accordance with state regulations. Open burning shall not violate applicable requirements developed under a State Implementation Plan (SIP) approved or promulgated by the Administrator pursuant to Section 110 under the Clean Air Act (CAA). Best practices should be used in opening burning to protect human health and the environment. Typically, only vegetative debris is burned in an open pit, while both vegetative debris and segregated clean building material may be burned in an ACI. Treated wood and wood coated with lead-based paint should be removed from the waste stream before open pit burning or ACI. No materials suspected to contain asbestos should be burned at debris management sites (40 CFR 61.145(c)(10)). Communities can contact and coordinate with the appropriate local, state, and federal authorities if there is any question as to the applicability of the asbestos NESHAP (or the state equivalent) if ACM is suspected to be present.

2.9 SUMMARY OF APPROPRIATE ENVIRONMENTAL PRACTICES CONCERNING DISPOSAL ISSUES

In responding to any natural disaster, being prepared to manage disaster debris is very important. Planning ahead of time should help a community achieve its goal of utilizing environmentally acceptable practices. Being prepared will help local officials ensure that: 1) hazardous wastes are being properly managed, 2) storage or staging locations have been sited in acceptable locations, 3) available landfill capacity is used appropriately and that new debris management units or closed units that are reopened have appropriate siting restrictions and controls in place, and 4) reuse and recycling opportunities are used to the fullest extent possible.

The first line of defense for disposal problems is to segregate debris materials and manage them appropriately. While recycling and reuse is preferred for most debris types, disposal is often a consideration. Segregating debris is best performed at the original deposited point, such as through curbside or field separation. Thus, residents and businesses should be educated and

instructed to segregate the debris into appropriate piles where feasible. Also, debris haulers should consider collecting the different types of debris separately. Debris can also be sorted at the temporary storage site or disposal site. Making sure that the appropriate debris is managed at the correct type of facility through separation and spotting can help achieve beneficial recovery as well as protection of human health and the environment.

Once debris is segregated and recycling occurs, management of the remaining debris needs to take place. Communities will, in some cases, be able to use existing capacity at debris management facilities. The use of an existing debris management facility should always be considered appropriate because existing facilities have been designed with adequate controls as previously determined by the state agencies. State solid waste management agencies typically have requirements for debris management facilities to consider minimization of odors and disease vectors, to have run-on and run-off controls, to provide daily cover, to limit access to the public, to have design standards, to provide for monitoring and to provide for adequate setbacks. Setbacks are typically considered for property boundaries, drinking water wells, surface water bodies, groundwater recharge areas, and public water supplies. In addition to adequate setbacks, certain locations, such as floodplains, wetlands, and close proximity to drinking water supplies are typically required to be avoided.

Local officials may want to consider their existing capacity and the potential need to open new debris management facilities or open previously closed debris management facilities. If a community is faced with limited debris management space, one option is to re-open a closed debris management facility. This can be preferable to siting a new debris management facility if the closed debris management facility was originally engineered to protect the environment and is located in an area with favorable hydrogeologic conditions. Environmental assessment and monitoring may be necessary before, during, and after the debris has been placed in the re-opened debris management facility, as determined by the state/local environmental agency. The environmental assessment and monitoring are the responsibility of the local government or other facility owner/operator, working with and obtaining approval from the state/local environmental agency. Attempting to conduct an assessment after a disaster occurs can delay debris management, increase citizen anxiety, and limit the extent of the assessment.

A new debris management facility may be necessary if sufficient capacity does not exist and closed debris management facilities are not an option due to distance or lack of environmental protection. New debris management facilities should be sited in areas with favorable hydrogeologic conditions. Environmental assessment and monitoring may be necessary before, during, and after the debris is placed in the new facility, as determined by the state/local environmental agency. Any new facility sited under emergency circumstances should comply with applicable state operational requirements. Focused pre-incident planning and preparation in regard to potential disaster debris land disposal capacity needs will alleviate much of the chaos, confusion and stress of all involved with this issue after a disaster has occurred.

Finally, it is recognized that while recycling and reuse of materials are preferred, it is not always possible to accomplish this while keeping protection of human health and the environment as a priority. Protection of human health and the environment should always take precedence.

3 State, Local, and Private Resources Available To Help

State and local governments are typically the first source of assistance to a community in the wake of a natural disaster. Many states and communities have prepared or are also preparing for disasters and are generally willing to share information and resources. Such assistance typically is available to communities impacted by natural disasters, regardless of whether they receive a federal disaster declaration.

3.1 State Governments

State emergency management agencies and the solid waste management programs of state environmental agencies have specific roles to play in managing disaster debris. The state emergency management agency serves as the local government's liaison to FEMA during the disaster and cleanup. The state environmental agency also can make special accommodations for the extraordinary debris management needs resulting from a natural disaster. State emergency management and environmental agencies can issue emergency management orders to help local governments better manage debris in order to protect human health and the environment. The National Emergency Management Association can provide state emergency management agency contacts (http://www.nemaweb.org). ASTSWMO has compiled a List of State Disaster Response Information that can be found at (http://www.astswmo.org/publications_solidwaste.htm). ASTSWMO represents state solid waste regulators and can provide appropriate contacts and information.

3.2 Mutual Aid Agreements and Other Local Resources

State and local governments can enter into mutual aid agreements with neighboring state and local governments prior to any natural disaster. Such an agreement could provide for either binding commitments or nonbinding intentions of support to assist one another in the event of a natural disaster. Through these agreements, communities can loan equipment and personnel with specific expertise or experience.

The Emergency Management Assistance Compact (EMAC) is an example of a mutual aid agreement between states. Established in 1996, EMAC is a congressionally ratified organization that provides form and structure to interstate mutual aid. Through EMAC, a disaster-impacted state can request and receive assistance from other member states quickly and efficiently, resolving two key issues upfront: liability and reimbursement. After a state's governor declares a state of emergency, an authorized state official from the affected state contacts EMAC and requests assistance. EMAC deploys a team to determine needs, costs, and availability of resources. EMAC then assists the state in negotiating costs, and the responding states send the requested resources. After the cleanup is underway, and the affected state returns to normal operations, the responding state requests reimbursement of costs. More information on EMAC can be found at (http://www.emacweb.org).

Local Emergency Planning Committees (LEPCs) were established by the Emergency Planning and Community Right-to-Know Act (EPCRA), which includes emergency planning and community right-to-know requirements. Many communities have a LEPC. The purposes of the

LEPC are: development, training, and testing of the hazardous substances emergency response plan for the community; development of procedures for regulated facilities to provide information and emergency notification to the LEPC; development of procedures for receiving and processing requests from the public under EPCRA; provision of public notification of LEPC activities. A major role for LEPCs is to work with industry and the interested public to encourage continuous attention to chemical safety, risk reduction, and accident prevention by each local stakeholder. To be prepared for a hazardous material incident in a community, the LEPC coordinates with community officials, first responders and industrial representatives, for the purpose of developing a detailed emergency plan designed to ensure public safety.

3.3 INFORMATION SHARING

One of the best ways to prepare for disasters is to learn what other communities have experienced. Appendix A contains some cases studies about lessons learned, but there are many others that are not captured here. Consider partnering with a similar community that has prepared or is currently preparing for natural disasters, whether in the same state or elsewhere. Develop an information sharing mechanism with that community that may include meetings and site visits. In addition, local planners may check with other communities that have experienced a disaster to learn about any environmental/legal issues may have been experienced and resulted in a slower response to the management of their disaster debris. If nearby, consider having an agreement with this community to share staffing resources in the event of a disaster. Having additional experienced personnel that already understand the disaster debris management plan can greatly aid in post-disaster clean-up.

3.4 PRIVATE SECTOR RESOURCES

In substantial natural disasters, community resources typically are overwhelmed. Communities likely will need to hire private disaster debris management contractors in these special circumstances. Often, such contractors are experienced in dealing with disaster recovery work, such as establishing staging areas, hauling and segregating debris, and coordinating FEMA reimbursement processes. It would be beneficial for municipal officials to identify what disaster debris management contractors are in their area. Planners could establish relationships with such contractors while drafting their community's disaster debris management plan.

Other private companies and local businesses may be able to offer assistance as well. Check with local companies to see if they could offer specific assistance such as allowing large parking lots to be converted into debris staging areas or community drop-off locations. Construction companies might make earth-moving equipment, water pumps, and other

Working with Private Companies

Dell Computer and Best Buy partnered with EPA, the states, and local governments to increase collection and safe recycling of computers and related electronic equipment, including monitors, printers, scanners, keyboards, mice, laptops, TVs, VCRs, DVD players, radios, and disks destroyed by the effects of Hurricane Katrina. This effort resulted in recycling of more than 220,000 pounds of electronics debris.

necessary equipment available for immediate use in the event of a disaster. Trucking companies might be able to lend trailers, dump trucks, or roll-off dumpsters. These opportunities are just examples of how a community can work with the private sector in the event of a disaster.

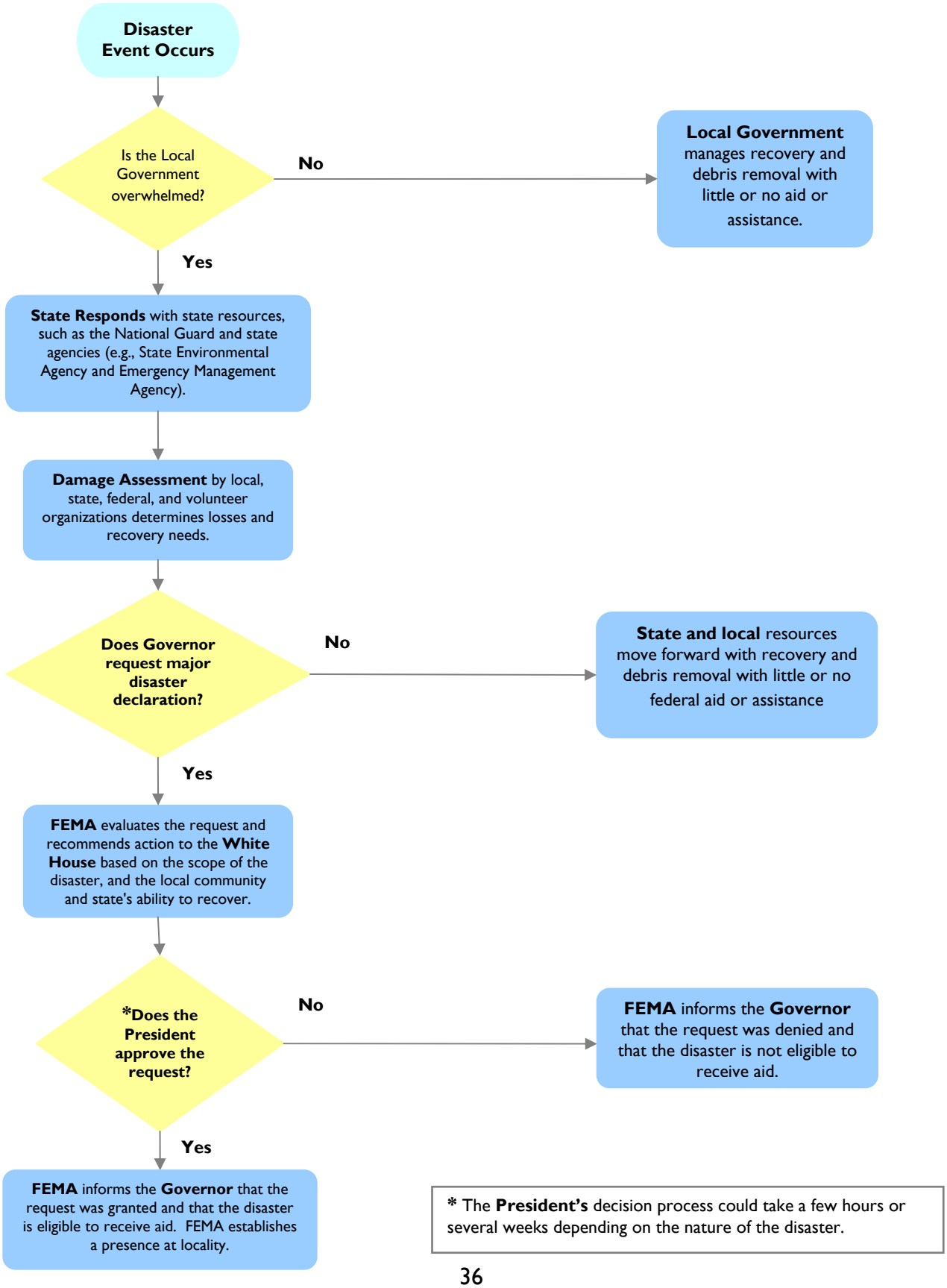
4 Federal Resources Available To Help

The legal authority for federal assistance in natural disasters comes from the Robert T. Stafford Disaster Relief and Emergency Assistance Act (hereafter referred to as the "Stafford Act"), which sets forth federal disaster relief responsibilities, procedures, and conditions for federal assistance. Among many other activities, the Stafford Act authorizes debris removal in "the public interest…from publicly and privately owned lands and water." The President makes the final decision to declare an area a major disaster and therefore eligible for federal assistance. The process for declaring a disaster is presented in Figure 3. Most disasters, however, do not qualify for federal assistance.

The National Incident Management System (NIMS) was created by the U.S. Department of Homeland Security (DHS) under Homeland Security Presidential Directive #5 (HSPD-5). The NIMS describes command and control response efforts at all levels of government. A copy of the NIMS report can be found on FEMA's website (http://www.fema.gov/emergency/nims/index.shtm). The NIMS provides a consistent nationwide template to enable federal, state, local and tribal governments to work together effectively and efficiently to prepare for, prevent, respond to, and recover from domestic incidents, regardless of cause, size, or complexity, including acts of catastrophic terrorism. HSPD-5 requires all federal departments and agencies to adopt the NIMS and use it in their individual domestic incident management and emergency prevention, preparedness, response, recovery, and mitigation programs and activities, as well as in support of all actions taken to assist state, local, or tribal entities.

NIMS describes the Incident Command System (ICS), a management system designed to enable effective and efficient domestic incident management by integrating a combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure. It is normally structured to facilitate activities in five major functional areas: command, operations, planning, logistics, and finance and administration. ICS is used by all levels of government—federal, state, local, and tribal—as well as by many private-sector and nongovernmental organizations. It is used to organize both near-term and long-term field-level operations for a broad spectrum of emergencies, from small to complex incidents, both natural and manmade. State and local government officials and other key personnel that will be involved with developing plans for, preparing for, and potentially responding to disaster debris could be familiar with and educated on the ICS. FEMA provides free, on-line training on ICS basics (ICS 100 and ICS 200), introduction to the NIMS (ICS 700), and introduction to the NRF (ICS 800; http://training.fema.gov/NIMS).

Figure 3. Typical Process for a Major Disaster Declaration



* The **President's** decision process could take a few hours or several weeks depending on the nature of the disaster.

4.1 NATIONAL RESPONSE FRAMEWORK

While NIMS outlines a management system for response efforts at all levels of government (federal, state, and local), DHS has developed the NRF to map out a uniform federal response and to provide supporting mechanisms for disasters (http://www.fema.gov/nrf). The NRF defines what qualifies as an incident of national significance. The first priority of the NRF is the preservation of human life through immediate response actions. Once response missions and life-saving activities conclude, the emphasis shifts from response to recovery operations and, if applicable, hazard mitigation. These actions include debris clearance, the emergency restoration of critical infrastructure, control, containment, and removal of environmental contamination, and protection of responder health and safety.

The NRF categorizes the capabilities of federal departments and agencies into 15 ESFs to provide the planning, support, resources, program implementation, and emergency services that are most likely to be needed for incidents requiring a coordinated federal response. Different federal agencies coordinate the various ESFs. The ESF coordinator is the entity with management oversight for that particular ESF. The coordinator has ongoing responsibilities throughout the preparedness, response, and recovery phases of incident management. The ESFs that govern natural disaster debris removal are ESF #3, "Public Works and Engineering" and ESF #10, "Oil and Hazardous Materials Response." DHS makes a final determination as to whether to activate each ESF; not all ESFs are necessarily activated in response to all disasters.

Emergency Support Functions Listed in the National Response Framework

ESF #	Function	ESF Coordinator
1	Transportation	U.S. Department of Transportation
2	Communications	U.S. Department of Homeland Security (National Communications System)
3	Public Works and Engineering	U.S. Department of Defense (U.S. Army Corps of Engineers)
4	Firefighting	U.S. Department of Agriculture (U.S. Forest Service)
5	Emergency Management	U.S. Department of Homeland Security (Federal Emergency Management Agency)
6	Mass Care, Emergency Assistance, Housing, and Human Services	U.S. Department of Homeland Security (Federal Emergency Management Agency)
7	Logistics Management and Resource Support	U.S. General Services Administration and U.S. Department of Homeland Security (Federal Emergency Management Agency)
8	Public Health and Medical Services	U.S. Department of Health and Human Services
9	Search and Rescue	U.S. Department of Homeland Security (Federal Emergency Management Agency)
10	Oil and Hazardous Materials Response	U.S. Environmental Protection Agency
11	Agriculture and Natural Resources	U.S. Department of Agriculture
12	Energy	U.S. Department of Energy
13	Public Safety and Security	U.S. Department of Justice
14	Long-Term Community Recovery	U.S. Department of Homeland Security (Federal Emergency Management Agency)
15	External Affairs	U.S. Department of Homeland Security

4.2 FEDERAL EMERGENCY MANAGEMENT AGENCY

FEMA is the lead federal agency that responds to disasters and emergencies to help save lives and protect public health, safety, and property. FEMA operates under specific regulations, which are found in Chapter 44 of the CFR. The Stafford Act and the CFR use the term "debris removal" in a broad sense to encompass the entire process of removing, handling, recycling, and disposing of debris. This regulation declares debris removal to be in the public interest, not only to protect life, public health, and safety, but also to ensure economic recovery of the affected community.

FEMA's most visible role in disaster recovery and debris management is in administering the Public Assistance (PA) Grant Program. The program provides supplemental federal disaster grant assistance to states, local governments, and certain nonprofit organizations for debris removal and disposal; emergency protective measures; and the repair, replacement, or restoration of disaster-damaged publicly owned facilities and the facilities of certain private nonprofit organizations. The PA Grant Program is administered through a coordinated effort among FEMA, the affected state, and the applicants. Communication and coordination among all of these agencies are important. After an emergency event, the state assumes the role of a "grantee" and is responsible for administering the federal grant. Understanding FEMA requirements prior to an emergency enables a community to recover the maximum allowable for cleanup costs.

PA funds are available to eligible applicants for debris clearance, removal, and disposal operations. Eligible applicants include state and local governments, Indian tribes, and certain private nonprofit organizations. In order to be eligible for FEMA funding, the debris removal work must:

- Be a direct result of a Presidentially declared disaster;
- Occur within the designated disaster area; and
- Be the responsibility of the applicant at the time of the disaster.

In addition, debris removal work must be necessary to:

- Eliminate an immediate threat to lives, public health and safety;
- Eliminate immediate threats of significant damage to improved public or private property; or
- Ensure the economic recovery of the affected community to the benefit of the community-at-large.

Examples of eligible debris removal activities include:

- Debris removal from a public right-of-way to allow the safe passage of emergency vehicles; and
- Debris removal from public property to eliminate health and safety hazards.

Examples of ineligible debris removal activities include:

- Removal of debris, such as tree limbs and trunks, from an applicant's unimproved property or undeveloped land;
- Removal of pre-disaster sediment from engineered channels;
- Removal of debris from a natural channel unless the debris poses an immediate threat of flooding to improved property;
- Removal of debris from federal lands or facilities that are the authority of another federal agency or department, such as federal-aid roads, USACE navigable waterways, and Natural Resources Conservation Service canals.

Debris removal from private property is generally not eligible for PA grant funding because it is the responsibility of the individual property owner. If property owners move the disaster-related debris to a public right-of-way, the local government may be reimbursed for curbside pickup and disposal for a limited period of time. If the debris on private business and residential property is so widespread that public health, safety, or the economic recovery of the community is threatened, FEMA may fund debris removal from private property, but it must be approved in advance by FEMA. Information on the PA Program, including links to PA policies, is available on FEMA's website (http://www.fema.gov/government/grant/pa/index.shtm). PA resources for Debris Management, including policies and specifically referring to FEMA's Debris Management Guide are available at http://www.fema.gov/government/grant/pa/index.shtm.

In 2007, FEMA began a PA Pilot Program designed to reduce the Federal costs of administering the PA Grant Program, increase flexibility in administering the PA Grant Program, and expedite the much-needed recovery dollars to the program's applicants following disasters. FEMA developed the PA Pilot Program in response to the 2007 DHS Appropriations Act. The pilot procedures are applicable to debris removal and the repair, restoration, and replacement of damaged facilities. Participation in the PA Pilot Program is open to state and local governments on a voluntary basis. FEMA expects to meet the goals of the Pilot Program by focusing on four key procedures:

- Providing grants on the basis of estimates.
- Increasing the Federal cost share to applicants that have a FEMA-approved debris management plan and at least two pre-qualified debris and wreckage removal contractors identified prior to a disaster.
- Allowing applicants to retain any revenue from recycling disaster debris as an incentive to recycle debris.
- Reimbursing the straight- or regular-time salaries and benefits of an applicant's permanently employed staff that performs debris-related activities.

More information about the PA Pilot Program can be found at:
http://www.fema.gov/government/policy/papilot.shtm.

4.3 U.S. Army Corps of Engineers

USACE is a public engineering organization that operates within the Department of Defense. According to the NRF, USACE is the coordinator and primary agency for ESF #3, "Public Works and Engineering." USACE also plays key roles in support of FEMA or other federal

agencies. Typical USACE activities and mission assignments include providing emergency power, establishing temporary shelters and housing, providing temporary roofs, assessing building structural safety, emergency repair of public infrastructure, supporting search and rescue operations, providing safe drinking water and ice, and performing debris removal and disposal operations.

USACE maintains seven national response teams and ten regional contracts for debris operations, all dedicated to supporting state and local governments. Under the NRF, USACE provides assistance to state and local governments by either a Technical Assistance mission assignment or a Direct Federal Assistance mission assignment. Under Technical Assistance, USACE provides expert advice on all aspects of debris management and helps local governments perform their own debris operations. Direct Federal Assistance is provided at the request of the state/local government when the scope of work is beyond the capacity of the local government to perform. This is where USACE uses its teams and contracts to perform the debris operations mission in partnership with the local government. Additional information can be found on the USACE's website (http://www.usace.army.mil/).

USACE Support

The USACE response to Hurricanes Dennis, Katrina, Rita, and Wilma in 2005 illustrates the type of support the Corps provides the nation under ESF #3 in support of FEMA:

- A total of 6,141 Corps employees supported the response to the hurricanes.
- The total amount of the FEMA missions assigned to the Corps was $4.4 billion.
- The Corps installed a total of 193,000 temporary roofs.
- The Corps delivered 27 million gallons of water and 232 million pounds of ice.
- The Corps conducted 2,406 generator pre-installation inspections and then installed 914 generators.
- The Corps removed a total of 38,967,195 cubic yards of debris.

4.4 U.S. Environmental Protection Agency

EPA is the primary federal agency responsible for administering the Resource Conservation and Recovery Act (RCRA). Under RCRA, EPA issues regulations and guidelines to properly manage solid and hazardous wastes, and provides technical assistance to states and local governments. EPA regulations provide explicit, legally enforceable requirements for hazardous waste management. In addition, the EPA provides technical assistance on nonhazardous waste management. A large part of the RCRA program is the development of EPA guidance and policy directives to clarify issues related to the implementation of the regulations. RCRA allows for state authorization by EPA for their hazardous waste management programs and most states are authorized. To support the implementation of RCRA, EPA manages an extensive database that documents EPA interpretations of the RCRA regulations. The RCRA online database is available on EPA's website (http://www.epa.gov/rcraonline). PCBs are regulated under TSCA (www.epa.gov/pcb). EPA's Office of Solid Waste (OSW) recently assumed the

disposal and clean-up programs for PCB management from the Office of Pollution Prevention and Toxics. A list of OSW PCB contacts can be found at: http://www.epa.gov/epaoswer/hazwaste/pcbs/pubs/contactus.htm and EPA regional office PCB contacts can be found at: http://www.epa.gov/epaoswer/hazwaste/pcbs/pubs/coordin.htm. Asbestos is primarily regulated under NESHAP (http://www.epa.gov/asbestos). A list of EPA headquarters and regional asbestos contacts can be found at: http://www.epa.gov/asbestos/pubs/contactus.html.

In addition to regulatory functions for hazardous wastes, EPA provides support and technical assistance on appropriate solid waste management practices. This is for the case for debris that is regulated at the state and local levels, such as C&D materials. While the state and local officials will provide the final decision on the management of these materials, EPA can provide support and technical assistance on how these materials can be best managed and provide contacts for partnerships.

EPA supports many voluntary programs, such as reuse and recycling programs, and can help foster such activities. EPA has been designated the authorized agency for the Recycling Electronics and Asset Disposition (READ) Services contract, providing recycling and asset disposition services on a government-wide basis for the recycling of electronic equipment, and the disposal of excess or obsolete electronic equipment in an environmentally responsible manner. Seven federal agencies are able to buy into the contract's services through the EPA. Communities may be able to utilize this vehicle through one of the federal agencies (EPA, USACE, National Park Service, FEMA, Department of Education, Bureau of Alcohol, Tobacco and Firearms, and DOE). Additional information can be found at (http://www.epa.gov/oam/read/).

Furthermore, EPA is the primary federal agency responsible for providing emergency support related to the release of hazardous materials and providing support under the NRF. As part of these responsibilities, EPA responds to releases of hazardous materials and provides technical assistance for environmental monitoring following releases. EPA is the lead federal agency under ESF #10, "Oil and Hazardous Materials Response." Under this ESF, FEMA funds EPA's management of orphan tanks (for propane and other fuel), drums, and HHW. EPA also provides support to local and state agencies in properly managing debris deemed hazardous, including HHW. Under ESF #3, "Public Works and Engineering," of the NRF, EPA assists USACE and local agencies in identifying disposal sites for debris. In addition, EPA assists with contaminated debris management activities by coordinating and/or providing resources, assessments, data, expertise, technical assistance, and monitoring. EPA also assists in the assessment and restoration of drinking water and wastewater infrastructure. EPA may be able to provide support, even when disasters are not federally declared, under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, the National Contingency Plan (NCP), and the National Response Center (NRC). These programs can be used to respond in a prompt manner to short-term threats involving the release and threatened release of hazardous substances, pollutants, or contaminants.

EPA Involvement in Hurricane Katrina

EPA worked with USACE and other federal agencies, state agencies, and local governments to facilitate the collection, segregation, and management of HHW. EPA provided extensive outreach and technical assistance on topics such as identifying and disposing of electrical equipment that may contain PCBs and on handling and disposal of debris containing asbestos. EPA also set up monitoring stations to monitor air and water quality following Hurricane Katrina. Additionally, EPA provided the affected states with technical assistance on the burning of disaster debris. A summary of this assistance can be found at http://www.epa.gov/katrina/debris.html.

4.5 U.S. COAST GUARD

The USCG supports USACE in responding to marine debris contaminated with oil or hazardous substances. Under ESF #3, the USCG:

- Marks and coordinates with USACE for the removal of obstructions declared to be hazards to navigation.
- Assists in vessel salvage and removal of vessel debris. This includes coordinating and/or providing resources, assessments, expertise, technical assistance, monitoring, and other appropriate support.

The USCG has statutory authority and responsibility to oversee oil and hazardous substance pollution response operations associated with debris removal and salvage operations in the Coastal Zone in accordance with the NCP (40 CFR Part 300). ESF #10 is primarily concerned with oil and hazardous materials response. While the EPA is the coordinator for ESF #10, USCG is the other primary agency responsible for coordination under ESF #10. Under ESF #10, the USCG:

- Provides expertise on environmental effects of oil discharges or releases of hazardous materials and environmental pollution control techniques.
- Maintains the NRC.
- Maintains continuously staffed facilities that can be used for command, control, and surveillance of oil discharges and hazardous materials releases occurring within its jurisdiction.

For incidents for which USCG is the primary agency, they:

- Maintain close coordination between USCG Headquarters, the affected area, district office(s), the EPA (as appropriate), the Domestic Readiness Group (DRG), the National Response Coordination Center (NRCC), other ESFs, and the NRT.
- Coordinate, integrate, and manage the overall federal effort to detect, identify, contain, clean up, dispose or minimize releases of oil or hazardous materials, or prevent, mitigate, or minimize the threat of potential releases.

- Provide on-scene coordinators (OSCs) for incidents within its jurisdiction (including for the coastal zone response for incidents for which EPA is the primary agency, but the incident affects both the inland and coastal zone).

4.6 U.S. DEPARTMENT OF AGRICULTURE

The U.S. Department of Agriculture (USDA) administers two emergency natural disaster debris recovery programs, the Emergency Watershed Protection Program (EWP) and the Emergency Conservation Program (ECP). They are quick response programs that provide immediate relief to disaster areas in the prevention of further damage to infrastructure caused by debris. USDA Farm Service Agency's (FSA) ECP provides emergency funding and technical assistance for farmers and ranchers to rehabilitate farmland damaged by natural disasters. This assistance is provided to remove debris, restore fences and conservation structures, and provide water for livestock in drought situations. More information can be found at the FSA's website (http://disaster.fsa.usda.gov). The purpose of the EWP program is to undertake emergency measures, including the purchase of flood plain easements, for runoff retardation and soil erosion prevention to safeguard lives and property from floods, drought, and the products of erosion on any watershed whenever fire, flood or any other natural occurrence is causing or has caused a sudden impairment of the watershed. The key to these programs is that they allow for local communities to receive assistance directly from the USDA. More information about the EWP program and points of contact can be found at the USDA's National Resources Conservation Service (NRCS) website (http://www.nrcs.usda.gov/programs/ewp/). USDA has local offices in almost every county of the country where communities can quickly seek out assistance.

The USDA provides leadership, technical expertise, and assistance for the management of animal carcasses. The USDA has produced "Disaster Planning," technical assistance on how to prepare for a disaster (http://www.nal.usda.gov/awic/pubs/IACUC/dis.htm). Kansas State University, Purdue University, and Texas A&M University produced "Carcass Disposal: A Comprehensive Review" for USDA's Animal and Plant Health Inspection Service (APHIS) (http://fss.k-state.edu/index.php?option=com_content&task=view&id=17&Itemid=37). APHIS also maintains the National Animal Health Emergency Management System Guidelines, which provide information that may be integrated into the preparedness plans of other federal, state and local agencies, tribes, and additional groups involved in animal health emergency management activities (http://emrs.aphis.usda.gov/nahems.html).

Under the NRF, the USDA is the coordinator and primary agency for ESF #11, "Agriculture and Natural Resources." Under this ESF, the USDA coordinates responding to animal and plant diseases and pests and ensuring the safety and security of the commercial food supply. USDA also supports the USACE under ESF #3, "Public Works and Engineering," if available, by providing engineering and contracting/procurement personnel and equipment to assist in emergency removal of debris (which may include animal carcasses), demolition, temporary protection of roads and bridges, temporary protection of essential public facilities, water supply, and sanitation. They also provide technical personnel to evaluate damage to water control facilities.

USDA is also part of the Federal WBUG along with DOE and DOI, which seeks to utilize biomass produced from disasters. The WBUG is working under the guidance of the interagency Memorandum of Understanding (MOU) on Policy Principles for Woody Biomass Utilization. The MOU can be found at (http://www.forestsandrangelands.gov/Woody_Biomass/wbug.shtml).

4.7 FEDERAL HIGHWAY ADMINISTRATION

The U.S. DOT FHWA assists in the emergency repair of federal roads—repairs made immediately following a disaster to restore essential traffic, to minimize the extent of damage, or to protect the remaining facilities. State and local transportation agencies are empowered to begin emergency repairs immediately. Properly documented costs will be reimbursed once the FHWA division administrator determines that the disaster is eligible for federal funding. The types of activities that are eligible for federal funding are regrading road surfaces, debris removal, and demolition and reconstruction of damaged bridges. The program only funds projects that restore the roadways to their pre-disaster design and purpose. Permanent road restoration work is not eligible for reimbursement if performed prior to authorization by the FHWA, unless it is determined to be more economical or practical to perform such work as an associated part of the emergency repairs. Permanent repairs should be administered using normal federal-aid contracting procedures. For more information on the grant assistance available through the FHWA, review its Emergency Relief Manual available electronically at (http://www.fhwa.dot.gov/reports/erm/index.htm).

5 Summary of Lessons Learned from Past Disasters

A summary of important lessons learned regarding disaster debris management plans is presented below. A compilation of individual case studies discussing lessons learned can be found in Appendix A. These case studies are presented as examples of how others overcame obstacles during clean-up and recovery.

A natural disaster may occur within a community, and if the first action after the disaster is to plan how the community will respond, the community will face serious consequences as it deals with disaster debris. If a natural disaster occurs in a community, local officials will want to immediately reach for their disaster debris management plan. Experience has shown that having a disaster debris management plan and thinking though the creation of the plan will minimize costly mistakes, speed recovery, protect human health and the environment, and avoid the creation of waste. It will also increase the confidence of the community in the local government's ability to respond effectively to such disaster.

EPA sought out people in communities that have experienced natural disasters to obtain their guidance on the importance of a disaster management plan and the individual components of such plans. These community leaders all believe that a disaster management plan "gives you a place to start" and "makes you more prepared when the battle comes." These community leaders differ on their opinions of most important component of a disaster management plan. Several community leaders stated that communicating with the public and having a community awareness plan was the most critical component, while others stated that being able to make an accurate estimate of the amount of debris to be potentially managed was the key. There is no one component of a disaster debris management plan that is the key component; rather, the key is to address all of the components and to update the plan regularly, and to be fully prepared to implement it when a natural disaster strikes.

Every disaster debris management plan should have the necessary components that have been described in this planning document. That is, communities need to anticipate the type of natural disaster that is likely to impact their community. Understanding the type and possible sizes of natural disasters will influence the type and amount of debris that may be generated. Having an inventory of existing waste management facilities, their capacities, and capabilities, and planning for additional temporary storage/staging and disposal options will help. Having pre-negotiated contracts or a list of pre-qualified contractors for managing debris will help ensure that clean-up efforts start quickly and proceed in a timely and efficient manner. Making sure that equipment and administrative needs are fulfilled will help to ensure that the necessary equipment and people will be in place. Communicating with the public will ensure that disaster debris clean-up will be understood. Making sure that debris management is accomplished in an environmentally sound manner will protect the community during and immediately after the natural disaster occurs, as well as, into the future.

6 Examples of State and Local Disaster Debris Management Plans and Guidance

The following documents are presented as examples of how state and local governments have planned for disaster debris management. This list is not exhaustive and these plans and guidance documents have not been reviewed or endorsed by EPA, but are included as examples of what others have done. Additional plans and guidance can be found from ASTSWMO at: http://www.astswmo.org/publications_solidwaste.htm.

6.1 State Plans and Guidance

Alabama Department of Environmental Management
"Guidelines for Open Burning of Natural Disaster Debris," 2004
http://www.adem.state.al.us/GuidelinesOpenBurning1.pdf

California Integrated Waste Management Board
"Disaster Preparedness and Response" Homepage
http://www.ciwmb.ca.gov/disaster/
"Integrated Waste Management Disaster Plan," 1997
http://www.ciwmb.ca.gov/disaster/disasterplan/

Connecticut Department of Environmental Protection
"Overview of Disaster Debris Management Planning for Connecticut Municipalities," 2006
http://www.ct.gov/dep/lib/dep/waste_management_and_disposal/solid_waste/DisasterDebrisManagementPlanning.pdf

Florida Department of Environmental Protection
"Guidance for Establishment, Operation and Closure of Staging Areas for Hurricane-generated Debris," November 19, 2004 (updated 09-22-05)
http://www.dep.state.fl.us/mainpage/em/info.htm

Louisiana Department of Environmental Quality
"Comprehensive Plan for Disaster Clean-Up and Debris Management"
http://www.deq.louisiana.gov/portal/portals/0/news/pdf/DEQDebrisPlan71306.pdf

Mississippi Department of Environmental Quality
"Hurricane Katrina Disaster Recovery"
http://www.deq.state.ms.us/MDEQ.nsf/page/Main_HurricaneKatrinaDisasterRecovery?OpenDocument

North Carolina Department of Environment and Natural Resources
"Prepared? Planning for a Natural Disaster," 2006
http://www.wastenotnc.org/swhome/emergencydebris.asp

Oklahoma Department of Environmental Quality
"Central Oklahoma Tornado: Guidelines for Debris Management," 1999
http://www.deq.state.ok.us/mainlinks/GuidelinesForDebrisMgmt.htm

6.2 CITY AND COUNTY PLANS

California

Alameda County
"Alameda County Disaster Waste Management Plan," 1998
http://www.stopwaste.org/home/index.asp?page=303

San Francisco City/County
"Disaster Debris Recovery Plan," 1997

Florida

Escambia County
"Debris Management Plan," 2006
http://www.co.escambia.fl.us/departments/purchasing/documents/DebrisMasterPlan.pdf

Palm Beach County
"Debris Management Plan," 2007
http://www.swa.org/pdf/debrismgmtplan.pdf

Pinellas County
"Disaster Debris Management Plan," 2006
http://www.pinellascounty.org/utilities/PDF/Debris-Mgmt-Plan.pdf

Massachusetts

Franklin County
"Disaster Debris Management Planning Document," 2006
http://frcog.org/pubs/emergency/Franklin_County_Debris_Document_Jan07.pdf

Virginia

City of Fairfax
"Debris Management Plan," 2006
http://www.fairfaxva.gov/EM/Docs/CityDebrisPlan.pdf

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Appendix A

Lessons Learned From Past Disasters

The following disaster debris case studies were provided by various federal, state, and local sources. They are examples in which planning benefited the debris management process, as well as those in which officials identified improved planning opportunities. Lessons learned are included for the following disasters:

- Louisiana: Hurricanes Katrina and Rita
- Mississippi: Hurricane Katrina
- Palm Beach County, Florida: Hurricanes Frances and Jeanne
- San Diego, California: 2003 Cedar and Pines Firestorm
- Escambia County, Florida: Hurricane Ivan
- Los Angeles, California: Northridge Earthquake
- Alstead, New Hampshire: 2005 Flooding

In addition to these lessons learned, other recommendations can be found in the Solid Waste Association of North America (SWANA) document "Hurricane Katrina Disaster Debris Management: Lessons Learned from State and Local Governments" (2005). The SWANA document discusses advice given to Louisiana and Mississippi from SWANA members that have experienced many different types of disasters. SWANA represents thousands of solid waste professionals (http://www.swana.org).

LOUISIANA: HURRICANES KATRINA AND RITA

On August 29, 2005, Hurricane Katrina struck southeastern Louisiana, causing widespread damage along the coastline and in New Orleans. The Louisiana Department of Environmental Quality (LDEQ) issued it first emergency declaration on August 30. This declaration, in part, addressed debris management issues. Thereafter, LDEQ developed a debris management plan. On September 24, 2005, Hurricane Rita made landfall near the Louisiana/Texas border, impacting several parishes in southwestern Louisiana and counties in Texas.

Communication

The LDEQ, together with EPA and the U.S. Coast Guard, formed a unified command. This facilitated debris management and recycling discussions between LDEQ and EPA. Daily communication was established with the US Army Corps of Engineers (USACE) and FEMA. Outreach to citizens was facilitated through flyers, websites, TV and radio announcements, and news releases.

Collection and Recycling

The State of Louisiana identified recycling as a priority. Consequently, recycling efforts were undertaken, not only by the state, but by the federal partners as well. Vegetative debris was generally chipped or ground. The federal, state, and local partners recognized that this vegetative debris could potentially be used for energy recovery. In Louisiana, an obstacle to this use was the Formosan termite infestation in the southeastern and southwestern parishes. As a result, all cellulose material was quarantined in nine southeastern, and three southwestern parishes. This made shipment to potential users problematic. In Louisiana, much of the chipped vegetative debris was used as cover at landfills.

Under ESF 10, EPA was tasked to lead the household hazardous waste collection effort in most Louisiana parishes. Returning citizens were encouraged to segregate household hazardous waste at the curbside, to facilitate collection. See Appendix B for examples of flyers used to communicate debris collection with the public. The USACE added incentives to contracts to ensure that the USACE contractors were conducting curbside debris segregation. Particular attention was given to segregation of household hazardous waste and electronics. EPA developed a plan for the collection and recycling of household hazardous waste, and coordinated daily with the USACE to ensure that materials were properly segregated. As many as 15 household hazardous waste collection centers were operating at one time. Through the efforts of EPA, USACE, and others, over 24 million pounds of household hazardous waste was collected. Much of the household hazardous waste was recycled. Recycled materials included batteries, propane cylinders, gasoline, and oil.

After Hurricane Katrina hit the Gulf Region in 2005, EPA and USACE worked to collect and recycle damaged electronic equipment in the New Orleans and surrounding areas. After the flooding subsided, over 500,000 homes were damaged. It was estimated that many of these homes had at least two televisions and one personal computer. In addition, numerous electronic items such as game consoles, musical equipment, and stereo equipment were discarded. After the initial Task Order was issued, EPA established seven staging areas in the New Orleans and surrounding areas where trucks would wait for the USACE and EPA personnel to sort the electronics into different electronic debris areas. Since November 2005, over 12,500 tons of discarded electronic wastes have been collected and properly recycled. The federal partners were able to ensure that the electronics were being properly recycled, in a cost effective manner, through the use of EPA's Recycling Electronics and Asset Disposition (READ) Services. Private partners, including Dell Computer and Best Buy expressed interest in helping with the Katrina electronics recycling effort. Both companies sponsored electronics collections events in the New Orleans area.

EPA, USACE, and local contractors were tasked with the collection, staging, cleaning & recycling of white goods. LDEQ specified in its "Emergency Declaration" that all white goods must be recycled. White goods included refrigerant containing appliances such as freezers, refrigerators, and air conditioners; and other large appliances such as ranges, ovens, dishwashers, washers and dryers. EPA was involved in the collection, refrigerant extraction, and recycling of the steel from nearly 400,000 white goods. Over 45,000 pounds of refrigerant were extracted and, of that, approximately 25,000 pounds of refrigerant were recycled.

The LDEQ was requested by the Governor's Office to remove the hurricane damaged vehicles and vessels destroyed after the two hurricanes. As of July 2007, they had collected approximately 12,000 vehicles and vessels from the public rights-of-way and from private property. The vessels ranged in size from small fishing boats and wave runners to 100-foot steel-hulled shrimp boats and barges. At the individual pickup/collection points on the highways, the contracts call for site remediation of leaking fuels, etc. After proper notifications to the registered owners, all lead batteries, mercury switches, Freon, antifreeze, fuels and oil reservoirs were drained. Contractors were also required to inspect for, and remove, any stoves, refrigerators, ammunition, or other explosives that may be found. All collected materials were inventoried and sent for recycling. The remaining metals, such as aluminum

masts and lead keel from sailboats, copper wiring, and crushed steel from vehicles, were separated, crushed, and recycled.

Guidance given by the EPA regarding disaster debris management following Hurricane Katrina can be found at: http://www.epa.gov/katrina.

MISSISSIPPI: HURRICANE KATRINA

Hurricane Katrina slammed into the Mississippi and Louisiana Gulf Coast on August 29, 2005 and moved up the eastern side of Mississippi. One of the biggest environmental challenges the Mississippi Department of Environmental Quality (MDEQ) faced was managing the enormous amount of debris caused by Hurricane Katrina. According to FEMA, approximately 46 million cubic yards of debris was created in the State of Mississippi alone. Of this amount, over 24 million cubic yards was generated in the three Gulf Coast counties of Hancock, Harrison, and Jackson. Approximately 70% (or over 17 million cubic yards) of the debris in these three coastal counties consisted of building and structural type wastes and the other 30% (or just over seven million cubic yards) consisted of trees, limbs, and other vegetative debris.

Communication

To respond to the ensuing debris management issues, MDEQ initiated several response actions. First, MDEQ stationed a team of engineers, scientists, and emergency responders on the coast from the agency's Jackson headquarters to assist local governments, industries, businesses and other agencies and organizations with monitoring and decision making on debris management issues. The MDEQ's South Regional Office located in Biloxi was not able to provide support after the storm since the facility was significantly damaged and several of the employees lost their homes and suffered other personal damage. Each week a new response team would rotate to the coastal station and assume responsibilities for assistance and monitoring of debris management activities and sites. A daily conference call between MDEQ headquarters and the response team stationed on the coast was implemented to discuss and help address various decisions and issues related to debris management and other environmental conditions. In addition, MDEQ initially stationed debris specialists from the agency at the headquarters of the Mississippi Emergency Management Agency. It quickly became evident that the disaster debris conditions required more resources. Consequently, MDEQ established a debris response station and call center at the MDEQ headquarters in Jackson. The call center was also staffed with MDEQ engineers, scientists, data management specialists and others to help with planning, decision making, public complaints and inquiries and networking with other state and federal agencies to assist the citizens of the state with debris management issues as well as other environmental and public health problems. MDEQ maintained a system to track the resolution of calls and attempted to resolve all questions or inquiries with callers that were within our environmental oversight. In addition, MDEQ often worked with local emergency management personnel, local solid waste management personnel, volunteer groups, the State Department of Health, local landfills, and disposal contractors to assist citizens with other associated problems.

MDEQ also joined and participated in a Joint Debris Task Force of Federal and State Agencies to address the various aspects of the disaster debris management conditions. The Debris Task Force led by FEMA included representatives from MDEQ, the State Forestry Commission, the

State Department of Agriculture and Commerce, the EPA, USACE, the State Department of Archives and History, the USCG, and various other agencies. The Task Force met weekly, discussed targeted debris management problems, and worked together on a joint resolution of those problems.

MDEQ Addresses Problem Wastes and Debris Management

MDEQ had to address wastes that had been released into the environment that would create the most pressing environmental and public health concerns. MDEQ worked with the EPA to assess facilities and communities across the Gulf Coast for release of hazardous constituents. State and federal representatives visited various industrial and commercial facilities to assess potential hazardous releases to the environment. The state was fortunate that these assessments did not reveal widespread release of hazardous materials. Those releases that could be identified were contained and addressed. Smaller quantities of hazardous materials from damaged households and businesses would be dealt with by ongoing identification and segregation of the material from the normal debris collection and management activities. An additional problem that had public health concerns was the tremendous amounts of food waste including poultry, bananas, and pork belly products at the state port in Gulfport, fish and other seafood products at the Pascagoula Port, and at seafood industries along the Gulf Coast. Most of these materials had to be collected and disposed quickly to prevent public health problems from the decomposing foods. In a few instances, the bulk food wastes were of such significant concern that MDEQ worked with EPA to dispose of the materials under the hazardous material management provisions. MDEQ also dealt with grocery and convenience stores along the coast that had suffered electricity outages and in some instances that were flooded, leaving rotting and decaying food in the stores. MDEQ worked with store owners to develop plans for cleanout and disposal of these food products to prevent these materials from creating public health concerns.

In addition to these actions on problem wastes streams, MDEQ had to address the large amount of debris from homes, commercial buildings and other structures. Immediately after the storm, MDEQ conducted an evaluation of the recycling capabilities and of the existing landfill capacity on the Gulf Coast to determine what additional disposal capacity the three coastal counties might need to in order to dispose of the hurricane debris. This evaluation indicated that recycling of much of the disaster debris would be difficult given that the materials were mixed together and in some instances contaminated or damaged beyond recovery. Consequently landfill disposal would likely be the most practical solution to the largest volume of the debris. The evaluation also indicated that there was a significant shortfall in needed landfill disposal capacity and that MDEQ in coordination with the local governments would likely need to consider new emergency landfill sites for the debris as well as other management options. The emergency landfills sites, upon approval, would only operate temporarily until the debris clean up could be completed. MDEQ also was concerned that the communities should preserve some available landfill capacity for the future needs of the counties as large volumes of wastes would also be generated in rebuilding our Gulf Coast. Consequently, MDEQ worked with local governments in the three coastal counties in approving the 13 temporary emergency disposal sites in addition to six permitted landfill sites that existed prior to the hurricane.

MDEQ also worked with local governments, the USACE, and with other debris contractors to develop sites for staging and temporary storage of wastes to segregate various types of the debris for proper management. At these sites, vegetative debris, white goods, electronics, hazardous materials, and other materials would be segregated for management at the proper disposal or recycling site. This type of segregation was also done at the landfill sites. Sites were developed with EPA to manage and temporarily store the hazardous materials that would be pulled from the debris piles and segregated for proper management or that would be collected from residents or hazardous material clean up actions. In some areas, the EPA was able to offer curbside collection of HHW. Over the course of the debris clean up, sites would also be established for white goods recycling, staging damaged boats and automobiles, crushing concrete, and staging debris removed from state waters, and other activities.

MDEQ also worked with local governments and other state and federal agencies to set up vegetative debris management sites, focusing on the waste stream that included downed trees, stumps, large limbs and other similar wastes. These sites involved mulching and burning the vegetative wastes to reduce the volume of materials. Conditions were developed for locating burn sites that included various set back distances and location stipulations to avoid problems and nuisances for local citizens. MDEQ developed an ash use policy that would allow burn sites to (upon appropriate sampling) propose beneficial use of the debris ash as a soil conditioner. In addition, MDEQ worked with the USACE to promote use of the millions of cubic yards of mulch created. Mulch was reused as boiler fuel, at blueberry farms, and landscaping around municipal and county properties, golf courses, schools and other sites. Mulch was even used in some of the live oak recovery efforts along the gulf coast, helping the trees recover from the surge and wind damage of Hurricane Katrina. Despite finding these varied uses for the mulch, the volume of materials was so great that MDEQ had to create additional disposal sites in some communities strictly for mulch materials for which no market or end use could be found. These problems become more urgent when several of these large mulch piles in southern part of the state began to spontaneously combust. MDEQ worked with the USACE at that time to evaluate and approve emergency disposal sites to move the mulch to for final disposal.

Overall, some 340 temporary sites were approved for handling the wastes generated by Katrina. In addition, numerous permanent solid waste landfills, transfer stations, and other solid waste facilities were used for the management of hurricane debris. Of the 340 sites, more than 250 were chip or burn sites for vegetative wastes only, approximately 30 sites were approved for staging wastes, and approximately 80 sites were approved as burial sites. On the coast, the 13 temporary emergency landfill sites and the six permitted disposal sites received the bulk of the 17 million cubic yards of building and structural debris (along with six permitted disposal sites). The other disposal sites were used primarily for the disposal of vegetative debris which could not be recycled.

MDEQ Emergency Debris Site Evaluation and Operating Procedures

MDEQ recognized, in developing the temporary emergency landfill sites, that protection of the state's groundwater and surface water resources was paramount, especially in the midst of the nation's worst disaster. Consequently, MDEQ implemented a number of policies and actions in the management of the hurricane debris to ensure that the disposal of this tremendous amount of debris would not create long term environmental problems for the area. As stated, MDEQ

worked with local governments in the three coastal counties to approve 13 temporary emergency disposal sites in addition to six permitted landfill sites that existed prior to the hurricane. These existing landfill sites all had gone through an extensive environmental review in the process to obtain a permit to ensure that the locations where these landfills were constructed were geologically suitable with underlying low permeable clays to protect groundwater resources in the area of disposal. In addition, MDEQ also evaluated each of the 13 sites used for the temporary emergency landfills to determine if the underlying geology and groundwater conditions at the sites were suitable for debris disposal. Sites that did not have suitable underlying clay soils or where groundwater was unacceptably close to the surface were not approved for disposal of the hurricane debris. MDEQ also evaluated these sites for other environmental concerns including wetlands protection, protection of nearby surface waters (such as rivers, streams, or bayous), proximity to residences and other types of structures, and proximity to the debris to attempt to minimize the distances that wastes would need to be transported.

In addition to the environmental siting review conducted on each site, MDEQ also required that the sites be operated in a manner that was protective of the environment and that prevented public nuisances and other problems. Debris sites were required to receive proper compaction, a periodic earthen cover and a final earthen cover upon closure. MDEQ maintained a daily presence at these emergency landfill sites during the clean up activities following the hurricane to ensure that the sites were being operated in a proper manner that was protective of our state's natural resources. Another primary operational concern for these sites was that materials that contain chemicals or toxics should be removed from the debris prior to ultimate disposal. Consequently, there were often several points in the debris management at which these potentially hazardous wastes in the debris were segregated and disposed of in a different manner. HHW and similar items from commercial businesses were segregated from the debris at the point of initial collection, in some instances at a specific staging or segregation site, and then finally again at the actual disposal sites. Smaller items such as household chemicals and cleaners, solvents, paints, petroleum products, and various other materials were removed from the wastes to the extent possible and segregated for management by the EPA under ESF #10.

Larger household items (such as large appliances, lawn mowers, computers, and televisions) were also segregated and removed because these items contain chemicals, refrigerant, heavy metals, and petroleum products. In addition, these bulky items would make proper compaction at the landfills difficult to achieve. Proper compaction was important at landfills because it helps to prevent the infiltration of rainwater into the landfill, thereby reducing leachate generation and the combustion potential within the landfill. These segregated large household items were recycled where possible. Items which could not be recycled was sent to municipal solid waste landfills with constructed liner systems for disposal.

Perhaps the greatest recycling success was with white goods and other similar metals. In the three coast counties, information given to MDEQ indicates that more than 24,000 tons of metal was collected, baled, and recycled at white goods collection sites. Assuming an average of weight of approximately 100 pounds per white good unit, it is estimated that over 450,000 refrigerators, freezers, washers, dryers and hot water heater units were recycled. Efforts were

made to extract the refrigerant from each refrigerator and freezer units prior to baling. Approximately 1,500 pounds of refrigerant was salvaged and recycled. A smaller amount of aluminum and iron was recycled as well. Mississippi had less success in recycling electronics products due to the damage and salt water inundation to many of the units that were collected. However, there were some sponsored events on the coast to recover damaged electronic materials. EPA and the Best Buy Retail Chain teamed up with MDEQ and Jackson County to sponsor a collection event in that county for damaged electronics.

Ensuring Proper Site Closure

In addition to the considerations in approving and operating these emergency sites, MDEQ has also worked with FEMA to ensure proper closure of disposal sites, mulch sites, burn sites and staging sites. As of August 31, 2007, most of the 340 emergency debris management sites had been closed, including 250 or more mulch and burn sites as well as the 30 staging sites. With FEMA's assistance, MDEQ installed groundwater monitoring systems at each of the 13 emergency disposal sites and at the six permitted existing disposal sites that took the Katrina debris. These monitoring systems consisting of wells constructed around the perimeter of each landfill. They will help MDEQ detect potential groundwater contamination. MDEQ has conducted monitoring events at these sites and is planning to conduct additional groundwater monitoring events.

Approximately ten percent of the sites had various issues that had prevented the sites from being considered as properly closed. These conditions vary but they include sites where debris has not been properly removed or processed, sites where ash and other residuals have been left in an apparently unacceptable condition, and other sites where authorized debris management activities were not initiated or properly completed for various reasons. MDEQ is in the process of working with MEMA to assure proper closure of the remaining debris sites and to resolve the remaining environmental issues at the sites so that the State of Mississippi can move forward with completion of Katrina-related debris management issues. The scope of the work entails reviewing and assessing the conditions at each site, determining the proper course of action to remedy site conditions, identifying the persons responsible for conducting remedial actions, and then moving forward with these actions to complete the closure process.

MDEQ is also working on an evaluation and revision of the Emergency Debris Management policies implemented after Katrina. The revised policies will be compiled into a Debris Management Plan that will assist MDEQ, other State and Federal Agencies, local governments, emergency management responders, and emergency management debris contractors in being prepared for the next disaster event that could occur in Mississippi. In summary, MDEQ believes that the debris management activities in Mississippi have been conducted in a manner that will ensure protection of the environment for generations to come.

For more information on Hurricane Katrina debris management in Mississippi, see http://www.deq.state.ms.us/MDEQ.nsf/page/Main_HurricaneKatrinaDisasterRecovery?OpenDocument and http://www.epa.gov/katrina.

PALM BEACH COUNTY, FLORIDA: HURRICANES FRANCES AND JEANNE

On September 3, 2004, Palm Beach County, Florida was hit by Hurricane Frances. The county's Solid Waste Authority (SWA) immediately established nine temporary debris management sites throughout the county. Three weeks later, the county was hit by Hurricane Jeanne. With winds exceeding 115 miles per hour, these two powerful storms caused a large amount of damage to the county.

Preparedness

Palm Beach County had a debris management plan in place prior to the 2004 storm season. Marc Bruner, director of environmental programs for the Palm Beach County Solid Waste Authority (SWA), stated, "Hurricane Irene was the last storm that we were unprepared for." When Hurricane Irene hit Palm Beach County in 1999 with up to 95 miles per hour winds and 15 inches of rain, the county did not have pre-event contracts or a debris management plan in place at that time. "That year was a real wake up call with Hurricane Irene hitting us and Hurricane Floyd narrowly missing. We've now taken the necessary steps to put a solid plan in place."

SWA drafted a plan to restore public infrastructure following a disaster, locate and secure temporary debris storage sites, put policies in place to assist local municipalities in clearing roads for emergency personnel, and facilitate federal reimbursement. The plan included pre-existing contracts that provide trained and qualified debris management contractor services in the event of a disaster. Five contractors and numerous subcontractors and vendors were employed in the debris collection and management processes, all of which were approved by FEMA.

Collection and Recycling

Local haulers and contractors, coordinating with SWA, cleared roadways and neighborhoods of more than two million cubic yards of debris during four weeks after the hurricane. Temporary debris collection sites were established at nine locations two days after Hurricane Frances passed. The temporary debris sites stayed open for three months and approximately four million cubic yards of debris were collected and processed. Approximately 80% of the debris was vegetative debris and 20% was mixed debris.

More than three million cubic yards of vegetative debris was ground up and consolidated into chipped mulch. SWA innovatively diverted most of the mulch from the landfill and conserved more than 25 acres of landfill space. SWA reused approximately 872,000 cubic yards of mulch through land application to large tracts of agricultural land located in the western parts of Palm Beach County.

Communication with the Public

In the hours before Hurricane Frances made landfall, SWA began communicating with the public through the Palm Beach County Emergency Operations Center. The initial message was that the county would resume normal perishable garbage collection as quickly as possible and

instructed residents to keep garbage separated from storm debris. SWA also announced that its customer service information hotline would be open within hours immediately following the storm. The customer service information staff received and processed more than 100,000 phone calls between the day that Hurricane Frances hit and the beginning of November (two months). "Everyone wanted their streets cleared as soon as possible," Bruner said, "but our message was consistent—be patient; our crews will be there." Bruner also believed that a public information campaign conducted just before hurricane season educated the public to place vegetative debris and mixed debris in different piles. The campaign proved to be very effective in shaping the public response during the recovery efforts.

Palm Beach County's 2007 Debris Management Plan can be found at http://www.swa.org/pdf/debrismgmtplan.pdf.

SAN DIEGO COUNTY, CALIFORNIA: 2003 CEDAR AND PINES FIRES

In October 2003 there were two wildfires that burned more than 400,000 acres of land and destroyed nearly 6,000 structures and 4,000 vehicles throughout unincorporated San Diego County. At its height, the fire advanced at a rate of two acres per second and lasted for 14 days. The San Diego County Office of Public Works responded immediately, focusing all available resources on the recovery effort. A plan was in place within a week and the debris removal effort commenced approximately six weeks after the fires began. Overall, more than 128,000 tons of debris was collected in the wake of the fires. Approximately 74,000 tons of concrete, metal, and vegetative debris was recycled resulting in a recycling rate of nearly 60% and preserving more than 185,000 cubic yards of landfill space.

Planning

While San Diego County did have an emergency response plan in place before the fires, it did not include a debris management plan. During the first few weeks after the fires, county officials focused on securing contractors to collect, transport, manage, and monitor debris through a competitive bid process and established a fire debris assistance hotline. Subsequent to this experience, the county identified that not having a plan as a major program challenge. The county felt that time could have been saved and FEMA reimbursement may have been easier if a plan was in place.

Communication

County officials quickly established a fully staffed, eight-hour-a-day fire debris hotline that provided the public with information detailing all aspects of the county's fire debris removal efforts. The hotline served as a starting point for cleanup efforts and also gave residents information on erosion control and volunteer coordination. Hotline activity dramatically increased after the county announced its free debris removal services; more than 2,500 calls were received related to the county's bin program. Additional public assistance was included a on the county's website that was dedicated to the firestorm, including an ash and debris cleanup guidance document developed in collaboration with the Regional Water Quality Control Board.

Collection and Recycling

The County had two incentives to recycle the disaster debris. At the time of the fires, California required a 50% diversion rate. The County could have deducted the wildfire debris tonnages from the annual disposal tonnages if it was demonstrated that a majority of the recyclables were diverted. In addition, the County projected that their existing landfill had four years left of capacity.

The County provided empty roll-off bins (typically 30 or 40 cubic yards each) to be used by citizens to remove debris from their property. This service was provided at no cost to the fire victims. The bins were requested by both individual property owners and by communities cleaning multiple properties. These bins were intended for use by the surrounding community – owners of the property on which the bins were placed were required to sign right-to-enter forms. Thus, anyone could use them, not just the person who requested the bin. The residents were given written instructions to separate metals and wood first into provided recycling bins. After that, a bin was delivered for all remaining mixed debris material. County officials concluded that the bin program was very successful in assisting in the timely clean-up of fire debris from structures. More than 1,500 bins provided the infrastructure necessary for the management of more than 10,000 tons of debris.

Most HHW had burned in the fires due to the intensity of the heat. Some remained and needed to be collected to ensure health of volunteers, workers, and the general public. San Diego County held three temporary HHW collection events following the wildfires. They collected more than 82,000 pounds of material at the events, 13,000 pounds of which was from fire victims. The County also established a burned vehicle program that collected and recycled more than 4,000 vehicles.

Additional lessons learned from the wildfires and subsequent debris management can be found at: http://www.ciwmb.ca.gov/disaster/Fires2003. The final report, "County of San Diego Debris Removal and Recycling Programs for the 2003 Cedar & Paradise Fires Final Report," published in 2005, can be found at this website. San Diego County's Department of Public Works can be found at: http://www.sdcounty.ca.gov/dpw/recycling/index.html.

ESCAMBIA COUNTY, FLORIDA: HURRICANE IVAN

On September 15, 2004, Escambia County, Florida, Hurricane Ivan made landfall with winds exceeding 130 miles per hour. The 661 square mile county, including the Pensacola metropolitan area, was impacted by the storm's eastern eyewall that produced the strongest wind gusts and heaviest rain bands. The storm generated more than ten million cubic yards of debris in a 12-hour period. Escambia County successfully diverted more than half of the debris from disposal in landfills and recovered more than 90% of the displaced beach sand.

Preparedness

Escambia County Solid Waste Management Department officials had a hurricane debris management plan in place prior to Hurricane Ivan. The plan, drafted in 2003, was the culmination of months of work. Mark Triplett, the acting director of solid waste management

for Escambia County at the time of the storm, stated that the time spent planning was time well spent. In developing the plan, private contractors submitted information to be placed on a list of potential debris management service providers. County officials planned to select contractors from this list in the event of a disaster.

The existing management plan also identified temporary debris storage and processing sites. Many of the county-owned parks were used to stage debris for processing and disposal. These sites easily could be returned to recreational facilities after the debris was removed. One large debris site that was not in the original plan was Blue Angel Recreation Area, formerly the Bronson Field Naval Air Station. Triplett said, "Being granted permission to use Old Bronson Field to process debris was a godsend." Approximately two million cubic yards of debris was processed at the Navy-owned recreation area. The County would have realized a major shortcoming in its storage capacity without the site. The temporary sites that had been included in the County's plan could not have accommodated such a large volume of debris.

Collection and Recycling

Hurricane Ivan generated more than ten million cubic yards of debris in Escambia County. Escambia County and Florida Department of Transportation road crews quickly began the task of clearing major roadways of debris immediately as soon as it was safe. County officials also began contracting debris management service providers and consultants to manage the removal and management activities. Triplett stated that clearing the roadways by cutting and staging downed trees was the first priority of the state and county road crews while County officials initiated the contractor selection process. This first stage of debris removal by County road crews allowed time to secure contractors. Triplett stated that clearing the roads usually takes between five and seven days, depending on the size of the storm.

Once contracts were in place, it was ultimately the debris contractors' responsibility to identify the means of debris management. The contractors knew that the vegetative waste held value and was marketable. The vegetative waste was ground into mulch and then managed in various ways, including incineration, land application, and as a raw material in paper mills. Nearly all of the two million cubic yards of debris processed at the Blue Angel Recreation Area was exported to Italy after the contractors brokered a deal for its use as biomass in power plants. The mulch was transported to Port Canaveral, Florida, and then shipped from there to Italy. The County managed more than 6.5 million cubic yards of vegetative debris in various ways: 60% exported to Italy and sold as biomass for energy generation; 15% sold to paper mills; 15% used as landfill cover; and 10% incinerated on site in air curtain incinerators.

Sand was another type of debris displaced along the barrier islands of Escambia County. The storm eroded the existing beaches and dune system and deposited the sand onto roadways and beachfront properties and into Escambia Bay. More than 1.35 million cubic yards of sand needed to be moved. The sand was filtered through a screen to sort out contaminants and to comply with restrictions regarding the composition of the area's beach sand. Approximately 95% of the sand was recovered through the screening process and reused to establish a five-year protective berm.

Communication with the Public

As soon as the area was placed under a hurricane warning, Escambia County officials began communicating with the public through radio and TV public service announcements. Residents were urged to segregate debris generated by the hurricane from other household or municipal wastes. These messages continued throughout the event and were the primary means of communication with the public until newspapers resumed operations. A debris hotline was also established after Hurricane Ivan and was still in operation a year later, making valuable contributions to the clean up efforts of both Hurricanes Dennis and Katrina in 2005.

Lessons Learned

County officials included a list of contractors in the county's debris management plan. The contractors were not pre-qualified, which slowed the initial evaluation process after the storm hit. It took 12 days to select three contractors and finalize rates and contracts. If the contractors had been pre-qualified prior to Hurricane Ivan's landfall, they could have begun processing debris as road crews staged it. County officials have since revised their current debris management plan. It now contains pre-qualified debris contractors in the case of another storm or other disaster event. These contractors can be mobilized and engaged prior to the landfall of a hurricane.

Escambia County officials also learned that communication with the public should be ongoing through a public awareness campaign. Triplett stated that the lack of such a campaign was a significant flaw in their preparations. One of the biggest problems that the county faced was public outcry for debris to be picked up sooner rather than later. Making the public aware of the county's debris management procedures and policies would help the public plan and react in a better and more efficient way.

The Escambia County Debris Management Plan can be found at:
http://www.co.escambia.fl.us/departments/purchasing/documents/DebrisMasterPlan.pdf.

LOS ANGELES, CALIFORNIA: THE NORTHRIDGE EARTHQUAKE

The City of Los Angeles relied heavily on recycling to manage debris from the January 1994 earthquake. In response to the earthquake, City staff negotiated with FEMA to designate recycling as the preferred method of debris management. The City developed contracts with existing businesses to recycle clean, source-separated materials and worked with more than nine businesses to develop processing capacity for mixed debris. By midsummer, the City was able to recycle approximately 56% of the earthquake debris collected, totaling over 1.5 million tons.

Collection and Recycling

The City of Los Angeles did not have a plan for debris management prior to the earthquake but quickly developed debris management procedures after the disaster. The day after the earthquake struck, the City instituted a curbside debris collection program. Prior to the earthquake, C&D materials typically composed 10% to 15% of Los Angeles' debris stream but

increased from 150 tons per day to 10,000 tons per day following the earthquake. City officials updated an existing list of licensed, insured debris removal contractors, asked them to attend an orientation meeting, and signed contracts for debris removal.

At first, contracts for debris removal were only two pages long and expired after one week of work. These early contracts allowed the City to begin removing debris quickly, yet did not include recycling, subcontracting parameters, or other requirements. Contracts ultimately grew to 22 pages. The City assigned each contractor a grid of streets to clear. City inspectors monitored contractors and kept records to determine whether debris in each area was collected within seven days of being set out. When contractors expended their total contract amounts, City officials placed them at the bottom of the list of approved contractors and called them again when their turns came.

After two months of negotiation, FEMA allowed the City to include recycling as a debris management method. This decision was based primarily on the City's local policy supporting recycling and a recycling pilot that documented a potential 82% recycling rate. Contractors separated wood, metal, soil, concrete and asphalt, and red clay brick. Most of the materials collected were recyclable. Recyclers crushed concrete and asphalt (mixed with up to 15% soil) and sold it for use as sub-base in roads. They reused soil as landfill cover and soil amendment. They ground and screened wood, selling fine pieces by the cubic yard for landscaping and coarse pieces for compost or biomass-to-energy. Recycling facilities either ground up brick for use on baseball infields or chipped it for use in landscaping. Scrap metal dealers recycled metal waste.

The City required its contractors to send all mixed debris to four facilities that were capable of recycling it. Two of them used an automated process that screened out fine debris and sent the remainder along a conveyor belt where workers removed and separated wood, brick, metal, and trash by hand. A vibrating screen removed any soil left in the remaining stream. At the end of the process, only clean concrete and asphalt were left. The facilities were able to recycle approximately 80% of the mixed debris.

City officials also ensured that debris was recycled by providing incentives to haulers. For example, City officials required haulers to develop a recycling plan that included scouting for recyclables and dedicating trucks to a given type of debris, so that debris separated at the curb did not become mixed in the truck. The City also created contract incentives that placed source-separated recycling at a higher priority than mixed recycling. With these efforts, the City expanded its C&D recycling capacity by approximately 10,000 tons per day. Immediately after the earthquake, all debris began to be disposed of in only three landfills. Just over a year later, the City had added 18 recycling facilities and one landfill. This expansion also helped meet a long-term goal to increase recycling of routine C&D materials.

Communication to the Public

Soon after the earthquake, officials announced to the public through various media outlets that they could leave debris for pickup on the street in a pile as wide as a parked car. At first, the City allowed residents to leave mixed debris at the curb, but as the effort progressed, residents were asked to separate concrete and asphalt, soil, red clay brick, wood, and all other material.

Residents had become accustomed to the relaxed requirements that allowed them to set out mixed debris, so City workers distributed door-hangers requesting that residents separate debris. Where residents still did not separate debris into its recyclable components, work crews preceded the debris haulers to separate the debris. When residents placed yard trimmings or other non-earthquake-related debris on the curb, workers left door-hangers explaining why these materials were not picked up and provided directions on how to reuse, recycle, or dispose of it.

The City relied on both residents and City staff to determine which locations needed debris removal. A telephone hotline staffed by multilingual operators accepted residents' requests for debris removal. Staff entered the address of each caller into a GIS-database and regularly produced maps showing areas needing pickups. At the same time, City inspectors supervising the debris management work reported streets where debris was ready for pickup.

Lessons Learned

The Los Angeles program successfully recycled and diverted a high percentage of the debris generated from the Northridge earthquake. Although the efforts were successful, the efforts were reactive because the City did not have a comprehensive disaster debris management plan in place prior to the earthquake. While this approach worked in this instance, other communities may not experience this level of success without a considerable amount of pre-disaster planning. Most communities would find it beneficial to develop a disaster debris management plan if they hope to recycle a reasonably high percentage of the debris generated. Los Angeles attributed its success to quick action and to a high level of participation and cooperation by its residents.

Outside Assistance

In the aftermath of the Northridge quake, the California Office of Emergency Services provided a liaison to FEMA and issued emergency regulations expanding permit hours for solid waste facilities. FEMA funded the debris recycling program, including paying recycling facility tipping fees, as well as the costs associated with hiring data entry staff and contracting with a consultant to manage recycling efforts. In addition, recycling saved the City transportation costs since recycling facilities were closer to the devastated areas and many had shorter lines. California's Integrated Waste Management Board helped Los Angeles obtain this funding by writing a letter to FEMA stating that recycling was state policy. Los Angeles, like every community in California, has been required to submit a plan for source reduction, recycling, and composting under the state's Integrated Waste Management and Litter Reduction Act. FEMA determined that since Los Angeles had a recycling policy prior to the earthquake, the City did not need to demonstrate that recycling would save money in order to obtain FEMA funding.

ALSTEAD, NEW HAMPSHIRE: 2005 FLOODING

During the first week of October 2005, the western part of the State of New Hampshire was subjected to intense flooding and damage. The area received approximately 12-inches of rainfall in a 30-hour period. The inability of existing drainage networks to handle the intense rainfall caused a road embankment to fail resulting in a 30-40 foot high wall of water and debris being

discharged into the valley. The resulting flood resulted in loss of life, damage to private property, destruction of homes and businesses, severe damage to infrastructure, extensive erosion, contamination of drinking water and loss of agricultural productivity.

Collection and Recycling

The local community field in the town became a temporary storage area for flood debris. Materials were sorted into separate piles of tires, wood, cars, metal, and trees. Trees were shredded into wood chips and topsoil was recovered by screening some of the woody debris.

Communication to the Public

Soon after the flooding subsided, the Town of Alstead relied on local television, cell phones, and word of mouth (the small nature of the town made this possible) to inform residents of the magnitude of the flooding and what plans were being put in place to collect debris.

Lessons Learned

The Town found that statutory and rule authority needs to address debris management during and after a disaster. Emergency Permits for temporary facilities were helpful in collecting, processing, and disposing /reuse (CPD) of disaster debris. Proximity of CPD's to the main debris fields and damaged structures was a major factor in siting CPDs. Approval of local land owners may prove to be difficult on a short time schedule during the emergency. Pre-identifying emergency CPDs is extremely helpful so that their site capacity and handling rates can be estimated. It is also necessary to account for any archeological, historic or environmental issues associate with these CPD sites. Modification of existing facility permits, on a temporary basis, was important to handle incoming disaster debris. Among the modifications were the allowance of vegetative material/tree parts to be disposed in landfills with debris and the annual/monthly disposal rates to be exceeded to account for the additional disaster debris.

Pre-planning in the following areas also can save time and money and/or increase the effectiveness of the operations: 1) estimate volumes and types of debris to be encountered, 2) establish debris segregation protocol (including homeowner curbside and separate containers for homeowners and state clean-up debris) prior to the event and communicate with others, e.g. FEMA, ACE, EPA, USCG and Other States, so that there is a minimum of duplication of efforts, 3) pre-identify processing/disposal facilities and capacities (e.g., wood burning power plants for tree/brush/clean wood), and 4) open burning is almost inevitable for some debris; especially trees and brush (pre-identify State Air Agency/EPA requirements for the burns, including air monitoring).

Implementation of clean-up efforts was another area where valuable lessons were learned. These included: 1) trying to have 2-3 weeks of supplies for response staff to be self-sufficient on-site, 2) reviewing debris clean-up projects for any Supplemental Environmental Projects (SEPs) being considered by the enforcement agencies to see if they can be included and/or modified for disaster debris clean-up, 3) reviewing debris types and characteristics and deciding if any special processing tools are relevant (e.g. shaking screens to remove dirt/sediment from

building debris prior to landfill disposal, need for tugs to remove sunk vessels, etc), and 4) making sure that homeowner debris is separate from state/local agency clean-up efforts to simplify FEMA reimbursement.

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Appendix B

Hazardous Waste Bulking Center Overview and Public Information Flyers Used for Debris Management During Hurricane Katrina Clean-up in Louisiana

Orleans Household Hazardous Waste and Hazardous Waste Bulking Center Overview

Updated May 13, 2006 by EPA Region 6

Orleans Household Hazardous Waste and Hazardous Waste Bulking Center (10200 Old Gentilly Rd, New Orleans, LA 70127)

The Bulking Center receives household hazardous wastes (HHW) and hazardous waste (HW) from EPA and US Army Corps of Engineers (USACE) crews. All HHW are shipped off site as non-hazardous after being categorized according to hazard class. The other waste streams handled include commercial and industrial waste streams or products. These are characterized and bulked if possible prior to shipment as hazardous waste. Water/fuel mixtures recovered from automobile gas tanks are bulked.

Introduction to the Pad

The Orleans HHW/HW Bulking Center (the Pad) is laid out to direct vehicles through a counter clockwise route. This allows EPA crews to drop off commercial/industrial waste prior to entering the HHW area. Also for EPA crews collecting ammunition they must drop this material off before moving on to other locations on the Bulking Center. Although the USACE contractors follow the same route, they proceed to the HHW counting station and then are off-loaded in a sorting area, divided according to waste classification categories.

This summary presents a brief description of the stages of unloading and characterization and what to look for at each station.

Site Safety and Evacuation

Three short blasts on the air horn indicate the need to evacuate the area. Immediately stop what you are doing, observe the wind socks and proceed upwind or crosswind to either the front (adjacent to the office trailers) or back (open field off the southeast corner of the) muster location. If you are driving in the beyond the pad entry area and the evacuation alarm sounds, stop and put the vehicle in park, turn it off, and leave the key in the ignition – proceed on foot to the muster location. One long blast on the air horn means “all clear.”

During severe weather alerts the crews will be instructed to move to the concrete building at the rear of the pad near the propane tank storage area. There are doors on the north and south sides of the building.

Air Monitoring

The Superfund Technical Assessment & Response Team (START) contractors maintain and monitor the air monitors which are generally located in the following locations:

1. Oxidizer Section
2. HHW Hazcat Section
3. Flammable/Bulking area
4. Chemical Offloading Pad (2 monitors)
5. Gas Tank Bulking Area/Haz Cat (2 monitors)
6. Special Refrigerator Storage Area
7. HW storage Pad
8. Cylinder Storage Pad

When the Pad is operating with a limited crew, such as on Sunday when no bulking or Hazcat operations are performed, or when a location has no stored wastes, fewer monitors are needed.

The air monitors measure LEL (Lower Explosive Limit), O_2, CO, H_2S, and VOCs. The monitor at the Special Refrigerator Storage Area monitors SO_2 in place of CO. The monitors in the Oxidizer Section and the Hazcat Section also monitor for CL_2 in place of H_2S. The monitors in the Oxidizer Section, Hazcat Section, Gas Tank Bulking Area/HW Hazcat Area and Special Refrigerator Storage Area also have Gas Alert single gas monitors for Ammonia.

All of these monitors are checked every hour, and the current and maximum readings for each parameter are recorded in a logbook. The units are also data loggers and are downloaded at the end of each day.

START contractors will enter the site in the morning and set up the air monitoring stations prior to entry by the crews. START is responsible for completing air monitoring activities. The ERRS crews at a station are aware of the monitors and have been instructed to move away from the area if the alarm on a monitoring location continues to sound. They will notify START of the alarm. Once conditions have improved the crew can continue working in the area.

1. Site Entry

The administrative trailers are at the site entrance. There is a Command Post (EPA/START) trailer and a contractor (Emergency Rapid Responders or ERRS) trailer. All visitors are requested to sign in and out inside the Command Post. This includes the USACE QA staff and contractors working for the ER Group who are not

assigned to the Bulking Center who come on site to drop off firearms and ammunition. This does not include collection crews only dropping off their HHW/HW loads.

Also in this area are "conex" shipping containers with water, Tyvek, gloves, and other supplies near the ERRS trailer. The break area tent for the pad workers is also located in this area. Portable toilets are located just south of the break tent. The large abandoned building on the site is not to be used by the crews.

There is a stop sign at the truck entrance. Beyond this point hard hat, safety glasses and high visibility vest are required. Cell phones and radios should be turned off. Bobcats, large trucks, and other heavy equipment traverse the pad in various directions past this point, so caution is needed.

There two USACE contractors who monitor their trucks coming and going at this point. These contractors are not under our control so we ask that they sign in and out every day to ensure their safety on the site. The USACE contractors check the HHW trucks come in, looking for hazard items which should not have been collected (e.g., biomedical wastes, ammunition) and for mixed incompatible chemicals; feedback is given to the crews to improve the process. The EPA representative should spot-check this QA process and assist in speeding this check during periodic truck backups. Field Observers might also watch here for unstable or unsafe loads coming in to the PAD. This includes leaking containers that are not bagged and liquids spilled inside the bins.

The HHW/HW pad receives items from multiple contractors working for the USACE and EPA. Currently, we are receiving items from Orleans Parish on a daily basis. Items are also received from Jefferson Parish, although this does not appear to be a regular drop-off. EPA crews are also traveling to Plaquemines Parish a few days a week to pickup HHW from the USACE contractors in that Parish at a central location. The USACE contractors delivering items to the HHW collection site include: EE&G, ECC and CERIS (Jefferson Parish). ECC delivers HHW in two trucks; one is a large stake bed truck and the other is a pickup and trailer marked with ES&H.

Field Observer might watch for PPE being donned prior to entry. Safety glasses, hard hats and highly visible vest are required. Gloves should be worn when any waste materials are being handled. There are hand washing/emergency eye washing stations just adjacent to the corrosives

station, at the Hazcat station, at the drum storage facility, at the battery pad, and within the gas tank bulking facility. Additional PPE is required for workers in the HHW Bulking, Fire Extinguisher Station and Gas Tank Bulking Area.

The drivers of the USACE trucks are not allowed to exit their vehicles while in the pad area, except in an emergency.

2. Counting station.

Only HHW loads are counted at this location. For EPA commercial/industrial waste operations, START contractors are responsible for counting the items, which usually involves drums, cylinders and automobile gas tanks. On the way, the trucks pass the following features that will be discussed further along: scrap metal salvage pad, conex boxes for ammunition and weapons, hazardous waste bulking and storage areas, non-freon refrigerant area, and the pad for standard propane cylinders and commercial-size gas cylinders.

The counting station is staffed by one to two START contractors, according to the day and time. The task of the counters is to count and mark each item (HHW) in the incoming truck. Items are counted in three categories; propane tanks, cylinders, and "smalls". The "smalls" are essentially anything that doesn't fall into one of the other categories. Each item is marked with orange spray paint during the count. We do not count empty containers. Our count is for the tracking of the total quantity of material kept out of the municipal landfill. This allows the Pad to keep a tally of items delivered by EPA and USACE contractors. There are two exceptions to counting the loads: one of the larger ECC trucks is counted when it is unloaded due to the size of the load and the way the bins are stacked; and the box trucks, carrying large items, will be unloaded prior to counting. The counters should never count items inside of box trucks because of the potential for fumes to collect inside the trucks.

The START contractors try to get a true item count although some items such as medicines and other small items that would normally be packaged together are estimated or counted as one item. In addition to not counting empty containers, the counters should not count non-HHW items, such as caulking tubes, hair care products, laundry detergents, incandescent light bulbs and numerous other items, that the crews have been clearly instructed not to collect.

3. Chemical Offloading Pad

Trucks go directly from the counting station to the Chemical Offloading Pad. From this area, all chemicals are taken to the various stations around the pad. Typically the workers from each station gather the materials appropriate to their station in order to have the trucks unloaded more quickly. The stations are described later in this document. From the unloading station the trucks leave the Pad for further collections.

Field Observers should look for items placed in the wrong area, such as waste oils placed on paint pallets, cylinders placed in the wrong holding area (oxygen with flammables) and miscellaneous leaking containers placed in with the leaking paint boxes.

For all areas at the end of the shift the workers should cover with plastic sheeting any items that were not processed and close the lids on any drums or boxes.

4. Household Hazardous Waste and Commercial/Industrial Waste Stations

This is a summary of HHW/HW stations on the Pad, and the procedures at each station. Stations are discussed in counterclockwise order following the route of the truck.

a) Shipping Pad

Bulked waste drums, overpack drums, and waste in Gaylord boxes are stored on a center-draining concrete pad which has a sealed drain. These containers are taken to Phillips Services in Houston, TX. Field Observes should check the condition of the containers and verify that commercial/industrial waste is being handled properly.

b) Fire Extinguisher Station

Here fire extinguishers are emptied, some of them are crushed others are placed directly into a scrap metal roll off bin.

Caution: Some halon extinguishers are designed for high release rates, presenting a high danger; crew members at this station should be reminded to never attempt to discharge them. These units do not have hand-

held triggers. All halon units are now stored in a Gaylord box for delivery to a facility where they can be safely exhausted.

Fire extinguishers are unloaded at the Chemical Offloading Pad and placed in pallets with plywood sides. They are then taken by forklift to the Fire Extinguisher Pad for processing. The powder is placed in a Gaylord box (cardboard 1-cubic-yard box). The powder is taken to Phillips Services in Houston, TX.

c) Scrap Salvage Station

The scrap salvage "crushing" station is located on the west side of the scrap metal roll-off bin. Empty metal containers such as gasoline tanks, fire extinguishers, insulation cylinders, and drums are crushed and placed in the scrap bin. The scrap metal is taken to Southern Scrap. Plastic tanks and drums are also crushed here before placement in the trash roll off bin.

Field observers should watch that the area is roped off during the time the crew is crushing empty containers and that containers are empty.

d) Ammunition and Weapons Storage

Ammunition and weapons are stored but not processed here. Field Observers should make sure the boxes are locked and have "Flammable" placards. The area should be kept picked up, no open containers and no trash in the area. The boxes are moved in and out as needed for disposal. These items are brought in by the Emergency Response Branch teams. The ammunition is taken by Clean Harbors.

e) Battery Storage Area

Batteries are placed on pallets in the HHW unloading pad and full pallets are transferred to the storage pad which is located on the west edge of the site. The batteries are periodically picked up by Interstate Battery Company.

f) Gas Tank Bulking and Commercial/Industrial Waste Storage/Hazcat Operations

Automotive gasoline/diesel tanks are unloaded into the building or on the concrete pad located on the north end of the building. Empty tanks are unloaded directly in the scrap salvage area. The fuel is bulked into drums which are transferred to the drum shipping pad. The empty tanks are then crushed and placed in the scrap metal roll-off. Oil can also be bulked in this area. The observer should make sure that tanks with fuel have all but one of their lines duct-taped in order to prevent spillage or vapor buildup. Hazardous waste (HW) Hazcat testing is also performed in the building.

The HW storage area is located across the road (west) from the gasoline bulking area. Drums are stored here until they are categorized. After Hazcat testing, they are transferred to the drum storage/shipping pad for shipping. The observer should watch for leaking drums and tears in the liners. Drums placed here should have a tracking ("T") number marked on them; START also marks these drums with a "D" number for tracking purposes.

g) Special Refrigerator Storage Area

Special refrigerators use non-freon refrigerants. Two common refrigerants are sulfur dioxide and ammonia. Like ammunition and firearms, special refrigerators are not processed here. They are only stored until a full load is accumulated; then they will be shipped off site for disposal. Special units include: Sulfur dioxide, ammonia, methyl formate, R-113, and R-23. Based upon information in the NIOSH guide, SO_2 units should be segregated from the ammonia units. Units should be stored in an orderly manner. Units are only accepted from one of our crews. Dumas (an ERRS subcontractor) periodically picks up these units.

h) Tank/Cylinder Pad

Pressure tanks and cylinders (e.g., propane, Freon, oxygen, acetylene) are accumulated here.
Propane tanks are off-loaded at the Chemical Offloading Pad and then taken by wagon to the Tank/Cylinder Pad where they are

accumulated prior to being placed on pallets, secured with plastic wrap, and made ready for shipment. These cylinders pallets are stored just east of the pad and are picked up by Blue Rhino.

Containers of Freon gas are handled by the same contractor, Dumas, who does the extractions at the White Goods area. The empty containers are then returned to the site and crushed. The Freon contractor cannot take cylinders without a label. These should be separated for alternative disposal.

Miscellaneous small tanks (insulation, pesticides, and adhesives) are also stored at this location prior to disposal.

Commercial-size cylinders are stored into segregated areas, grouped as flammables, non-flammables, oxidizers and unknowns. Commercial cylinders should have T-numbers marked on them by the collection crews prior to being dropped off at the pad. START will add a C-number at the pad. These numbers are used to track the items into and out from the Pad Site. If the cylinders have owner labels, owners are contacted and asked to retrieve their property. Orphan oxygen and carbon dioxide cylinders will be vented on site; orphan propane cylinders are burned off in the northwest area of the site using large gas cooking burners with pots of water.

Field observers should observe whether the tanks/cylinders are being handled and segregated in a safe manner. Aisle space should be left between the propane pallets to allow access to the containers.

i) Bulking Pad

Oil, antifreeze, poisons, and flammable liquids are bulked here. Most poisons to be bulked arrive in unmarked sprayers (the manual pump insecticide sprayers). The containers first go through the Hazcat station to make sure their contents are compatible. Flammable liquids to be bulked include various oils and gasoline that arrives in gas cans. The flammable liquid drums are grounded to prevent sparking.

Potential issues for a Field Observer to keep in mind here is the potential for some incompatible material to be mixed in with the gasoline and other flammable materials. Gasoline tanks are assumed to contain gasoline, but other uses are possible. Proper grounding of bulking tanks is important to avoid buildup of static electricity. In addition to the protective clothing worn by all pad workers, this area requires respirators and splash aprons. In addition, workers should attempt to bulk and secure all material received at this pad prior to leaving for the night.

j) Hazardous Waste Categorization (Hazcat)

This section is where unknown materials are separated into broad categories according to their hazard class (as opposed to specific chemical make-up). The Hazcat station workers may wear Level C PPE during some categorization.

The purpose of the hazard categorization (Hazcat) and segregation is to pack and bulk items for shipping and prevent incompatible chemicals from being packed and shipped together. Incompatible chemicals might react with each other during shipment and cause fire, toxic vapors, explosions, or other dangerous reactions.

Actual identification of each and every chemical is not required in order to pack products for shipping, and, given the large number of items passing through this facility, such identification is not practical.

With minor modifications specific to this site, personnel at the Hazcat station at this pad follows procedures outlined in the Environmental Quality Management, Inc., Standard Operating Procedure.

Because this analysis is conducted outdoors, fume hoods are not required.

1. Sample Documentation: Record color, clarity, and other physical description of the sample.

2. Air Monitoring: Screen the sample with a PID (Photo Ionization Detector) or FID (Flame Ionization Detector) to help identify volatile compounds in the sample.

3. Solubility Testing: Water will be used for solubility testing at this site.

4. Density Test: Used for insoluble compounds. Recorded as lighter or denser than water.

5. Sample Reactivity: Air reactivity is observed upon opening the sample prior to hazcat testing. Air reactivity is normally a result of a reaction with moisture in the air.

6. Water Reactivity is noted during water solubility testing.

7. pH Test: pH is tested during water solubility testing. The pH strip is first immersed in water to wet it. The strip is then placed in the sample. The strip color is compared against a chart.

8. Peroxide Test: Flammable solvents should be tested for the presence of peroxides. Peroxide strips are used for this test. The strips should be quality control checked daily by immersing them in hydrogen peroxide.

9. Oxidizer Test: This test also uses a test strip. The strip is wetted and one drop of 5% HCl is added to the strip. If oxidizers are present, the strip will turn a blue-black color. These strips should be quality control checked daily.

10. Cyanide Test: The cyanide test is available here, but is not normally run because cyanide is not a common household chemical.

11. Sulfide Test: Add sample to the test kit tube, add a few drops of HCl. After agitation the lead acetate paper will turn blue-black if sulfides are present.

12. The Bielstien Test: This test is used to determine if solvents are chlorinated solvents. The test will not be run at this site.

13. Flash Point: A small portion of the sample is added to a watch glass. A lighted match is then held near the sample. If it lights, it is definitely flammable. If the match has to touch the sample to light it, flash point is approximately 140° F. If it takes longer than a second to light the sample the flashpoint is over 140° F.

k) Oxidizer Area

This area is at the south end of the bulking/sorting tables located behind the unloading area. This area receives oxidizers including bleach, certain pool chemicals, and peroxides. These chemicals give off oxygen and can cause or enhance the combustion of other materials. Chemical names ending in “ate” or “ite” such as chromate or nitrite, or beginning with “per” or “peroxy” indicate oxidizers.

Note that older pool treatment chemicals might be hypochlorite, an oxidizer, while newer pool chemicals may be organic chlorinators such as isocyanurates (cyanuric acids), which are incompatible with hypochlorites, strong bases, and strong acids!! This is an example of products that might be purchased for the same purpose, but are not compatible.

l) “Household” Section

This is not a DOT category, but this section sorts chemicals from a wide variety of household products into the appropriate containers. Acids and alkalines are packed separately. Many products fall into a broad category called “paint-related materials” or PRM. These are boxed as non-hazardous (for example, latex paint or caulking) if they don’t contain hazardous chemicals, or drummed as flammable if oil-based or containing flammable liquids like alcohols.

Sometimes seemingly-related materials need to be put in separate categories. For example, automobile windshield fluid is a flammable PRM because it contains methanol, while Windex is an alkaline because it contains ammonia. Another example is toilet bowl cleaner, which may be either a strong acid or a strong base. All HHW is shipped to Phillips Services in Houston, TX.

m) Poisons

The term "poison," according to the DOT classification, simply means that it has been classified as toxic even in small doses. Products may contain the word "poison" in the warning label as a warning against ingestion, but not necessarily fall under the DOT classification. Common vaporous products found in this section are insecticide gasses, solvents, isocyanates, refrigerants, and chlorinated materials under pressure. These items should either be capped, or have their spray nozzle heads removed prior to packing.

Poisons in solid form may include medicines (frequently in prescription pharmacy containers), pesticides & herbicides (like powders or granules in bags). Reactive chemicals such as corrosives and oxidizers should be kept separate from these materials.

Various drums and lined Gaylord boxes are located behind these tables for the various categories of waste.

n) Flammable Section and Paints

This section separates flammable solids, liquids, and aerosol cans into appropriate containers. Flammable liquids should be packed in drums if leaking.

Paints are palletized according to latex or oil, and transported to the front of double-lined roll-off containers (one for oil, one for latex). Oil paint cans are transported to a facility to be crushed, and the paint used to make a fuel. Latex is dried and disposed. Cans are recycled.

o) Batteries

Automotive Batteries are palletized. They are wrapped in yellow chemical resistant absorbents if open or leaking. Full pallets are stored on the west edge of the facility for pickup.

Small Batteries are separated and drummed depending on the type.

p) First Aid and Emergency Showers

The first aid station is located on the left side as you enter the HHW/HW operations, just outside the exclusion zone. One emergency shower and eye wash station is located next to the first aid station. The other one is located in the drum storage building. Other emergency eye wash stations are located near the Corrosives (battery), Hazcat, Oxidizers, and Gas Tank Bulking stations. One first aid responder is on site at all times of operation.

St. Tammany Parish

HOUSEHOLD HAZARDOUS WASTE DROP-OFF

Final Dates for Drop-off at EPA Sites - Now through DECEMBER 20

- **CLEANERS (such as bleach and ammonia)**
- **ROACH & OTHER PEST KILLERS**
- **PAINT & WORKSHOP SUPPLIES**
- **AUTOMOTIVE PRODUCTS**
- **FLAMMABLE PRODUCTS (such as oil, gas and propane)**
- **LAWN & GARDEN PRODUCTS**
- **OTHER HOUSEHOLD CHEMICALS**
- **FLUORESCENT LIGHTS**
- **THERMOMETERS**
- **BATTERIES**
- *Televisions, computers and other electronics will also be collected.*

DROP-OFF LOCATIONS AND SCHEDULE:

Western St. Tammany Parish
Open 8 am to 4 pm Monday through Friday (last day for drop-off December 20)
Mandeville High School – To access the site, take the West Causeway Approach to Mandeville High Boulevard. Take Mandeville High Boulevard to the circle at the end of the road – look for yellow signs.

Northern St. Tammany Parish
Open 8 am to 4 pm Saturday, Sunday and Wednesday (last day for drop-off December 18)
Near Parish Jail in Covington – To access the site, take Columbia St. to Champagne St. and follow signage.

Eastern St. Tammany Parish
Open 8 am to 4 pm seven days a week (last day for drop off December 20)
Near Slidell, eastern gate of Camp Villere – To access the site, take US Hwy 11 to Browns Village Road just north of I-12. Drive about two miles west following signs until you reach the end of paved road at the East Gate of Camp Villere. Drop-off site is just inside the gate on the left.

At household hazardous waste collection centers, we CANNOT accept: commercial or industrial waste, medical waste, building materials, vegetation, debris, and large appliances.

For more information on household hazardous waste disposal, call EPA at **1-800-401-1327** (prior to December 20) or the St. Tammany Parish Environmental Service at 985-898-5243 (after December 20). For questions on ammunition, guns or explosives, call 817-233-2757.

* Large appliances (white goods) should be placed curbside. Do not take them to drop off locations.

St. Tammany Parish

LARGE APPLIANCES (WHITE GOODS) FREE CURBSIDE PICK-UP

Items Must be Curbside by JANUARY 2, 2006

- **AIR CONDITIONERS**
- **REFRIGERATORS and FREEZERS**
- **STOVES AND OVENS**
- **MICROWAVE OVENS**
- **DISHWASHERS**
- **WASHERS AND DRYERS**
- **WATER HEATERS**
- *Televisions, computers and other electronics will also be collected.*

➢ **TO ENSURE A CURBSIDE PICK UP, OR FOR FURTHER INFORMATION ON COLLECTION, CALL THE EPA HOTLINE AT 1-800-401-1327.**

➢ You MUST place all items at the side of the road (Collectors CANNOT pick up white goods on private property). Do not place items in a ditch or on the road.

➢ Items must be curbside by **January 2, 2006**. Crews will begin to pick up white goods and electronics on January 3, 2006.

➢ This will be the final pick up of white goods in St. Tammany Parish by EPA and the Army Corps of Engineers.

United States Environmental Protection Agency
Office of Solid Waste
EPA530-K-08-001
www.epa.gov/osw
March 2008

Public Assistance

Debris Management Guide

FEMA-325 / July 2007

FEMA

Foreword

The Federal Emergency Management Agency (FEMA) encourages State and local governments, tribal authorities, and private non-profit organizations to take a proactive approach to coordinating and managing debris removal operations as part of their overall emergency management plan. Communities with a debris management plan are better prepared to restore public services and ensure the public health and safety in the aftermath of a disaster, and they are better positioned to receive the full level of assistance available to them from FEMA and other participating entities.

The core components of a comprehensive debris management plan incorporate best practices in debris removal, reflect FEMA eligibility criteria, and are tailored to the specific needs and unique circumstances of each applicant. FEMA developed this guide to provide applicants with a programmatic and operational framework for structuring their own debris management plan or ensuring that their existing plan is consistent with FEMA's eligibility criteria. This framework:

1. Identifies and explains the debris removal eligibility criteria that applicants must meet in order to receive assistance under the FEMA Public Assistance (PA) Program
2. Provides a blueprint for assembling an effective and responsive plan for the entire debris management cycle
3. Outlines the FEMA Public Assistance debris removal organizational structure and strategy

We encourage local officials to review their community's vulnerability to a disaster and to consider how to manage large-scale debris clearance, removal, and disposal operations should the need arise. Your State emergency management agency and the FEMA regional office may provide additional technical assistance in your area.

An electronic version of this guide is available on FEMA's website at fema.gov. **Because this document is not exhaustive and the provisions are subject to modification, consultation with the State and FEMA may be necessary.**

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PART I – PUBLIC ASSISTANCE ELIGIBILITY

Part I – Public Assistance Eligibility

Introduction

The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended, 42 U.S.C. § 5121, et seq. (hereinafter referred to as the Stafford Act), authorizes the FEMA Public Assistance Program to award Federal funding to State and local governments, Federally recognized tribes, and eligible private non-profit organizations in order to assist them in their disaster response and recovery activities. Specifically, the Program provides assistance for debris removal, implementation of emergency protective measures, and permanent restoration of eligible facilities and infrastructure.

A fundamental goal of the Public Assistance Program is to ensure that everyone shares a common understanding of the Public Assistance Program policies and procedures. To support this goal, FEMA has undertaken an effort to provide its State, tribal, and local partners with more and better information about the Public Assistance Program. Part I describes the Public Assistance Program's basic debris eligibility criteria and is intended to be a reference for planning and recovery purposes.

This document provides a summary of the eligibility criteria specifically for debris removal operations. For a more comprehensive understanding of the Public Assistance Program, additional information regarding FEMA Public Assistance policies, Fact Sheets, and guidance materials, including *FEMA 321 – Public Assistance Policy Digest, FEMA 322 – Public Assistance Guide, and FEMA 323 – Public Assistance Applicant Handbook, c*an be obtained online at fema.gov.

Chapter 1 – Public Assistance Debris Removal Eligibility

Chapter Highlights

Public Assistance Grant Program
General Eligibility Criteria
- Definition of Eligibility
- Grantee/Subgrantee
- Facility
- Work
- Public Interest
- Reasonable Cost

Environmental and Historic Preservation Special Considerations
- National Environmental Policy Act
- Executive Orders

Duplication of Benefits
- Other Federal Agencies
- Insurance Settlements
- Salvage Value

Public Assistance Grant Program

The Federal government may provide grants through the Public Assistance Program to reimburse the response and recovery efforts of an applicant (State and local governments, and certain private non-profit organizations) for Presidentially declared disasters. To receive supplemental disaster assistance under the Public Assistance Program, applicants must meet FEMA eligibility criteria.

An applicant may conduct debris operations in any manner it deems appropriate. However, only costs associated with applicants, facilities, and work deemed eligible according to FEMA eligibility criteria and complying with special consideration requirements are reimbursed under the Public Assistance Program. Therefore, these eligibility criteria and special consideration requirements should be taken into consideration by the applicant when developing its debris management plan.

General Eligibility Criteria

Definition of Eligibility

Eligible means qualifying for and meeting the stipulated requirements of the Public Assistance grant. The term eligible can be applied to applicants, facilities, work, and costs.

Eligibility is based on a hierarchy of statute, regulations, policies, fact sheets, guidance documents, and disaster-specific documents:

- **Statute** is the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. § 5121 et seq. (Stafford Act), the authority governing the Public Assistance Program.
- **Regulations,** which are published in 44 Code of Federal Regulations (CFR), Parts 13 and 206, implement and interpret the statute.
- **Policies** are written to apply the statute and regulations to specific subjects and situations.
- **Fact Sheets, guidance documents, and disaster-specific documents** provide clarification and detailed explanations of issues and concerns.

The terms **ineligible** or **not eligible** are used to indicate the applicant, facility, work, or cost does not qualify for a Public Assistance grant.

Grantee/Subgrantee

Grantee means the government, usually the State, to which a grant is awarded by the Federal government and is accountable for the use of the funds provided.

Subgrantee (applicant) is the entity to which a subgrant is awarded and is accountable to the grantee for the use of the funds provided. Four types of subgrantees are eligible for Public Assistance grants:

1. State government agencies, such as:

    - State department of transportation
    - State environmental resources agency
    - State parks agency

2. Local governments, such as:

    - Towns, cities, counties, boroughs
    - Municipalities, townships
    - Local public authorities

3. Private Non-Profit (PNP) organizations or institutions that own or operate facilities that provide certain services otherwise performed by a government agency. Eligible facilities are limited to:

    - Educational
    - Emergency
    - Medical

- Utility
- Custodial care
- Irrigation
- Other essential governmental services, which are open to the general public and do not fall into one of the categories described above include community centers, rehabilitation facilities, homeless shelters, libraries, museums, senior citizen centers, shelter workshops, zoos, performing arts facilities, community arts centers, and health and safety services of a governmental nature.

4. Federally recognized Indian Tribes or authorized tribal organizations and Alaskan Native village organizations. This does not include Alaska Native Corporations, which are owned by private individuals. Indian Tribal Governments may serve as a grantee instead of a subgrantee.

Since this document speaks specifically to debris issues, it is assumed the city, county, township, or other governing body will take responsibility for planning and implementing the debris operations. The terms "jurisdiction" and "governing body" are used to indicate the eligible applicant planning or implementing the debris management operation.

Facility

A facility is any publicly or privately owned building, works, system, or equipment, built or manufactured, or an improved and maintained natural feature. Land used for agricultural purposes is not an eligible facility. The eligible facility must be located in the designated disaster area and must be the legal responsibility of an eligible applicant.

Work

FEMA characterizes work eligible for Public Assistance grants as either emergency or permanent work. These are classified into seven different categories identified by letters A through G. This document discusses only emergency work, Category A – Debris Removal and Category B – Emergency Protective Measures. To be eligible, an item of work must meet all of the following:

- Be required as a result of the disaster event;
- Be located within a designated disaster area, except that sheltering and evacuation activities may be located outside of the designated disaster area; and
- Be the legal responsibility of an eligible applicant.

Public Interest

Eligible debris work must be in the public interest, which is defined as work necessary to meet the following:

- Eliminate immediate threats to life, public health and safety;
- Eliminate immediate threats of significant damage to improved public or private property;
- Ensure economic recovery of the affected community to the benefit of the community-at-large; or
- Mitigate the risk to life and property by removing substantially damaged structures and associated appurtenances as needed to convert property acquired through a FEMA hazard mitigation program to uses compatible with open space, recreation, or wetlands management practices.

Reasonable Cost

A reasonable cost is defined by the Office of Management and Budget (OMB) Circular A-87, *Cost Principles for State, Local, and Indian Tribal Governments* and Circular A-122, *Cost Principles for Non-Profit Organizations*, as a cost which in its nature and amount does not exceed that which would be incurred by a prudent person under the circumstance prevailing at the time the decision was made to incur the cost. Considerations include evaluating historical costs for similar work, analyzing costs for similar work in the region, reviewing published unit cost data for the work, or comparing costs with the FEMA Schedule of Equipment Rates and Cost Codes. The source of costs may include: the applicant's force account labor, equipment, and materials; contracted services; and mutual aid agreements. Costs are discussed further in Chapter 2, *Costs*.

Environmental and Historic Preservation Special Considerations

State and local regulations, laws, and ordinances need to be addressed and followed for all environmental and historic preservation issues.

FEMA uses the term "special considerations" to describe issues other than basic program eligibility that affect the scope of work and funding for a project. Applicants have a critical role in identifying and resolving special considerations issues. The applicant should assist FEMA by identifying the issues as early as possible and providing the information necessary for review. A brief description of environmental and historic preservation special considerations that relate to debris operations are set forth below.

National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires every Federal agency to follow a specific planning process to ensure that agency decision-makers and applicants have considered and the general public is fully informed about, with the opportunity to comment on, the environmental consequences of a Federally funded action. This review and consultation process is used to evaluate the impact a project and its alternatives may have on the environment. The review process required by NEPA is usually the vehicle through which FEMA addresses other environmental laws and regulations; however, FEMA is provided with statutory exclusions under Section 316 of the Stafford Act. These exclusions exempt certain actions from the NEPA review process and generally include debris removal, clearance of roads, and demolition of unsafe structures. If an action is not statutorily excluded, the appropriate level of NEPA review must be determined. FEMA makes the statutory exclusion determinations.

It should be noted that compliance with other individual laws such as the Endangered Species Act, the National Historic Preservation Act, the Clean Air Act, and the Clean Water Act is still required, even when a project is statutorily excluded from NEPA review. Environmental laws and regulations that may impact debris operations are briefly described in the following sections.

Clean Water Act

The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States. It makes it unlawful for any person to discharge any pollutant from a specific source into navigable waters, unless a permit was obtained under its provisions. Through Section 404 of CWA, permits are required to discharge dredged and fill materials into waters of the United States, including wetlands.

Section 402 of CWA implements the National Pollutant Discharge Elimination System, which establishes a permit program controlling water pollution by regulating point sources that discharge pollutants into the waters of the United States.

Debris removal projects such as dredging, demolition, and construction and operation of sites used for debris management must comply with the requirements of CWA as administered by the Federal, State, or local regulatory agency.

Clean Air Act

The Clean Air Act was established to protect the nation's air through the reduction of smog and atmospheric pollution. Several State and local governments have enacted similar legislation, either implementing Federal programs or implementing more stringent air quality requirements within their jurisdictions.

Projects that are funded under the Public Assistance Program such as debris clearance, removal, disposal, recycling, reduction, and demolition, must comply with the air quality standards required by the Federal, State, or local regulatory agencies.

Coastal Barrier Resources Act

The Coastal Barrier Resources Act (CBRA) restricts Federal expenditures and financial assistance that encourage development of coastal barriers so that damage to property, fish, wildlife, and other natural resources associated with the coastal barrier is minimized. Coastal barriers are located along the Atlantic and Gulf Coasts and along the Great Lakes. They are identified on FEMA's Flood Insurance Rate Maps as Coastal Barrier Resources System (CBRS) units.

Costs for debris removal and emergency protective measures in designated CBRS units may be eligible for reimbursement under the Public Assistance Program provided the actions eliminate an immediate threat to lives, public health and safety, or protect improved property.

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) requires safe disposal of waste materials, promotes the recycling of waste materials, and encourages cooperation with local agencies. It applies to disposal of disaster-generated debris and is of particular concern when hazardous materials may be present.

Endangered Species Act

The Endangered Species Act (ESA) prohibits Federal actions that cause unnecessary harm to species listed as threatened or endangered, or the destruction or adverse modification of the habitat for these species. Endangered species include mammals, fish, birds, reptiles, and amphibians, as well as plants and insects. If a project involves the known habitat of a threatened or endangered species, FEMA must consult with the United States Fish and Wildlife Service and the National Marine Fisheries Service before approving funding for that project.

National Historic Preservation Act

The National Historic Preservation Act (NHPA) requires Federal agencies to take into account the effects of their undertakings on historic properties. Federal agencies must consult with parties who have an interest in the effects of the undertaking in order to identify the affected historic properties, assess the effect of the undertaking on historic properties, and seek ways to avoid, minimize, or treat any adverse effects on historic properties. FEMA complies with NHPA and its implementing regulations in 36 CFR Part 800, either by executing Statewide programmatic agreements or by following standard regulatory procedures, commonly referred to as the Section 106 Process.

Historic properties include districts, buildings, structures, objects, landscapes, archaeological sites, and traditional cultural properties that are included in, or eligible for inclusion in, the National Register of Historic Places. These properties are not just old buildings or well-known historic sites, but places important in local, State, or national history. Facilities as diverse as bridges and water treatment plants may be considered historic. The National Register of Historic Places is a list of recognized historic properties. However, this list is not complete, and States may have additional properties with historic significance. Through the use of programmatic agreements, FEMA has delegated the identification and evaluation tasks to State Historic Preservation Officers (SHPO) in many States.

Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) encourages the management of coastal zone areas and provides grants to be used in maintaining coastal zone areas. It requires that Federal agencies be consistent in enforcing the policies of State coastal zone management programs when conducting or supporting activities that affect a coastal zone. It is intended to ensure that Federal activities are consistent with State programs for the protection and, where possible, enhancement of the nation's coastal zones.

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act authorizes the United States Fish and Wildlife Service to administer programs for the planning, development, maintenance, and coordination of State wildlife resource conservation and rehabilitation. If a proposed project would destroy wildlife habitat or modify a natural stream or body of water, it requires an evaluation of that action's impact on fish and wildlife.

Wild and Scenic Rivers Act

The Wild and Scenic Rivers Act (WSRA) was established by Congress to preserve selected rivers in its free-flowing condition in order to protect the water quality and fulfill other national conservation purposes. These rivers are considered protected, much like a national wildlife refuge. Federal agencies may not fund projects that would have a direct and adverse effect on the values for which a river was designated. If a proposed project is located on a river designated as wild and scenic, FEMA must review it for compliance with WSRA.

Executive Orders

In addition to the laws described above, several Executive Orders (EOs) issued by the President also affect Public Assistance Program projects. The EOs that most frequently affect the Public Assistance Program are the following:

EO 11988 requires Federal agencies to undertake certain responsibilities for floodplain management. FEMA's procedures for complying with this EO are outlined in 44 CFR Part 9.

EO 11990 outlines the protection of wetlands and requires a planning process that considers alternatives and evaluates impacts to wetlands. The process for complying with this EO is similar to that for complying with EO 11988 and is outlined in 44 CFR Part 9.

EO 12898 requires Federal agencies to evaluate actions for disproportionately high and adverse effects on minority or low-income populations and to find ways to avoid or minimize these impacts where possible. Field personnel should identify any neighborhoods or communities with minority or low-income populations.

Duplication of Benefits

In accordance with Section 312 of the Stafford Act, no applicant will receive assistance for any loss for which financial assistance has been received under any other program or from insurance or from any other source. Therefore, the use of Federal or State funds, insurance settlements, and other grants or cash donations granted for the same purpose constitutes a duplication of benefits.

Other Federal Agencies

If another Federal agency has the authority to provide an applicant with assistance for debris removal operations, FEMA cannot provide funds for that project. Applicants should pursue funding assistance offered through those agencies.

The Federal Highway Administration (FHWA), United States Army Corps of Engineers (USACE), National Resources Conservation Service (NRCS), Environmental Protection Agency (EPA), Department of Housing and Urban Development (HUD), and United States Coast Guard (USCG) may provide assistance to applicants for certain debris removal activities. Applicants must become aware of the agencies' roles, responsibilities, and jurisdictions to ensure a duplication of benefits does not occur between other Federal agencies and FEMA. Descriptions of other Federal agencies and their programs are found in Appendix G, *FEMA RP9580.202, Fact Sheet: Debris Removal - Authorities of Federal Agencies*.

Insurance Settlements

Insurance policies that include coverage for debris removal activities are potentially a duplication of benefits. The applicant should contact its insurance provider for a statement of loss to determine the amount of insurance settlement related to debris removal. The insurance settlement is reflected in the Public Assistance grant as a line-item credit against the eligible cost for the project.

Similarly, applicants should be aware that some residents within a declared disaster area may obtain funds for removing debris from their property through their homeowner insurance or

under the FEMA Individual Assistance (IA) Program. Should residents receive funds under the IA Program or insurance proceeds for the removal and disposal of debris from their properties, but also place debris at the curbside rights-of-way, the applicant should make a concerted effort to collect the proportionate cost of the curbside removal from those residents in an effort to comply with Section 312 of the Stafford Act.

While FEMA understands that this could become an arduous task, applicants can put in place protocols to inform residents that receiving a benefit for the same purpose from the Federal government or any other source is in violation of Federal law.

When applicants receive reimbursements from residents for the cost of curbside collection, applicants are required to report the total amount of proceeds collected from those residents to FEMA. The Federal share of the Public Assistance grant is calculated after the reimbursement proceeds are reduced from the total cost of the curbside collection.

Salvage Value

Applicants may choose to recover materials from disaster debris for beneficial uses. Applicants may sell materials such as metals, woody debris, concrete, masonry, or other types of debris to recyclers, to the construction or agricultural industry, or to energy generators. The salvage value for various recyclable or reusable debris materials depends on the regional recycling markets.

Applicants that sell disaster debris for a salvage value must offset the cost of the eligible debris removal work by the revenues received from the sale of the debris. Applicants must document and report to FEMA the revenues obtained through the sale of debris materials. Public Assistance grant funding is limited to the Federal share of the difference between the amount of revenue received and the cost of the debris removal.

Applicants that contract for debris removal may allow the contractor to take possession of the recoverable debris materials. This type of agreement must take into account the salvage value, and the applicant should negotiate a credit to reflect this value within the terms of the contract. The sale of the recoverable disaster debris materials should offset the cost of the contracted services.

Chapter 2 – Costs

Chapter Highlights

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- Labor
- Equipment
- Documentation

Mutual Aid Agreements

Contract Services
- Competition
- Methods of Procurement
- Types of Contracts

Other Considerations
- Contract Scope of Work Recommendations
- Piggyback Contracts
- Prohibited Contracts

Additional Contract Requirements

Applicant Resources

Eligible work accomplished with an applicant's own labor, equipment, and materials may be funded under the Public Assistance Program. An applicant's employees' labor and an applicant's equipment are called force account labor and force account equipment, respectively. It is important for the applicant's staff to document hours worked and equipment used to complete the eligible work.

Labor

For debris removal work, overtime labor costs (including benefits) are eligible for permanent employees, reassigned employees, and seasonal employees used during the season of anticipated employment. The cost of straight-time labor costs (including benefits) of an applicant's permanently employed personnel are not eligible in calculating the cost of eligible emergency work, which includes debris removal. Straight-time and overtime is determined in accordance with an applicant's pre-disaster policies, which should be applied consistently in both disaster and non-disaster situations.

Both straight-time and overtime labor costs are eligible for non-budgeted employees assigned specifically to perform emergency work.

Please refer to Appendix G, *FEMA RP9525.7, Labor Costs - Emergency Work* for specific eligibility guidance regarding labor costs for permanent, temporary, essential, reassigned, and seasonal employees.

Equipment

Reimbursement for the use of force account equipment is limited to the time the equipment is actually in use. Standby and idle time are not eligible for Public Assistance grant funding.

Force account equipment may be reimbursed at an hourly rate. This hourly rate typically includes the operation, depreciation, maintenance, and fuel for that particular piece of equipment, but does not include operator labor cost. FEMA publishes a FEMA Schedule of Equipment Rates, which is available online at fema.gov.

FEMA may recognize State equipment rates. Applicants that use rates established under State guidelines in their normal day-to-day operations may use State rates up to $75 per hour upon Public Assistance Program approval of the cost development methodology. Rates over $75 per hour may be approved by FEMA on a case-by-case basis.

FEMA may also recognize an applicant's use of rates developed by a local government in their normal day-to-day operations. Reimbursement is based either on the local rates or the FEMA Schedule of Equipment Rates, whichever is less. If the local rate is lower and the applicant certifies that the local rate does not reflect the actual cost, the FEMA Schedule of Equipment Rates may be used.

Documentation

Appendix C, *FEMA Forms* are frequently used to document work completed with force account labor and equipment. The FEMA summary record forms provide the minimum information required for Public Assistance grant reimbursement consideration. These summary record forms are not required forms; the applicant may use its own forms or accounting summary, or alter the FEMA forms to fit its needs, as long as the minimum information required is provided.

Applicants are required to maintain source documentation such as timesheets, work logs, and equipment use sheets, that show the work was disaster-related and support the hours claimed on the force account summary forms submitted for the project.

Mutual Aid Agreements

Applicants may have agreements with other jurisdictions and agencies for the provision of debris management services in the event of an emergency. The employees of the entity providing supplemental assistance are considered as extra hires or contract labor; therefore, both straight-time and overtime are eligible. FEMA will reimburse mutual aid costs provided that:

- The assistance is requested by the receiving applicant;

- The work performed is directly related to the disaster and is otherwise eligible for FEMA assistance;
- The entity that received the aid incurred a cost for that aid, i.e. the providing jurisdiction or agency bills the receiving applicant for the service;
- Provision of services under the agreement are not contingent upon declaration of a major disaster or emergency by FEMA; and
- The requesting and providing entities can provide documentation of rates and payment for services.

FEMA RP9523.6, Mutual Aid Agreements for Public Assistance and Fire Management Assistance contains additional information on mutual aid agreements and is available online at fema.gov.

Contract Services

An applicant may hire a contractor to perform such work as debris clearance, removal, disposal, reduction, recycling, and/or monitoring. Public Assistance grant funding is limited to the scope of work necessary to remove debris that is an immediate threat to life, public health and safety, or poses an immediate threat of significant damage to improved public or private property. Moreover, the costs must be reasonable for the respective scope of work in order to be eligible for Public Assistance grant reimbursement. The procurement of the contract is subject to all provisions of 44 CFR Part 13. The full text of 44 CFR Part 13 is available online through the United States Government Printing Office at gpoaccess.gov.

Appendix G, *FEMA RP9580.4, Fact Sheet: Debris Operations - Clarification: Emergency Contracting vs. Emergency Work* should be reviewed by the applicant and taken into consideration when soliciting contractors.

Contracts must be of reasonable cost, generally must be competitively bid, and comply with Federal, State, and local procurement standards. FEMA will reimburse only fair and reasonable costs of any contract an applicant enters into. An applicant must consider costs, conflicts of interest, and all Federal, State, and local laws and regulations when hiring a contractor.

Compliance with local procurement practices and the procurement competition requirements specified in 44 CFR Part 13.36 are essential to successfully receiving Public Assistance grant funding. The Federal procurement regulations ensure that applicants procure contracts in a manner that provides full and open competition, and provide financial and record-keeping requirements. In addition, applicants should maintain a written code of standards for conduct governing the performance of employees, officers, or agents who select and award contracts.

It is important that applicants secure contracts with reputable and qualified licensed contractors. Applicants should conduct reference checks on a contractor's history of performance with the State's contractor licensing board and with the contractor's previous

clients before awarding contracts. Appendix G, *FEMA RP9580.201, Fact Sheet: Debris Removal - Applicant's Contracting Checklist* is provided as guidance to assist Public Assistance applicants in the procurement process.

Competition

Pursuant to 44 CFR Part 13.36(c)(1), applicants may not restrict the bidding in order to disqualify a population of bidders. Some of the situations considered to be restrictive of competition include, but are not limited to:

- Placing unreasonable requirements on firms in order for them to qualify to do business
- Requiring unnecessary experience and excessive bonding
- Noncompetitive pricing practices between firms or between affiliated companies
- Noncompetitive awards to consultants that are on retainer contracts
- Organizational conflicts of interest
- Specifying only a ''brand name'' product instead of allowing ''an equal'' product to be offered and describing the performance of other relevant requirements of the procurement
- Any arbitrary action in the procurement process

Applicants who have prequalified lists of persons, firms, or products must keep such lists current in order to ensure open and free competition during the bidding process, in accordance with 44 CFR Part 13.36(c)(4), which states:

> *"Grantees and subgrantees will ensure that all prequalified lists of persons, firms, or products which are used in acquiring goods and services are current and include enough qualified sources to ensure maximum open and free competition. Also, grantees and subgrantees will not preclude potential bidders from qualifying during the solicitation period."*

Methods of Procurement

An applicant may request that FEMA review its procurement process to determine whether the process meets the standards set forth in 44 CFR Part 13.36.

FEMA finds the following four methods of procurement acceptable:

> **Small purchase procedures** procurement, an informal method for securing services or supplies that do not cost more than $100,000 by obtaining several price quotes from different sources.

Sealed bids procurement, a formal method where bids are publicly advertised and solicited, and the contract is awarded to the responsible bidder whose proposal is the lowest in price. This method is the preferred method for procuring construction contracts.

Competitive proposals procurement, a method similar to sealed bid procurement in which contracts are awarded on the basis of contractor qualifications instead of on price. This method is often used for procuring architectural or engineering professional services. In addition, this method normally involves more than one source submitting an offer and is used when conditions are not appropriate for sealed bids.

Noncompetitive proposals procurement, a method whereby a proposal is received from only one source. Noncompetitive proposals should only be used when the award of a contract is not feasible under small purchase procedures, sealed bids, or competitive proposals, and one of the following circumstances applies:

- The item is available only from a single source
- There is an emergency requirement that does not permit a delay
- Solicitation from a number of sources has been attempted, and competition is determined to be inadequate

FEMA strongly discourages applicants from using a noncompetitive contract for debris removal operations. A contract may be regarded as noncompetitive if the applicant has only one responsive bidder. In this case the applicant is required to comply with 44 CFR Part 13.36(f), which states in part:

> *"…A cost analysis will be necessary when adequate price competition is lacking, and for sole source procurements, including contract modifications or change orders, unless price reasonableness can be established on the basis of a catalog or market price of a commercial product sold in substantial quantities to the general public or based on prices set by law or regulation. A price analysis will be used in all other instances to determine the reasonableness of the proposed contract price."*

Applicants are required by 44 CFR Part 13.36(f)(2) to negotiate profit as a separate element of the price for each contract in which there is no price competition and in all cases where cost analysis is performed. Consideration shall be given to the complexity of the work performed, risk borne to the contractor, contractor's investment, amount of subcontracting, quality of the contractor's record of past performance, and industry profit rates in the surrounding geographical area for similar work.

Types of Contracts

FEMA provides reimbursement for four types of contracts:

Lump sum contracts, for work within a prescribed boundary with a clearly defined scope and a total price

Unit price contracts, for work done on an item-by-item basis with cost determined per unit

Cost-plus-fixed-fee contracts, either lump sum or unit price contracts with a fixed contractor fee added into the price

Time-and-materials contracts, where the contractor bills the applicant for labor, equipment, materials, and overhead. These contracts should be avoided, but may be allowed for work that is necessary immediately after the disaster has occurred when a clear scope of work cannot be developed. Time-and-materials contracts are allowed in circumstances when they are more cost-effective and appropriate for the amount and type of eligible work to be performed. The costs must be reasonable for the type of work required. Applicants must engage in comprehensive active monitoring activities to ensure contractor efficiency. **Typically, FEMA will reimburse for only 70 hours of a time-and-materials contract.** If a time-and-materials contract is awarded, the applicants must:

- Monitor and document contractor expenses;
- Have a cost ceiling or "not to exceed" provision in the contract; and
- Contact the State to ensure proper guidelines are followed.

After 70 hours of work, the applicant should have sufficient information on the scope of work necessary to complete debris collection and disposal, and on a basis for estimating a reasonable cost for the contract work, to effectively solicit a lump sum or a unit price contract. For some types of debris work where time-and-materials contracts may be the most cost-effective and the most well-suited to the type of work, applicants should work closely with the State and FEMA when awarding the time-and-materials contracts to ensure eligibility requirements are met.

Other Considerations

Contract Scope of Work Recommendations

The contract scope of work should reference "eligible work," "work eligible under FEMA Public Assistance regulations, policies, and guidance," "work performed on public property and/or public rights-of-way," or other similar elements.

Piggyback Contracts

FEMA does not favor "piggyback contracts." Applicants have used piggyback contracts on occasion to have disaster-related work performed by another jurisdiction's contractor. The variables associated with the scope of work and costs generally make this an option to be avoided. The competitive procurement requirements of 44 CFR Part 13 are also a prime concern. If FEMA encounters a request for reimbursement of costs derived from such a contract, the reimbursable costs for eligible work will be based on reasonableness.

Prohibited Contracts

In accordance with 44 CFR Part 13.36(f)(4), cost plus percentage of cost contracts shall not be used. Use of such contracts may result in FEMA limiting the Public Assistance grant to an amount determined to be reasonable based on the eligible work performed.

Contracts that are awarded by an applicant to debarred contractors are prohibited pursuant to 44 CFR Part 13.35; thus, no Federal funding can be awarded for eligible work completed.

Additional Contract Requirements

Contract payment provisions should address the obligations between parties to the contract only and not include any language that makes payment to the contractor contingent upon the applicant's receipt of funding from FEMA.

All contracts in excess of $10,000 must contain a provision for termination for cause and for convenience by the applicant, including the manner by which it will be effected and the basis for settlement, according to 44 CFR Part 13.36(i)(2).

For contracts over $100,000 the applicant must have the following minimum bonding requirements, in accordance with 44 CFR Part 13.36(h):

- A bid guarantee from each bidder equivalent to five percent of the bid price;
- A performance bond on the part of the contractor for 100 percent of the contract price; and
- A payment bond on the part of the contractor for 100 percent of the contract price.

In accordance with 44 CFR Part 13.36(b)(8):

> *"Grantees and subgrantees will make awards only to responsible contractors possessing the ability to perform successfully under the terms and conditions of a proposed procurement. Consideration will be given to such matters as contractor integrity, compliance with public policy, record of past performance, and financial and technical resources."*

Documentation requirements are specified in 44 CFR Part 13.36(b)(9) and include, but are not limited to, rationale for the procurement method, contract type, contractor selection or rejection, and the basis for contract price.

For additional contracting information, refer to Appendix G, *FEMA RP9580.201, Fact Sheet: Debris Removal - Applicant's Contracting Checklist*.

Chapter 3 – Debris Removal from Public Property

Chapter Highlights

Eligible Debris Removal
Ineligible Debris Removal
Debris Clearance and Removal Operations
Field Eligibility Determinations
- Vegetative Debris Eligibility
- Construction and Demolition Debris
- Hazardous Waste
- White Goods
- Soil, Mud, and Sand
- Vehicles and Vessels
- Putrescent Debris
- Infectious Waste
- Chemical, Biological, Radiological, and Nuclear-Contaminated Debris
- Garbage

Monitoring Debris Removal Operations
Disposal

This chapter discusses debris operations on public property and public rights-of-way. Applicants should document locations, conditions, and special circumstances of the debris prior to removal. This chapter includes preferred documentation information and requirements. Proper documentation enables an applicant to fully account for costs incurred in the event that Federal disaster assistance is made available.

Eligible Debris Removal

Eligible debris removal work under the Public Assistance Program must meet the following criteria:

- The debris was generated by the major disaster event;
- The debris is located within a designated disaster area on an eligible applicant's improved property or rights-of-way; and
- The debris removal is the legal responsibility of the applicant.

Ineligible Debris Removal

The following are not eligible for FEMA assistance under the Public Assistance Program:

- Any debris removal from an eligible applicant's unimproved property or undeveloped land;
- Any debris removal from a facility that is not eligible for funding under the Public Assistance Program, such as a PNP cemetery or PNP golf course; or
- Any debris removal from Federal lands or facilities that are the authority of another Federal agency or department, such as Federal-aid roads, USACE navigable waterways, and NRCS canals. See Chapter 16, *Other Federal Assistance*, for a description of these authorities.

Debris Clearance and Removal Operations

Debris removal operations generally occur in two phases: (1) initial debris clearance activities necessary to eliminate life and safety threats; and (2) debris removal activities as a means to recovery. Whether the work was performed using an applicant's own resources or by contractors, documentation is necessary for Public Assistance grant consideration.

An applicant's initial response phase of the debris operation may begin during the disaster event. Crews may be activated to clear debris on emergency access roads; usually this is vegetative debris that is cut and tossed to the rights-of-way. The purpose is to eliminate an immediate threat to lives, and public health and safety. The transition period from initial clearance activities to debris removal depends on the magnitude of disaster impact. Typically, the debris removal recovery phase begins after the emergency access routes are cleared and police, firefighters, and other first responders have the necessary access.

Often residents begin clearing disaster debris from their properties and placing it on the public rights-of-way. If the property owners move the disaster-related debris to a public right-of-way, an applicant may be reimbursed for debris pickup, haul and disposal from the right-of-way for a limited period of time. If an applicant does not have the legal responsibility to maintain a right-of-way, then debris removal from that right-of-way is not eligible for reimbursement.

Field Eligibility Determinations

To assist in implementation of the Public Assistance Program and the applicants' understanding of it, FEMA has established specific eligibility guidance for debris. This section addresses the most common eligibility issues for various types of debris and recommends documentation for Public Assistance grant consideration. Consultation with the State and FEMA is advised for scenarios not addressed within this section.

Only FEMA has the authority to make eligibility determinations for Public Assistance grant funding; contractors cannot make eligibility determinations. Information on eligibility can be found in FEMA 321 – Public Assistance Policy Digest, FEMA 322 – Public Assistance Guide, FEMA 323 – Public Assistance Applicant Handbook, and this document.

Vegetative Debris Eligibility

Vegetative debris consists of whole trees, tree stumps, tree branches, tree trunks, and other leafy material. Depending on the size of the debris, the collection of vegetative debris may require the use of flat bed trucks, dump trucks, and grapple loaders.

Figure 3.1 - Typical Vegetative Debris on a Public Right-of-Way

Most vegetative debris consists of large piles of tree limbs and branches that are piled on the public rights-of-way by the residents. The collection of this type of debris is eligible for reimbursement if it is within public rights-of-way and collected by an eligible applicant. Applicants normally limit the number of times the debris is collected; for instance, the applicant may choose to make two passes throughout the jurisdiction before resuming its normal collection activities. The applicant should discuss with FEMA the number of passes that may be eligible.

Vegetative debris is bulky and consumes a significant volume of landfill space if buried. To minimize the use of landfill space, it is prudent to reduce the volume of vegetative debris before burying. Vegetative debris may be reduced by as much as 75 percent of its volume by mulching or grinding and as much as 90 percent of its volume through burning technologies. Costs to reduce vegetative debris are eligible for Public Assistance grant funding if found to be reasonable.

A hazardous tree or stump may be collected individually, while downed or fallen debris is collected from rights-of-way or at a designated collection center. Tree and stump collection prices are typically based on the size of the tree or stump and charged by unit. Other fallen or downed material is usually billed by weight (tons) or volume (cubic yards).

Determining eligibility for hazardous trees and stumps is challenging. FEMA has established criteria to assist in making these eligibility determinations, using objective information that can be collected in the field.

Hazardous Trees

Removing a hazardous tree may be eligible for Public Assistance grant funding. A tree is considered hazardous if its condition was caused by the disaster; it is an immediate threat to lives, public health and safety, or improved property; it has a diameter breast height of six inches or greater; **and one or more of the following criteria are met**:

- It has more than 50 percent of the crown damaged or destroyed;
- It has a split trunk or broken branches that expose the heartwood;
- It has fallen or been uprooted within a public-use area; and/or
- It is leaning at an angle greater than 30 degrees.

Trees determined to be hazardous and that have **less than 50 percent of the root-ball exposed** should be cut flush at the ground level. Grinding of the resulting stump after the tree has been cut flush at the ground level is not eligible work. The cut portion of the tree is included with regular vegetative debris. The applicant should make an effort to cut the tree trunk as close to the ground as possible.

The eligible scope of work for a hazardous tree may include removing the leaning portion and cutting the stump at ground level. An example of an ineligible costing method for such work would be removing the tree and stump for two separate unit costs.

The Public Assistance Program may reimburse straightening and bracing if they are less costly than removal and disposal. Straightening and bracing are emergency protective measures if they eliminate an immediate threat to lives, public health and safety, or improved property. If an applicant chooses to straighten and brace a tree in lieu of removal, the tree would not be eligible for removal if it dies.

Hazardous Limb Removal (Hangers)

Removing hanging limbs may be eligible for Public Assistance grant assistance. Limbs must be:

- Located on improved public property;
- Greater than two inches in diameter at the point of breakage; and
- Still hanging in a tree and threatening a public-use area, e.g. trails, sidewalks, golf cart paths.

Only the minimum amount of work necessary to remove the hazard is eligible. Pruning, maintenance trimming, and landscaping are not eligible. Work should be executed in an efficient manner. For example, all hazardous limbs in a tree should be cut at the same time, not in passes for particular sizes. Work to remove hanging limbs from a tree that has been determined to be a hazard and is scheduled for removal is not eligible. If this work is contracted out, it is typically done on a per tree basis.

An eligible scope of work may be to cut the branch at the closest main branch junction. Removing the entire branch back to the trunk may not be eligible.

If the canopy of a tree located on private property extends over a public right-of-way such as a sidewalk, removal of hazardous limbs on the tree that extend over the public right-of-way and meet the above criteria may be eligible. Limbs on the tree that do not extend over the public right-of-way are not eligible.

Documentation required for Public Assistance grant consideration:

- Describe the immediate threat, e.g. photos of hanging limbs or leaning trees;
- Clearly define the scope of work to remove the immediate threat;
- Specify the improved public property location by recording the nearest building address and/or GPS location; and
- Denote date, labor (force account or contract), and equipment used to perform the work.

Hazardous Tree Stumps

A stump may be determined to be hazardous and eligible for Public Assistance grant funding as a per-unit cost for stump removal if it meets all of the following criteria:

- It has 50 percent or more of the root-ball exposed (less than 50 percent of the root-ball exposed should be flush cut);
- It is greater than 24 inches in diameter, as measured 24 inches above the ground;
- It is on improved public property or a public right-of-way; and
- It poses an immediate threat to life, and public health and safety.

If an uprooted stump must be removed **prior to FEMA's approval**, the applicant must submit the following information for Public Assistance grant consideration:

- Photographs and GPS coordinates that establish the location on public property;
- Specifics of the threat;
- Diameter of the stump 24 inches from the ground; and
- Quantity of material needed to fill the resultant hole.

FEMA may reimburse a reasonable cost to remove, transport, dispose of, and fill the hole from a stump of **more than 24 inches in diameter** if:

- The applicant and State agree the tree or stump is hazardous according to the above definition;
- Generally, FEMA approved the removal in advance; and

- A Hazardous Stump Worksheet is completed and submitted for FEMA approval. A copy of the Hazardous Stump Worksheet may be found in Appendix G, *FEMA DAP9523.11, Hazardous Stump Extraction and Removal Eligibility*.

In some instances, grinding of an uprooted stump and filling the resulting cavity may cost less than a complete extraction. In these cases, the applicant should present the cost comparison documentation to FEMA for consideration; however, the stump must have already been determined eligible for removal according to the above criteria.

Stumps measuring **24 inches in diameter or less** do not require special equipment for removal; therefore, reimbursement will be based on the reasonable unit cost per cubic yard, using the Stump Conversion Table found in Appendix G, *FEMA DAP9523.11, Hazardous Stump Extraction and Removal Eligibility*. The unit price for stump removal includes the extraction, transport, and disposal of the stump as well as filling the cavity that remains.

FEMA will reimburse the applicant at the unit cost rate (usually cubic yards) for normal debris removal for all stumps, regardless of size, placed on the public rights-of-way by others, i.e., contractors did not extract them from public property or property of eligible PNP organizations. In such instances, applicants do not incur additional costs to remove these stumps; the same equipment used to pick up vegetative debris can be used to pick up these stumps.

See Appendix G, *FEMA DAP9523.11, Hazardous Stump Extraction and Removal Eligibility* for more information on hazardous stumps.

Construction and Demolition Debris

The definition of construction and demolition debris may vary between States. Construction and demolition debris can be defined as damaged components of buildings and structures such as lumber and wood, gypsum wallboard, glass, metal, roofing material, tile, carpeting and floor coverings, window coverings, pipe, concrete, fully cured asphalt, equipment, furnishings, and fixtures. To be eligible, construction and demolition debris must be a result of a Federally declared disaster.

Certain types of construction and demolition debris are reusable or recyclable. To conserve landfill space, it is prudent to separate materials for reuse or recycling.

Some construction and demolition debris may be hazardous, such as asbestos roofing and floor tile, and lead pipes. Public Assistance grant eligibility is subject to all other Federal laws and regulations, including environmental and hazardous waste ordinances. Documentation of the debris origin, any processing (reduction or recycling), and the final disposition is required for Public Assistance grant consideration.

Figure 3.2 - Construction and Demolition Debris

Typically, removal of construction by-products generated by repairs or rebuilding is covered by insurance policies or included in the overall cost for reconstruction projects; therefore, it is not eligible for Public Assistance grant funding as emergency work under debris removal. It may, however, be reimbursed as part of the permanent work for the reconstruction of an eligible project.

Hazardous Waste

Hazardous waste is waste with properties that make it potentially harmful to human health or the environment. Hazardous waste is regulated under RCRA. In regulatory terms, a RCRA hazardous waste is a waste that appears on one of the four hazardous waste lists or exhibits at least one of the following four characteristics: ignitability, corrosivity, reactivity, or toxicity.

Public Assistance grant funding may be available for measures that address widespread hazardous materials contamination. The measures may include retrieval and proper disposal of orphan drums, pumping water contaminated with hazardous materials, control or stabilization of oil or other hazardous material releases, and cleanup and disposal of hazardous materials. Certified hazardous waste technicians should handle, capture, recycle, reuse, and dispose of hazardous waste. The applicant must comply with Federal, State, and local environmental requirements for handling hazardous waste.

Public Assistance grant funding is not available to test for mold or contaminants in water, air, or soil for the purposes of long-term cleanup actions. FEMA and EPA determine the specific activities that may be funded under the Public Assistance Program and those activities that are under the authority of EPA.

Figure 3.3 - Hazardous Waste

Household Hazardous Waste (HHW) refers to hazardous products and materials that are used and disposed of by residential, rather than commercial or industrial consumers. HHW includes some paints, stains, varnishes, solvents, pesticides, and other products or materials containing volatile chemicals that catch fire, react, or explode under certain circumstances, or that are corrosive or toxic.

Electronic waste, or e-waste, refers to electronics that contain hazardous materials such as cathode ray tubes. Examples include computer monitors and televisions.

White Goods

White goods are defined as discarded household appliances such as refrigerators, freezers, air conditioners, heat pumps, ovens, ranges, washing machines, clothes dryers, and water heaters.

Many white goods contain ozone-depleting refrigerants, mercury, or compressor oils. The Clean Air Act prohibits the release of refrigerants into the atmosphere, and requires that certified technicians extract refrigerants from white goods before they are disposed of or recycled. Some States also require certified technicians to extract compressor oils before disposing of or recycling white goods. Applicants should follow all Federal, State, and local requirements concerning ozone-depleting refrigerants, mercury, or oils. Documentation of proper disposal may be required for Public Assistance grant consideration.

Figure 3.4 - White Goods Stockpiled for Processing

Soil, Mud, and Sand

Floods, landslides, and storm surges often deposit soil, mud, and sand on improved public property and public rights-of-way. Facilities commonly impacted by this type of debris may include streets, sidewalks, storm and sanitary sewers, water treatment facilities, drainage canals and basins, parks, and swimming pools.

The removal of this type of debris from improved public property and public rights-of-way may be eligible for Public Assistance grant funding. For instance, removing soil, mud, and sand from a roadway or sidewalk, or clearing out mud and sand from sewer lines, may be eligible for Public Assistance grant funding if it is the legal responsibility of an eligible applicant. Natural streams and unimproved property are not considered eligible facilities.

The amount of Public Assistance grant funding for removal of soil, mud, and sand is based on the quantity that was deposited due to the disaster. In order to determine the disaster-related debris quantities, the applicant should provide regularly scheduled maintenance reports that indicate the pre-disaster soil, mud, and sand levels. Maintenance reports are commonly requested for soil, mud, and sand removal from sewers, water treatment facilities, and drainage channels.

The applicant is responsible for identifying the damage incurred due to the disaster. Public Assistance grants do not provide funds for random surveys to look for damage, such as TV inspection of sewer lines. However, if disaster-related damage is evident, a Public Assistance grant may cover inspections to determine the extent of the damage and method of repair.

Drainage channels and canals may be an element of a flood control work or water control facility. These types of facilities are often under the jurisdiction of the United States Army Corps of Engineers (USACE) or the Natural Resources Conservation Service (NRCS). If a flood control work or water control facility falls under another Federal jurisdiction, it is generally not eligible for Public Assistance grant funding. For additional information regarding USACE and NRCS facility eligibility, refer to Appendix G, *FEMA RP9524.3, Policy for Rehabilitation Assistance for Levees and Other Flood Control Works - Decision Tree.*

Vehicles and Vessels

For the removal of vehicles and vessels to be eligible, the applicant must demonstrate that:

- The vehicle or vessel presents a hazard or immediate threat that blocks ingress/egress in a public-use area;
- The vehicle or vessel is abandoned, e.g. the vehicle or vessel is not on the owner's property and ownership is undetermined;
- The applicant followed local ordinances and State law by securing ownership; and
- The applicant verified chain of custody, transport, and disposal of the vehicle or vessel.

All supporting documentation relating to removal of abandoned vehicles and vessels must be submitted to FEMA for Public Assistance grant consideration. For navigational vessels, applicants must follow their hazard abatement laws, coordinate with the requirements of the marine and harbor patrol agencies, and comply with local laws governing navigational vessels.

It is important for the applicant to follow its normal written procedures regardless of the circumstances. Any duplication of benefits issues should be addressed.

Putrescent Debris

Putrescent debris is any debris that will decompose or rot, such as animal carcasses and other fleshy organic matter. The cost of putrescent debris collection and disposal may be eligible. Disposal of putrescent debris must be in compliance with applicable Federal, State, and local requirements to be eligible for Public Assistance grant funding. NRCS has developed specific disposal guidelines for animal carcasses.

Infectious Waste

Infectious waste is waste capable of causing infections in humans, including contaminated animal waste, human blood and blood products, isolation waste, pathological waste, and discarded sharps (needles, scalpels, or broken medical instruments).

Clearance, removal, and disposal of infectious waste may be the authority of another Federal agency. Upon review of applicable Federal statutes, regulations, and policies governing infectious waste, FEMA will determine eligibility on a case-by-case basis and may develop disaster-specific guidance when appropriate.

Chemical, Biological, Radiological, and Nuclear-Contaminated Debris

Chemical, Biological, Radiological, and Nuclear (CBRN)-contaminated debris is debris contaminated by chemical, biological, radiological, or nuclear materials as a result of a natural or man-made disaster, such as a Weapon of Mass Destruction (WMD) event. Eligibility determinations on the clearance, removal, and disposal of CBRN-contaminated debris will be made by FEMA based on applicable Federal statutes, regulations, policies, and other guidance documents. Depending on the nature of the disaster and the debris it generates, FEMA may develop additional or disaster-specific eligibility guidance.

Garbage

Garbage is waste that is regularly picked up by an applicant. Common examples of garbage are food, packaging, plastics, and papers. In general, household food wastes can be collected through normal municipal waste collection methods and are not eligible.

Monitoring Debris Removal Operations

Eligible applicants are required to monitor debris removal operations in order to document eligible quantities and reasonable expenses to ensure that the work is eligible for Public Assistance grant funding. Failure to do so properly may jeopardize funding.

In Federally declared disasters, FEMA personnel periodically validate the applicant's monitoring efforts to ensure eligible debris is being removed and processed efficiently. **Debris monitoring is primarily the responsibility of the applicant.** Applicants may use force account resources, temporary hires, and/or contractors to accomplish the monitoring.

Reasonable costs for applicant debris monitors with appropriate qualifications may be eligible. It is not necessary to have professional engineers and other certified professionals perform debris monitoring duties. In addition to the costs for the monitors, the applicant may claim as part of its monitoring activities reasonable costs for the provision of training, oversight, and data compilation to verify debris removal costs as required by the monitoring operation.

Overhead costs for architectural and engineering service are not eligible. Costs associated with attending meetings with FEMA or the State and costs associated with the administration of project worksheets are funded through the administrative allowance as stated in 44 CFR Part 206.228 and cannot be a direct charge to a Public Assistance grant.

Additional guidance on monitoring debris removal operations is located in Appendix G, *FEMA DAP9580.203, Fact Sheet: Debris Monitoring*.

Disposal

Landfill tipping fees usually include fixed and variable costs along with some special taxes or fees assessed by the jurisdiction. Examples of variable costs include costs for labor, supplies, maintenance, utilities, and gas or recovery systems. Fixed costs generally include equipment, construction, permits, landfill closure, post closure, and amortized costs for ancillary landfill building structures.

Eligible landfill costs are limited to the variable and fixed costs that are directly related to landfill operations. Jurisdictions may incorporate special taxes or fees into the landfill tipping fee to fund government services or public infrastructure. When tipping fees include such costs, those costs are not eligible for Public Assistance grant funding.

Chapter 4 – Private Property Debris Removal and Demolition of Private Structures

Chapter Highlights

Private Property Debris Removal
- Approval for FEMA Assistance
- Documentation for PPDR
- Types of Eligible PPDR Work

Demolition of Private Structures
- Eligible Demolition Costs
- Documentation for Demolition

Commercial Property

Duplication of Benefits for PPDR and Demolition

The FEMA policies on debris removal from private property and demolition of private structures can be found in Appendix G.

Private Property Debris Removal

Private property debris removal (PPDR) is generally not eligible for reimbursement under the Public Assistance Program because debris on private property does not typically present an immediate health and safety threat to the general public. Also, debris removal from private property is generally the responsibility of individual private property owners, and other sources of funding, such as insurance, are commonly available to property owners to cover the cost of work. However, if private property owners move disaster-generated debris to the public right-of-way, the costs associated with removing this debris from the right-of-way may be eligible under the Public Assistance Program.

When large-scale disaster events cause mass destruction and generate large quantities of debris over vast areas, debris on private property may sometimes pose health and safety threats to the public-at-large. If private property owners are not available because they have evacuated, the State or local government may need to enter private property to remove debris considered to be an immediate threat to the lives, health, and safety of its residents. In such situations, the Federal Coordinating Officer (FCO) is authorized to approve the provision of Public Assistance for the removal of debris from private property when it is considered to be in the public interest. The section below describes the process through which applicants may obtain approval for Public Assistance funding for the costs of performing PPDR.

Approval for FEMA Assistance

FEMA will work with States affected by large-scale disasters to designate those areas where the debris is so widespread that removal of debris from private property is in the public interest on a case-by-case basis. Any applicant that intends to seek reimbursement to remove debris from private property within those designated areas will, prior to commencement of work, submit a written request to the FCO seeking approval for reimbursement. The applicant must provide documentation confirming that an immediate threat to the public exists as well as evidence of its legal responsibility to enter private property to eliminate the threat posed by the debris. Specifically, this includes:

Immediate Threat Determination

The applicant must provide documentation from the applicant's public health authority or other public entity with legal authority stating that disaster-generated debris on private property in the designated area constitutes an immediate threat to life, public health, and safety.

The applicant may also provide documentation stating that the debris poses an immediate threat to improved property and that its removal is cost effective. The cost to remove the debris should be less than the cost of the potential damage to the improved property in order for the debris removal to be eligible.

Documentation of Legal Responsibility

The applicant must demonstrate its authority and legal responsibility to enter private property to remove debris. The legal basis for this responsibility must be established by law, ordinance, or code at the time of the disaster and must be relevant to the post-disaster condition representing an immediate threat to life, public health, and safety, and not merely define the applicant's uniform level of services. Typically, solid waste disposal ordinances are considered part of an applicant's uniform level of services.

Applicants ordinarily rely on condemnation and/or nuisance abatement authorities to obtain legal responsibility prior to the commencement of debris removal work. There may be circumstances where the applicant determines that ordinary condemnation and/or nuisance abatement procedures are too time consuming to address an immediate public health and safety threat. Applicants do not have to precisely follow their nuisance abatement procedures, or other ordinances, that would prevent the applicant from taking emergency protective measures to protect public health and safety.

In addition to providing documentation detailing an applicant's immediate threat determination and legal responsibility to remove debris from private property, the applicant must confirm that a legally authorized official has ordered the exercise of public authority to enter private property to perform PPDR. The applicant must also submit in its request

indemnification to the Federal government and its employees, agents, and contractors from any claims arising from the removal of debris from private property.

The FCO will approve or disapprove in writing each applicant's request for Public Assistance to perform PPDR. If approval is granted, applicants should immediately begin identifying properties for PPDR work and establishing specific scopes of work on each of these properties.

Additional information on the applicant approval process for PPDR may be found in Appendix G, *FEMA DAP9523.13, Debris Removal from Private Property.*

Documentation for PPDR

If PPDR is authorized and considered for Public Assistance grant funding, applicants are required to properly document all legal processes used to gain access to private property, as well as document applicable scopes of work, and compliance with Federal, State, and local environmental and historic preservation review requirements. Applicants should work with the Public Assistance staff prior to the commencement of any PPDR work to ensure that all legal, environmental, historic, and scope of work considerations are addressed.

The following documents are necessary for Public Assistance funding for PPDR work:

1. **Right-of-Entry.** A right-of-entry signed by the property owner should include a hold harmless agreement and indemnification applicable to the project's scope-of-work. FEMA's Office of Chief Counsel (OCC) should review the right-of-entry form and the language of the hold harmless agreement and indemnification. The right-of-entry form may also include space for the private property owner's insurance information (policy number) for verification purposes, if applicable.

2. **Photos** are strongly encouraged to show the condition of the property prior to the beginning of the work. Generally, pictures are used to confirm the address and identified scope-of-work on the property.

3. A **PPDR Assessment** is a property-specific assessment which establishes the scope of eligible work. This may be a map which serves as a guide indicating the location of the eligible items of work that present an immediate threat relative to improved property or ingress and egress routes. These maps may incorporate symbols and a legend to identify structures, property lines, and eligible items of work. This assessment may also be a work order or may be covered in the right-of-entry form, as long as the scope of work can be clearly identified.

4. **Documentation of Environmental and Historic Review**. Debris removal work from private property must satisfy compliance review requirements as established by 44 CFR Parts 9 and 10 and all other applicable Federal environmental and historic preservation requirements.

Additional documentation may be required by Public Assistance staff on a case-by-case basis to demonstrate eligible work performed and compliance with applicable Federal, State, and local laws and regulations.

Types of Eligible PPDR Work

Eligible debris removal work from private property includes removal of:

- Large piles of disaster-generated debris in the living, recreational, and working areas of properties in urban, suburban, and rural areas, including large lots.
- Disaster-generated debris obstructing primary ingress and egress routes to improved property.
- Disaster-damaged limbs and leaning trees in danger of falling on improved property, primary ingress or egress routes, or public rights-of-way.
    - Hazardous tree removal is eligible only if the tree is greater than six inches in diameter (measured at diameter breast height) and:
        - has more than 50% of the crown damaged or destroyed, or;
        - has split trunk or broken branches that expose heartwood, or; the tree itself is leaning at an angle greater than 30 degrees and shows evidence of ground disturbance.
    - Hazardous limb removal is eligible only if the limb is greater than two inches in diameter measured at the point of break.
- Debris created by the removal of damaged interior and exterior materials from improved property.
- Household hazardous wastes (such as household cleaning supplies, insecticides, herbicides, etc.)
- Disaster-generated debris on private roads and streets of a gated community, provided that the removal of the debris has become the legal responsibility of an eligible applicant.

Ineligible debris removal work on private property includes the removal of:

- Debris from vacant lots, forests, heavily wooded areas, unimproved property, and unused areas.
- Debris on agricultural lands used for crops or livestock.
- Concrete slabs or foundations-on-grade.
- Reconstruction debris consisting of materials used in the reconstruction of disaster-damaged improved property.

Demolition of Private Structures

State and local governments may need to enter private property to demolish private structures made unsafe by disasters to eliminate immediate threats to life, public health, and safety. In some cases, the costs of performing demolition of private structures may be eligible for Public Assistance grant funding. Typically, the demolition of private structures to eliminate immediate threats is authorized under Section 403(a)(3)(E) of the Stafford Act.

FEMA will consider alternative measures to eliminate threats to life, public health, and safety posed by disaster-damaged unsafe structures, including fencing off unsafe structures and restricting access, when evaluating requests for Public Assistance grant funding for demolition work. The Public Assistance staff must also concur that the demolition of unsafe structures and removal of demolition debris are in the public interest.

The demolition of unsafe privately owned structures and subsequent removal of demolition debris may be eligible when the following conditions are met:

- The structures were damaged and made unsafe by the declared disaster, and are located in the area of the disaster declaration;
- The applicant certifies that the structures are determined to be unsafe and pose an immediate threat to the public. An unsafe structure is a non-commercial or non-industrial structure that threatens the life, health or safety of the public because the structure is so damaged or structurally unsafe that partial or complete collapse is imminent. This certification may be made by the State or local government's building inspector and may be based on a structural assessment in accordance with local ordinances and building codes;
- The applicant has demonstrated that it has legal responsibility to perform the demolition. Similar to private property debris removal, the applicant must demonstrate its authority and legal responsibility to enter private property to perform demolition of unsafe structures. The legal basis for this responsibility must be established by law, ordinance, or code at the time of the disaster and must be relevant to the post-disaster

condition representing an immediate threat to life, public health, and safety, and not merely define the applicant's uniform level of services;

- A legally authorized official has ordered the demolition of unsafe structures and removal of demolition debris;
- The applicant has indemnified the Federal government and its employees, agents, and contractors from any claims arising from the demolition work; and
- The demolition work is completed within the completion deadlines outlined in 44 CFR §206.204 for emergency work.

Additional information on the general eligibility of demolition of private structures may be found in Appendix G, *FEMA DAP9523.4, Demolition of Private Structures.*

Eligible Demolition Costs

Eligible costs associated with the demolition of private structures may include, but are not limited to:

- capping wells;
- pumping and capping septic tanks;
- filling in basements and swimming pools;
- testing and removing hazardous materials from unsafe structures including asbestos and household hazardous wastes;
- securing utilities (electric, phone, water, sewer, etc.);
- securing permits, licenses, and title searches. Fees for permits, licenses, and titles issued directly by the applicant are not eligible unless it can be demonstrated that the fees are above and beyond administrative costs; and/or
- demolition of disaster-damaged outbuildings such as garages, sheds, and workshops determined to be unsafe.

Ineligible costs associated with the demolition of private structures include:

- removal of slabs or foundations, except in very unusual circumstances, such as when disaster-related erosion under slabs on a hillside causes an immediate public health and safety threat; and/or
- removal of pads and driveways.

Structures condemned as safety hazards before the disaster are not eligible for demolition and subsequent demolition debris removal under Public Assistance grant authority.

Individuals and private organizations (except for eligible PNPs) will not be reimbursed for demolition activities on their own properties under the Public Assistance Program.

Documentation for Demolition

In order to receive reimbursement of eligible demolition costs, applicants should provide documentation of applicable legal processes and scopes of work performed, similar to the private property debris removal process described above. Specifically, this includes:

- Rights-of-entries;
- Photos of the structures;
- Structural assessments, or other certifications that the structures are determined to be unsafe or pose an immediate threat to the public, based on local ordinances or building codes;
- Notices of demolition; and
- Documentation of environmental and historic review.

All documentation should be consistent with the requirements of applicable Federal, State, and local laws and regulations governing demolition of private structures. Similar to PPDR work, additional documentation may be required by Public Assistance staff on a case-by-case basis to demonstrate eligible work performed and compliance with applicable Federal, State, and local laws and regulations.

Commercial Property

The removal of debris from commercial property and the demolition of commercial structures are generally not eligible for Public Assistance grant funding. It is assumed and expected that these commercial enterprises retain insurance that can and will cover the cost of debris removal and/or demolition. However, in some cases as determined by the FCO, the removal of debris from private commercial property and/or the demolition of private commercial structures by a State or local government may be eligible for FEMA reimbursement only when such removal is in the public interest.

Industrial parks, private golf courses, commercial cemeteries, apartments, condominiums, and mobile homes in commercial trailer parks are generally considered commercial property.

Duplication of Benefits for PPDR and Demolition

FEMA is prohibited from approving funds for work that is covered by any other source of funding. Therefore, State and local governments must take reasonable steps to prevent such an occurrence, and verify that insurance coverage or any other source of funding does not exist for

PPDR work and the demolition of private structures. Typically, the rights-of-entries used for PPDR and demolition of private structure have a clause that states that a private property owner will re-pay an applicant the amount of insurance proceeds received for any PPDR or demolition work performed. The right-of-entry form being used by the applicant may also include space for the private property owner to list insurance information (policy number) for verification purposes.

When PPDR and demolition of private structures is covered by an insurance policy, the insurance proceeds must be used as the first source of funding. Public Assistance grant funding may be eligible for the remainder of the cost of the eligible work after insurance proceeds are recouped from the property owner. If it is discovered that a duplication of benefits has occurred, FEMA will de-obligate funds from the Grantee in the amount that such assistance duplicates funding the property owners received from other sources.

PART II – DEBRIS MANAGEMENT PLANNING CONCEPTS

Part II – Debris Management Planning Concepts

Introduction

Applicants are encouraged to review their community's vulnerability to a disaster and to consider their response and recovery activities, specifically in handling debris issues.

Debris removal operations can be time-consuming and costly. Over the last five years, debris removal operations accounted for approximately 27 percent of the disaster recovery costs. FEMA urges applicants to develop a debris management plan that considers large-scale debris removal and disposal operations. By developing a debris management plan, communities will be better prepared to address disaster-related debris in a time-efficient manner, expediting the recovery process. Additionally, a sound and properly executed debris management plan may better position an applicant for Public Assistance grant assistance.

Part II, Debris Management Planning Concepts, provides applicants with guidance in planning, organizing, mobilizing, and controlling a debris removal and disposal operation. Chapter 5, *Applicant Roles and Responsibilities*, outlines the staff who will develop a debris management plan. The remaining chapters of Part II describe the major elements of a debris management plan, the considerations applicants need to address, and information that may be required for Public Assistance grant assistance consideration.

Helpful tools within these chapters include the "Questions to Consider" and "To Do Checklist" at the end of the chapters. The "Questions to Consider" are intended to assist the planning team in applying the information within each chapter to the specific needs of their jurisdiction. The "To Do Checklist" is provided as a reminder of important issues and considerations to include within the debris management plan.

It is important to note that all or portions of Part II may be used depending on the size of the debris removal operation. The "Questions to Consider" at the end of each chapter may be used to help determine if a specific debris planning element is applicable for the specific jurisdiction.

Chapter 5 – Applicant Roles and Responsibilities

Chapter Highlights

Debris Management Staff Organization and Structure
Debris Management Staff Responsibilities
- Debris Project Manager
- Debris Management Planning Sections

Questions to Consider
To Do Checklist

The success of a debris management plan is dependent upon the commitment of an applicant to researching, planning, implementing, and evaluating the plan effectively and efficiently. Proper planning by management and employee training provides an applicant with a foundation for a quick and successful recovery.

The following text discusses the personnel that are necessary to plan and develop the debris management plan. A sample outline for a debris management plan is supplied for use and reference in Appendix A, *Debris Management Plan Outline*. During a disaster event, the same staff members would be expected to implement the plan. The organization of departments and management staff may vary between applicants, but roles and tasks do not change.

Debris Management Staff Organization and Structure

The size and composition of a staff organized to manage debris clearance, removal, and disposal issues depends on the magnitude of the disaster and the size of the jurisdiction. A pre-disaster debris planning staff may be quite small; however, following a major disaster, additional staff members may be required.

Successful debris operations require collaborative efforts between departments within the applicant and with specific external agencies that have regulatory authority over debris operations. It is essential that prospective staff members have as much training as possible and interface with other agencies responsible for debris clearance, removal, and disposal activities, such as the National Guard, the State department of transportation, the State police, and the State emergency management office, prior to any event.

To implement debris operations quickly, it is important for emergency response and recovery personnel to have a clear understanding of how their normal job responsibilities and functions apply to debris operations. The applicant's debris planning staff should be comprised of full-time personnel supplemented with personnel from other staffs and agencies. The planning process should include a review of individual departmental functions and responsibilities for implementing debris operations.

Immediately following a disaster event, the planning process should establish a disaster debris management team, which convenes as a working group to facilitate successful coordination following a disaster event. Team members should consist of personnel from departments within the applicant and representatives from external agencies, such as regional waste management, joint power authorities, sanitation districts, State and Federal environmental offices, and other agencies which have shared responsibilities for solid waste issues. Each member of the team is responsible for implementing debris operations in accordance with the planned goals and objectives, and in compliance with Federal, State, and local laws.

Debris Management Staff Responsibilities

No two jurisdictions have the same department or section designations; therefore, this document refers to each department or section according to its function rather than a specific department designation. The following discussion gives the function of each department and a brief description of the tasks each performs in developing the debris management plan

Each department is responsible for specific elements of the debris management plan. Those general duties are explained in the remainder of this chapter. Department responsibilities often overlap, making coordination and communication critical to the success of the debris management plan. In many instances, a particular department is involved in numerous elements of the debris management plan.

These overlapping responsibilities illustrate the need for one primary coordinator or Debris Project Manager. The Debris Project Manager's role and responsibilities are paramount in coordinating efforts and ensuring communication between planning and implementation sections.

Debris Project Manager

The primary decision maker is the Debris Project Manager. The Debris Project Manager should be knowledgeable of the applicant's processes, procedures, personnel, resources, and limitations. It is important for the Debris Project Manager to keep communication and coordination efforts between departments a priority.

The Debris Project Manager has overall responsibility for the operations, planning, logistics, and cost of the debris management operations. The Debris Project Manager assigns tasks to team members and tracks the completion of tasks to ensure quick implementation of the debris removal operations.

Debris Management Planning Sections

Administration

The Administration department typically includes the finance, personnel, and public information sections within a governing body. It is important for this department to establish a records management system in order to collect and keep all the documentation that may be required for the Public Assistance grants. Documentation may include, but is not limited to:

- Personnel policies.
- Labor and equipment timesheets and summaries.
- Safety procedures.
- Contract procurement procedures.
- Contracts.
- Billing and invoices, including debris hauler load tickets.
- Environmental permits.
- Right of entry and hold harmless agreements for private property debris removal and demolition, when applicable.
- Public information announcements.
- Debris salvage value information.

The finance section is usually responsible for developing an emergency response and recovery budget, tracking expenses, and ensuring funds are available for personnel, equipment, supplies, and contract service costs.

The Administration department should include a public information officer to distribute information and educate citizens about the debris operations. Planning components of the public information strategy should include the use of various types of information vehicles (print, radio, internet, etc.) and the pre-scripted information that will be distributed concerning topics such as:

- Debris pick-up schedules.
- Disposal methods and ongoing actions to comply with Federal, State, and local environmental regulations.
- Disposal procedures for self-help and independent contractors.
- Restrictions and penalties for creating illegal dumps.

- Curbside debris segregation instructions.
- Public drop-off locations for all debris types.
- Process for answering the public's questions concerning debris removal.

Chapter 14, *Public Information Strategy* further discusses the types of information and how it may be distributed.

Contracting and Procurement

The primary role of the Contracting and Procurement department is to have debris contracts in draft form ready for advertisement or have pre-qualified contractors in place prior to the event. This portion of the plan needs to be updated as the jurisdiction's procurement procedures and contracts may expire and change over time. Contracting and Procurement planning includes the following tasks:

- Develop contract requirements.
- Establish contractor qualifications.
- Distribute instructions to bidders.
- Advertise bids.
- Establish a pre-disaster list of pre-qualified contractors.
- Manage the contract scope of work.
- Establish a post-disaster contracting procedure if necessary.

Legal

The applicant's Legal staff leads the review process for all legal matters in the debris management planning process. In addition to advising the debris management planning staff, the following tasks should also be performed by the legal department:

- Review all contracts.
- Review and/or establish a land acquisition process for temporary debris management sites.
- Review all insurance policies.
- Ensure environmental and historic preservation compliance before, during, and after operations.
- Ensure that site restoration and closure requirements are fulfilled.
- Review and/or establish a building condemnation processes.

- Review and/or establish a legal process for private property demolition and debris removal.
- Review right-of-entry and hold harmless agreements.

Operations

The Operations staff is responsible for the supervision of government and contract resources and overall project implementation. The Operations department is responsible for implementing the entire debris removal operation. Planning tasks include:

- Position equipment and resources for the response and recovery debris removal operations.
- Develop staff schedules and strategies.
- Provide communication, facilities, services, equipment, and materials to support the response and recovery activities.
- Monitor and direct force account and contract labor.
- Distribute response and recovery resources.
- Operate and manage the collection, debris management site, and disposal strategies.
- Create a demolition strategy for structures, if necessary.
- Report progress for distribution to the debris management planning staff.

Engineering/Planning

The Engineering staff supports all other debris management sections in a technical role. The Engineering department provides debris quantity assumptions, economic analysis, and feasible solutions for the debris operations. The following are tasks that may be completed by the Engineering staff:

- Forecast debris volume based on assumed disaster type.
- Develop an estimating strategy for post-disaster debris quantities.
- Strategize and map debris haul routes.
- Select debris management sites and design the site layout.
- Determine reduction and recycling means and methods.
- Identify and coordinate environmental issues.
- Assess available landfill space and determine if additional space is needed.
- Develop the debris collection strategy.
- Write contract scopes of work, conditions, and specifications.

- Coordinate with other local and State jurisdictions for road clearance and operations.
- Establish a process for building damage assessment and condemnation (including public and private properties).
- Issue permits.

Questions to Consider

1. What departments within your agency are responsible for:

   - Debris removal?
   - Solid waste removal?
   - Demolition?
   - Public information?
   - Contract services?

2. What departments within your agency should participate in the development of a debris management plan?

3. Who will be the Debris Project Manager for your jurisdiction?

4. What staff positions within your agency or department should be designated to coordinate State and Federal assistance for debris management activities?

5. What local ordinances that have been adopted in your community apply to debris management activities?

6. What Federal and State environmental regulations apply to debris removal activities?

7. Which staff member will be responsible for coordinating efforts with FEMA and the State during a Presidentially declared disaster?

To Do Checklist

1 Assign management personnel to a debris management team for planning and implementation of the debris management plan. Assignments include management and planners for:

- Administration
- Contracting/Procurement
- Legal
- Operations
- Engineering/Planning

2. Establish an organization chart with names and contact numbers for distribution to the planning staff.

3. Assign a primary coordinator, and additional staff if necessary, to coordinate State and Federal assistance for debris management activities.

4. Assemble any local ordinances that have been adopted in the jurisdiction that apply to debris management activities.

Chapter 6 – Debris Forecasting for a Design Event

Chapter Highlights

Design Disaster Event
Disaster Characteristics
Land Use and Geography
Forecasting Methods
- Buildings
- Vegetation
- Volume – Weight Conversion Factors
- Other Forecasting Methods

Questions to Consider
To Do Checklist

Please see Chapter 1, *Public Assistance Debris Removal Eligibility*, and Chapter 3, *Debris Removal from Public Property*, for eligibility issues to consider in developing the debris management plan.

Quantifying the amount of debris after the disaster is known as "estimating." Predicting the amount and type of debris prior to a disaster event is known as "forecasting."

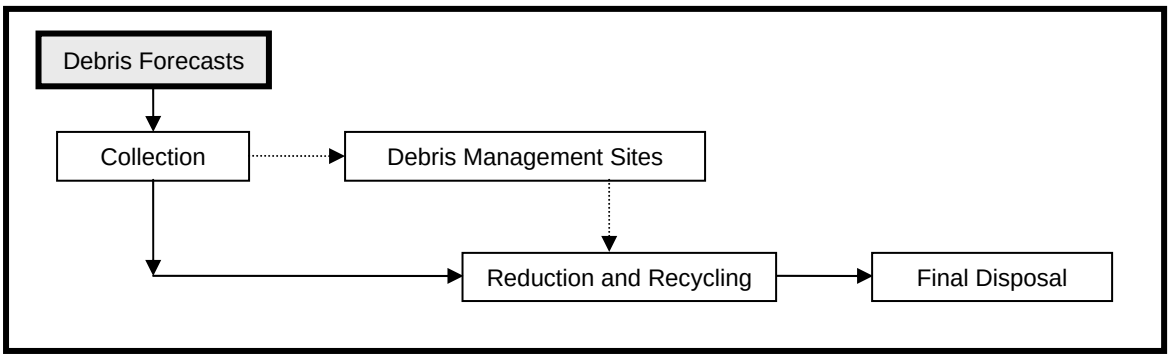


Figure 6.1 – Debris Management Forecasting Component

Forecasting the type and quantity of debris begins the debris planning process. By forecasting the type and quantity of debris, the planning staff can better define the scope of work of the debris management operations. Debris forecasts can be used to determine the required response and recovery resources, the number and size of storage and reduction sites, and the final disposition of the disaster-related debris.

Staff can reasonably forecast debris by becoming familiar with the impacts that result from various types of disasters. Realistic debris forecasts depend on the type and size of disaster an applicant anticipates their community will encounter.

Design Disaster Event

The type of disaster and the debris that is generated may be similar for an entire region of the country, but the size and extent of the affected areas is specific to an applicant's jurisdiction. The more information gathered during the planning process, the more realistic the projected debris quantities will be for future disasters. For planning purposes, an applicant should consider a "design event" to calculate and forecast the amount of debris that will be generated. Planning staff needs to determine the size and extent of a potential disaster.

Historical data is most often used to determine the design event for hurricanes, tornadoes, ice storms, wildfires, and floods. The design disaster event must be within reason and take into account historic events and any additional altered criteria that may affect the disaster scenario. For example, a flood event may not impact as many single-family homes as a previous event, due to a change in a river channel or revised zoning laws that prohibit building in a flood-prone area.

Earthquake design events should be analyzed for reasonableness and practicality. For instance, an applicant may only need to plan with the assumption that a portion of its structures will be damaged or destroyed during a disaster event, rather than all of its structures, if more stringent seismic building codes and better construction practices have been adopted since a previous event of the same nature.

Terrorist events have limited historical data; information from natural disasters and/or analyzing vulnerabilities of a particular applicant's jurisdiction may provide useful insight into the challenges an applicant could anticipate.

Disaster Characteristics

The following are general descriptions of natural and manmade disasters and the associated debris that each generates.

Hurricanes and Typhoons

The terms "hurricane" and "typhoon" are two regional names for the same phenomenon. The damaging forces of hurricanes and tropical storms include high velocity winds (up to 150 miles per hour or higher in gusts), storm surge, and wave action. The most severe damage frequently occurs in the shore lands adjacent to the ocean. The resultant debris consists primarily of vegetative matter, construction materials from damaged or destroyed structures, personal property, marine vessels, and sediment. The greatest concentration of debris is located along the shoreline. Flooding and tornadoes spawned by hurricanes can cause damage and leave extensive amounts of natural and manmade debris far inland.

It is important to consider the mix of debris that may be generated, though there is no standard composition data that can be applied for all hurricanes. For example, the composition of debris from Hurricane Andrew (1992) in Florida was generally 30 percent clean, woody debris and 70 percent construction and demolition debris. After Hurricane Fran (1996) in North Carolina, the mix was exactly the opposite. Considering the land-use types and existing infrastructure (types of structures) will assist in making forecasts for planning purposes.

Tsunamis

A tsunami is a wave train, or series of waves, generated in a body of water by an impulsive disturbance that vertically displaces the water. Earthquakes, landslides, volcanic eruptions, explosions, and even the impact of cosmic bodies, such as meteorites, can generate tsunamis. Tsunamis can savagely attack coastlines, causing devastating property damage and loss of life. They are capable of inundating and flooding areas hundreds of yards inland past the typical high water level. The fast-moving water associated with the inundating tsunami can crush homes and other coastal structures. Debris from tsunamis may consist of construction and demolition debris, vegetative debris, dead mammals, fish, and other marine forms. Tsunamis can be very deadly, and a community could expect to have a high loss of life.

Tornadoes

Damage from tornadoes is caused by high-velocity rotating winds. The severity of the damage depends on the velocity of the tornado funnel and the length of time the funnel is on the ground. Damage is generally confined to a narrow path, which can be up to one-half mile wide and from 100 yards to several miles long. Tornado debris consists primarily of vegetative debris, construction materials from damaged or destroyed structures, and personal property.

Floods

Severe rainstorms, hurricanes, tsunamis, or reservoir failure can cause flooding. Damage to structures from flooding is caused either by inundation or high-velocity water flow. Structural damage is usually limited to the floodway and the floodplain area immediately adjacent to the waterway. Heavy structural damage may result from high-velocity waters in mountainous areas or failure of a flood control project, such as a dam or levee. Flood debris may consist of sediment, wreckage, personal property, and sometimes hazardous materials deposited on public and private property. Additionally, heavy rains and floods may produce landslides; in such cases, debris consists primarily of soil, gravel, rock, and some construction materials.

Earthquakes

Seismic forces along fault lines generate shock waves that cause ground shaking, surface ruptures, liquefaction, landslides, mudflows, and earth cracking. Damage may be localized at the epicenter or widespread across adjoining areas. Secondary effects of earthquakes such as aftershocks, fires, explosions, and landslides cause further damage. Debris from an earthquake generally consists of damaged personal property, structural building materials, charred material, concrete, and asphalt.

Fires

Wildfires or urban fires can destroy or partially damage building structures, vehicles, public infrastructure, and vegetation. The loss of vegetative growth on hillsides may result in mudslides and subsequently cause further structural damage. Debris from fires consists of burnt personal property, burnt metals, charred wood, ash, asbestos, and other hazardous wastes.

Ice Storms or Snowstorms

Debris from ice storms or snowstorms consists of significant amounts of vegetative debris and overhead utility service components.

Acts of Terrorism

Terrorism includes the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives. Since terrorism is regarded as a criminal act, it involves coordination with law enforcement authorities, the coroner's office, and health officials before debris is handled or disposed.

Debris generated as a result of an act of terrorism is highly variable in both quantity and type, depending upon the specific means utilized by the terrorists. An act of terrorism could generate little to no debris at all, or could result in large quantities of multiple types of debris, potentially requiring highly specialized personnel, procedures, and equipment for its removal and disposal.

Disaster Debris Streams

Typically, disasters generate a mix of different types of debris. Figure 6.2 summarizes the typical types of debris for each type of disaster.

		Typical Debris Streams								
		Vegetative	Construction & Demolition (C&D)	Personal Property/ Household Items	Hazardous Waste	Household Hazardous Waste (HHW)	White Goods	Soil, Mud and Sand	Vehicles and Vessels	Putrescent
Types of Disasters	Hurricanes / Typhoons	X	X	X	X	X	X	X	X	X
	Tsunamis	X	X	X	X	X	X	X	X	X
	Tornadoes	X	X	X	X	X	X		X	X
	Floods	X	X	X	X	X	X	X	X	X
	Earthquakes		X	X		X	X	X		
	Wildfires	X		X		X	X	X		
	Ice Storms	X				X				

Figure 6.2 – Typical Debris Streams for Different Types of Disasters

Different handling and disposal methods are required for particular debris types and impact the scope of work of the debris management plan. Managing debris containing hazardous, household hazardous, medical, and infectious materials requires various specialized handling and disposal methods. Planning Staff should consider the proper handling and disposal methods for each type of debris that could be generated during each design disaster event when preparing debris management plans. Refer to Chapter 3, *Debris Removal from Public Property*, for discussion on typical debris streams.

Land Use and Geography

The planning staff should take into consideration land use, terrain, and accessibility of areas located within the applicant's geographic boundaries to determine the types of debris that will be generated and to establish effective debris collection programs.

Understanding the local land use provides information as to the types of debris that will be generated and offers insight as to the type of handling that would be necessary to safely manage the debris. For example, rural areas may have more vegetative debris; whereas, urban residential areas may have more construction and demolition debris. Industrial parks may have

special environmental concerns compared to park areas. Planning staff may find it useful to divide the jurisdiction into sectors in order to keep the forecasting manageable.

Evaluating accessibility and terrain of various locations within a jurisdiction is critical to determining the types of debris collection programs that should be undertaken. Remote areas may require the planners to safely store the debris until accessibility is established. Usually, finding debris contractors, recyclers, or disposal facilities in remote areas is a challenge. To promote expedient recovery efforts, planners should identify and maintain lists of available debris contractors, recyclers, and disposal facilities.

Forecasting Methods

After the disaster parameters and geographic extent is established, specific debris volumes can be quantified by using historical information or forecasting models.

Historical records provide a basis for forecasting disaster-generated debris and can be used for planning purposes. Previous contracts for debris removal, recycling activities, volume-reduction processing, and landfill disposal records should be reviewed thoroughly to determine the quantity of disaster debris that was generated for a particular disaster event.

If previous disaster data is not available, assumptions may be made from neighboring jurisdictions' experience, or from USACE modeling. USACE emergency management staff has developed a modeling methodology designed to forecast potential amounts of hurricane-generated debris. Based on data from Hurricanes Frederic (1979), Hugo (1989) and Andrew (1992), the methodology has a predicted accuracy of plus/minus 30 percent. USACE mathematical modeling forecasts the quantity of debris specifically generated by hurricanes and is available in Appendix B, *USACE Hurricane Debris Estimating Model*.

Buildings

Several basic techniques have been established to forecast destroyed building debris quantities. These techniques can be used to forecast debris quantities prior to an event or estimate quantities after a disaster.

Residential buildings

A formula for estimating the debris quantities from a demolished single-family home and associated debris is:

L′ x W′ x S x 0.20 x VCM =___ cubic yards of debris (cy)

Where:

L = length of building in feet
W = width of building in feet
S = height of building expressed in stories
VCM = Vegetative Cover Multiplier

The vegetative cover multiplier is a measure of the amount of debris within a subdivision or neighborhood. The descriptions and multipliers are described as:

- **Light** (1.1 multiplier) includes new home developments where more ground is visible than trees. These areas will have sparse canopy cover.
- **Medium** (1.3 multiplier) generally has a uniform pattern of open space and tree canopy cover. This is the most common description for vegetative cover.
- **Heavy** (1.5 multiplier) is found in mature neighborhoods and woodlots where the ground or houses cannot be seen due to the tree canopy cover.

The table below can be used to forecast debris quantities for totally destroyed single-family, single-story homes in the applicable vegetative cover category.

Typical House (square feet)	Vegetative Cover Multiplier			
	None	Light (1.1)	Medium (1.3)	Heavy (1.5)
1000 sf	200 cy	220 cy	260 cy	300 cy
1200 sf	240 cy	264 cy	312 cy	360 cy
1400 sf	280 cy	308 cy	364 cy	420 cy
1600 sf	320 cy	352 cy	416 cy	480 cy
1800 sf	360 cy	396 cy	468 cy	540 cy
2000 sf	400 cy	440 cy	520 cy	600 cy
2200 sf	440 cy	484 cy	572 cy	660 cy
2400 sf	480 cy	528 cy	624 cy	720 cy
2600 sf	520 cy	572 cy	676 cy	780 cy

Figure 6.3 – Debris Forecasting Table for Totally Destroyed Homes

The amount of personal property within an average flooded single-family home has been found to be:

- 25-30 cy for homes without a basement
- 45-50 cy for homes with a basement

Mobile homes have less wasted space due to their construction and use. The walls are narrower, and the units contain more storage space. Therefore, the typical mobile home generates more debris by volume than a single-family home. Historically, the volume of debris from mobile homes has been found to be:

- 290 cy of debris for a single-wide mobile home
- 415 cy of debris for a double-wide mobile home

Outbuildings

All other building volumes may be calculated by using the following formula:

$$\frac{L' \times W' \times H' \times 0.33}{27} = \_\_\_ \text{ cubic yards of debris}$$

Where:

L = length of building in feet
W = width of building in feet
H = height of building expressed in feet
0.33 is a constant to account for the "air space" in the building
27 is the conversion factor from cubic feet to cubic yards

Vegetation

Vegetation is the most difficult to estimate due to the random sizes and shapes of trees and shrubbery. Based on historical events, USACE has established a few rules of thumb in forecasting and estimating vegetative debris.

- Treat debris piles as a cube, not a cone, when estimating
- 15 trees, 8 inches in diameter = 40 cy (average)
- One acre of debris, 3.33 yards high = 16,117 cy

Volume – Weight Conversion Factors

These factors to convert woody debris from cubic yards to tons are considered reasonable and were developed by USACE.

Softwoods	6 cubic yards = 1 ton
Hardwoods	4 cubic yards = 1 ton
Mixed debris	4 cubic yards = 1 ton
C&D	2 cubic yards = 1 ton

To verify these conversion factors in the field, several truckloads may be tested. Trucks should be well loaded, contain woody debris typical of that being removed, and truck capacities should be verified. It is recommended that testing be performed with all affected parties present.

Other Forecasting Methods

Remote Sensing

The use of remote sensing information (aerial photographs, satellite data, etc.), either alone or in combination with field surveys, may be of significant use in forecasting the amount, mix, and extent of debris. Geographic Information System (GIS) maps should be considered early in the planning process. Depending upon the area, it is usually possible to quickly obtain GIS maps of landfills, Superfund sites, transportation routes, etc. As data on debris is obtained, plotting it on GIS maps should be considered.

Forecasting Models in Development

The private sector is currently developing other debris estimating models for tornadoes and hurricanes. These models are based on GIS or phone book data and on the USACE model. The Federal government and private industry are also working on a model to determine earthquake debris. The model takes into consideration various characteristics of an earthquake to anticipate the quantity of debris that could be generated by an earthquake.

Other debris forecasting methodologies and computer models may be available through other private vendors or other public sources.

Note that FEMA does not specifically endorse a particular product; however, such products may assist in forecasting disaster-generated debris and may be utilized for planning purposes.

Questions to Consider

1. Describe the types of disasters and debris streams that place your jurisdiction at risk.

2. Historically, what type of disaster generated:

   - The most amount of debris (quantity)?
   - The most varied types of debris?

3. Who will be responsible for:

   - Forecasting the debris quantities prior to the disaster?
   - Estimating the post-disaster debris quantities?

To Do Checklist

1. Establish a design disaster event. This may be based on historical events.

2. Forecast the type and quantity of debris for the design event. This can be based on historical data, recent neighboring community damage, or modeling methods.

3. Consider jurisdictional geography when forecasting and divide the jurisdiction into sectors if necessary.

Chapter 7 – Debris Collection Strategy

Chapter Highlights

Developing a Collection Strategy
- Response Operations
- Recovery Operations

Types of Collection Methods
- Curbside Collection
- Collection Centers

Collecting Hazardous Waste and White Goods
- Household Hazardous Waste
- White Goods

Questions to Consider

To Do Checklist

Please see Chapter 1, *Public Assistance Debris Removal Eligibility* and Chapter 4, *Private Property Debris Removal and Demolition of Private Structures*, for eligibility issues to consider in developing the debris management plan.

The next step after determining the design event and debris forecasting is to develop a debris collection strategy.

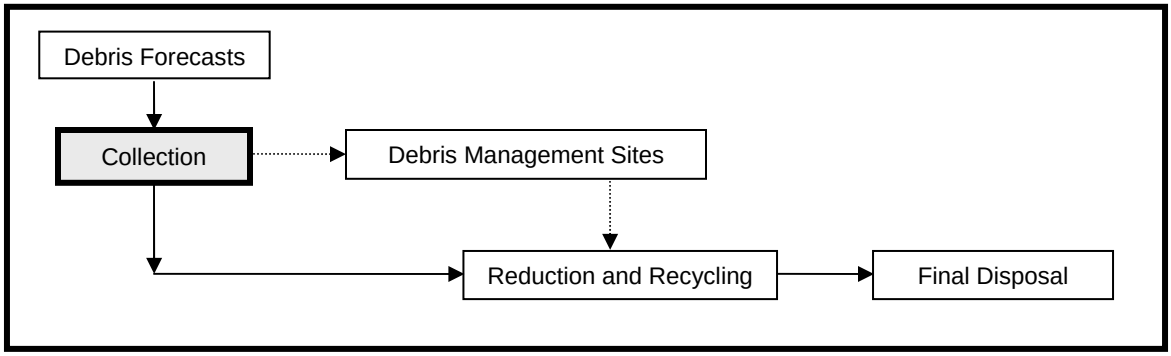


Figure 7.1 – Debris Collection Component

Collection operations are normally broken into two phases: response and recovery. An efficient debris management plan includes collection activities for response and recovery debris strategies. Response occurs sometimes during and always immediately after an event in order to clear emergency access routes. The recovery operation usually begins after the emergency access routes are cleared and the residents return to their homes and begin to bring debris to the public rights-of-way.

Developing a Collection Strategy

To develop a strategy, the planning staff must consider several variables, which include:

- Amount and type of forecasted debris
- Employee labor resources
- Available equipment
- Urgency of the debris operations
- Damage to priority infrastructure
- Limitations of forces and skills for specialized debris issues

Response Operations

Debris removal activities during the response phase include immediate actions for the removal of debris to facilitate search and rescue efforts, to allow access to critical facilities, and to prevent flooding. Actions required during the response phase are usually completed within a matter of days following a disaster event.

Applicants often use their own labor force and equipment to remove debris during this phase. In circumstances when the existing labor force is not sufficient, or when specialized services are required, applicants may supplement their work efforts by activating mutual aid agreements or by awarding short-term debris removal contracts for specific work.

Response operations primarily focus on the emergency access routes and main arterials. The planning staff should identify which roads and streets are essential to emergency operations so they can manage and direct local resources. The planning staff should identify and target areas for possible State and mutual aid assistance to augment their efforts.

Prior to and immediately following the event, extricating people and providing access to health care facilities are the top priorities; therefore, the major arterial routes are given priority for the emergency services staff such as police, fire, and ambulance service. Emergency operations infrastructure, such as the emergency operations center and supply distribution centers, normally are the next priority.

Other infrastructure, such as water, wastewater, and utilities, is typically given the third priority. Priorities for all other routes are established by the applicant based on its particular situation. The following is an example priority list:

1. Fire, police, and ambulance service routes
2. Access routes to trauma centers, hospitals, critical care units, and jails
3. Major arterial routes
4. Roads and streets to the debris management center and emergency operations center
5. Supply routes to emergency supply distribution centers

6. Roads and streets to government facilities
7. Communication towers and systems access
8. Utility access routes
9. Routes to shelters

Maps showing specific streets, roads, buildings, hospitals, and addresses, along with specific labor assignments are necessary for emergency staff to understand their roles. All other roads and streets are normally cleared once the emergency and major access routes are opened and the jurisdiction transitions to the recovery operations.

Recovery Operations

The recovery phase focuses on collecting the remaining debris, reducing or recycling, and final disposal. Development and management of a debris management site is considered a recovery activity as well. Depending on the quantity and the complexity of the debris removal actions, debris removal activities could continue for several months. Applicants can use a combination of force account and contractor services for debris removal activities during this phase.

Types of Collection Methods

The fundamental component of a disaster debris management strategy is the collection of debris. The public expects to have debris removed from neighborhoods immediately after a disaster event. The implementation of disaster debris collection immediately after the disaster event assures the public that recovery efforts are in progress and that the community will return to normal quickly. Developing an approach to collect debris during the planning process will assist applicants to begin collecting debris immediately following a disaster event.

The debris type, amount, and urgency determines which collection method is used. The two main methods of debris collection are curbside collection and collection centers.

The planning staff may tailor the collection operation using curbside collection, collection centers, or a combination of both depending on the specific jurisdiction, quantities, and types of debris.

Curbside Collection

Curbside collection parallels an applicant's normal garbage and trash collection operations. Debris is placed at the curb or public rights-of-way by the residents for the applicant's collection. The only difference between the subcategories discussed below is the separation of the types of debris at the point of collection.

Mixed Debris Collection

Collecting mixed debris by the applicant allows for residents to place all debris types in one specified area, usually along the public right-of-way in front of their residence. While this is the most convenient for the public, it does not facilitate effective recycling and reduction efforts, as the debris will need to be handled multiple times. Therefore, this method prolongs recycling and reduction efforts and increases operational costs.

Source-Segregated Debris Collection

Residents are directed to sort the debris by material type and place it at the curb in separate piles. Trucks designated for a particular debris type collect the assigned debris and deliver it to a temporary staging area, or debris management site, reduction, recycling, or disposal facility. The disadvantage of this method is that it requires more trucks to collect the different types of debris; however, this increased equipment cost may be offset by avoiding the labor cost and time to separate the debris by hand. Source-segregated debris collection offers the potential of high salvage value and efficient recycling/reduction processing. This method is important when collecting hazardous and environmentally sensitive debris, such as household hazardous waste and white goods. Both types of debris are discussed at the end of the Collection Methods section.

Collection Centers

The second type of collection method is to have the residents transport their debris to a common location. Large roll-off bins may be placed on public rights-of-way or public property for the residents to bring their debris for collection. This is well suited for rural, sparsely populated areas or logistically difficult conditions (i.e., hilly neighborhoods) where curbside collection is not practical. Separate bins can be designated for particular types of debris. The associated costs are generally low since the public essentially accomplishes the material collection and separation themselves.

The planning staff should assign employees to manage the development of the site and oversee the operations of the collection center. The planning staff needs to design the circulation for proper ingress, egress, and collection bin exchanges. Employees need to be stationed at the centers during the collection period in order to have empty bins brought in when the current ones are full, to ensure that debris materials are placed in the correct bins, and to ensure a collection center does not become a dumping ground for non-disaster-related debris.

The planning staff's legal counsel should investigate the liability issues that the site may present, especially if debris is being brought in and handled by the jurisdiction's residents.

Collecting Hazardous Waste and White Goods

The two most common types of debris that will need special handling are hazardous waste and white goods. Regardless of which collection method is used, the planning staff needs to understand the effects this collection can have on the overall debris clearance, removal, and disposal mission.

Household Hazardous Waste

HHW mixed with other debris types will contaminate the entire load, which necessitates special disposal methods such as storage in a particular part of a landfill. Typically, the landfill requires special liners and a more intense permit standard due to the hazardous waste. The disposal cost of HHW is generally higher than the disposal of other waste; therefore, the overall cost of debris disposal can escalate quickly if the HHW collection and disposal is not planned and executed with care.

Local governments, in coordination with the State and county, often host HHW collection center events, or "round-ups," several times during the year. The round-ups are planned scheduled events for residents to legally dispose of unused HHW. The applicants should host a HHW round-up following a disaster event, in order to avoid the commingling of the hazardous waste with other disaster-related debris. This limits the amount of contaminated waste, thereby reducing the overall disposal cost of the debris.

Pre-disaster planning should include training for hazardous waste response teams to collect, sort, store, and dispose of excessive quantities of HHW. The planning staff may consider having emergency hazardous waste removal/disposal contracts in place or pre-qualifying contractors to perform the work. The planning staff may prepare generic scopes of work that can be fine tuned with minimal effort, in order to begin recovery operations as soon as possible.

White Goods

The planning staff needs to take special care in finding certified recycling centers that are permitted to take white goods. Refrigerants and other machine fluids are normally regulated by the State environmental agency and can only be reclaimed by certified technicians and disposed of at a permitted facility. To avoid releases of refrigerants or oils, the collection of white goods should be accomplished carefully by manually placing the appliance on trucks or by using lifting equipment that will not damage the elements that contain the refrigerants or oils.

Having contracts or agreements in place prior to a disaster expedites the recovery efforts.

Recycling scrap metals and parts from white goods presents an opportunity for applicants to offset the collection and disposal costs. This also reduces the amount of waste going to a landfill.

The State environmental office and EPA provide first response functions in cases of commercial, agricultural, industrial, and toxic waste spills. The debris management plan should include the contact information for both parties in case of a large contamination issue.

Questions to Consider

1. What facilities will be critical for establishing clearance or removal priorities in the debris management plan?
   - Emergency (police, fire, hospitals)
   - Utilities (electrical, water, sewer, communications)
   - Other

2. Who will conduct response and recovery activities? Force account labor? Contractors?

3. How will debris be collected throughout the jurisdiction?

4. How will the collection activities handle HHW and white goods?

5. Have the necessary environmental controls for hazardous waste been designed for the collection centers, such as liners and berms?

6. Have the appropriate State and local regulatory agencies been involved in the selection of collection center sites, to ensure they are not placed in environmentally sensitive areas?

To Do Checklist

1. Establish priorities for debris clearance and removal during response and recovery operations.

2. Identify which collection method best suits the jurisdiction.

3. If collection centers are used:

   a. Identify appropriate locations for collection centers
   b. Identify if hazardous waste or HHW will be collected
   c. Identify how the collection centers will be monitored
   d. Identify how long the collection centers will be in place

4. If using curbside collection, identify the work force that will collect the debris:

   a. If Force account, assignments for:
      - Labor
      - Equipment
      - Sector or section of the applicant's jurisdiction

   b. If Contractors, assignments for:
      - Labor
      - Equipment
      - Sector or section of the applicant's jurisdiction
      - Monitor assignments for contractor activities

5. Establish a process for handling HHW and white goods.

6. Train staff and emphasize the need for documenting key debris eligibility requirements for Public Assistance grant consideration:
   a. Hours worked
   b. Hours the equipment was operating
   c. Location of work performed
   d. Amount of debris removed
   e. Type of debris

Chapter 8 – Debris Management Sites

Chapter Highlights

Advantages and Disadvantages
Identifying Debris Management Sites
- Ownership
- Size
- Location
- Environmental and Historic Preservation Concerns

Baseline Data Collection
Environmental Monitoring Program
Permits
Establishment and Operations Planning
- Site Design
- Site Management
- Site Closure

Questions to Consider
To Do Checklist

Please see Chapter 1, *Public Assistance Debris Removal Eligibility*, for eligibility issues to consider in developing the debris management plan.

Debris Management Sites (DMS) are established when applicants are unable to take debris directly from the collection point to the final disposition location.

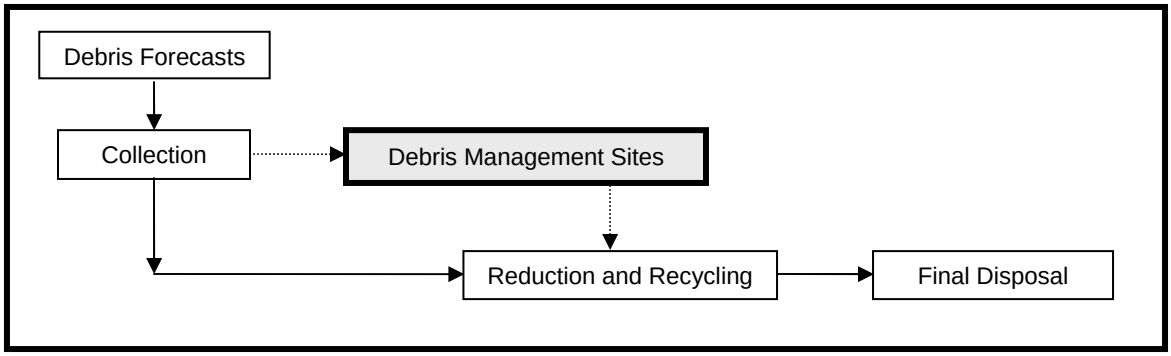


Figure 8.1 – Debris Management Site Component

A DMS is a location for applicants to temporarily store, reduce, segregate, and/or process debris before it is hauled to its final disposition. It is frequently used to increase the operational flexibility when landfill space is limited or when the landfill is not in close proximity to the debris removal area.

By employing a DMS, the debris can be collected from the rights-of-way and public properties in order to expedite permanent recovery operations. Locations for temporary debris storage and processing facilities should be identified during the planning process, and a listing of the locations should be included in the debris management plan.

Advantages and Disadvantages

The advantages and disadvantages of a DMS are:

Advantages:

- Flexibility of operations. The DMS may also include a collection center for the public's use.
- Facilitation of recycling and reduction of debris. Specific reduction, recycling, or segregation needs can be designed into the site.
- Expedition of debris collection. Having a site for temporary storage and reduction allows time for local landfill site preparation before final disposal. The DMS may also be established at a location central to the disaster event, thereby reducing travel time from the disaster area to the disposal site.

Disadvantages:

- Additional cost to handle the debris twice. Once to the DMS and the second time to final disposition.
- If applicant-owned land is not available, leasing land is expensive.
- Additional costs for proper planning, engineering, and permitting.
- Considerable time and effort required to complete environmental and historic preservation compliance reviews prior to establishing the site.
- Environmental review and potentially extensive site cleanup may be necessary to properly close the site.
- DMS requires dedicated site management and staff for efficient operations, safety, and documentation considerations.

Identifying Debris Management Sites

Identifying potential sites before a major natural disaster expedites debris removal and subsequent volume reduction and disposal actions. The designated Debris Project Manager and staff should work closely with other local, tribal, and State officials to develop and maintain

current listings of potential debris storage and reduction sites in areas prone to natural disasters. Site selection should be based on the following criteria:

- Ownership
- Size
- Location
- Environmental and historic concerns (baseline study findings)

Ownership

The planning staff should consider public lands first in order to avoid costly land leases. Existing disposal or recycling facilities that are in close proximity to the disaster area are ideal locations for DMS. Nearby landfill and recycling center capacities need to be evaluated for site feasibility. Applicant-owned sites that will not require extensive repair costs, such as parks, vacant lots, or sports fields, should be considered as well. State-to-State or county-to-county agreements may present possible solutions for public land use.

When this is not possible, the planning staff should develop criteria for identifying potential private property locations for the DMS. Private land leases need to be reviewed by the legal staff in order to avoid extensive damage claims upon site closeout.

Land Lease Agreements

The duration of the land lease agreement should be inclusive of all the time the applicant will be present at the site, beginning with the baseline environmental study and ending once the property owner takes back legal ownership.

The agreement should include a requirement to conduct a baseline environmental evaluation of the site before the site is occupied and an environmental evaluation before returning the property back to the owner. Both documents may become an annex to the land lease agreement.

The land lease agreement should be for a specific time frame with the ability to extend the lease if debris removal and processing activities are not completed.

Size

The size of the site is dependant on the quantity of debris that is stored and processed. The site should be large enough to safely accommodate processing of various debris materials, storing heavy equipment, and maneuvering trucks and large processing equipment. Historic disasters have shown that it takes 100 acres of land to process one million cubic yards of debris. USACE has found that approximately 60 percent of the area will be used for roads, buffers, burn pits, HHW disposal areas, etc.

Location

The DMS should be established in an area that does not impede the flow of traffic along major transportation corridors, disrupt local business operations, or cause dangerous conditions in residential neighborhoods or schools. Whenever possible, avoid locating a DMS near residential areas, schools, churches, hospitals, and other such sensitive areas.

The DMS requires good ingress/egress to accommodate heavy truck traffic. The planning staff should consider adjusting traffic signals to accommodate projected truck traffic on critical haul routes. The DMS selection criteria should consider access to major routes to allow for trucks to transport material to final disposition locations.

The planning staff needs to consider public acceptability when selecting a potential DMS. It is largely dependent upon the activities planned for the site. Smoke from burning, around-the-clock light and noise from equipment operation, dust, and traffic are generally tolerated early in a disaster recovery operation, but may have to be curtailed later. The planning staff is strongly encouraged to notify citizens early about planned site activities and possible ramifications.

Environmental and Historic Preservation Concerns

When selecting public or private sites, pre-existing conditions should be considered because the sites will have to be restored upon site closeout. Proper management of the site allows the site to be closed with manageable efforts. For site closure reasons, planning staff should refrain from aggravating an existing environmental issue during the debris management operations.

Therefore, a DMS should not be established in an environmentally or historically sensitive area such as wetlands, critical animal and plant habitats, sole source aquifers, freshwater well fields, historic districts, or archeological sites. This applies specifically to any Superfund site or area within a 100-year floodplain. DMS selection criteria should also take into consideration any disproportionately high or adverse impacts on minority or low-income populations, in accordance with EO 12898. Adverse impacts should be avoided or minimized where possible. If an environmental or historic preservation concern is found during the baseline data collection process (described below), the potential site should be ranked lower than others. However, if use of such areas is unavoidable, the State and local environmental and historic preservation requirements must be followed. Compliance with environmental and historic preservation requirements is still required.

By conducting a baseline data collection study, the planning staff is able to further establish the feasibility of potential sites, document the existing site, and vet potential environmental issues. Data collection needs to be completed prior to establishing the site and continued throughout the operations. The final evaluation should include the same documentation in order to avoid disagreements on the condition of the site prior to the operations and the condition to which it was returned.

Baseline Data Collection

Baseline data collection is essential to documenting the condition of the land before it is used as a DMS. Private and public land used as a DMS needs to be returned to its original condition following the end of all debris operations. As soon as a potential site is selected, the designated Debris Project Manager and staff should work closely with local, tribal, and State officials to develop baseline data criteria. The following actions are suggested to document the baseline data on all sites:

1. **Videotape and/or Photograph the Site**. Thoroughly videotape and/or photograph (ground or aerial) each site before beginning any activities. Periodically update video and photographic documentation to track site evolution.

2. **Document Physical Features**. Note existing structures, fences, culverts, irrigation systems, and landscaping that can help evaluate possible damage claims made later.

3. **Investigation of Historic Significance**. Research the past use and ownership of the property to document any issues regarding the existence of historic structures or archeological sites. The SHPO may have information about the property.

4. **Sample Soil and Water**. Soil and groundwater samples should be collected prior to use of the site. Advance planning with community and State environmental agencies can establish requirements, chain of custody, acceptable sampling methods, certified laboratories, and testing parameters. If in-house assets are not available, the planning staff may consider establishing a contract with an environmental consulting firm that can respond rapidly. Planned HHW, ash, and fuel storage areas should be sampled prior to site setup.

Environmental Monitoring Program

As operations proceed additional data should be collected throughout the operations for closeout and quality assurance reasons. The data can be compared to the previously established information in order to determine any remediation that may be necessary.

1. **Sketch Site Operation Layout.** DMS operations may grow, shrink, or shift on the site. It is important to track reduction, hazardous waste collection, fuel, and equipment storage in order to sample soil and water for contaminants. Periodically map or sketch activity locations so that areas of concern can be pinpointed later for additional sampling and testing.

2. **Document Quality Assurance Issues**. Document operations that will have a bearing on site closeout, such as petroleum spills at fueling sites, hydraulic fluid spills at equipment breakdowns, installation of water wells for stock pile cooling or dust control, discovery of HHW, and commercial, agricultural, or industrial hazardous and toxic waste storage and disposal.

3. **Restoration of Site**. Final restoration of the landscape must be acceptable to the landowner, but within reasonable expectations. Therefore, plan the landscape restoration as early as possible, preferably incorporating provisions within the lease.

Permits

Environmental permits and land-use variances may be required to establish a temporary DMS. Several agencies may be involved in issuing permits and granting land-use approvals. The planning process should identify the potential permits that will be required to establish a facility. A listing of the permits should be part of the debris management plan and may include:

- Waste processing and recycling operations permit
- Temporary land-use permits
- Land-use variances
- Traffic circulation strategies
- Air quality permits
- Water quality permits
- Coastal commission land-use permits
- HHW permits
- Fire department permits

Establishment and Operations Planning

Site Design

The information gathered during the baseline data collection becomes important to the design of the site. Additional concerns, such as site operations and closure criteria, need to be taken into consideration when the site is designed. Many of these issues will be addressed in planning, but will be implemented after the debris-generating event occurs.

Site Preparation

The topography and soil/substrate conditions should be evaluated to determine the best site layout. When planning site preparation, the designer should consider ways to make site closure and restoration easier. For example, if the local soils are very thin, the topsoil can be scraped to bedrock and stockpiled in perimeter berms. Upon site closeout, the uncontaminated soil can be

re-spread to preserve the integrity of the tillable soils. Operations that modify the landscape, such as substrate compaction and over-excavation of soils when loading debris for final disposal, adversely affect landscape restoration.

Site Layout

The efficiency and the overall success of the DMS operations is determined by how the site is designed. Debris should be constantly flowing to incinerators and grinders, or recycled with the residue and mixed construction and demolition materials going to a landfill. Significant accumulation of debris should not be allowed to occur at temporary storage sites, due to environmental and safety concerns, such as the risk of fire. Moreover, permits for such sites usually impose maximum capacity restrictions. Additional debris management sites may be required if the actual debris quantities flowing into the site are greater than the site storage and processing capacity.

Figure 8.2 - DMS With Undesired Debris Accumulation

Figure 8.3 - DMS With Little Debris Accumulation

Operational Boundaries

Operational boundaries are the boundaries or areas that clearly define the difference in use areas at the DMS. In establishing the operational boundaries, the DMS design staff may consider using earthen berms, temporary barriers, or any other physical restriction. This aids traffic circulation and helps keep debris amassing at the DMS to a minimum.

Common operational uses are:

- Reduction
- Recycling
- Tipping areas (unloading)
- Loading areas for processed debris to go to its final disposition
- Drop-off centers for the general public (this may include vegetative, recycling, or construction and demolition debris)
- HHW storage
- Monitoring tower locations at both the ingress and egress points
- Equipment, fuel, and water storage

The separation between all of the areas listed above needs to be clearly delineated and defined. As operations proceed, the lines may be moved to accommodate either growing demand for space or a reduction in preparation for closure.

The reduction, recycling, tipping, and loading areas need ample room for large equipment operations. The design should take into consideration the possibility of multiple pieces of equipment being in the same activity area at one time. Depending on the scale of operations, each debris stream may have its own tipping area and should be designed accordingly. Reduction activity considerations are discussed in Chapter 9, *Debris Reduction/Recycling Methods and Disposal.*

General public drop-off areas for recycling, reduction, and construction and demolition debris may be included within a DMS. These public use areas should be carefully designed for passenger vehicle traffic and public safety.

HHW storage should be close to the public drop-off center yet restricted so that qualified personnel may process the waste appropriately. The design staff may consider constructing an impermeable lining and earthen berms in order to contain spills and prevent surface water runoff from leaving the area.

Monitoring towers should be located at ingress and egress points. Monitoring towers should be constructed of durable structural materials. The structures should be designed to withstand active and static loads. A stepladder is not an acceptable monitoring tower. Additional monitoring concerns and issues are discussed in Chapter 11, *Monitoring Debris Removal.*

Equipment and fuel should have a designated storage area and signs posted appropriately. The fuel storage areas need to be designed to contain spills. Water should be readily available at all times. Water storage areas should be strategically positioned throughout the site and identified appropriately.

Traffic Patterns

The traffic circulation needs to be well defined throughout the entire site. Although traffic signs and barricades aid in directing traffic, the planning staff may consider flag personnel to help direct traffic. Drivers unfamiliar with the new environments, routes, and rules will need assistance in order to safely navigate through the DMS.

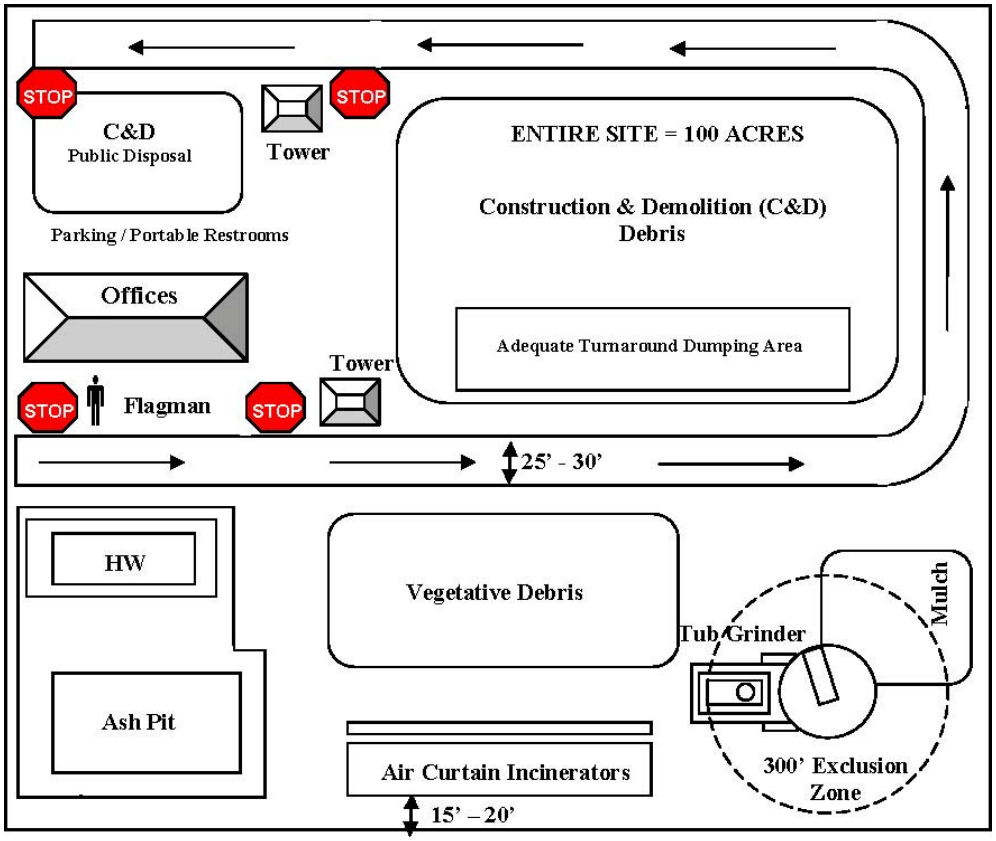


Figure 8.4 - Sample DMS Layout

Optimally, the designed traffic pattern should allow trucks to enter and exit through different access points, as long as each is monitored. Haulers are typically paid by the volume of a load. The load is evaluated when entering the site as a percentage of the full capacity of the truck. Stationing monitors at ingress and egress points ensures every truck releases the entire load prior to leaving the site. This avoids debris left in a truck from a previous load from being counted again in a subsequent load.

The empty trucks that enter the site to remove the processed (reduced) debris should enter and exit through an access point other than that of all other traffic. This reduces the site management and debris monitor confusion regarding debris being deposited or leaving the site.

Site Management

To meet overall debris management strategy goals and to ensure that the site operates efficiently, the management of the site should be under the direction of the applicant.

Applicants could use in-house personnel or contracted services to manage the site. In either situation, a site manager, debris monitors, and safety personnel are needed to ensure safe and efficient operations.

Site Manager

The site manager is responsible for supervising the overall day-to-day operations, maintaining daily logs, preparing site progress reports, and enforcing safety and permitting requirements during site operations. The site manager is also responsible for scheduling the environmental monitoring and updating the site layout. The site manager has oversight for monitoring the activities of the debris removal contractors and the onsite debris processing contractors to ensure they comply with the terms of their contracts.

Debris Monitors

Applicant's monitors (whether force account or contractors) should be placed at ingress and egress points in order to quantify debris loads, issue load tickets, inspect and validate truck capacities, check loads for hazardous waste, and perform quality control checks. The specific duties of the monitors are dependent on how debris is collected. Chapter 11, *Monitoring Debris Removal*, includes additional information concerning monitoring roles and responsibilities.

Safety Personnel

Safety personnel are responsible for traffic control and ensuring that site operations are in compliance with State and Federal occupational safety regulations.

Site Closure

When the site operations are complete, the property must be restored to its original condition before returning the site to the property owner. Restoration of a site involves removing all traces of the operations and possible remediation of any contamination that may have taken place during the operations. The site, either applicant owned or leased, must be brought back to its environmental state, prior to it being returned to the owner.

Debris, processing equipment, storage tanks, protection berms, and other structures built on the site should be removed from the site upon completion of all debris removal and processing operations.

The final environmental site evaluation is an extension of the environmental monitoring program. Similar testing as completed in the baseline study will be conducted to confirm that the site has been returned to its pre-activity state. Test samples should be taken at the same locations as those of the initial assessment and monitoring program. However, if warranted, additional test samples may need to be taken at other locations on or adjacent to the site.

Based on the results of the testing, additional remediation may be required before the owner takes final acceptance of the site. The lease agreement should have provisions to release the applicant from future damages when the site is returned in its original condition or final acceptance is received from the owner.

Questions to Consider

1. What are the remaining capacities of your landfills? How would you acquire this information?

2. Are there any restrictions to the types of materials that can be taken to your landfills?

3. Does the governing jurisdiction have available property that can be used as a DMS? If not, who would have the responsibility to locate a potential DMS and prepare legal lease agreements?

4. Who in your staff could manage the DMS? What staff is available to work at the DMS?

5. Will contracting additional labor and equipment be necessary to operate the DMS?

To Do Checklist

1. Identify landfills within the jurisdiction that can be used for a DMS, final disposal, or both. If landfill space is not available, what are the alternatives?

2. If it is determined that a DMS is necessary:

   a. Perform the baseline data collection

   b. Have the legal staff review and obtain a lease (if private property)

   c. Identify any outstanding environmental concerns with the site

   d. Obtain all permits from the governing authority or agencies

3. Identify the jurisdictional staff member(s) that will be responsible for the DMS operations.

4. Identify the types of operations that will be taking place at the DMS.

5. Design the DMS layout.

6. Identify how the DMS activities will be performed:

   - Force account labor and equipment
   - Contract labor and equipment.

7. Develop an ongoing environmental monitoring strategy for while the DMS is operating. Document appropriately for potential site closure remediation.

8. Perform a final environmental data collection to ensure the property is returned as it was accepted.

9. If the DMS is leased, ensure the property is returned and accepted by the owner without future action due to environmental contamination.

Chapter 9 – Debris Reduction/Recycling Methods and Disposal

Chapter Highlights

Methods of Reduction
- Incineration
- Chipping and Grinding
- Recycling

Final Disposition Operations
Questions to Consider
To Do Checklist

Please see Chapter 1, *Public Assistance Debris Removal Eligibility* and Chapter 2, *Costs*, for eligibility issues to consider in developing the debris management plan.

Based on the debris forecasting, the planning staff will have a concept of the amount and types of debris that will be collected and disposed of. During this period, the staff may consider reduction and recycling methods to lower the overall cost of a debris removal operation.

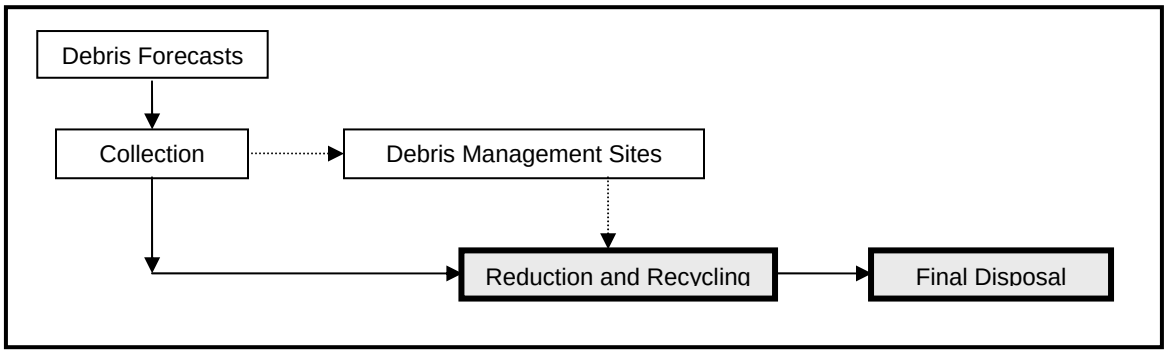


Figure 9.1 – Debris Reduction/Recycling and Final Disposal Component

Reducing and/or recycling disaster-related debris has financial and environmental advantages. These operations can decrease the overall cost of a debris removal operation by reducing the amount of material that is taken to a landfill. This diminishes the cost of final disposition in the form of tipping fees. In the case of recycling, potential end-use products for specific markets may offset the cost of operations even more. In many communities, recycling operations are an important component of the community public policy and are a priority. The staff should evaluate the types of reduction methods appropriate for the anticipated debris based on different disaster scenario events.

Methods of Reduction

The planning staff has three main types of reduction methods to consider and use during the operations: incineration, chipping/grinding, and recycling.

One method or a combination of methods may be utilized as appropriate depending on the type and anticipated volume of debris. The applicant must ensure all Federal, State, county, and local laws are followed before any reduction activities begin.

Incineration

Burning vegetative debris is a popular reduction method since it has up to a 95 percent reduction rate. Local agricultural extension personnel should be consulted to determine if the resulting ash can be recycled as a soil additive. This option should be terminated if mixed debris enters the waste stream.

The incineration process requires a minimum of three steps, to include:

1. Unloading the debris.
2. Moving the debris into an incinerator.
3. Removing the ash from the incinerator to final disposition. Final disposition may be an appropriately constructed area at the DMS or a landfill.

This process is illustrated in the following figure.

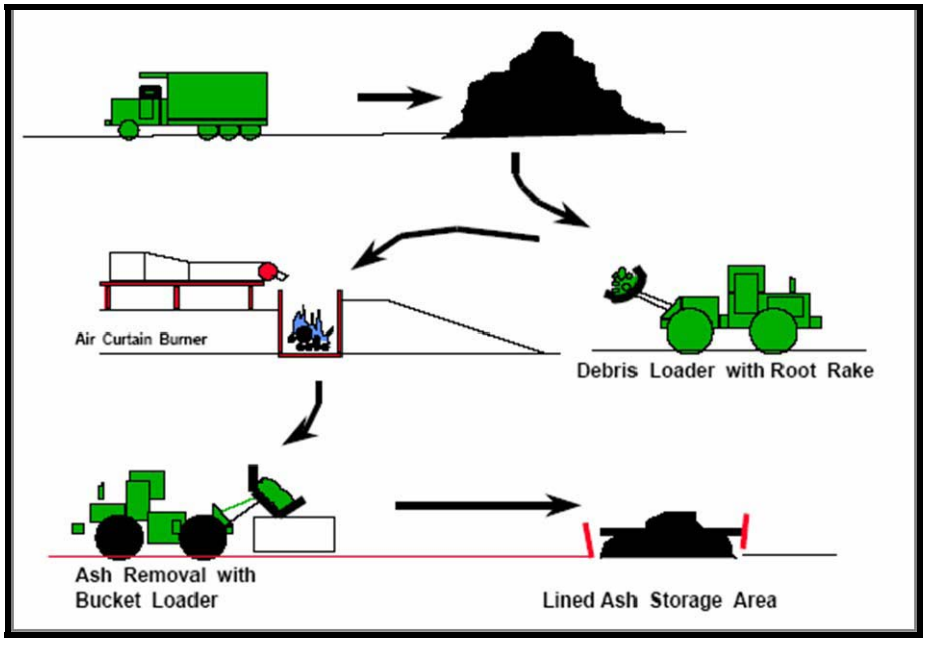


Figure 9.2 – Flow Diagram for a Burning Operation

There are several incineration methods available for volume reduction.

Uncontrolled Open-Air Incineration is reducing debris with no control over how much or how quickly it is allowed to burn. It is the least desirable method of volume reduction because it lacks any type of environmental control. Applicants may employ this method early in a disaster to make progress quickly. However, if circumstances dictate that open-air burning is the only option for managing debris, the applicant should conduct environmental evaluations to include air quality monitoring and implement control measures to limit impacts to humans and the environment. This reduction method should be closely monitored to ensure that only clean woody debris is incinerated.

Controlled Open-Air Incineration carefully reduces vegetative debris by burning debris within a contained fixed area. The reduction of clean woody debris presents little environmental damage and is cost-effective.

Air Curtain Pit Incineration offers an effective means to expedite the volume reduction process while substantially reducing the environmental concerns caused by open-air incineration. The air curtain incineration method uses a pit constructed by digging below grade or building above grade (if a high water table exists) and using a blower unit. The blower unit and pit comprise an engineered system that must be precisely configured to function properly.

The burning chamber is usually no more than 8 feet wide and 9 to 14 feet deep. The length of the pit varies depending on site size, environmental permitting, and labor/equipment limitations. The designs of successful air curtain incinerators used in past disasters are presented in the following figures, for reference and planning use only.

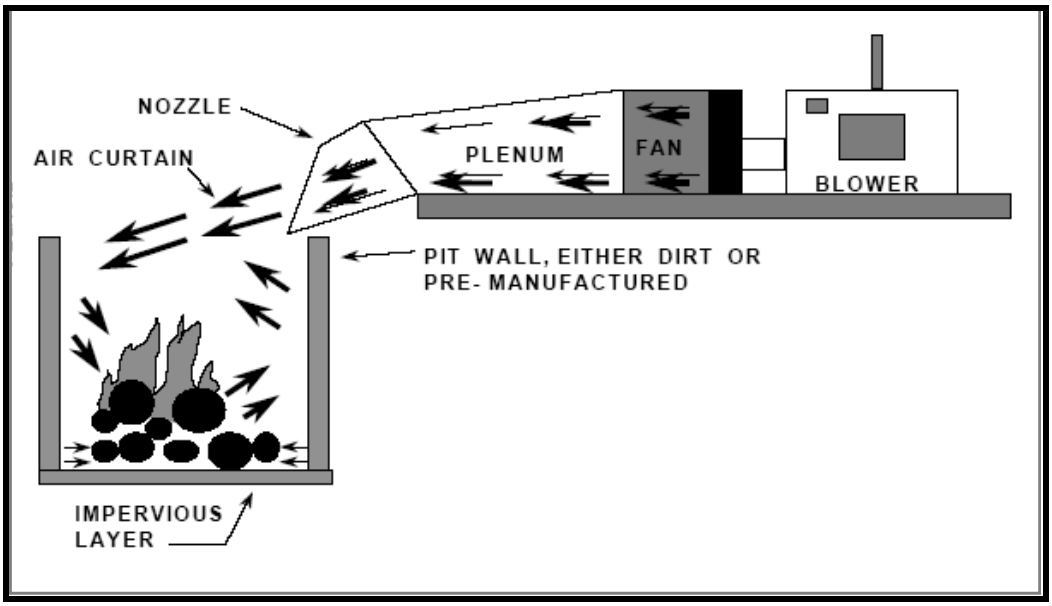


Figure 9.3 - Below-Grade Air Curtain Operation

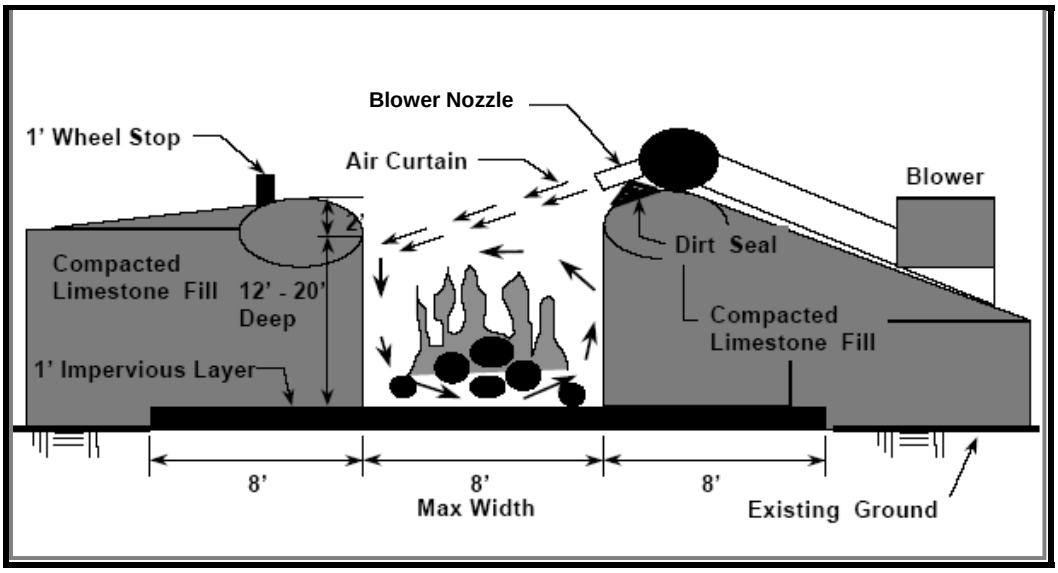


Figure 9.4 - Above-Grade Air Curtain Operation

It is important to note that there are no industry standards for air curtain pit design. The applicant should seek knowledgeable personnel who are experienced with air curtain pit incinerator design and operating procedures when soliciting expertise to perform incineration services. The planning staff should research and solicit qualified personnel to properly train all staff that may be operating or maintaining this process.

Portable Air Curtain Incinerators use the same methods as air curtain pit incinerator systems, except that the portable incinerators use a pre-manufactured pit rather than an onsite constructed earth/limestone pit. Portable air curtain incinerators are the most efficient incineration systems available because the pre-manufactured pit is engineered to precise dimensions to complement the blower system. The pre-manufactured pit requires little or no maintenance as compared to earth or limestone constructed pits, which are susceptible to erosion. Portable air curtain units are ideal for areas with high water tables and sandy soils as well as areas where smoke capacity must be kept to a minimum.

Environmental and Safety Concerns

With all of the incineration methods, environmental compliance and safety concerns need to be addressed within the plan. The planning staff must check with appropriate State agencies for State-specific requirements. Setback, permitting, and public information suggestions should be included in the plan.

Setbacks and buffer zones need to be established within and around the reduction sites not only for the public safety but also for the safety of the debris operations. A setback of at least 100 feet should be maintained between the debris piles and the incineration area. It is often suggested that 1,000 feet be allowed between the incineration area and the nearest building in order to create a generous buffer zone for emergency vehicles, if needed. The fire should be

extinguished two hours before anticipated removal of the ash mound. The ash mound should be removed before it reaches two feet below the lip of the incineration pit. To prevent explosions, hazardous or contaminated flammable material should not be placed in the pit. Finally, fencing and signage are simple and effective means to keep the public away from the incineration area.

Smoke generated by any of the above incineration methods is often interpreted by the general public as having an environmental impact. Therefore, it is important to also address smoke as part of the air monitoring guidelines. The governing State environmental or forestry agency will have guidelines that need to be met in order to acquire and retain a burn permit.

Planners should take the initiative in keeping the public informed. Applicant staff, environmental groups, and residents should be thoroughly briefed on the incineration methods being used, how the systems work, environmental standards, health issues, and the risks associated with each type of incineration. A proactive public information strategy should be included in any operation that uses incineration as a primary means of volume reduction. Please see Chapter 14, *Public Information Strategy* for additional information.

Chipping and Grinding

The second most common type of reduction method is to chip or grind disaster-related debris. Vegetative debris is the most common material reduced by using this method. The planning staff may also employ chipping and grinding methods in reducing rubber and some metals prior to being shipped to the recycling facility. The planning staff will have to investigate the opportunities, economics, and equipment in order to determine if this reduction method is appropriate for its jurisdiction.

There are significant differences in volume reduction between chipping and grinding and incineration. Incineration reduces the volume by approximately 95 percent, leaving only ash residue for disposal. Chipping and grinding reduces the volume by 75 percent. Since 25 percent of the volume remains from chipping and grinding, the benefit of this reduction method can be increased by identifying alternate uses of the residual material. The ability to use recycled wood chips as mulch for agricultural purposes, fuel for industrial heating, or in a cogeneration plant helps to offset the cost of the chipping and grinding operation.

If the grinding operation is strictly for volume reduction, the size of the mulch is not important; however, mulch to be used for agricultural purposes must be of a certain size and virtually free of paper, plastic, and dirt. Because of shallow topsoil conditions in some locations, mulch is a desirable product. In other locations, however, the mulch may become nothing more than a landfill product. The designated debris manager and planning staff should work closely with local environmental and agricultural groups to determine if there is a market for mulch.

Plastics should be eliminated completely. To help eliminate contaminants, root rake loaders should be used to feed or crowd materials to the chipper or grinder. Hand laborers should remove contaminants prior to feeding the chippers and grinders.

Bucket-loaders tend to scoop up earth, causing excessive wear to the grinder or chipper. Shaker screens should be used when processing stumps with root-balls or when large amounts of soil are present in the woody debris. The separated soil may be recycled back to the agricultural community.

Equipment

Grinders are ideal for use at debris storage and reduction sites because of their high-volume reduction capacity. However, a large area is needed to hold the resulting mulch. Chips or mulch should be stored in piles no higher than 15 feet and located so as not to hinder hauling operations. Properly locating the grinders is critical for noise and public safety considerations.

There are numerous makes and models of grinders and chippers on the market. Tub-grinders have production rates ranging from 160 to 340 cubic yards per hour for brush and yard waste. Manufacturer-published grinder production logs can be misleading because they reflect only the engine hours and ideal rate of production. These production logs do not take into account personnel monitoring or consider varying debris conditions. Production rates should be verified by monitoring operations.

The reduced debris production output should average 100 to 150 cubic yards per hour when debris is moderately contaminated with plastic and dirt and feeding operations are slow. When the debris is relatively clean, the production rates can increase up to 250 cubic yards per hour.

Brush chippers can be hauled or towed to the site of the downed vegetation and are ideal for use in residential areas. Damaged and uprooted trees present significant problems if they are pushed to the rights-of-way to wait for eventual pick-up and transport to storage and reduction sites. The brush chippers allow the downed trees and limbs to be reduced in place. The use of onsite chippers also allows the material to be used as mulch in the area where it is chipped, thereby saving the cost of transporting it.

Recycling

Based on the debris management goals and objectives, the decision to recycle disaster debris should be made during the planning process. The planning staff may find that marketing and selling the reduced debris is more financially attractive than hauling the unreduced debris to a local landfill.

Processing disaster debris through grinding, shredding, or any other means without an understanding of the end uses and market specifications may result in the products becoming

unusable for their intended purposes, necessitating disposal of the debris. For that reason, it is incumbent upon applicants to thoroughly research the market opportunities and establish criteria to assist emergency personnel in making decisions to recycle certain types of debris.

Debris management plans should include a list of the types of debris materials that can be recycled. The plans should determine end-use products that can be made from disaster debris, determine the market demand for each product, identify the product buyers, and when feasible, secure the sales of those products prior to an event.

The debris management plan needs to detail the implementation of the appropriate processing technique to achieve the desired end product. If the applicant uses contracted services to process debris, the contract agreements should include the processing specifications so that the contractor uses the correct types of equipment to achieve that specification.

Hurricanes and earthquakes may present opportunities to contract large-scale recycling operations and achieve an economic return from some of the contractors who exercise their initiative to segregate and recycle debris as it arrives at the DMS or landfill.

Specialized contractors should be available to bid on disposal of debris by recycling, if it is well sorted. Contracts and monitoring procedures should be developed to ensure that the recycling contractors comply with local, tribal, State, and Federal environmental regulations.

Common Recyclable Materials

Metals - Hurricanes and tornadoes can cause extensive damage to mobile homes, sun porches, and green houses. Most of the nonferrous and ferrous metal debris is suitable for recycling. Metal maulers and shredders can be used to shred trailer frames, trailer parts, appliances, and other metal items. Ferrous and nonferrous metals are separated using an electromagnet and then sold to metal recycling firms.

Soil - Debris removal operations may include transporting large amounts of soil to the DMS. At the DMS, it may be combined with other organic materials that will decompose over time. This procedure can produce significant amounts of soil that can be sold, recycled back into the agricultural community, or stored onsite to be used as cover.

In agricultural areas where chemical fertilizers are used heavily, recovered soil may be too contaminated for use on residential or existing agricultural land. It may be necessary to monitor and test the soil to ensure that it is not contaminated with chemicals. If the soil is not suitable for any agricultural or residential use, it may ultimately have to be disposed of at a permitted landfill.

Concrete, Asphalt, and Masonry Debris - Concrete, asphalt, and masonry products can be crushed and used as base material for certain road construction products or as a trench backfill. Debris targeted for base materials needs to meet certain size specifications as determined by the end user.

Final Disposition Operations

The planning staff will need to identify the final disposition site of whole, reduced, or recycled debris. The most cost-efficient measure is usually to make use of the applicant's own or normally utilized landfills. The available space often determines the most appropriate type of reduction method to employ. If local landfills are not adequate, the staff should conduct a search of landfills close to the disaster area for disposal.

County-to-county agreements are sometimes used in order to achieve an equitable solution. Some county landfills do not accept waste from other areas and may have stringent rules regarding what can be brought into the landfill.

Landfill tipping fee cost structures become important to the planning staff, especially if debris is being taken to a neighboring county. Tipping fee cost structures include operating and maintenance costs, permitting fees, capital improvement costs, and taxes. The capital improvement costs may be directly related to the landfill itself or may be for projects within the county.

Some fees and taxes may be waived for a neighboring governing body. The planning staff should investigate and compare the fees that are truly applicable for its debris disposal strategy.

Questions to Consider

1. Do you have a strategy for reduction?

2. Do you currently have a recycling strategy? Is the jurisdiction considering a recycling strategy?

3. Which agency within your jurisdiction would be responsible for developing and implementing a recycling strategy?

4. What departments within the State, county, or your organization would be responsible for permitting burning or incineration operations?

5. What is your strategy for final disposition?

To Do Checklist

1. Identify potential end use of the reduced or recycled materials. Identify if the end-use materials may represent potential income to offset processing, or entail no cost for disposal.

2. Identify reduction and recycling methods that will be used at the DMS.

3. Identify how the reduction and recycling activities will be performed:
   a. Force account labor and equipment
   b. Contract labor and equipment

4. Determine final disposition locations.

Chapter 10 – Contracted Services

Chapter Highlights

Common Misconceptions
Procurement Considerations
General Contract Provisions
Types of Contracts
- Unit Price Contract
- Lump Sum Contract
- Time-and-Materials Contract
- Prohibited Contracts
- Contract Matrix

Questions to Consider

Please see Chapter 2, *Costs*, for eligibility issues to consider in developing the debris management plan. This chapter also references information in Chapter 11, *Monitoring Debris Removal*.

The planning staff may find it necessary to contract for debris removal services if the magnitude of the disaster is beyond the capabilities of its force account resources, State resources, mutual aid agreements, and volunteer labor. Possible contracted services include:

- Collection, including clearance during response phase
- Reduction or recycling
- Hazardous waste handling, processing, and disposal
- Hauling to final disposition
- DMS activities
- Demolition
- Monitoring
- Environmental studies
- Project management

The applicant's contracting/procurement and legal staff has a major role in this planning component of the debris management plan. The staff should use the debris management plan development as an opportunity to familiarize themselves with their contracting procedures, particularly with regard to emergency procurements. In procuring and awarding contracts, the applicant should follow its established procurement and contracting procedures.

Common Misconceptions

Contracts written by contractors often use the FEMA name to gain credibility and give the appearance that the work to be performed would be eligible for Public Assistance grant funding. Applicants should be aware of the common phrases used by contractors and why the statements are false. Three of the most common phrases are:

1. **"FEMA-approved contract and rates."** FEMA does not certify, credential, or recommend contractors.

2. **"FEMA eligibility determinations."** Debris contractors do not have the authority to make eligibility determinations. Only FEMA can make an eligibility determination.

3. **"FEMA training in eligibility, documentation, and Project Worksheet development provided."** These services often have a fee attached. Most of the training and information offered by a contractor is available free from FEMA or the State.

Applicants may enter into any contractual arrangements they wish. However, it should be noted that FEMA is not bound to applicant contractual obligations because it is not a party to those contracts. Applicants are strongly encouraged to work with State emergency management staff and FEMA to ensure compliance with the provisions of the Public Assistance Program, as well as other applicable statutes and regulations, if the applicant intends to seek Public Assistance grant assistance. The applicant is responsible for payment of its contracted services regardless of whether such services are eligible for Public Assistance grant funding. If a contract is in place prior to the applicant's meeting with FEMA Public Assistance staff, the terms of the contract need to be reviewed to ensure compliance with the Federal procurement regulations and with the Public Assistance Program eligibility criteria. By doing so, it becomes easier for the applicant to provide FEMA with pertinent documentation to receive Public Assistance grant funding.

Additional information on developing contracts that comply with Public Assistance Program requirements is provided in Appendix G, *FEMA RP9580.201, Fact Sheet: Debris Removal – Applicant's Contracting Checklist*.

There are two main areas of contracting that the applicant's staff should review in the contract development planning process. These include procurement procedures and general contract provisions. Other provisions and terms are determined by the type of contract being employed for a specific service.

Procurement Considerations

The applicant's legal staff needs to review the applicant's procedures for compliance with 44 CFR Part 13 requirements, outlined in Chapter 2, *Costs* and available online through the United States Government Printing Office at gpoaccess.gov.

In the past, some applicants risked losing Public Assistance Program funding when procurement procedures were overlooked in the interest of time. There are methods by which applicants can expedite the procurement process without jeopardizing potential grant funding. An applicant may use one or more of the following methods to best serve its jurisdiction.

- **Pre-drafted contracts** – Applicants may draft a contract prior to a disaster event. Once the extent of the disaster is known, the contract can then be finalized with the appropriate scope of work and advertised in a timely manner.

- **Pre-qualified contractors** – Typically, contractors must meet minimum requirements, such as insurance, bonding, and licensing, prior to being awarded a contract by an applicant. Applicants may advertise a Request for Qualifications (RFQ) for contractors to establish their company as a credible candidate for a contract award. The pre-qualified contractors on the list are invited to bid on a contract. The pre-qualified contractors can then focus on developing costs rather than assembling documentation in order to qualify for bidding.

- **Pre-event contracts** – The applicant may choose to solicit bids and award contracts in non-disaster times. This allows time for a deliberate procurement process and gives applicants flexibility in mobilizing the appropriate resources in anticipation of an event.

The applicant may expedite procurement procedures for purpose of public exigency; this does not mean that competitive proposals are not required. In many cases, an expedited process allows for shorter time frames for receiving competitive bid proposals. Appendix G, *FEMA RP9580.4, Fact Sheet: Debris Operations – Clarification: Emergency Contracting vs. Emergency Work*, explains the emergency contracting procedures provided in 44 CFR Part 13.36(d)(4)(i)(B).

When soliciting competitive bid proposals, the applicant should be the entity that develops the engineering estimate and scope of work for the contract bid solicitation.

General Contract Provisions

To protect the applicant's interests, specific items should be included in the contract to minimize potential conflicts with the contractor. These items include the basis of payment, the duration of the contract, the performance measures, an agreement to restore collateral damage, a termination for convenience, and a conflict resolution process.

The basis of payment and the payment process should be clearly outlined in the contract. Contractor payments should be based on verification of completed work, and the required information for the payment request should be included within the provisions of the contract. Weight to volume conversion factors should be published in order to further clarify possible differences between invoices and payment.

Basis of payment is usually based on the volume and/or weight of the contractor's loads. If the contract payment is based on volume, specific contract provisions are required to substantiate invoices and payment. These contract provisions need to provide a truck certification process, which includes determining the volume of the truck and how it will be identified during the recovery operation. Recertification of a truck is usually required if the physical truck identification becomes damaged or the volume capacity becomes suspect during operations. Additional information regarding truck certification is included in Chapter 11, *Monitoring Debris Removal*.

Applicants should consider using a progress payment method for contract services. This requires specific documentation from the contractor to verify and validate the completed work, support the contractor's invoices, and receive reimbursement under the Public Assistance Program. Typical documentation includes debris monitor reports, truck certification lists, and load tickets. This documentation is discussed in Chapter 11, *Monitoring Debris Removal*.

To ensure that debris removal is conducted expeditiously, the contract should include specific timelines for work to be completed. The duration of contract should be clearly stated. By doing so, the applicant sets clear expectations for the contractor. Moreover, the contractor can effectively manage resources and schedule work to meet the applicant's expectations.

Debris removal activities may impart damage to the local infrastructure, such as broken curbs, crushed sidewalks, and broken water meters. A contract provision should include a requirement that the contractor is to restore and/or repair, at the contractors cost, all damaged infrastructure back to its pre-existing condition if the damage was caused by their activities.

The contract should also include contract language for performance measures and a termination for convenience and default. A termination clause allows the applicant the ability to terminate the contract if the contractor does not deliver services in the manner delineated in the contract. The contract language clauses should be specific as to how performance will be evaluated and what would be considered reasons for termination.

The conflict resolution process should be well defined within the contract. The process should also include alternatives for mediation should an issue prove difficult to resolve.

To ensure that the contracts are in accordance with the Federal, State, and local procurement laws the planning staff should seek guidance from their legal counsel.

Types of Contracts

There are several types of contracts that can be used for debris operations. The most common types of contracts are unit price, lump sum, and time-and-materials. Due to the use and structure of a specific type of contract, there are specific provisions and documentation considerations that should be included to keep costs reasonable and to protect the applicant's interests. Descriptions of the different types of contracts, specific contract provisions, monitoring efforts, and documentation requirements are described in this discussion and are summarized in a matrix at the end of this chapter.

Unit Price Contract

Use and Structure

The schedule of payment of unit price contracts is based on a set cost for a specific task.

For example:

Remove, haul, and dispose of vegetative debris = $X / cubic yard
or
Remove and dispose of refrigerant = $Y / appliance.

Unit price contracts are used when the individual work tasks are known but the total amount of work cannot be quantified. The quantities of work to be completed are estimated by the applicant and included in the applicant's bid solicitation package. The contractor uses the estimated quantities to establish a total contract price. Units of work can be measured in terms of weight, volume, or any other quantifiable measure.

The estimated quantity of work described in the bid solicitation can be adjusted to reflect a more accurate quantity when debris operations are under way and the true extent of the disaster is realized. To keep the price of the contract reasonable, the applicant can eliminate as many variables as possible by incorporating detailed specifications in the contract and monitoring the contract operations.

Contract Provisions

Developing specifications for unit price contracts requires a full understanding of all the particular tasks that are required to complete the work to the applicant's satisfaction. Applicants should clearly define the individual tasks and activities that are required to accomplish the scope of work when soliciting bids. These may include the collection, transportation, and incineration of vegetative debris; extraction of refrigerants; grinding of debris; or special handling of hazardous wastes.

The estimated quantities of each type of debris that will be collected and clear descriptions of how each is to be handled or processed should be included in the specifications. The solicitation should incorporate special sections for hazardous and special wastes, if applicable. If the applicant intends to market processed debris for certain end uses, the bid specifications should describe the end user's product specifications in detail.

The applicant's bid solicitation and the final contract documents should include details on how the applicant will monitor the contractor's work and how the applicant's monitoring information will be used to verify the contractor's costs and payment.

Lump Sum Contract

Use and Structure

Lump sum contracts are used when the scope of work can be easily identified and quantified. These bid requests include a set of specifications that have a well-defined scope of work for a finite amount of time. For example:

> Haul 250 tons of mulched debris from 1000 N Debris Road to applicant landfill at 3450 S Main Street = $XX,YYY.

Two common uses of a lump sum contract define how the debris is to be collected, by geographical area or by "passes."

> The **area method** defines the geographical boundary in which the debris is to be collected. By providing geographical boundaries, the quantity of debris may be forecasted or estimated based on topography and land use.
>
> The **pass method** describes the number of times debris will be collected from the curbside within a specified geographical boundary. Limiting the number of passes for an area keeps the scope of work known.

The advantage of a lump sum contract is that the total price for the specified work is known at the time the bids are opened.

Contract Provisions

Although contractors usually present one total price in their bids, applicants should request a breakdown of costs for each item of work activity in the bid specifications so that if additional work is necessary during the term of the contract, the applicant can easily determine the cost for that work based on the unit cost. By requesting unit costs, the applicant can determine whether the contractor included costs for contingencies in the fixed price and if all costs are reasonable.

The bid specifications for a lump sum contract take more effort to write in comparison with other methods, but may reduce change orders during contract execution. The specifications should include every work activity that will be required, the exact quantity of debris to be removed, or the specific number of passes that will be required, to collect all debris.

If recycling is part of the scope of work, the bid specifications should include a list of debris materials that are expected to be recycled. The contract should also specify who owns the recycled materials and how the revenue from the sale of the recycled materials affects the contract cost.

Time-and-Materials Contract

Use and Structure

Time-and-materials contracts are used when the scope of work necessary to achieve an outcome is unknown.

A typical use of time-and-materials contracts for debris is during the response phase of the debris removal operations when an applicant needs additional labor and equipment resources to clear emergency routes. A time-and-materials contract establishes hourly rates for labor and equipment that will be used to perform specific tasks. For example: backhoe, with loader, 1 cy bucket, with operator = $50 / hour.

The contractor is paid based on the actual time spent to perform the specified tasks and for the usage of equipment. The contractor is also paid for the actual cost of materials that are used during operations.

Contract Provisions

Solicitation for a time-and-materials contract should include descriptions of the types of work items that would be required inclusive of debris removal, debris processing, and recycling.

Normally, a time-and-materials contract identifies the classification of each worker and a skill level. The equipment rate schedule lists the type of equipment and the hourly rate. The hourly rates for equipment should include the operator, fuel, and maintenance costs. A provision should state that the applicant only pays for the time the equipment is in operation. Mobilization and standby costs should not be invoiced at the hourly equipment rate. Public Assistance grants do not fund standby or idle-time costs.

Applicants should establish the maximum number of hours the contractor can work or set a ceiling for the contract to control costs when using a time-and-materials contract. FEMA generally limits the Public Assistance grant reimbursement cost of a time-and-materials contract to 70 hours of actual work. FEMA may provide a Public Assistance grant for a time-and-

materials contract that has been extended for a short period of time, but only under extreme extenuating circumstances.

Intense monitoring of time-and-materials contracts is extremely important. Work inspection reports should be prepared each day. These reports clearly state the amount of work accomplished that day in quantitative terms, such as the number of cubic yards of debris hauled, the type and number of trucks used, and the number of hours worked.

Load tickets may be used if debris is being hauled based on cubic yards under a time-and-materials contract as a way of checking contractor efficiency.

Applicant personnel should verify the certification of work performed and copies of the inspection reports should be furnished to the contractor to expedite the submittal of invoices for payment.

Time-and-materials contracts are usually terminated once the maximum number of hours or price cap is reached. Contract provisions should include the applicant's right to terminate a contract at its discretion. An applicant should terminate the time-and-materials contract when a more cost-effective contract is awarded for the remainder of the debris removal operations.

Time-and-materials contracts are the least preferred among contracts, and they are typically used only for initial emergency work or when there are complex life-saving activities that are dependent on the removal of debris. Again, FEMA generally limits reimbursement of time-and-materials contracts to the first 70 hours of actual work. The use of a time-and-materials contract for longer than 70 hours may impact the amount of reimbursement the applicant receives.

Prohibited Contracts

In accordance with 44 CFR Part 13.36(f)(4), cost plus percentage of cost contracts shall not be used. Use of such contracts may result in FEMA limiting the grant to an amount determined to be reasonable based on the eligible work performed.

Contracts that are awarded by an applicant to debarred contractors are prohibited pursuant to 44 CFR 13.35; thus, no Federal funding can be awarded for eligible work completed.

Contract Matrix

A summary of the aforementioned contracts and their associated characteristics is provided as a reference in the following matrix.

Unit Price Contract Summary Matrix						
Type of Contract	**Structure and Use**	**Required Provisions**	**Advantages**	**Disadvantages**	**Monitoring**	**Documentation**
UNIT PRICE	Uses units of measure (cubic yards, tons, each) and prices to develop line item costs and total contract costs	Specific documentation requirements, based on quantifiable units, such as load tickets, and payment	Scope of work may be adjusted easily at a known cost	Possibility of contractor fraud if operations are not closely monitored	Labor intensive	Load ticket system
	Used when scope of work is difficult to quantify. The bid proposals are based on applicant-estimated quantities and units of work		Accurate account of actual quantities when work is complete	Trucks require measurement and loads accurately documented		Monitors at collection points and where the debris is unloaded (DMS or final disposition)
			Simplicity of contract encourages competition	Segregated curbside collection may complicate the scope of work		
			Low risk for contractors			

Figure 10.1 – Unit Price Contract Summary Matrix

Lump Sum Contract Summary Matrix

Type of Contract		Structure and Use	Required Provisions	Advantages	Disadvantages	Monitoring	Documentation
LUMP SUM	All Lump Sum	Establishes a fixed contract based on the applicant scope of work specified in the bid solicitation Used when the scope of work is clearly defined by the applicant, including quantity, type, and location of debris	Specific process for a change order request, exact quantity of debris, and types of debris. Provision to cover if the collection or unloading location changes after the contract is awarded	Cost is established at the bid opening Easy to determine when the work is complete	Scope of work must be very specific to avoid change orders Often difficult to quantify debris and identify the types of debris requiring collection	Minimum	Amount of debris collected, reduced/ recycled, and disposed will be required to establish reasonable price
	Collection - Area Method	Used when a well defined area can be provided for bidding purposes	Specific process for a change order request, exact quantity of debris, and types of debris. Provision to cover if the collection or unloading location changes after the contract is awarded		Scope of work has to be accurately quantified to minimize change orders Estimating the amount of debris to be brought to the rights-of-way difficult to determine High probability of change orders if estimates are based on speculation	Minimum	Amount of debris collected, reduced/ recycled, and disposed will be required to establish reasonable price
	Collection - Pass Method	Defines how many times a curbside collection will be completed on a particular street or through a well defined area	Specific process for a change order request, exact quantity of debris, and types of debris. Provision to cover if the collection or unloading location changes after the contract is awarded	Possibility of fewer change orders since the scope of work is better defined Average management duties	Up-to-date street information and plans to be included in the scope of work Requires cooperation of the public to place only eligible debris at the curb and participate in segregating materials Intense public information campaign	Minimum	Amount of debris collected, reduced/ recycled, and disposed will be required to establish reasonable price

Figure 10.2 – Lump Sum Contract Summary Matrix

Time-and-Materials Contract Summary Matrix

Type of Contract	Structure and Use	Required Provisions	Advantages	Disadvantages	Monitoring	Documentation
TIME-AND-MATERIALS	Paid on an hourly rate for labor, materials, and equipment	Capped by the period of performance and/or monetary ceiling	Good for response activities	Requires close contractor oversight and direction as to work to be performed	Labor Intensive	Intense
	A known quantity of work is not established prior to the contractor beginning work	Price for equipment applies only when the equipment is in use	Extremely flexible; not limited by a specific scope of work	Requires documentation of actual hours worked by equipment and operators		Actual labor and equipment must be accounted for during entire performance period
		Hourly rate for equipment includes fuel, maintenance, and repair	Range of uses; appropriate clearance of major access routes or roads to critical facilities	Reasonable hourly rates may be difficult to establish if not competitively bid		
		Bids should include all overhead costs		Equipment specifications may have to be generalized in order to encourage competition		
		Specific hours the contractor is to perform work (to ensure monitoring staff is present to document activity)		Requires full-time trained monitors to document work completed and verify hours worked		
		No guarantee of a minimum number of hours				
		If multiple contracts are awarded, the period of performance should run concurrently rather than consecutively				

Figure 10.3 – Time-and-Materials Contract Summary Matrix

To assist applicants in identifying and contacting contractor resources, an online debris contractor registry tool is available on FEMA's website, fema.gov. The information provided in the registry is maintained by contractors and their representatives. FEMA does not verify and takes no responsibility for the accuracy of any of the information submitted. FEMA does not endorse, approve, or recommend any contractors, including those in the registry. Applicants should perform all appropriate due diligence prior to entering into a contract. Contracting with any of the entities listed in the registry does not assure an applicant of reimbursement under a Federal grant. Applicants should follow their competitive procurement procedures when selecting a contractor.

Questions to Consider

1. Do you have in-place debris contracts prepared?

2. Do you have a list of local pre-qualified contractors?

3. Can you use components of existing contracts, such as garbage collection or roadway time-and-materials contracts for disaster debris clearance, removal, or disposal?

4. What departments within your agency would be required to prepare the debris management bid documents and contracts?

Chapter 11 – Monitoring Debris Removal

Chapter Highlights

Debris Monitoring Staff
- Force Account Resources
- Outsourcing Monitoring Duties

Debris Monitor Roles

Monitoring Methods for Debris Removal
- Debris Monitor Reports
- Truck Certification List
- Load Ticket System

Special Monitoring Issues
- Equipment
- Monitoring Tips

Questions to Consider

To Do Checklist

Please see Chapter 1, *Public Assistance Debris Removal Eligibility*, Chapter 2, *Costs,* Chapter 3, *Debris Removal from Public Property,* and Chapter 4, *Private Property Debris Removal and Demolition of Private Structures,* for eligibility issues to consider in developing the debris management plan.

Debris monitoring procedures should be established and included in the debris management plan for the applicant's financial interest, especially if the applicant has contracted for any component of the debris removal operation. Monitoring debris removal operations achieves two objectives:

- Verifying that the work completed by the contractor is within the contract scope of work
- Providing the required documentation for Public Assistance grant reimbursement

Failure to document eligible work and costs may jeopardize Public Assistance grants. In Federally declared disasters, FEMA periodically validates the applicant's monitoring efforts to ensure that eligible debris is being removed and processed efficiently.

Only FEMA has the authority to make eligibility decisions; contractors cannot make eligibility determinations. Information on eligibility can be found in this document, FEMA 321 – Public Assistance Policy Digest, FEMA 322 – Public Assistance Guide, and FEMA 323 – Public Assistance Applicant Handbook.

Debris Monitoring Staff

Applicants can use force account resources, contractors, or a combination of both to monitor debris removal operations.

Force Account Resources

Applicants are encouraged to use their own employees to monitor debris removal operations. The applicant's employees are the most familiar with the jurisdiction and know the priorities of the applicant's debris management plan. Force account employee costs are reimbursed based on the Public Assistance Program's labor cost policies for emergency work.

Outsourcing Monitoring Duties

In some cases the monitoring task is outsourced to a contractor. As with any contractual arrangement, the applicant must ensure that the contractor is meeting the performance requirements of the contract. If a contractor is hired to perform a monitoring task, the applicant is required to ensure that the hired contractor performs satisfactorily.

If the applicant outsources a monitoring task, the contract must be awarded to a contractor who has no vested interest in the debris removal contract or contractor. There must be no conflict of interest between the monitoring contractor and the debris removal contractor.

When soliciting for debris monitoring contracts, the advertisement should outline the required qualifications of the debris monitors. The qualifications should be appropriate for the individual responsibilities and duties. Debris monitors should have experience working on construction sites and be familiar with safety regulations, but it is not necessary to have professional engineers and other certified professionals perform these duties. Primarily, debris monitors should be able to estimate debris quantities, differentiate between debris types, properly fill out load tickets, and follow all site safety procedures.

The specifications should outline possible monitoring locations and reporting requirements to document eligible debris quantities.

Monitoring contracts are typically time-and-materials and should contain a not-to-exceed clause per the requirements of 44 CFR Part 13. The applicant should ensure the level of monitoring and overhead claimed is consistent with the level of effort required to effectively monitor the debris removal operations.

It is important that the debris monitoring contract provide for submission of reports and payment estimates to help promote efficiency and effectiveness in the overall debris removal operations. By continuously monitoring the debris removal operations, an applicant can track

progress toward completion and determine the financial status of the monitoring and debris removal contracts.

Applicants should require debris monitors to submit the following reports:

- Debris collected from curbside and/or collection centers
- Debris accepted at the DMS and/or final disposition
- Debris recycled/reduced at the DMS and taken to final disposition
- Any operational or safety issues

If FEMA provides funding for the debris monitoring contract, a sample of the reporting requirements outlined in the contract in order to substantiate eligible costs is required. The sample must be adequate to demonstrate that sufficient measures were taken to ensure that eligible and accurate quantities were reported as part of the grant. If the monitoring contract is time-and-materials, the applicant must supply labor, equipment, and materials records to the Public Assistance Program staff in order to substantiate the actual costs of the grant.

Debris Monitor Roles

Monitoring operations are meant to ensure that the debris removal contractor is performing the scope of work required by the contract, and to document the debris removal operations. The primary role for debris monitors is to document the location and amount of debris collected.

The key elements of information that are needed to verify the contractor's scope of work and determine eligibility are the:

- Type of debris collected
- Amount of debris collected
- Original collection location

From this information the applicant can document eligible location and work completed.

The debris monitor's roles and responsibilities in the field include:

- Measure and certify truck capacities (recertify on a regular basis).
- Complete and physically control load tickets (in monitoring towers and the field).
- Validate hazardous trees, including hangers, leaners, and stumps (use appropriate documentation forms).
- Ensure that trucks are accurately credited for their load.
- Ensure that trucks are not artificially loaded to maximize reimbursement (e.g., debris is wetted, debris is fluffed - not compacted).

- Ensure that hazardous waste is not mixed in with loads.
- Ensure that all debris is removed from trucks at the DMS.
- Report to project manager if improper equipment is mobilized and used.
- Report to project manager if contractor personnel safety standards are not followed.
- Report to project manager if general public safety standards are not followed.
- Report to project manager if completion schedules are not on target.
- Ensure that only debris specified in the scope of work is collected and identify work as potentially eligible or ineligible.
- Monitor site development and restoration of the DMS.
- Ensure daily loads meet permit requirements.
- Ensure that work stops immediately in an area where human remains or potential archeological deposits are discovered.
- Report to project manager if debris removal work does not comply with all local ordinances as well as State and Federal regulations.

The applicant is responsible for ensuring that applicant-managed debris removal work (either force account or contract) being funded under the Public Assistance Program is eligible in accordance with Public Assistance Program criteria.

Applicants may request State/FEMA assistance with debris monitoring or monitor training.

Monitoring Methods for Debris Removal

Additional documentation requirements depend on how the debris is collected and processed. The following describes methods and systems to monitor and document work completed by force account resources and/or contractors.

The planning staff should develop tools for their documentation duties. It is suggested that all three of the following tools be used to document all types of debris removal contracts – unit cost, lump sum, and time-and-materials contracts.

Debris Monitor Reports

Applicants should develop a debris monitoring report to make all reporting documents consistent regardless of who performs the work. An example of a debris monitor's report is supplied in Appendix D, *Sample Monitoring Forms*. Applicants are not required to use this report; however, they should have a reporting document that captures the types of information if seeking Public Assistance reimbursement.

The debris monitoring report is important for monitoring time-and-materials contracts that may be used during the response phase of the operations. Monitoring documentation for time-and-materials contracts includes:

- Actual labor hours worked
- Actual equipment hours operated
- Type and specification of equipment used

The labor and equipment summary records provided in Appendix C, *FEMA Forms,* are often used by applicants as a starting point for their specific documentation needs and contract requirements.

Truck Certification List

A truck certification list allows the monitor to identify the truck itself and its hauling capacity in a standardized manner. It is important to know the truck hauling capacity since debris, specifically vegetative debris, is often hauled and billed by volume. The standard list of requirements includes:

- Size of hauling bed in cubic yards
- License plate number
- Truck identification number assigned by the owner
- Short physical description of the truck

Monitors may need to be trained to measure truck capacities for certification purposes. Recertification of the hauling trucks on a random and periodic basis should be implemented for contract compliance and reimbursement considerations. See Appendix D, *Sample Monitoring Forms,* for an example truck certification worksheet.

Load Ticket System

The term "load ticket" refers to the primary debris-tracking document. A load ticket system tracks the debris from the original collection point to the DMS or landfill. By positioning debris monitors at each point of the operations (collection, DMS, and/or final disposition), the eligible scope of work can be properly documented. This is how the applicant documents and tracks the debris from the initial collection location to the DMS and final disposal location. If the applicant uses a contract hauler, this ticket often verifies hauling activities and is used for billing purposes.

Traditionally, load tickets have been carbon paper tickets with at least four copies generated for one load of debris. More advanced tracking tools have been developed and used in the field to reduce human error and expedite funding. These computer-based systems often include the same information as a traditional load ticket.

Each monitor is responsible for populating specific areas of the load ticket. The following table lists the load ticket information and the portions of the ticket to be completed by the respective monitor.

	Monitor Ticket Responsibilities	
Load Ticket Information	**Collection Point Monitor**	**DMS or Landfill Monitor**
Preprinted ticket number	NOT APPLICABLE	
Contract number	Contracts may be identified by a number or name	
Prime contractor's name		
Date	X	
Truck number	X	
Truck driver's name	X	
Vegetation	X	
Construction & Demolition	X	
White Goods	X	
Household Hazardous Waste	X	
Other (required to be described applicable)	X	
Load Location	GPS or address preferred	
Loading date/time (departure from collection location)	X	
Loading Site Monitor name/signature	X	
Truck capacity in cubic yards or tons		X
Load Size, either cubic yards (percent of actual) or tons		X
Unloading location		X
Unloading date/time (arrival at disposal site)		X
Unloading site monitor name/signature		X

Figure 11.1 – Debris Monitor Responsibilities for Load Tickets

Each monitor keeps a copy of the load ticket, and the driver/contractor keeps two copies for billing purposes.

In computer-based systems, the collection monitor gathers the same information as in a traditional paper load ticket system and inputs this information into a handheld digital device. The collection monitor gives the hauler the information in a digital format (card or small driver). The monitor, stationed at the DMS or landfill, downloads the information, and completes the transaction in a manner similar to the traditional method. The monitor, stationed at the DMS or landfill, can then print a ticket for the hauler's billing purposes.

Special Monitoring Issues

The issues described below highlight the need for an applicant to closely monitor large contracted debris clearance, removal, and disposal activities. The issues focus on some of the problems associated with major debris disposal contracts and justify the need to monitor activities at local debris management and final disposal sites. It is essential that applicant's staff work to ensure that the debris removal contractors perform the required services at a reasonable cost.

Equipment

The most typical unit measurement for vegetative and construction and demolition debris is the cubic yard. Debris trucks are evaluated for capacity at the DMS or final disposal sites. Applicants should require contractors to use appropriate equipment to load debris efficiently so that the maximum level of compaction can be achieved to facilitate expeditious removal of debris from the public rights-of-way.

The photos below illustrate the capacities to which a truck may be loaded.

Figure 11.2 - 100% Loaded Truck

Figure 11.3 - Less Than 100% Loaded Truck

Equipment limitations impact the maximum loading capacity of some vehicles. The following is a list of truck conditions and the eligible capacities.

Hand-loaded trucks and trailers cannot achieve compaction levels comparable to mechanically-loaded vehicles. This effectively reduces the capacity of the hand-loaded truck or trailer in comparison to a truck or trailer that is loaded mechanically. Therefore, FEMA only reimburses 50 percent of the debris monitor's observed capacity percentage for a hand-loaded truck or trailer.

Example: If a hand-loaded truck or trailer appears to be 100 percent full and would normally be recorded at 100 percent, that load should be recorded at 50 percent.

Figure 11.4 – Hand-Loaded Trailer

A truck with no tailgate or no solid tailgate cannot be compacted to its full capacity; therefore, FEMA only considers a maximum of 85 percent of the certified truck capacity for reimbursement purposes.

Figure 11.5 – Truck With No Tailgate

Figure 11.6 – Truck With No Solid Tailgate

Also, hand loading debris in trucks or trailers does not achieve maximum compaction and as a result debris removal operations take longer to complete. A hand-loaded truck hauls less debris by weight per cubic yard than a mechanically loaded truck.

Applicants should be aware of the differences between hand loading and mechanical loading when negotiating unit costs and should establish standard conversion factors in the contract agreements to address those differences. Refer to Appendix G, *FEMA RP9523.12, Debris Operations - Hand-Loaded Trucks and Trailers*, for additional information about hand-loaded trucks and trailers.

Monitoring Tips

Monitors should be aware of situations that could impact an applicant's reimbursement under the Public Assistance Program. They should be on the lookout for:

Inaccurate Truck Capacities - Trucks should be measured before operations and load capacities should be documented by truck number. Periodically, trucks should be pulled out of operation and re-measured by the applicant.

Trucks Not Fully Loaded - Do not accept the contention that loads are higher in the middle and if leveled would fill the truck. Monitors may check to see if that statement is valid.

Trucks Lightly Loaded - Trucks arrive loaded with treetops (or a treetop) with extensive voids in the load. Trucks need to be loaded to their full capacity with front end loaders or other similar equipment.

Trucks Overloaded - Trucks cannot receive credit for more than the measured capacity of the truck or trailer bed even if material is above the sideboards. If a truck is measured to carry 18 cubic yards, it cannot receive credit for more than 18 cubic yards. However, it can receive credit for less if not fully loaded or lightly loaded as described above.

Changing Truck Numbers - Normally, trucks are listed by an assigned vehicle number and capacity. There have been occasions where truck or trailer numbers with a smaller carrying capacity have been changed to one with a larger capacity. For instance, a 20-cubic-yard truck may have a number for a truck that can carry 30 cubic yards. This can be detected if the applicant periodically re-measures the trucks or records actual State license plate numbers in addition to a description of the truck. Maintaining truck and trailer certifications with attached photos at the DMS tower can assist in mitigating such activities.

Reduced Truck Capacity or Increased Truck Weight - There have been occasions where trucks have had heavy steel grating welded two to three feet above the bed after being measured, thus reducing the capacity or inflating the weight of a load. This can be detected by periodically re-measuring the truck bed or recertifying the truck tare weight.

Wet Debris When Paid by Weight - Excessive water added to debris will increase the weight of the load. When the contractual unit cost is based on weight, this increases the cost to the applicant. Contractors have added excessive water to debris loads to increase the weight when being paid by the ton. This can be detected during monitoring if there is excessive water dripping from the truck bed or by inspecting the truck bed immediately after unloading. The applicant should periodically recertify the truck tare weight.

Multiple Counting of the Same Load - Trucks have been reported driving through the disposal site without unloading, then re-entering with the same load. This can be detected by observing

the time of departure and time of arrival recorded on the driver's load ticket. This may also indicate problems with the applicant's debris monitors at the loading or unloading site. The debris monitors at the unloading area must ensure the truck is empty before it leaves the DMS.

Picking up Ineligible Debris - This is difficult to detect unless debris monitors are watching the pick-up process. Monitors should have a good understanding of eligible debris and any time limits imposed on picking up specific types of debris. Examples (from actual occurrences) include sweeping areas for abandoned cars and white goods, cleaning up illegal dump sites, removing cut trees from subdivisions under development, and removing/cutting trees from off the rights-of-way in rural areas.

Questions to Consider

1. Do you have a process or a strategy for hiring and training debris monitors? If not, who should develop this strategy?

2. Do you have access to a local labor force qualified to perform these functions?

3. What jurisdictional department will coordinate these efforts?

4. Do you have monitoring report procedures and forms established?

To Do Checklist

1. Evaluate and identify staff that will lead the monitoring operations.

2. Identify if additional labor will be required for the monitoring operations and how they will be trained.

3. Establish a record management system to be implemented during a disaster event. The record management system will include:

    a Labor and equipment timesheets

    b. Labor and benefit rates

    c. Personnel pay policy

d. Invoices

e. Load tickets

f. Load ticket summaries

g. All other field documentation that may be required for eligibility considerations.

h. Staff to organize labor and equipment timesheet

Chapter 12 – Planning for Private Property Debris Removal and Demolition

Chapter Highlights

Labor Resources
Condemnation Criteria and Procedures
- Legal Documentation for Demolition
- Demolition Permitting
- Inspections

Special Use Areas
- Mobile Home Park Procedures
- Navigation Hazard Removal

Questions to Consider
To Do Checklist

Private property debris removal (PPDR) and/or demolition is not common. Public jurisdictions may undertake PPDR and demolition in extreme cases where public health, life, safety, and the economic recovery of the community-at-large are at risk. The planning staff should establish procedures for this type of work in the event this becomes necessary. The planning effort for PPDR and demolition includes the following:

- Criteria for implementing PPDR and demolition operations
- Documentation requirements and procedures
- Inspection and demolition procedures

Throughout the planning process, the staff needs to establish how the private property owner will be included in decisions and operations.

Appendix G, *FEMA DAP9523.13, Debris Removal from Private Property*, and *FEMA DAP9523.4, Demolition of Private* Structures, set forth the FEMA eligibility criteria and requirements that the planning staff should consider when developing the PPDR and demolition strategy.

Labor Resources

Demolition and debris removal from private property is an extremely document- and labor-intensive operation. The planning staff is responsible for assigning tasks to the appropriate departments and labor forces.

Typically, the building safety or inspection section takes the lead during these operations, with the administrative staff collecting and logging all of the required documents. The planning staff may consider employing temporary personnel or contractors for any portion of the operation.

Condemnation Criteria and Procedures

When an applicant assumes the responsibility to demolish structures, it must comply with its normal condemnation procedures. This normally requires a building safety official to contact the homeowner and assess and determine building structural integrity.

The applicant's normal building safety assessment should be used for the disaster condemnation criteria as well. Typically, any building or structure may be condemned if the building official determines that it represents a hazard to the health and safety of the public or poses a threat to public rights-of-way. Following that determination, the applicant would then initiate condemnation proceedings.

Usually, owner notification and condemnation hearings are held in order to give the property owner time to correct the threat without government action. In some cases, liens are secured in order for jurisdictions to enforce the condemnation order. In this case, if the applicant performs the work, executing liens against the property allows the applicant to recoup the costs of demolition and debris removal from the property owner.

The applicant's normal procedures that require multiple notices to property owners, condemnation hearings, and liens may be expedited in the event of a catastrophic disaster that causes a high concentration of debris on private property over a widespread area presenting an immediate health and safety hazard.

In the event of a disaster, it is helpful to have the applicant's laws, regulations, legal notices, and forms within the debris management plan, for reference and use. The planning staff should review the condemnation criteria and procedures for the benefit of the debris management plan.

Legal Documentation for Demolition

An applicant usually has standard procedures that apply to its condemnation process. During the planning process, the applicant may have its legal counsel review and update any documents for inclusion within the plan.

The following is a general list of documents that may be included in the plan.

- **Verification of ownership** ensures that the proper site and owner are identified and the owner is aware of nature of the scheduled building assessment.
- **A right-of-entry form** is signed by the homeowner and allows the building official to enter the property to complete the assessment. It often contains a hold harmless agreement that documents the property owner's promise that he or she will not bring legal action against the applicant if there is damage or harm done to the property.

- **Building official assessment** is the documentation of the damage to the structure and the description of the threat to public health and safety. This assessment often contains the building official's determination as to whether the structure should be condemned and whether it should be repaired or demolished. This may be an official structural assessment.
- **Verification of insurance information** allows the applicant to pursue financial compensation if the property owner's homeowner insurance policy covers demolition and debris removal.
- **Archeological review** outlines the archeological low-impact stipulations for demolition and debris removal activities and highlights the implications for the applicant if they fail to comply with the guidelines.
- **Environmental review** ensures that adverse impacts to protected environmental resources are minimized or avoided when removing debris from the proposed site. These reviews should be acceptable to the appropriate resource agency. Wetlands and other water resources, hazardous materials, and endangered species habitats are among the resources of most frequent concern. Some jurisdictions may also have State or local requirements for the evaluation or assessment of impacts to natural resources.
- **SHPO review** confirms that SHPO has been notified and correspondence has been received absolving the area of any historic significance.
- **Photos** that show the disaster-damaged condition of the property prior to the beginning of the demolition work. This is generally one or more labeled pictures that confirm the address and identified scope of work on the property.

If it is determined that a structure needs to be demolished, additional documentation may be required, not only for the applicant's legal protection, but also for the public's health and safety during the demolition and debris removal operations.

- **Letter or notice of condemnation** is a document signed by the building official that outlines the specific threat to public safety and health.
- **Notice of demolition** is issued to inform the property owner when the demolition will begin; notices shall be posted so as to provide a reasonable period of time in order for personal property to be removed. The applicant should attempt to notify the property owner, if not already contacted, through direct mail and local media.
- **Notice of intent to demolish** is normally for the public health and safety of the neighboring residents. This notice is conspicuously posted on the structure to be demolished.

Demolition Permitting

Applicants may have a demolition permitting process in place. The planning staff may want to use those demolition permit requirements during a disaster-related demolition project.

Common requirements for obtaining a demolition permit include a demolition plan, public notification, inspection requirements, and a hazardous waste report.

The demolition strategy may require the following information:

1. **Site map**, to scale, showing the site with all structures and other features of interest.
2. **Site ingress and egress** showing the fronting streets and planned route for the project. This may also include a movement of traffic strategy. Normal traffic will need to be diverted into other lanes.
3. **Site preparation documents** illustrate any pre-demolition work that may be required. Examples include erosion control, vegetation removal, or utility pole adjustments.
4. **Staging strategies** show the sequence of events prior to, during, and after demolition of the structure.
5. **Hazardous waste handling requirements** detail if contents of the structure require dust suppression or wet demolition. These provisions also describe how hazardous waste or environmentally sensitive materials will be handled or disposed. This includes HHW and white goods. Asbestos requires specialized removal, handling, and disposal personnel and permits.

Special documents or strategies may be required if the demolition of the building involves shoring, stabilizing structures, or any other special circumstances that may jeopardize another structure or the public's health and safety.

Once it has been established that the building is to be demolished and the required processes are underway, a notification to demolish notice is posted on the building.

Inspections

The applicant normally conducts regular inspections of demolition sites a few days prior to, the day of, during (occasionally), and upon completion of the operations. Inspectors generally take photographs at each site visit for their records. These inspections and verifications generally include the following:

1. **Water and sewer/septic tank inspection** to verify the utilities have been terminated and isolated from the proposed sphere of influence during the demolition operations. The inspector normally verifies that all other utilities have been terminated during the same visit.

2. **Occupancy inspection** is conducted immediately prior to demolition to ensure that no one is physically in the building.
3. **Open void inspection** is performed if the structure has a basement that is to be filled. This inspection will be conducted once the above-grade structure is gone and the inspector can visually see the entire below-grade excavation.
4. **Post-demolition inspection** is completed once the structure is demolished, the debris is removed, and the site graded.

The applicant usually requires that a hazardous materials report be submitted to the State environmental protection agency. This report normally includes a description of any hazardous material that was found in the building, the means and measures to collect it, and the final disposal location of the hazardous waste.

A checklist that may be used for demolition activities is available in Appendix F, *Demolition Checklist.*

Special Use Areas

The discussion so far has pertained to fairly low density situations, such as single-family homes or businesses on individual sites. Planning staff may need to consider specific areas of their jurisdiction that require additional planning and coordination for debris operations. Mobile home parks and navigation hazards present intense and sometimes complicated obstacles for the debris operations.

Mobile Home Park Procedures

Higher density situations, specifically mobile home parks, create an extensive amount of mixed debris in a relatively small area. The planning staff may consider the same procedures for individual sites as a basis to be used in mobile home parks but should expect a more intense operation in all accounts of the operation.

The most complex aspect of the operation may be documenting legal responsibility within the parks. Sometimes the mobile home park site is owned, operated, and maintained by one or more parties. The individual homes may be owned by one of those same parties or by the individuals that occupy the structures.

As part of the planning exercise, the planning staff may investigate the legal responsibility for debris issues within the mobile home parks within its jurisdiction. The applicant should coordinate the potential PPDR and demolition operations with the park owners in order to expedite recovery after an event. Agreements need to be made with respect to the debris collection, location, separation of materials, and the amount of debris expected to be handled.

Navigation Hazard Removal

Damage to publicly-owned marinas caused by a major disaster can include abandoned sunken boats and other debris that may impede navigation. The procedures used for individual sites may be modified for this situation.

The applicant should coordinate with USCG, the State marine patrol, local government agencies, legal counsel, marine salvage contractors, commercial divers, and certified surveyors to ensure that navigation hazards are removed safely and efficiently.

The two main challenges with navigation hazards are locating the debris and finding legal owners. Marinas can be inspected visually by a helicopter or boat. Sonar or dive teams may need to be employed for submerged vessels. A location or flotation marker may be helpful in order to keep vessel positions documented. The legal owner's information may be obtained by using the vessel's registration number and marina records.

Questions to Consider

1. How do your laws, codes, and ordinances address entering and condemning private property?

2. What are your emergency police powers as they relate to demolishing private property?

3. Who is responsible for enforcing the existing laws, codes, and ordinances with regard to private property?

4. How do you (the applicant) protect yourself from legal action when taking action on private property?

To Do Checklist

1. Review, assess, and revise laws, codes, and ordinances to address emergency demolition activities.

2. Assign a primary point of contact to manage the demolition and private property debris removal operations.

Chapter 13 – Health and Safety Strategy

Applicants should include a health and safety strategy in the overall debris management plan. This enables applicants and their contractors to avoid accidents during debris recovery operations and to protect workers from exposure to hazardous materials. The health and safety strategy should establish minimum safety standards for the applicant and contractor personnel to follow.

To facilitate cooperation between applicant and contractor employees, the health and safety strategy should specify how the applicant will disseminate safety information to all emergency workers and how the applicant will monitor compliance with the minimum safety standards. The strategy should also include specific corrective actions to be taken if workers do not comply with the minimum safety standards.

The health and safety strategy should identify potential hazards at debris loading areas and DMS. Debris operations involve the use of heavy equipment to move and process various types of debris. Many of these actions can pose safety hazards to emergency response and recovery personnel and the public. In addition to those safety hazards, exposure to certain types of debris, such as building materials that contain asbestos and mixed debris that contains hazardous materials, can pose potential health risks to emergency workers.

The health and safety strategy should provide emergency workers with information on how to identify hazardous conditions and specific guidelines on the appropriate and proper use of personal protective equipment.

Chapter 14 – Public Information Strategy

Chapter Highlights

Assignment of Tasks
Information to be Included
- Collection
- Debris Management Sites

Distribution Strategy
- Update and Redistribution
- Debris Information Center

To Do Checklist

After a disaster, residents want answers regarding recovery operations. The goal of the public information strategy is to ensure that the residents are given accurate and timely information for their use and own individual planning purposes. If information is not distributed quickly, rumors and misinformation spread and erode confidence in applicant management of the recovery operations.

Assignment of Tasks

The public information strategy should assign staff the following tasks:

- Prepare information to be distributed.
- Process to distribute the information.
- Process to update, correct, revise, and redistribute information as operations progress.
- Establish a debris information center or a venue to address all concerns, questions, and complaints.

Information to be Included

The information should include the parameters, rules, and guidelines of debris operations so residents can begin their personal recovery activities. The staff responsible for developing and writing the information must present the information in a clear, direct, and organized manner. The language used must be simple and easy for all residents to understand. Jargon and acronyms only lead to confusion and are ineffective. Information may have to be distributed in more than one language for it to be understood by non-English-speaking populations and neighborhoods.

The public information campaign answers the same questions addressed during the debris management planning process. The following is a list of topics that should be included within the campaign.

Collection

How will the debris be collected?

If curbside collection:

- Will applicant employees or a contractor collect the debris?
- What are the schedules and the routes for collection?
- What is the final collection date for streets, sectors, or subdivisions?
- What type of debris will be collected?

If collection centers:

- Where are the collection centers?
- What are the daily collection center hours?
- Is debris to be segregated at the collection centers?
- What types of debris will be accepted at the centers?
- How long will the collection centers accept disaster-related debris?

Debris Management Sites

A collection center and a DMS may be the same site. If so, the same information for the collection centers above applies to the DMS, along with:

- Where can a resident find a site map of the DMS for public debris drop off of HHW, construction and demolition debris, etc? Are these areas segregated and well marked for vehicular traffic?
- Will residents be charged a fee to use the DMS?
- Will residents be restricted as to how much disaster-related debris can be dropped off at the DMS?
- Will the DMS have burning, chipping, or grinding operations? If so, during which hours will these activities take place? Address any environmental concerns the public may have as well.
- How long will residents be able to bring their disaster-related debris to the DMS?
- How long will the DMS be open to process (reduce/recycle) debris?
- Are there traffic changes that will impact the general public due to the location or operation of the DMS?

Distribution Strategy

The public information strategy should include its methods to disseminate the prepared information to the general public. This can be accomplished in a number of ways. The following are suggested vehicles for distributing the information:

- **Media** – Local television, radio, newspapers, or community newsletters.
- **Internet Site** – Applicant website and debris information flyers for printing.
- **Public Forums** – Interactive meetings at town hall or shopping mall kiosks.
- **Direct Mail Products** – Door hangers, direct mail, fact sheets, flyers within billings, and billboards.

The public information staff must take advantage of every information vehicle available if power, utilities, and other infrastructure have been damaged. Many times the best carriers of information are the responders in the field. The general public recognizes their role and frequently asks questions regarding the operations. Stocking the equipment and trucks with flyers, pamphlets, and other print media allows responders to perform their duties while also satisfying the public's need for information.

Update and Redistribution

Residents hold community leaders responsible for misinformation and slow progress if information is not routinely updated to remain current and accurate. The planning staff must consider how the public information strategy addresses changes and revisions as the debris removal operations progress. The changes in operations directly affect how often information to the general public is distributed.

During the early stages of the operations, the applicants may rely on the immediate transmission of the information, such as through radio and television, to update the general public regarding the debris removal operations. Once the operations become more routine and predictable, the information can be distributed through the print media, such as newspapers, mailings, and flyers.

Debris Information Center

Applicants should establish a temporary debris information center to address concerns and complaints, and answer questions that are not included in the public information campaign at-large. The platform for the debris information center may be personal interactions at city hall, a telephone hotline, internet site, or a specific post office box. Regardless of the venue, it is important for applicants to address the residents' concerns, complaints, and questions in a timely and efficient manner.

The feedback from the information center gives the management staff an indication of how effective and efficient the operations are progressing. The management staff may use this information to adjust operations appropriately.

The debris information center may also be utilized to report fraud. Disaster victims want a full and quick recovery and have little tolerance of being taken advantage of during an already trying time. The ability to report fraud and crime is important to the public's feeling of safety and well being when the applicant's law and code enforcement agencies are stretched thin. Applicants should take advantage of residents' eyes and ears after a disaster event and provide an outlet for reporting crime and fraud within the recovery operations.

To Do Checklist

Assign staff to:

1. Prepare debris removal operations information.
2. Establish a process and strategy to distribute the information.
3. Update, correct, revise, and redistribute information as operations progress.
4. Establish and staff a debris information center.

PART III – FEDERAL GOVERNMENT OPERATIONS

Part III – Federal Government Operations

Introduction

Part III describes the Public Assistance staff organization and the other Federal agencies' debris-related roles and responsibilities for disaster events.

FEMA's Public Assistance staff will assemble a debris management team for the size and scope of the disaster. This team is responsible for providing debris-related technical assistance to applicants and managing the Public Assistance grant process. Chapter 15, *FEMA Public Assistance Operations*, describes the staff organizational structure and the roles and responsibilities of each staff member.

Chapter 16, *Other Federal Assistance*, provides an overview of additional Federal agencies' roles and responsibilities for disaster-related debris activities. This chapter also describes FEMA Mission Assignments that may be tasked to other Federal agencies.

Chapter 15 – FEMA Public Assistance Operations

Chapter Highlights

Public Assistance Organizational Structure
Public Assistance Staff Roles and Responsibilities
- Infrastructure Branch Director
- Public Assistance Group Supervisor
- Public Assistance Debris Task Force Leader
- Public Assistance Coordinator Crew Leader
- Public Assistance Debris Technical Specialist
- Public Assistance Debris Monitoring Specialist
- Additional Support for the Public Assistance Organization

Debris Operations Strategy

FEMA's Public Assistance Program goal during recovery operations is to supply staff and technical support to the applicants for the timely, efficient, and accurate production of Public Assistance grants. This is accomplished by the Public Assistance staff fulfilling their established roles and responsibilities and following the disaster-specific Debris Operations Strategy.

This chapter gives an overview of the organizational structure used by the Public Assistance organization, a summary of roles and responsibilities for the Public Assistance debris staff, and a general outline of the Debris Operations Strategy that will be developed by the debris management team.

Public Assistance Organizational Structure

FEMA Public Assistance follows a staffing organization called Incident Command System (ICS) that allows the Public Assistance organization to expand and contract depending on need. ICS defines the nomenclature, roles, and responsibilities of the staff members in order to ensure consistency across disasters. The following organization chart illustrates one example of staff organization under ICS.

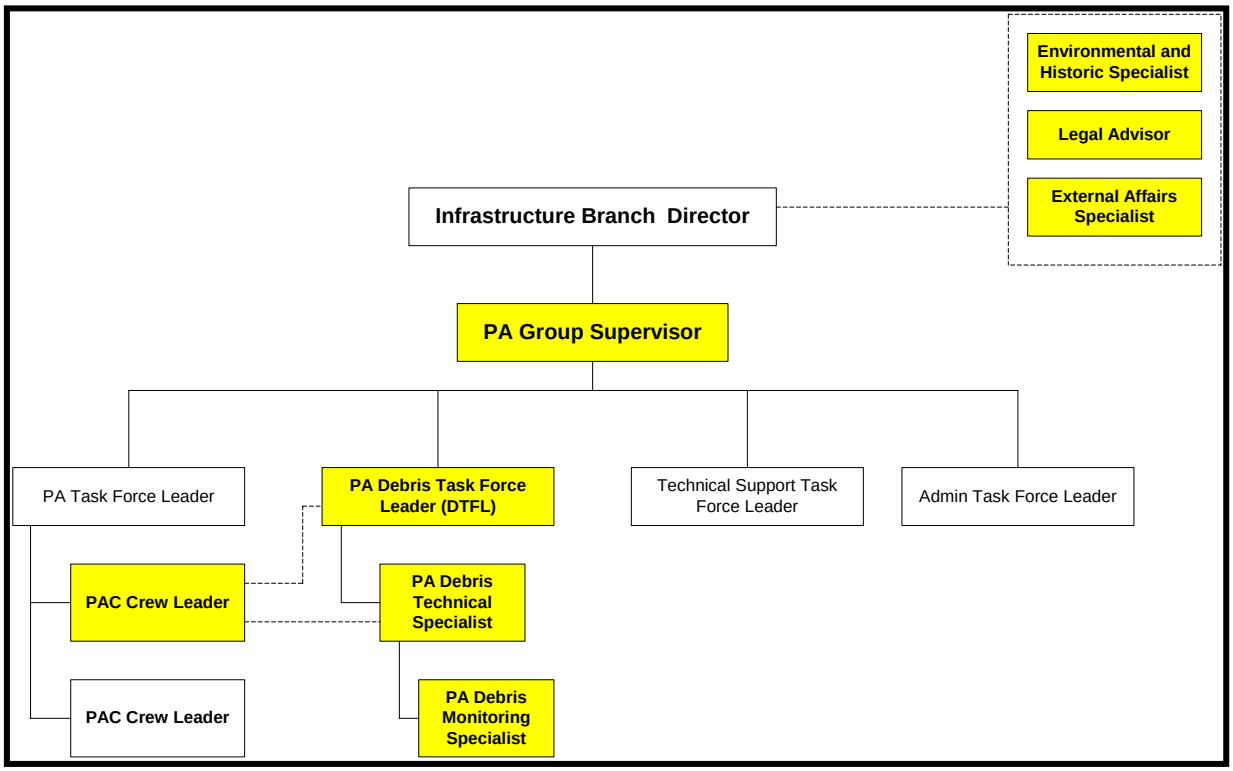


Figure 15.1 – Example Public Assistance Organization Chart

Public Assistance Staff Roles and Responsibilities

The amount of staff depends on the size and severity of the disaster. The Public Assistance staff roles and responsibilities are outlined in the descriptions below.

Infrastructure Branch Director

The Infrastructure Branch Director coordinates the restoration of essential public services and administers the Public Assistance Program. The Infrastructure Branch Director is responsible for:

- Identifying cross-programmatic issues and facilitating coordinated problem solving among the Program areas
- Requesting assistance outside of the Public Assistance Program to include supplemental Federal assistance in the form of Mission Assignments, to be completed by supporting Federal agencies

Public Assistance Group Supervisor

The Public Assistance Group Supervisor manages the overall Public Assistance Program. The Public Assistance Group Supervisor is responsible for:

- Identifying major debris issues and applicants with potential debris problems based on the Preliminary Damage Assessment (PDA) and in coordination with the State Public Assistance Group Supervisor
- Ensuring and approving the development of a Public Assistance Debris Operations Strategy
- Obtaining staffing resources to assist in managing debris operations (e.g. a Public Assistance Debris Task Force Leader and an appropriate number of Public Assistance Debris Technical Specialists and Public Assistance Debris Monitoring Specialists)
- Providing the Debris Task Force Leader with guidance and direction on problems, procedures, and policies pertaining to debris operations
- Coordinating debris-related Mission Assignments
- Advising the Infrastructure Branch Director on potential debris issues
- Allocating and approving the proper funding levels

Public Assistance Debris Task Force Leader

It is the responsibility of the Public Assistance Debris Task Force Leader (DTFL) to manage the debris operations under the direction of the Public Assistance Group Supervisor. The DTFL is responsible for:

- Ensuring that a Debris Operations Strategy is developed and implemented
- Providing applicants with technical assistance by conducting technical reviews of debris management plans and contracts to document compliance with the requirements of the Public Assistance Program eligibility criteria
- Assigning personnel to assist the applicant in developing the eligible debris scope of work for Public Assistance grants
- Coordinating with the Legal Advisor to review proposed debris-related contracts provided by applicants
- Managing all debris field staff
- Ensuring all of the debris field staff are properly trained
- Providing Public Assistance Coordinator Crew Leaders with information concerning procedures and policies pertaining to debris operations
- Coordinating debris-related Mission Assignments

- Reporting all potential debris issues to the Public Assistance Group Supervisor
- Compiling and submitting reports on debris operations to the Public Assistance Group Supervisor and the Infrastructure Branch Director

Public Assistance Coordinator Crew Leader

A Public Assistance Coordinator (PAC) Crew Leader is a customer service manager who works with the applicants to ensure that all applicants' Public Assistance grants are processed as efficiently as possible. The DTFL and Public Assistance Debris Technical Specialist keep the PAC Crew Leader informed of debris eligibility concerns. The PAC Crew Leader is responsible for:

- Serving as an applicant's single point of contact concerning eligibility considerations and Public Assistance grant status
- Coordinating and communicating with the Public Assistance Debris Technical Specialist and DTFL for the assigned applicants' debris issues
- Identifying debris issues during the Kickoff Meeting
- Educating the applicant on the availability of Public Assistance grants for debris operations
- Assisting the applicant in establishing priorities
- Managing resources and coordinating with debris staff on Public Assistance Program issues

Public Assistance Debris Technical Specialist

The Public Assistance Debris Technical Specialist provides applicants technical assistance and support for debris management issues and for the applicants' debris Public Assistance grants. The Public Assistance Debris Technical Specialist is responsible for:

- Estimating quantities of debris
- Collecting monitoring information from the Public Assistance Debris Monitoring Specialists in the field
- Formulating, developing, and writing the Public Assistance grants
- Recommending eligibility of debris projects within the Public Assistance grants
- Managing the Public Assistance Debris Monitoring Specialists
- Informing the PAC Crew Leader and DTFL of potential debris issues
- Supplying debris-related reports and progress updates to the DTFL

Public Assistance Debris Monitoring Specialist

The Public Assistance Debris Monitoring Specialist is responsible for monitoring and documenting debris removal activities in accordance with the debris monitoring strategy, and issues that may impact compliance with the rules and regulations that pertain to FEMA-funded activities. The Public Assistance Debris Monitoring Specialist is specifically responsible for:

- Recording quantities of debris accurately on load tickets and other documentation that may be outlined in the Debris Operations Strategy
- Completing reports such as daily logs, load tickets, incident reports, periodic reports, photographs, and sketches
- Coordinating with the applicant and contractor on daily operations
- Supplying completed paperwork
- Requesting necessary resources from the Public Assistance Debris Technical Specialist

Additional Support for the Public Assistance Organization

Other support may be available to assist the Public Assistance Group Supervisor and DTFL with technical, legal, and information issues.

- **Environmental and Historic Specialists** provide technical assistance to Public Assistance staff, management, and the applicant on environmental and historic preservation considerations for debris operations. These specialists research environmental and historic preservation compliance regulations and requirements for Public Assistance staff and applicant briefings. They coordinate with the PAC Crew Leader and Public Assistance Debris Technical Specialist to conduct site visits in order to identify potential environmental and historic preservation site considerations. Additional tasks include recommending eligibility determinations and supplying cost estimates for environmental and historic preservation compliance. Environmental and Historic Specialists provide documentation, comments, and recommendations for any Public Assistance grant that may have environmental and/or historical preservation issues that could impact the grant funding.

- **Legal Advisors** provide legal review and recommendations on issues that may impact the Public Assistance grant process, along with interpretation of Public Assistance regulations and policies. They review proposed and active debris contracts, right of entry permits, and hold harmless agreements. The legal advisors also provide counsel to the Public Assistance staff on such issues as land acquisition, condemnations, insurance requirements, liability, duplication of benefits, and environmental and historic preservation.

- **External Affairs Specialists** are responsible for all of the Public Assistance communications to outside media outlets including newspapers, radio, television, and the internet. The External Affairs Specialists coordinate with the Infrastructure Branch Director, Public Assistance Group Supervisor, and DTFL to clearly communicate debris policy, decisions, and initiatives.

Debris Operations Strategy

The most common tool used to accomplish FEMA's Public Assistance debris operations goal is the development and implementation of a Debris Operations Strategy. The Debris Operations Strategy is used to identify issues, assign the appropriate amount of staff, and report progress throughout the recovery efforts. It is a dynamic document meant to be updated to reflect the ongoing progress of the recovery operation and document debris-related decisions.

The DTFL is responsible to ensure the Debris Operations Strategy is written and implemented accordingly. The size and severity of the disaster dictates how detailed the strategy should be. Most strategies include the following key elements:

1. Situational analysis
2. Estimated quantities of debris, which may include specific types of debris
3. Specific debris-related eligibility issues, to include identification and resolutions
4. Concept of operations, to include staffing, goals, and reporting
5. Outline of Public Assistance grant development and routing process within the Public Assistance field office
6. Mission Assignment reporting and any other interagency coordination processes (if applicable)
7. Safety strategy for debris operations. Appendix E, *Debris Collection and Management Site Hazard Analysis*, contains information on safety considerations.

Chapter 16 – Other Federal Assistance

Chapter Highlights

Authorities of Federal Agencies
- United States Army Corps of Engineers
- United States Coast Guard
- United States Department of Agriculture's Natural Resources Conservation Service
- Environmental Protection Agency
- Federal Highway Administration

FEMA Mission Assignments
- Federal Agencies that Perform Mission Assignments
- Requirements
- Process
- Types of Mission Assignments
- Scope of Work
- Costs

Federal assistance may be available from other Federal agencies and departments in two different ways:

1. Another Federal agency is invested with the authority to address various aspects of debris-related work;
2. FEMA tasks another Federal agency or department with a debris-related Mission Assignment to accomplish the work.

These two types of assistance are distinct and separate. For example, the USCG has the authority to coordinate the removal of navigational hazards within their jurisdictional boundaries; therefore, the USCG would not be issued a FEMA Mission Assignment to complete the same work.

This chapter provides a general description of some of the Federal agencies and departments that provide debris-related work and provides a summary of Mission Assignments.

Authorities of Federal Agencies

There are Federal agencies and departments, other than FEMA, that have the authority to remove debris and/or coordinate and manage debris-related activities for their specific jurisdiction.

The following describes several Federal agencies' normal responsibilities and their debris-related authority and/or jurisdiction.

United States Army Corps of Engineers

USACE's mission is to provide design and management services for the construction of military facilities for the army and air force; design and construction management support for other defense and Federal agencies; and planning, design, construction, and operation of water resource and other civil works projects. USACE's authorities for debris-related activities include:

- Developing projects for the collection and removal of drift and debris from publicly maintained commercial harbors and from land and water areas immediately adjacent thereto.
- Continuing debris collection programs for five specific harbors of the United States.
- Removing sunken vessels or other obstructions from navigable waterways under emergency conditions.

Please see Appendix G, *FEMA RP9524.3, Policy for Rehabilitation Assistance for Levees and Other Flood Control Works - Decision Tree*, for further information.

United States Coast Guard

USCG is a military, multi-mission, maritime service within the Department of Homeland Security and one of the nation's five armed services. USCG has five fundamental roles: maritime safety, maritime security, maritime mobility, national defense, and protection of natural resources.

USCG is tasked to conduct the following debris-related activities in coordination with EPA:

- Conduct emergency removal of oil and hazardous materials from coastal zones.
- Coordinate removal of navigational hazards.
- Provide technical assistance on contaminated debris in coastal zones.

United States Department of Agriculture's Natural Resources Conservation Service

NRCS, formerly called the Soil Conservation Service, provides technical and financial assistance to private land owners, land users, communities, and units of State and local governments in planning and implementing conservation systems in an effort to conserve soil, water, and other natural resources.

NRCS is limited in its authority in that debris-related activities are limited to either runoff retardation or soil erosion prevention in response to a sudden impairment in the watershed which creates an imminent threat to life or property. Typically, this includes debris within, or close proximity to, a channel.

Environmental Protection Agency

EPA's role is to establish minimum regulatory standards that are, in most cases, implemented by the State, and to provide technical assistance. EPA administers other laws as well that may impact the management of debris.

EPA's primary authorities related to debris removal fall into two categories:

- Cleaning up debris that is mixed with or contains oil or hazardous materials in coordination with the USCG.
- Establishing a standard for proper management of debris.

Federal Highway Administration

FHWA provides Federal financial resources and technical assistance to State and local governments for constructing, preserving, and improving the National Highway System. FHWA has an Emergency Relief (ER) Program to support the repair or reconstruction of Federal-aid highways and roads on Federal lands which have suffered damage as a result of natural disasters or catastrophic failures from an external cause.

FHWA's authority for debris-related activities is limited to debris removal and disposal within their jurisdiction when the ER Program is activated.

Please see Appendix G, *FEMA RP9580.202, Fact Sheet: Debris Removal – Authorities of Federal Agencies*, for additional information.

FEMA Mission Assignments

When an impacted State or local government does not have the capability required to respond to a Presidentially declared disaster, a request for Technical or Direct Federal Assistance may be made. The approved request is called a Mission Assignment. A Mission Assignment is a work order issued by FEMA to another Federal agency directing completion of a specific assignment in anticipation of, or response to, a Presidential declaration of a major disaster or emergency.

Federal Agencies that Perform Mission Assignments

FEMA-issued Mission Assignments are performed by teams established by the National Response Plan (NRP). The NRP is a structured strategy that aligns Federal agencies and

departments to respond to disasters. These Federal teams are called Emergency Support Functions (ESF).
There are two ESFs that perform debris-related activities under FEMA Mission Assignments:

- **ESF #3 – Public Works and Engineering** is responsible for infrastructure protection, emergency repair, and restoration. This group provides engineering services and construction management, and serves as a critical infrastructure liaison. USACE is the lead agency for ESF #3.
- **ESF #10 – Oil and Hazardous Material Response** is responsible for responding to oil and hazardous material issues, environmental safety, and short- and long-term cleanup. The two most commonly deployed agencies that deal with these debris-related activities are EPA and USCG.

Requirements

All Mission Assignments have the following requirements:

- The Mission Assignment must be requested by the State.
- The community must demonstrate that the required disaster-related efforts exceed State and local resources.
- The scope of work must include specific quantifiable measurable tasks.
- FEMA issues mission assignments.

Process

The process to request and utilize Mission Assignments is as follows:

- The community demonstrates the work is beyond its capabilities.
- The State makes a formal request to FEMA for the Mission Assignment.
- FEMA reviews the request, and if approved, assigns it to a Federal agency.
- FEMA assigns qualified staff to coordinate and monitor the Mission Assignment activities.
- The assigned agency performs the scope of work included within the Mission Assignment.
- The assigned agency submits a bill to FEMA upon completion.
- FEMA informs the State of the required cost share.

Types of Mission Assignments

There are two types of Mission Assignments related to debris operations: Technical Assistance and Direct Federal Assistance.

Technical Assistance

Technical Assistance Mission Assignments are available when the State, tribe, or local community lacks technical knowledge or expertise to accomplish an eligible task. Technical assistance may be authorized in anticipation of a declaration of a major disaster or emergency. Eligible debris-related assistance provided through Technical Assistance includes assisting the State and/or applicants in the development of its overall debris management plan, and may include developing DMS plans, monitoring strategies, load ticket processes, and contracting guidelines. Technical Assistance is provided at 100 percent Federal share.

Direct Federal Assistance

Direct Federal Assistance Mission Assignments allow a Federal agency to perform debris activities on behalf of the State or applicant. Direct Federal Assistance Mission Assignments apply only to Emergency Work (debris removal and emergency protective measures) and must meet the general FEMA eligibility criteria for Emergency Work. Federal agencies must comply with all applicable regulations, laws, policies, requirements, and procedures.

An additional requirement for Direct Federal Assistance is that the State must provide a letter giving the Federal agency debris removal authority.

Scope of Work

In order to prepare the scope of work for a Mission Assignment, the community must provide information to the State about the specific geographic locations or easily definable areas where debris is located as well as estimated types and volumes of debris. The scope of work should be defined for FEMA's consideration.

Eligible debris-related activities provided by Direct Federal Assistance include:

- Removing debris from critical roadways and facilities.
- Removing debris from curbsides or from eligible facilities and hauling it to either temporary or permanent disposal sites.
- Identifying, designing, operating, and closing DMS.
- Monitoring debris removal operations.
- Demolishing and/or removing disaster-damaged structures and facilities in accordance with FEMA regulations and policies.

The duration of Mission Assignments for debris removal is limited to 60 days from the disaster declaration date. The time frame may be extended only under extenuating circumstances pursuant to 44 CFR Part 206.208(d).

Costs

Direct Federal Assistance Mission Assignments are subject to the cost-sharing provisions applicable to the disaster. The State will agree in advance to reimburse FEMA for the appropriate non-Federal share of the work including the overhead of the Federal agency assigned the Mission Assignment.

100 Percent Funding for Direct Federal Assistance

In some cases, the President may authorize 100 percent Federal funding for emergency work or debris removal.

FEMA will provide at 100 percent Federal share the cost of actual debris clearance and/or removal accomplished, not **Mission Assignment task orders** initiated, during the designated period. This includes debris clearance, pickup, hauling, processing, and disposal activities FEMA authorizes during the designated period. If further Federal assistance is necessary for debris clearance or removal after the designated period, the prevailing cost-share rate for that particular disaster applies.

See *FEMA RP9523.9, 100% Funding for Direct Federal Assistance and Grant Assistance*, for additional information.

Acronyms

C&D	Construction and Demolition
CBRA	Coastal Barrier Resources Act
CBRN	Chemical, Biological, Radiological, and Nuclear
CBRS	Coastal Barrier Resources System
CFR	Code of Federal Regulations
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DMS	Debris Management Site
DOT	Department of Transportation
DPW	Department of Public Works
DRM	Disaster Recovery Manager
DTFL	Debris Task Force Leader
EO	Executive Order
EPA	Environmental Protection Agency
ER	Emergency Relief
ESA	Endangered Species Act
ESF	Emergency Support Function
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
GIS	Geographic Information System
GPS	Global Positioning System
HHW	Household Hazardous Waste
HUD	Department of Housing and Urban Development
IA	Individual Assistance
ICS	Incident Command System
JFO	Joint Field Office
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NRCS	Natural Resources Conservation Service
NRP	National Response Plan
OCC	Office of Chief Counsel
PA	Public Assistance
PDA	Preliminary Damage Assessment
PNP	Private Non-Profit
PPDR	Private Property Debris Removal
PW	Project Worksheet
RCRA	Resource Conservation and Recovery Act
RFQ	Request for Qualifications
SHPO	State Historic Preservation Officer
SWM	Solid Waste Management
USACE	United States Army Corps of Engineers

USCG	United States Coast Guard
USDA	United States Department of Agriculture
WMD	Weapon of Mass Destruction
WSRA	Wild and Scenic Rivers Act

Terms Used in This Document

Chipping or Mulching - The process of reducing woody material, such as lumber and vegetative debris, by mechanical means into small pieces to be used as mulch or fuel. Woody debris can be reduced in volume by approximately 75 percent, based on data obtained during reduction operations. The terms "chipping" and "mulching" are often used interchangeably.

Construction and Demolition Debris (C&D) - The definition of construction and demolition debris may vary between States. Construction and demolition debris can be defined as damaged components of buildings and structures such as lumber and wood, gypsum wallboard, glass, metal, roofing material, tile, carpeting and floor coverings, window coverings, pipe, concrete, fully cured asphalt, equipment, furnishings, and fixtures.

Debris - Items and materials broken, destroyed, or displaced by a natural or man-made Federally declared disaster. Examples of debris include, but are not limited to, trees, construction and demolition material, and personal property.

Debris Clearance - Clearing roads by pushing debris to the roadside to accommodate emergency traffic.

Debris Management Site (DMS) - A location where debris is sorted, processed, reduced in volume, and/or disposed of (if debris management activities take place at a permanent disposal site).

Debris Removal - Picking up debris and taking it to a debris management site, composting facility, recycling facility, permanent landfill, or other reuse or end-use facility.

Demolition - The act or process of reducing a structure, as defined by State or local code, to a collapsed state. It contrasts with deconstruction, which is the taking down of a building while carefully preserving valuable elements for reuse.

Force Account Labor - Labor performed by the applicant's permanent, full time, or temporary employees.

Garbage - Waste that is regularly picked up by an applicant. Common examples of garbage are food, packaging, plastics, and papers.

Hazardous Waste - Waste with properties that make it potentially harmful to human health or the environment. Hazardous waste is regulated under the Resource Conservation and Recovery Act (RCRA). In regulatory terms, a RCRA hazardous waste is a waste that appears on one of the four hazardous wastes lists or exhibits at least one of the following four characteristics: ignitability, corrosivity, reactivity, or toxicity.

Hold Harmless - Generally, a contractual arrangement whereby one party agrees to hold the other party without responsibility for damage or other liability incurred as a result of a particular action or transaction.

Household Hazardous Waste (HHW) - Used or leftover contents of consumer products that contain chemicals defined in regulatory terms under the Resource Conservation and Recovery Act as appearing on one of the four hazardous waste lists or exhibiting one of the following characteristics: ignitability, corrosivity, reactivity, or toxicity. Examples of household hazardous waste include small quantities of normal household cleaning and maintenance products, latex and oil based paint, cleaning solvents, gasoline, oils, swimming pool chemicals, pesticides, and propane gas cylinders.

Infectious Waste - Waste capable of causing infections in humans, including contaminated animal waste, human blood and blood products, isolation waste, pathological waste, and discarded sharps (needles, scalpels, or broken medical instruments).

Legal Responsibility - In the context of debris management, a statute, formally adopted legal code, or ordinance that gives local government officials responsibility to perform work on public and/or private property.

Debris Monitoring - Actions taken by applicants in order to document eligible quantities and reasonable expenses during debris activities to ensure that the work complies with the contract scope-of-work and/or is eligible for Public Assistance grant reimbursement.

Mutual Aid Agreement - A written understanding between communities and States obligating assistance during a disaster. See *FEMA RP9523.6, Mutual Aid Agreements for Public Assistance and Fire Management Assistance.*

National Response Plan (NRP) - A plan developed to facilitate the delivery of all types of Federal assistance to States following a disaster. It outlines the planning assumptions, policies, concept of operations, organizational structures, and specific assignments and agencies involved in Federal assistance to supplement State, tribal, and local efforts.

Outbuilding - Any structure secondary to a house such as a barn, shed, or outhouse separated from the main structure.

Piggyback Contract - Term used to describe a type of goods or services procurement. A piggyback contract is a contract let by a government entity which is adopted and extended for use by another government entity.

Recycling - Activities by which discarded materials are collected, sorted, processed, and converted into raw materials and are then used in the production of new products.

Right of Entry - As used by FEMA, the document by which a property owner confers to an eligible applicant or its contractor or the United States Army Corps of Engineers the right to enter onto private property for a specific purpose without committing trespass.

Right-of-Way - The portions of land over which facilities such as highways, railroads, or power lines are built. It includes land on both sides of the facility up to the private property line.

Scale/Weigh Station - A scale used to weigh trucks as they enter and leave a landfill. The difference in weight determines the tonnage dumped, and a tipping fee is charged accordingly. It also may be used to determine the quantity of debris picked up and hauled.

Tipping Fee - A fee based on weight or volume of debris dumped that is charged by landfills or other waste management facilities to cover their operating and maintenance costs. The fee also may include amounts to cover the cost of closing the current facility and/or opening a new facility.

United States Army Corps of Engineers (USACE) - A component of the United States Army responsible for constructing and maintaining military installations and other government-owned and controlled facilities. The USACE may be used by FEMA when direct Federal assistance, issued through a mission assignment, is needed.

White Goods - White goods are defined as discarded household appliances such as refrigerators, freezers, air conditioners, heat pumps, ovens, ranges, washing machines, clothes dryers, and water heaters.

APPENDICES

Appendices

Appendix A – Debris Management Plan Outline

Appendix B – USACE Hurricane Debris Estimating Model

Appendix C – FEMA Forms

FF90-123	Force Account Labor Summary Record
FF90-128	Applicant's Benefits Calculation Worksheet
FF90-127	Force Account Equipment Summary Record
FF90-125	Rented Equipment Summary Record
FF90-126	Contract Work Summary Record
FF90-124	Materials Summary Record
FF90-91D	Project Worksheet – Photo Sheet

Appendix D – Sample Monitoring Forms

Load Ticket
Tower Monitor Log
Roving Monitor Report
Daily Issue Log
Truck Certification Form

Appendix E – Debris Collection and Management Site Hazard Analysis

Appendix F – Demolition Checklist

Appendix G – FEMA Policies and Fact Sheets

FEMA DAP9523.4	Demolition of Private Structures
FEMA DAP9523.11	Hazardous Stump Extraction and Removal Eligibility
FEMA RP9523.12	Debris Operations - Hand-Loaded Trucks and Trailers
FEMA DAP9523.13	Debris Removal from Private Property
FEMA RP9524.3	Policy for Rehabilitation Assistance for Levees and Other Flood Control Works - Decision Tree
FEMA RP9525.7	Labor Costs – Emergency Work
FEMA RP9580.4	Fact Sheet: Debris Operations – Clarification: Emergency Contracting vs. Emergency Work
FEMA RP9580.201	Fact Sheet: Debris Removal – Applicant's Contracting Checklist
FEMA RP9580.202	Fact Sheet: Debris Removal – Authorities of Federal Agencies
FEMA DAP9580.203	Fact Sheet: Debris Monitoring

APPENDIX A – DEBRIS MANAGEMENT PLAN OUTLINE

Debris Management Plan Outline

I. Staff Roles and Responsibilities

A. Staffing Organizational Chart

B. Roles and Responsibilities

1. Staffing Assignments and Duties
2. Administration
3. Contracting and Procurement
4. Legal
5. Operations
6. Engineering

C. Emergency Communications Strategy

D. Health and Safety Strategy and Procedures

E. Training Schedule

II. Situation and Assumptions

A. Design Disaster Event

B. Forecasted Debris
1. Forecasted Types
2. Forecasted Locations

III. Debris Collection Plan

A. List Priorities

B. Response Operations

C. Recovery Operations

Debris Management Plan Outline

1. Estimating Staff, Procedures and Assignments
2. Collection Method
   a) Curbside Collection
   b) Collection Centers
3. Collecting Hazardous Waste and White Goods
4. Monitoring Staff and Assignments

IV. Debris Management Sites

A. Site Management
   1. Site Manager
   2. Monitoring Staff and Assignments
   3. Safety Personnel

B. Establishment and Operations Planning
   1. Permits
   2. Locations
      a) Baseline Data for Each Location
      b) Ingress/egress for Sites
   3. Site Layouts
   4. Site Preparation
   5. Site Layout
   6. Volume Reduction Methods
      a) Incineration
      b) Grinding and Chipping
   7. Recycling
   8. Environmental Monitoring Program
   9. Site Closure

V. Contracted Services

A. Emergency Contracting/Procurement Procedures

B. Debris Operations to be Outsourced

C. General Contract Provisions

Debris Management Plan Outline

D. Qualification Requirements

E. Solicitation of Contractors

VI. Private Property Demolition and Debris Removal

A. Condemnation Criteria and Procedures
   1. Legal Documentation
   2. Demolition Permitting
   3. Inspections

B. Mobile Home Park Procedures

C. Navigation Hazard Removal Procedures

VII. Public Information Strategy

A. Public Information Officer

B. Pre-scripted Information

C. Distribution Strategy

Appendices

Maps of jurisdiction and priorities
Staffing assignment maps
Load Ticket
Debris Monitor Reports
Truck Certification List
Load Ticket System

APPENDIX B – USACE HURRICANE DEBRIS ESTIMATING MODEL

USACE HURRICANE DEBRIS ESTIMATING MODEL

U.S. Army Corps of Engineers
Hurricane Debris Estimating Model

Background

- The U.S. Army Corps of Engineers (USACE) Emergency Management staff has developed a modeling methodology designed to forecast potential amounts of hurricane generated debris.
- Based on actual data from Hurricanes Frederic, Hugo and Andrew.
- The estimated quantities produced by the model have a predicted accuracy of ± 30%.
- The primary factor used by the model is the number of households in a developed urban/suburban area.
- Other factors utilized are:
  - Cubic yards of debris generated per household per storm category.
  - Vegetative cover.
  - Commercial density.
  - Precipitation.
- Household debris includes damage to the house, contents and surrounding shrubs/trees.
- Vegetative cover includes all trees and shrubbery located along public rights-of-way, parks and residential areas.
- Commercial density includes debris generated by damage to businesses and industrial facilities.
- Private contractors will remove the majority of commercial related debris; however, disposal/reduction space is still required.
- Very wet storms will cause ground saturation, increasing tree fall.

Initial Planning Data

- For planning purposes, the worst case scenario should be used for the subject area.
- The most accurate process is to determine the defined areas by using Doppler Radar (National Weather Service Broadcasts) and Geographical Information Systems (GIS).
- Doppler radar will define the storm's intensity and the exact track of the eye of the storm in relation to the affected area.
- Track the storm and plot the eye path and 5-mile wide bands out from the eye to define areas and estimate wind speeds.
- The wind speed of the eye wall normally determines the reported storm category with the outward or 5-mile bands being a lesser category.

USACE HURRICANE DEBRIS ESTIMATING MODEL

- Track the storm inland until the wind speeds dissipate below hurricane strength.
- Divide outlined areas by storm category.
- Enter coordinates into a GIS database to determine areas and demographic information, such as:
    - Population.
    - Schools.
    - Businesses.

STEP 1—ESTIMATING DEBRIS QUANTITIES

The formula used in this model will generate debris quantity as an absolute value based on a known/estimated population or a debris quantity per square mile based upon population density per square mile.

- Determine population (P) in the affected area.
- For example, 1990 census data for Harrison County, MS, is 165,500.
- P = 165,500.
- The assumption of 3 persons per household (H) is used for this model.
- Known/estimated population (P) for a jurisdiction may be used to determine a value for H or H=P/3.

Example

A category 4 storm passes through Harrison County, MS. The area is primarily single family dwellings with some apartment complexes, schools, and shopping centers. Vegetation characteristic is heavy because of the proliferation of residential landscape shrubbery and trees throughout the area. The storm is very wet, with rain before and continuing for a few days after the hurricane.

Formula: Q= H(C)(V)(B)(S)

H= P/3= 165,500/3 = 55,167 (3 persons/household)

C= 50 (Factor for a Category 4 storm)

V= 1.5 (Multiplier for heavy vegetation)

B= 1.3 (Multiplier for heavy commercial due to schools/stores/apartments)

S= 1.3 (Multiplier for wet storm event)

Then Q = 55,167 x50x1.5x1.3x1.3 = 6,992,374 cubic yards of debris or 7 million cy

USACE HURRICANE DEBRIS ESTIMATING MODEL

The Model Formula: Q= H (C)(V)(B)(S) where:

Q is the quantity of debris in cubic yards.

H is the number of households.

C is the storm category factor in cubic yards.

V is the vegetation characteristic multiplier.

B is the commercial/business/industrial use multiplier.

S is the storm precipitation characteristic multiplier.

C is the storm category factor as shown below. It expresses debris quantity in cubic yards (cy) per household by hurricane category and includes the house and its contents, and land foliage.

HURRICANE CATEGORY	VALUE OF "C" FACTOR
1	2 cy
2	8 cy
3	26 cy
✓4	✓50 cy
5	80 cy

V is the vegetation multiplier as shown below. It acts to increase the quantity of debris by adding vegetation, including shrubbery and trees, on public rights-of-way.

VEGETATIVE COVER	VALUE OF "V" MULTIPLIER
LIGHT	1.1
MEDIUM	1.3
✓HEAVY	✓1.5

B is the multiplier that takes into account areas that are not solely single-family residential, but includes small retail stores, schools, apartments, shopping centers, and light industrial/manufacturing facilities. Built into this multiplier is the offsetting commercial insurance requirement for owner/operator salvage operations.

COMMERCIAL DENSITY	VALUE OF "B" MULTIPLIER
LIGHT	1.0
MEDIUM	1.2
✓HEAVY	✓1.3

USACE HURRICANE DEBRIS ESTIMATING MODEL

S is the precipitation multiplier that takes into account either a "wet" or "dry" storm event. A "wet" storm for category 3 or greater storms will generate more vegetative debris due to the uprooting of complete trees.

PRECIPITATION CHARACTERISTIC	VALUE OF "S" MULTIPLIER
NONE TO LIGHT	1.0
✓MEDIUM TO HEAVY	✓1.3

NOTE: **Steps 2 and 3 of this model can also be applied to other debris generating events once an estimated quantity of debris is established.**

STEP 2—DEBRIS STORAGE SITE REQUIREMENTS

- Estimate debris pile stack height of 10-feet.
- 60% usage of land area to provide for roads, safety buffers, burn pits and household hazardous waste areas.

1 acre (ac) = 4,840 square yards (sy)
10 foot stack height = 3.33 yards(y)
total volume per acre = 4,840 sy/ac x 3.33 y = 16,117 cy/ac

- From the example above, the acreage required for debris reduction sites is:

7,000,000/ 16,117 cy/ac = 434 acres (required for debris storage only, no buffers, etc.)

- To provide for roads and buffers, the acreage must be increased by a factor of 1.66.

434 ac x 1.66 = 720 acres or, since one square mile (sm) = 640 acres 720ac/640as/sm=1.12 sm.

- If you assume a 100 acre storage site can be cycled every 45 to 60 days or one time during the recovery period, then 720/2 = 360 ac or four 100 acre sites would be required.
- The number of sites varies with:
    - Size.
    - Distance from source.
    - Speed of reduction (mixed debris is slower than clean woody debris).
    - Removal urgency.
- The USACE commonly removes approximately 70% of the total volume generated with local governments, volunteer groups, and private individuals removing the remainder.

If 7 million cy were estimated, the USACE would estimate removing approximately 4.9 million cy of debris.

USACE HURRICANE DEBRIS ESTIMATING MODEL

STEP 3—CATEGORIES OF DEBRIS

Debris removed will consist of two broad categories:

- Clean wood debris.
- Construction and demolition (C&D) debris.

- The clean debris will come early in the removal process as residents and local governments clear yards and rights-of-way.
- The debris removal mission can be facilitated if debris is segregated as much as possible at the origin along the right-of-way, according to type.
- The public should be informed regarding debris segregation as soon as possible after the storm.
- Time periods should be set for removal, the first 7-10 days clean woody debris only, then followed by other debris, with the metals segregated from non-metals.
- Most common hurricane-generated debris will consist of the following:

  30% Clean woody debris
  70% Mixed C&D

  Of the 70% mixed C&D:

42%	Burnable but requires sorting
5%	Soil
15%	Metals
38%	Landfilled

- Based upon the above, 7,000,000 cy of debris would break down as follows:

  2,100,000 cy Clean woody debris
  4,900,000 cy Mixed C&D

- Of the 4,900,000 cy of mixed C&D, 2,058,000 cy is burnable but requires sorting, 245,000 cy is soil, 735,000 cy is metals, and 1,862,000 cy is landfilled.
- Burning will produce about 95% volume reduction.
- Chipping and grinding reduce the debris volume on a 4-to-1 ratio (4 cy is reduced to 1 cy) or by 75%.
- The rate of burning is basically equal to the rate of chipping/grinding, about 200 cy/hr. However, chipping requires on-site storage and disposal of the chips/mulch.

APPENDIX C – FEMA FORMS

- ***FF90-123 Force Account Labor Summary Record***
- ***FF90-128 Applicant's Benefits Calculation Worksheet***
- ***FF90-127 Force Account Equipment Summary Record***
- ***FF90-125 Rented Equipment Summary Record***
- ***FF90-126 Contract Work Summary Record***
- ***FF90-124 Materials Summary Record***
- ***FF90-91D Project Worksheet – Photo Sheet***

DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

FORCE ACCOUNT LABOR SUMMARY RECORD

PAGE ____ OF ____

O.M.B. No. 1660-0017
Expires Otober 31, 2008

APPLICANT	PA ID NO.	PROJECT NO.	DISASTER
LOCATION/SITE		CATEGORY	PERIOD COVERING

DESCRIPTION OF WORK PERFORMED

NAME / JOB TITLE	DATES AND HOURS WORKED EACH WEEK								COSTS				
	DATE								TOTAL HOURS	HOURLY RATE	BENEFIT RATE/HR	TOTAL HOURLY RATE	TOTAL COSTS
NAME	REG.												
JOB TITLE	O. T.												
NAME	REG.												
JOB TITLE	O. T.												
NAME	REG.												
JOB TITLE	O. T.												
NAME	REG.												
JOB TITLE	O. T.												
NAME	REG.												
JOB TITLE	O. T.												
NAME	REG.												
JOB TITLE	O. T.												
NAME	REG.												
JOB TITLE	O. T.												

TOTAL COST FOR FORCE ACCOUNT LABOR REGULAR TIME →	$
TOTAL COST FOR FORCE ACCOUNT LABOR OVERTIME →	$

I CERTIFY THAT THE ABOVE INFORMATION WAS OBTAINED FROM PAYROLL RECORDS, INVOICES, OR OTHER DOCUMENTS THAT ARE AVAILABLE FOR AUDIT.

CERTIFIED	TITLE	DATE

DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

APPLICANT'S BENEFITS CALCULATION WORKSHEET

PAGE ____ OF ____

O.M.B. No. 1660-0017
Expires October 31, 2008

APPLICANT	PA ID NO.

DISASTER	PROJECT NO.

FRINGE BENEFITS (by %)	REGULAR TIME	OVERTIME
HOLIDAYS		
VACATION LEAVE		
SICK LEAVE		
SOCIAL SECURITY		
MEDICARE		
UNEMPLOYMENT		
WORKER'S COMP.		
RETIREMENT		
HEALTH BENEFITS		
LIFE INS. BENEFITS		
OTHER		
TOTAL in % of annual salary		

COMMENTS

I CERTIFY THAT THE INFORMATION ABOVE WAS TRANSCRIBED FROM PAYROLL RECORDS OR OTHER DOCUMENTS WHICH ARE AVAILABLE

CERTIFIED BY	TITLE	DATE

DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

FORCE ACCOUNT EQUIPMENT SUMMARY RECORD

PAGE _____ OF _____

O.M.B. No. 1660-0017
Expires October 31, 2008

APPLICANT	PA ID NO.	PROJECT NO.	DISASTER

LOCATION/SITE	CATEGORY	PERIOD COVERING

DESCRIPTION OF WORK PERFORMED

TYPE OF EQUIPMENT		OPERATOR'S NAME	DATES AND HOURS USED EACH DAY								COSTS		
INDICATE SIZE, CAPACITY, HOURSEPOWER, MAKE AND MODEL AS APPROPRIATE	EQUIPMENT CODE NUMBER		DATE								TOTAL HOURS	EQUIPMENT RATE	TOTAL COST
			HOURS										
			HOURS										
			HOURS										
			HOURS										
			HOURS										
			HOURS										
			HOURS										
			GRAND TOTALS →										

I CERTIFY THAT THE ABOVE INFORMATION WAS OBTAINED FROM PAYROLL RECORDS, INVOICES, OR OTHER DOCUMENTS THAT ARE AVAILABLE FOR AUDIT.

CERTIFIED	TITLE	DATE

DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

RENTED EQUIPMENT SUMMARY RECORD

PAGE ____ OF ____

O.M.B. No. 1660-0017
Expires October 31, 2008

APPLICANT	PA ID NO.	PROJECT NO.	DISASTER
LOCATION/SITE		CATEGORY	PERIOD COVERING
DESCRIPTION OF WORK PERFORMED			

TYPE OF EQUIPMENT Indicate size, Capacity, Horsepower, Make and Model as Appropriate	DATES AND HOURS USED	RATE PER HOUR		TOTAL COST	VENDOR	INVOICE NO.	DATE AND AMOUNT PAID	CHECK NO.
		W/OPR	W/OUT OPR					

GRAND TOTAL →

I CERTIFY THAT THE ABOVE INFORMATION WAS OBTAINED FROM PAYROLL RECORDS, INVOICES, OR OTHER DOCUMENTS THAT ARE AVAILABLE FOR AUDIT.

CERTIFIED	TITLE	DATE

DEPATRTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRACT WORK SUMMARY RECORD

PAGE _____ OF _____

O.M.B. No. 1660-0017
Expires October 31, 2008

APPLICANT	PA ID NO.	PROJECT NO.	DISASTER

LOCATION/SITE	CATEGORY	PERIOD COVERING

DESCRIPTION OF WORK PERFORMED

DATES WORKED	CONTRACTOR	BILLING/INVOICE NUMBER	AMOUNT	COMMENTS - SCOPE

GRAND TOTAL →

I CERTIFY THAT THE ABOVE INFORMATION WAS OBTAINED FROM PAYROLL RECORDS, INVOICES, OR OTHER DOCUMENTS THAT ARE AVAILABLE FOR AUDIT.

CERTIFIED	TITLE	DATE

DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

MATERIALS SUMMARY RECORD

PAGE _____ OF _____

O.M.B. No. 1660-0017
Expires October 31, 2008

APPLICANT	PA ID NO.	PROJECT NO.	DISASTER

LOCATION/SITE	CATEGORY	PERIOD COVERING

DESCRIPTION OF WORK PERFORMED

VENDOR	DESCRIPTION	QUAN.	UNIT PRICE	TOTAL PRICE	DATE PURCHASED	DATE USED	INFO FROM (CHECK ONE)	
							INVOICE	STOCK
GRAND TOTAL →								

I CERTIFY THAT THE ABOVE INFORMATION WAS OBTAINED FROM PAYROLL RECORDS, INVOICES, OR OTHER DOCUMENTS THAT ARE AVAILABLE FOR AUDIT.

CERTIFIED	TITLE	DATE

DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY
PROJECT WORKSHEET - Photo Sheet

O.M.B. No. 1660-0017
Expires October 31, 2008

DISASTER FEMA-_____ -DR-____	PROJECT NO.	PA ID NO.	DATE	CATEGORY
APPLICANT		COUNTY		

PHOTO	PHOTO
DESCRIPTION	DESCRIPTION

APPENDIX D – SAMPLE MONITORING FORMS

- ***Load Ticket***
- ***Tower Monitor Log***
- ***Roving Monitor Report***
- ***Daily Issue Log***
- ***Truck Certification Form***

Load Ticket	Ticket No. 0012345
Municipality (Applicant)	Prime Contractor
	Sub-Contractor

Truck Information

Truck No	Capacity
Truck Driver (print legibly)	

Loading Information

Loading	Time	Date	Inspector/Monitor

Location (Address or Cross Streets)

When Using GPS Coordinates use Decimal Degrees (N xx.xxxxx)

N	**W**

Unloading Information

Debris Classification	Estimated %, CYs, or Actual Weight
☐ Vegetation ☐ C&D ☐ White Goods ☐ HHW ☐ Other* See Below	

Unloading	Time	Date	Inspector/Monitor

DMS Name and Location

*Other Debris Explanation	Original: Applicant Copy 1: _____ Copy 2: _____ Copy 3: _____

TOWER MONITOR LOG

Date: _____

Monitor: _____ **Applicant Monitor:** _____

Time	Truck No.	Load Ticket	Capacity	Vol. or Weight	Pick-Up Location	Photo/ Disc	Comments

Applicant:_____ **Page** ____ **Tower Site:**_____

Monitor:_____ **ROVING MONITOR REPORT** **Date:**_____

Time	Truck No.	Load Ticket	Capacity	Vol. or Weight	Pick-Up Location	Photo/ Disc	Comments

Applicant: _____ **Page**_____

Monitor:_____ **DAILY ISSUE LOG** **Date:_____**

Issue No.	Truck No.	Load Ticket	Pick-Up Location	Contractor/ Sub-Contractor	Applicant Monitor	Photo/ Disc	Issue/Resolution

Applicant:_____ **Page_____**

TRUCK CERTIFICATION FORM

General Information

Applicant: _____ **Monitor:** _____

Contractor: _____ **Date:** _____

Measurement Location: _____ **County:** _____

Declaration Number: _____

Truck Information

Make	Year	Color	License

Truck Measurements

Performed By: _____ **Date:** _____

Volume Calculated By: _____ **Date:** _____

Both Checked by: _____ **Date:** _____

Driver Information

Name: _____

Address: _____

Phone Number: _____

Owner Information

Name: _____

Address: _____

Phone Number: _____

Truck Identification

Truck Capacity

Photo

(See reverse for calculation worksheet)

TRUCK CERTIFICATION FORM

DUMP TRUCK

Measurements

Truck Measurements — Length (L) = ____ Width (W) ft = ____ Height (H) ft = ____

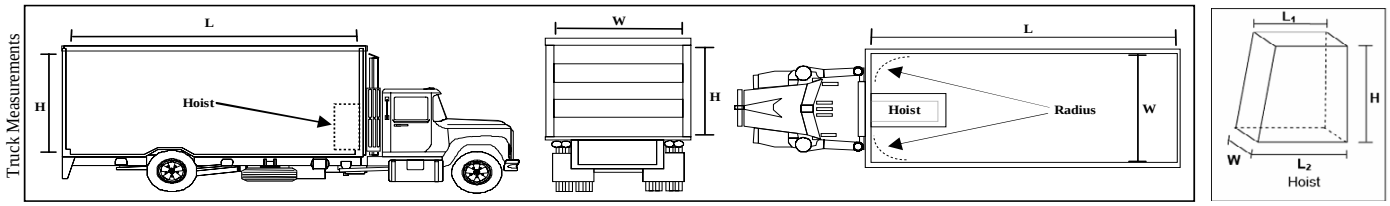
Hoist Measurement — $Length_1$ (L_1) ft = ____ $Length_2$ (L_2) ft = ____ $WidthH$ (W_H) ft = ____ $Height_H$ (H_H) ft = ____

Radius — Radius ft = ____ Height (H) = ____

Calculations

Bed Volume (Basic)	(LxWxH)/27 =	+	cyd
Hoist Volume	((L1+L2/2) x W_H x H_H)/27 =	-	cyd
Radius Volume	(3.14xR^2xH)/27 =	-	cyd
	Total =		cyd

Cubic Yards



EXTRA TRAILER

Measurements

Truck Measurements (Basic) — Length (L) = ____ Width (W) ft = ____ Height (H) ft = ____

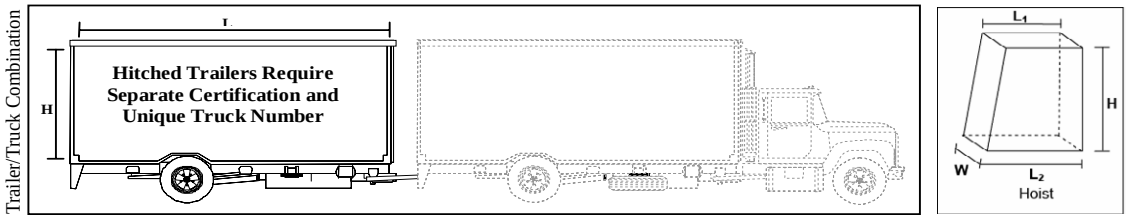
Hoist Measurement — $Length_1$ (L_1) ft = ____ $Length_2$ (L_2) ft = ____ $WidthH$ (W_H) ft = ____ $Height_H$ (H_H) ft = ____

Radius — Radius ft = ____ Height (H) = ____

Calculations

Bed Volume (Basic)	(LxWxH)/27 =	+	cyd
Hoist Volume	((L_1+L_2/2) x W_H x H_H) =	-	cyd
Radius Volume	(3.14xR^2xH)/27 =	-	cyd
	Total =		cyd

Cubic Yards



ROUND BOTTOM TRUCK

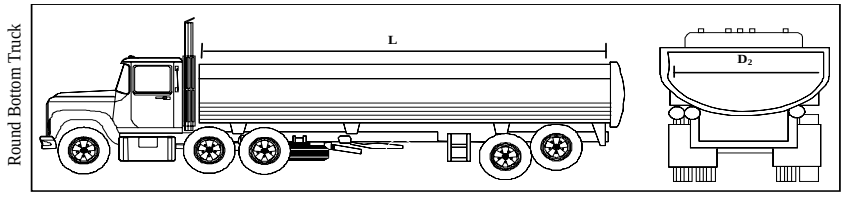
Measurements

Truck Measurements — Length (L) ft = ____ Diameter (D) ft = ____

Calculations

Approx. Volume (3.14 x $(D/2)^2$ x L) /27 = ____ cyd (round bottom portion only)

Cubic Yards



APPENDIX E – DEBRIS COLLECTION AND MANAGEMENT SITE HAZARD ANALYSIS

DEBRIS COLLECTION and MANAGEMENT SITE HAZARD ANALYSIS

Disaster debris collection and management sites pose a multitude of health and safety concerns. Hazards and exposures are a function of the unstable nature of the site, the potential of hazardous substances being present, and the type of work being performed. This hazard analysis serves as general guidance only. Each site will have its own unique hazards, all of which cannot be anticipated.

The listed hazards, risks, and accompanying general recommendations represent suggested site hazard assessment and therefore will not represent actual field hazards present at all debris collection and management sites. It is incumbent upon the responsible entity (e.g. – State, local government, private contractor, etc.) chosen to perform and/or manage this work to assure a comprehensive site specific hazard analysis is performed and that resulting recommendations are implemented.

SITE SAFETY CHECKLIST

- ☐ Conduct a job hazard analysis to identify hazards prior to beginning site work.
- ☐ Assign key personnel and alternates responsible for site safety.
- ☐ Describe risks associated with each operation conducted.
- ☐ Confirm that personnel are adequately trained to perform jobs.
- ☐ Describe the protective clothing and equipment to be worn by personnel during site operations.
- ☐ Describe needed air monitoring, personnel monitoring, and environmental sampling.
- ☐ Describe actions to be taken to mitigate existing hazards to make work environment less hazardous.

POTENTIAL HAZARDS AND GENERAL RECOMMENDATIONS

HAZARD 1: Massive piles of woody debris and other types of debris; unstable work surfaces

Risks: Traumatic, serious, or fatal injuries or illnesses can occur due to slips, trips, falls, or collapsing materials.

- **General Recommendations:**
  - Ensure that surfaces are as stable as possible.
  - Ensure scaffolding is erected on a stable surface; anchor scaffolding to a structure capable of withstanding the lateral forces generated.
  - Ensure workers have ANSI approved safety footwear with slip resistant soles. Consider drop and roll over hazards as well as puncture hazards.
  - Site personnel to be observant of changes in walking surfaces.

HAZARD 2: Hazardous noise

Risks: Communication and possible noise induced hearing loss.

- **General Recommendations:**
  - Monitor noise levels. If 8-hour time-weighted average exposures are 85 decibels (dB) or more, a Hearing Conservation Plan is needed.
  - Try engineering out workplace noise by isolating the equipment, reduce the equipment vibration, or installing sound barriers.
  - Consider hearing protection devices are used whenever noisy equipment (e.g., large trucks, grinding equipment, loaders, generators, large motors, etc.) is used.

HAZARD 3: Breathing dust containing fine airborne particles and gases generated through diesel exhaust fumes, smoke, ash, and road dust

Risks: Irritation of eye, nose, throat, and lung.

- **General Recommendations:**
  - Workers should be protected from breathing airborne contaminants as determined through the site's analysis of respiratory hazards.
  - Respiratory protection: determine respirator type, as needed, through site specific hazard analysis.
  - Respirators must fit properly to protect workers.

- Dust concentrations in the air should be appropriately monitored.
- Stay upwind of dust generating activities.
- Maintain low speeds on construction equipment to keep dust down.
- Airborne dust may be suppressed by application of water based mist.

HAZARD 4: Heat stress from working in a hot, humid climate

Risks: Significant fluid loss can progress to clinical dehydration, raised core body temperature, impaired judgment, disorientation, fatigue, muscle cramping, resulting in heat stroke.

- **General Recommendations:**
  - Adjust work schedules, rotate personnel, and add additional personnel if needed.
  - Replenish fluids (e.g. – water, electrolytes) as needed.
  - Consider personnel and environmental monitoring plans.
  - Know the warning signs of heat related illnesses.
  - Provide shelter for personnel in shaded areas.
  - Where possible, block out sun or other direct sources of heat from fixed work locations.
  - Prevent sun related overexposure to skin by using a sunscreen lotion with a significant sun protection factor (SPF) of 15 or greater.

HAZARD 5: Cold stress from working in a cold, wet climate

Risks: This allows exposed skin and the extremities to cool rapidly and increases the risk of frostbite and hypothermia.

- **General Recommendations:**
  - Get into heated shelter as necessary to maintain body temperature.
  - Replace wet clothing immediately.
  - Drink warm fluids often.
  - Wear adequate clothing to reduce threat of cold stress.
  - Know the signs of cold stress.

HAZARD 6: Carbon monoxide risk from heaters, gasoline or propane-powered generators, or heavy machinery

Risks: Headache, dizziness, drowsiness, or nausea. This may progress to vomiting, loss of consciousness, and collapse. Coma or death may occur under prolonged or high exposures.

- **General Recommendations:**
  - Use CO warning sensors when using or working around combustion sources since CO has no warning properties. CO is a colorless and odorless gas.
  - Shut off equipment or machinery immediately if symptoms of exposure appear and immediately go to a fresh air source or location.

> **Warning!** Do not use gasoline generators or portable heaters in confined spaces or poorly ventilated areas.

HAZARD 7: Work zone traffic hazards

Risks: Traumatic or fatal injuries due to failure of or improper use of equipment or workers being struck by moving equipment.

- **General Recommendations:**
  - Establish a traffic control plan for motorists and pedestrians.
  - Use standard highway signs and control devices to instruct drivers.
  - Use barriers (concrete, water, sand, collapsible barriers, crash cushions, and truck-mounted attenuators) to limit motorist intrusion into the work zone.
  - High visibility safety garments should be provided for those providing temporary traffic control (class 2 or 3) and workers on foot (class 1, 2, or 3).
  - Seat belts and rollover protection should be used on equipment and vehicles as stated by the manufacturer.
  - Workers on foot, equipment operators, and drivers in internal work zones need to know the routes construction vehicles will use.
  - Be mindful of limited visibility (e.g. – blind spots) which heavy machine operators have while driving machines at the work site.
  - Maintain safe driving distances, avoid using cell phones while driving, and obey all traffic laws.

HAZARD 8: Eye, face, hand, and head injuries from flying debris; wood particles

Risks: Traumatic injuries, ranging from minor injuries requiring first aid to serious eye injuries, even disabling or fatal traumatic injuries.

- **General Recommendations:**
  - Only use protective eyewear, face shields, and protective head wear that are ANSI approved.
  - Educate workers regarding safe work procedures before beginning work.
  - Provide workers with a full array of personal protective equipment, including hard hats, safety shoes, eyeglasses, and work gloves.
  - Ensure that workers do not walk under or through areas where cranes and other heavy equipment are being used to lift objects.
  - Proper eye protection (e.g. - goggles or safety glasses).
  - As a minimum requirement use safety glasses with side shields by all site workers. Faceshields are not a substitute for safety glasses.
  - Use safety goggles for protection from fine dust particles rather than using regular prescription eyeglasses.
  - Choose hand protection to fit the hazards determined through the hazard analysis (e.g. – laceration hazards, need for gripping, need for dexterity, etc.).
  - Stay outside the 300 foot safety zone while a chipper is in operation.
  - Check the kick-back device on chainsaws before use.

HAZARD 9: Use of various types of heavy equipment, including cranes, bucket trucks, skid-steer loaders, etc.

Risks: Traumatic injury, including serious and fatal injuries, due to failure of improper use of equipment, or workers being struck by moving equipment.

- **General Recommendations:**
  - Wear safety vests. Safety orange vests with reflective stripes are recommended.
  - Ensure operators are aware of the activities around them to protect workers on foot from being struck by moving equipment.
  - Ensure that workers do not walk under or through areas where cranes and other heavy equipment are being used to lift objects.
  - Ensure that workers do not climb onto or ride loads being lifted or moved.
  - Ensure that all equipment warning devices are working (flashers, strobes, back-up alarms).
  - Machinery is to be inspected by a qualified worker before each use, per OSHA requirements.
  - Stay at lease 20 feet beyond maximum equipment swing radius or movement areas. Assign spotters as needed.
  - Do not exceed the load capacity of cranes and other lifting equipment.

HAZARD 10: Chemicals, flammables and combustibles

Risks: Traumatic, serious, or fatal injuries or illnesses can occur due to inhalational, dermal, and fire hazards.

- **General Recommendations:**
  - Ensure that hazardous waste (batteries, PVC piping, solvents, pesticides, and compressed gas cylinders, etc.) are properly separated from “burnable” trash.
  - Utilize GFCI for any extension cords or power tools.
  - Store gasoline in an approved container not to exceed 5-gallon capacity.
  - Allow gasoline power tools to cool down prior to refueling.
  - Ensure containers are bonded and grounded during dispensing.
  - Ensure adequate fire extinguishers are available at work sites and on work vehicles.
  - Maintain a fire watch during all fire-related activities until material has been extinguished and cooled.
  - If possible, avoid establishing debris management sites where there is a limited public water supply, lack of 911 service, or delays in fire department response time.

HAZARD 11: Isolated work areas and sanitation

Risks: Remote locations delay response times from emergency providers. Precaution can reduce the severity of the event.

- **General Recommendations:**
  - Water-borne disease:
    - Always wash your hands.
    - Use hand sanitizers frequently.
    - Exercise good housekeeping.
    - Only drink from proven potable water sources.
  - Blood-borne disease:
    - Use latex or similar type gloves when handling remains.
    - Replace gloves if punctured or torn.
    - Receive appropriate vaccinations (Hepatitis A, B, Tetanus, Diphtheria, etc).
    - Avoid standing water.
    - Observe universal precautions.
  - Food-borne disease:
    - Identify and dispose of food that may not be safe to eat.
    - Handle food properly.
    - Keep a supply of water and food on hand.
    - Rest when off duty.
  - Emergencies:
    - Know location and phone numbers of nearest hospital, doctor, and police.
    - Carry a first-aid kit.
    - Know the address or nearest cross-road of work site to notify emergency responders.

HAZARD 12: Insects, animals, reptiles, and plants

Risks: Traumatic, serious, or fatal injuries or illnesses can occur due to insect or animal bites.

- **General Recommendations:**
  - Protection from plants:
    - Be alert of poisonous plants.
    - Use barrier creams if available.
    - Wash affected area after contact.
  - Protection from wild or stray animals:
    - Avoid animal habitats (infested areas, rodent burrows, and nests).
    - Do not attempt to take custody of animals unless properly trained.
    - Avoid wild or stray animals. Assume all animals are rabid. Call local authorities to handle animals.
    - Dispose of animal carcasses according to local guidelines.
  - Protection from insects (mosquitoes, bees, spiders, fire ants, etc):
    - Wear appropriate clothing (long pants, socks, long sleeved shirts, etc).
    - Avoid infested areas.
    - Use insect repellents that contain DEET or Picaridin, when necessary.
  - Protection from snakes:
    - Assume all snakes are poisonous. Be on alert for snakes that may be hiding in unusual places after flooding.
    - Seek immediate medical attention if you are bitten.
    - Try to identify the snake so that if it is poisonous you can be given the correct anti-venom.

HAZARD 13: Power lines and gas lines

Risks: Traumatic, serious, or fatal injuries or illnesses can occur due to electrocution.

- **General Recommendations:**
  - Treat all power lines and cables as energized until proven otherwise. De-energized lines can be energized by a secondary power sources such as a backup generator.
  - Use appropriately grounded low voltage equipment.
  - Do not approach detected gas leaks.

- Contact utilities (e.g. – utility locate service) for buried power line location.
- Stay at least 10 feet away from live overhead power lines.
- Get the owner or operator of the lines to de-energize and ground lines when working near them.
- Use non-conductive wood or fiberglass ladders when working near power lines.
- Keep area burn piles, observation areas, and areas where heavy equipment is used away from power lines and other electrical equipment.

HAZARD 14: Debris towers

Risks: Traumatic, serious, or fatal injuries or illnesses can occur due to falls from elevated surfaces.

- **General Recommendations:**
  - Inspect scaffolds and scaffold components for defects before each work shift and after any incident which could affect structural integrity.
  - Provide adequate buffer zones around the tower.
  - Anchor the scaffold to prevent displacement from wind with guide wires
  - Do not exceed load capacity of the scaffold.
  - Footing of the tower must be level, sound, rigid, and capable of supporting the load without settling or displacement.
  - A standard guardrail (top, mid, toe) and handrail system must be installed along all open sides.
  - Provide appropriate ventilation if a heating system is present.
  - No smoking.
  - Use established construction guidance (e.g. – US Army Corps of Engineers).

HAZARD 15: Aerial lifts and scissor lifts

Risks: Traumatic, serious, or fatal injuries or illnesses can occur due to falls, tip-overs, and pinch points.

- **General Recommendations:**
  - Only trained and authorized people may operate the lift.
  - Check for overhead objects before use.
  - Stay far from debris piles, drop-offs, and floor openings.
  - Never use equipment near electric lines unless the lines are de-energized or adequate clearance is maintained.
  - Refuel tanks only when the machine is off.
  - Elevate the lift only when it is on a firm and level surface.
  - Never drive the lift when in the extended position.

HAZARD 16: Severe weather

Risks: Traumatic, serious, or fatal injuries or illnesses can occur due to hypothermia, hyperthermia, and lightning strikes.

- **General Recommendations:**
  - Monitor local weather conditions regularly.
  - Recognize the signs of an oncoming thunder and lighting storm and seek shelter.
  - Avoid small sheds, wooded areas, metal fences and open areas.

You can help prevent workplace injuries and illnesses by looking at your workplace operations, establishing proper job procedures, and ensuring that all employees are trained properly. One of the best ways to determine and establish proper work procedures is to conduct a job hazard analysis. A job hazard analysis is a technique that focuses on job tasks as a way to identify hazards before they occur. It focuses on the relationship between the worker, the task, the tools, and the work environment. Ideally, after you identify uncontrolled hazards, you will take steps to eliminate or reduce them to an acceptable risk level.

A job hazard analysis can be conducted on many jobs in your workplace. Priority should go to the following types of jobs:

- Jobs with the highest injury or illness rates;
- Jobs with the potential to cause severe or disabling injuries or illness, even if there is no history of previous accidents;
- Jobs in which one simple human error could lead to a severe accident or injury;
- Jobs that are new to your operation or have undergone changes in processes and procedures;
- Jobs that are complex enough to require written instructions.

APPENDIX F – DEMOLITION CHECKLIST

Demolition Checklist

Property Address: _____

Pre-Demolition

	Action	Initial	Date	Notes
1	Establish property management file for each parcel of private property. One (1) copy each for local and State records management			
2	Provide notice of condemnation			
3	Complete environmental and historic preservation reviews			
4	Obtain right of entry and hold harmless agreements			
5	Verify property description and ownership (i.e., tax assessment, legal description)			
6	Document property owner's insurance coverage for future recovery			
7	Notify lien holder(s) of intent to demolish as needed			
8	Conduct building inspection as needed			
9	Conduct public health inspection as needed			
10	Conduct fire inspection as needed			
11	Provide public notification of condemnation/demolition			
12	Verify personal property removal			

Demolition

13	Verify structure is unoccupied			
14	Cap well, water, sewer, and septic lines. Disconnect electrical service. Remove propane tanks.			
15	Mark easements and underground utilities			
16	Identify/remove/dispose of asbestos, lead-based paint and other hazardous materials per State environmental agency/EPA requirements			
17	Identify/remove/dispose of all HHW per State environmental agency/EPA requirements			
18	Record GPS coordinates. Photograph site before and after demolition.			
19	Document actual demolition and removal of debris			

Complete documentation is compiled within the project file for each individual structure/property.

I, the authorized applicant official, certify that all processes and documentation referred to in this checklist are complete (except Item 19) prior to the demolition of the referenced structure.

Name (Print) Title Signature Date

APPENDIX G – FEMA POLICIES AND FACT SHEETS

- ***FEMA DAP9523.4 – Demolition of Private Structures***
- ***FEMA DAP9523.11 – Hazardous Stump Extraction and Removal Eligibility***
- ***FEMA RP9523.12 – Debris Operations - Hand-Loaded Trucks and Trailers***
- ***FEMA DAP9523.13 – Debris Removal from Private Property***
- ***FEMA RP9524.3 – Policy for Rehabilitation Assistance for Levees and Other Flood Control Works - Decision Tree***
- ***FEMA RP9525.7 – Labor Costs – Emergency Work***
- ***FEMA RP9580.4 – Fact Sheet: Debris Operations – Clarification: Emergency Contracting vs. Emergency Work***
- ***FEMA RP9580.201 – Fact Sheet: Debris Removal – Applicant's Contracting Checklist***
- ***FEMA RP9580.202 – Fact Sheet: Debris Removal – Authorities of Federal Agencies***
- ***FEMA DAP9580.203 – Fact Sheet: Debris Monitoring***

I. TITLE: Demolition of Private Structures

II. DATE: JUL 18 2007

III. PURPOSE:

This policy provides guidance in determining the eligibility of demolition of private structures under the Federal Emergency Management Agency's (FEMA) Public Assistance Program.

IV. SCOPE AND AUDIENCE:

The policy is applicable to all major disasters declared on or after the date of publication of this policy. It is intended for FEMA personnel involved in the administration of the Public Assistance Program.

V. AUTHORITY:

Section 403(a)(3)(E) of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), 42 U.S.C. 5170b, 42 U.S.C. 5172, 44 CFR 206.225, and 44 CFR 206.226.

VI. BACKGROUND:

A. Section 403 of the Stafford Act, 42 U.S.C. 5170b, provides FEMA authority to provide assistance essential to meeting immediate threats to life and property resulting from a major disaster. Specifically, Section 403(a)(3)(E) provides FEMA authority to fund the demolition of unsafe structures which endanger the public on public and private property (44 CFR 206.225). Eligible Public Assistance applicants may be eligible for Public Assistance grant funding under Section 403 of the Stafford Act under the conditions of this policy.

B. The demolition of unsafe structures owned by eligible public and private nonprofit (PNP) applicants may be eligible for Public Assistance grant funding under Section 406 of the Stafford Act, which funds the repair, restoration, reconstruction, or replacement of eligible facilities (44 CFR 206.226).

VII. POLICY:

A. Definitions.

1. Demolition: The act or process of reducing a structure, as defined by State or local code, to a collapsed state.

2. Demolition debris: Materials including building materials and personal effects that are deposited as a result of the demolition process.

3. Legal responsibility: A statute, formally adopted local code, or ordinance that gives local government officials the responsibility to enter private property to demolish unsafe structures or to perform work to remove an immediate threat (44 CFR 206.223(a)(3), 44 CFR 206.221(c), and 44 CFR 206.225(a)(3)).

4. Unsafe structure: A structure found to be dangerous to the life, health or safety of the public because such structure is so damaged or structurally unsafe as a direct result of the declared disaster that partial or complete collapse is imminent.

B. Duplication of Benefits (44 CFR 206.191). FEMA is prohibited by Section 312 of the Stafford Act from approving funds for work that is covered by any other source of funding. Therefore, State and local governments must take reasonable steps to prevent such an occurrence, and verify that insurance coverage or any other source of funding does not exist for the demolition of private structures.

1. When demolition of private structures is covered by an insurance policy, the insurance proceeds must be used as the first source of funding. Public Assistance grant funding may be used to pay for the remainder of the demolition costs.

2. If it is discovered that a duplication of benefits from any other source of funding has occurred, FEMA will de-obligate funds from the Grantee in the amount that such assistance duplicates funding the property owners received from other sources.

C. Eligibility of Demolition of Private Structures.

1. Demolition of privately owned structures and subsequent removal of demolition debris may be eligible for Public Assistance grant funding under Section 403 of the Stafford Act when the following conditions are met:

a. The structures were damaged and made unsafe by the declared disaster, and are located in the area of the declared disaster (44 CFR 206.223(a)(1) and (2)).

b. The State or local government applicant certifies that the structures are determined to be unsafe and pose an immediate threat to the public (44 CFR 206.225(a)). The Public Assistance applicant provides a detailed explanation documenting its legal responsibility to enter private property to demolish an unsafe structure, and confirms that all legal processes and permission requirements (e.g., rights-of-entry) for such action have been satisfied. The Public Assistance Group Supervisor must concur that the demolition of unsafe structures and removal of demolition debris are in the public interest. FEMA will consider alternative measures to eliminate threats to life, public health, and safety posed by disaster-damaged unsafe structures, including fencing off unsafe structures and restricting public access, when evaluating requests for demolition.

i. The eligible applicant must demonstrate the legal basis as established by law, ordinance, or code upon which it exercised or intends to exercise its responsibility following a major disaster to demolish unsafe private structures (44 CFR 206.223(a)(3)). Codes and ordinances must be germane to the structural condition representing an immediate threat to life, public health, and safety, and not merely define the local government's uniform level of services.

States and local governments ordinarily rely on condemnation and/or nuisance abatement authorities to obtain legal responsibility prior to the commencement of demolition of private structures. There may be circumstances, however, where the State or local government determines that ordinary condemnation and/or nuisance abatement procedures are too time-consuming to address an immediate public health and safety threat. In such circumstances, applicants may not have to precisely follow their nuisance abatement procedures or other ordinances that would prevent the State or local government from taking emergency protective measures to protect public health and safety (44 CFR 206.225(a)).

ii. The applicant's legal responsibility to take action where there is an immediate threat to life, public health, and safety should be independent of any expectation, or request, that FEMA will reimburse costs incurred for demolition of private structures and the removal of demolition debris from private property. In addition, an applicant's legal responsibility is not established solely by an applicant obtaining signed rights-of-entry and hold harmless agreements from property owners.

c. The State or local government confirms that a legally authorized official has ordered the exercise of public emergency powers or other appropriate authority to enter onto

private property in order to remove/reduce threats to life, public health, and safety threat via demolition of unsafe structures and removal of demolition debris (44 CFR 206.223).

d. The State or local government indemnifies the Federal government and its employees, agents, and contractors from any claims arising from the demolition of unsafe private structures and removal of demolition debris from private property (44 CFR 206.9).

e. The work is completed within the completion deadlines outlined in 44 CFR 206.204 for emergency work.

2. Eligible costs associated with the demolition of private structures may include, but are not limited to:

a. capping wells;

b. pumping and capping septic tanks;

c. filling in basements and swimming pools;

d. testing and removing hazardous materials from unsafe structures, including asbestos and household hazardous wastes;

e. securing utilities (electric, phone, water, sewer, etc.);

f. securing permits, licenses, and title searches. Fees for permits, licenses, and titles issued directly by the applicant are not eligible unless it can be demonstrated that the fees are above and beyond administrative costs; and

g. demolition of disaster-damaged outbuildings such as garages, sheds, and workshops determined to be unsafe.

3. Ineligible costs associated with the demolition of private structures may include:

a. removal of slabs or foundations, except in very unusual circumstances, such as when disaster-related erosion under slabs on a hillside causes an immediate public health and safety threat;

b. removal of pads and driveways;

4. Structures condemned as safety hazards before the disaster are not eligible for demolition and subsequent demolition debris removal under Public Assistance grant authority.

5. Individuals and private organizations (except for eligible PNPs) will not be reimbursed for demolition activities on their own properties under the Public Assistance Program (44 CFR 206.224(c)).

6. The removal of substantially damaged structures and associated appurtenances acquired through a Section 404 FEMA Hazard Mitigation Grant Program buyout and relocation project may be eligible for Public Assistance grant funding under Section 407 of the Stafford Act. Such removal must be completed within two years of the declaration date, unless extended by the Assistant Administrator of the Disaster Assistance Directorate (44 CFR 206.224(a)(4)).

D. Demolition of Commercial Structures. The demolition of commercial structures is generally ineligible for Public Assistance grant funding. It is assumed and expected that these commercial enterprises retain insurance that can and will cover the cost of demolition. However, in some cases as determined by the FCO, the demolition of commercial structures by a State or local government may be eligible for FEMA reimbursement only when such removal is in the public interest (44 CFR 206.224(a) and (b)).

Apartments, condominiums, and mobile homes in commercial trailer parks are generally considered commercial structures with respect to Public Assistance funding.

E. Environmental and Historic Review Requirements. Eligible demolition activities must satisfy environmental and historic preservation compliance review requirements as established by 44 CFR Parts 9 and 10, the National Historic Preservation Act, the Endangered Species Act, and all other applicable legal requirements.

VIII. ORIGINATING OFFICE: Disaster Assistance Directorate (Public Assistance Division).

IX. SUPERSESSION: This policy supersedes Recovery Policy 9523.4 dated November 9, 1999, and all previous guidance on this subject.

X. REVIEW DATE: Three years from date of publication.

Carlos J. Castillo
Assistant Administrator
Disaster Assistance Directorate

FEMA
DISASTER ASSISTANCE POLICY

I. TITLE: **Hazardous Stump Extraction and Removal Eligibility**

II. DATE: MAY 15 2007

III. PURPOSE:

Establish criteria used to reimburse applicants for removing eligible hazardous stumps from public or, where authorized, private property.

IV. SCOPE AND AUDIENCE:

The policy is applicable to all major disasters and emergencies declared on or after the date of publication. It is intended for all personnel involved in the administration and execution of the Public Assistance Program, including applicants.

V. AUTHORITY:

Sections 403 and 407 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. 5121-5206, as amended.

VI. BACKGROUND:

Public Assistance regulations authorize reimbursement for the removal of debris from public and private land when it is in the public interest. Such removal is in the public interest when it is necessary to: eliminate immediate threats to life, public health and safety, or eliminate immediate threats of significant damage to improved public or private property; or to ensure economic recovery of the affected community to the benefit of the community at large. Trees that are uprooted during a disaster event such that all or part of their roots are exposed may pose an immediate threat to public health and safety.

VII. POLICY:

A. When a disaster event uproots a tree or stump (i.e., 50% or more of root ball is exposed) on a public right-of-way, improved public property or improved property owned by certain private nonprofit organizations, and the exposed root ball poses an immediate threat to life, public health and safety, FEMA may provide supplemental assistance to remove, transport, dispose, and provide fill for the root cavity of an eligible uprooted tree or stump. The Federal Emergency Management Agency (FEMA) will reimburse applicants reasonable costs for this type of work only when uprooted stumps are more than 24 inches in diameter (measured two feet from the ground), with the consensus of the Applicant and the State, and is approved in

advance by FEMA, using the attached Hazardous Stump Worksheet.

1. If it is necessary to remove an uprooted stump before it can be inspected by FEMA because it poses a threat that must be dealt with immediately, the applicant must submit documentation, to FEMA including photographs, that establishes its location on public property, specifics on the threat, stump diameter measured two feet up the trunk from the ground, quantity of material to fill the hole, and any special circumstances.

2. FEMA will reimburse applicants for extraction, transport and disposal of stumps with a diameter of 24 inches or smaller at the unit cost rate for regular vegetative debris, using the attached Stump Conversion Table, as such stumps do not require special equipment.

3. FEMA will reimburse applicants at the unit cost rate (usually cubic yards) for normal debris removal for all stumps, regardless of size, placed on the rights-of-way by others (i.e., contractors did not extract them from public property or property of eligible Private Non Profit organization). In such instances, applicants do not incur additional cost to remove these stumps because the same equipment that is used to pick up "regular" debris can be used to pick-up these stumps.

4. If an applicant incurs additional costs in picking up large stumps (over 24 inches in diameter) from rights-of-way, it should complete the Hazardous Stump Worksheet and present documentation to FEMA in advance for consideration.

5. Stumps with less than 50% of their root ball exposed should be cut flush at ground level and the cut portion included with regular vegetative debris.

6. Straightening or bracing of trees is eligible for reimbursement if it is less costly than removal and disposal. Applicant must provide a cost analysis showing cost effectiveness.

VIII. ORIGINATING OFFICE: Disaster Assistance Directorate (Public Assistance Division)

IX. SUPERSESSION: This policy supersedes Recovery Policy Number 9523.11, Hazard Stump Removal and Extraction Eligibility dated May 6, 2006.

X. REVIEW DATE: Three years from the date of publication.

David Garratt
Acting Assistant Administrator
Disaster Assistance Directorate

Hazardous Stump Worksheet

Applicant: _____ Date: _____

Applicant Representative: _____ Signature: _____

FEMA Representative (if available) _____ Signature: _____

State Representative (if available):_____ Signature: _____

	Physical Location (i.e., Street address, road, cross streets, etc.)	Description of Facility (ROW, Park, City Hall, etc.)	Hazard		GPS (decimal degrees, 00.000000)		Tree Size (Diameter)	Eligible		Fill For Debris Stumps	Comments (See attached sketch, photo, etc.)
			Yes	No	Latitude (N)	Longitude (W)		Yes	No	CY	
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

Stump Conversion Table

Diameter to Volume Capacity

The quantification of the cubic yards of debris for each size of stump in the following table was derived from FEMA field studies conducted throughout the State of Florida during the debris removal operations following Hurricanes Charley, Frances, Ivan and Jeanne. The following formula is used to derive cubic yards:

$$\frac{[(\text{Stump Diameter}^2 \times 0.7854) \times \text{Stump Length}] + [(\text{Root Ball Diameter}^2 \times 0.7854) \times \text{Root Ball Height}]}{46656}$$

0.7854 is one-fourth Pi and is a constant.
46656 is used to convert cubic inches to cubic yards and is a constant

The formula used to calculate the cubic yardage used the following factors, based upon findings in the field:

- Stump diameter measured two feet up from ground
- Stump diameter to root ball diameter ratio of 1:3.6
- Root ball height of 31”

Stump Diameter (Inches)	Debris Volume (Cubic Yards)	Stump Diameter (Inches)	Debris Volume (Cubic Yards)
6	0.3	46	15.2
7	0.4	47	15.8
8	0.5	48	16.5
9	0.6	49	17.2
10	0.7	50	17.9
11	0.9	51	18.6
12	1	52	19.4
13	1.2	53	20.1
14	1.4	54	20.9
15	1.6	55	21.7
16	1.8	56	22.5
17	2.1	57	23.3
18	2.3	58	24.1
19	2.6	59	24.9
20	2.9	60	25.8
21	3.2	61	26.7
22	3.5	62	27.6
23	3.8	63	28.4
24	4.1	64	29.4
25	4.5	65	30.3
26	4.8	66	31.2
27	5.2	67	32.2
28	5.6	68	33.1
29	6	69	34.1
30	6.5	70	35.1
31	6.9	71	36.1
32	7.3	72	37.2
33	7.8	73	38.2
34	8.3	74	39.2
35	8.8	75	40.3
36	9.3	76	41.4
37	9.8	77	42.5
38	10.3	78	43.6
39	10.9	79	44.7
40	11.5	80	45.9
41	12	81	47
42	12.6	82	48.2
43	13.3	83	49.4
44	13.9	84	50.6
45	14.5		

FEMA
RECOVERY POLICY - RP9523.12

I. TITLE: **Debris Operations – Hand-Loaded Trucks and Trailers**

II. DATE: May 1, 2006

III. PURPOSE:

To describe the criteria the Federal Emergency Management Agency (FEMA) will use to reimburse applicants for eligible debris removal accomplished with trucks and trailers loaded physically by hand, rather than with mechanical equipment.

IV. SCOPE AND AUDIENCE:

The policy is applicable to all major disasters and emergencies declared on or after the date of publication. It is intended for all personnel involved in the administration and execution of the Public Assistance Program, including applicants.

V. AUTHORITY:

Sections 403 and 407 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. 5121-5206, as amended.

VI. BACKGROUND:

A. Debris removal companies under contract with local governments have frequently supplemented their vegetative debris removal operations by hiring subcontractors who modify their trucks and trailers by extending sidewalls with plywood or other materials to increase the vehicle's load capacity. Because of the tenuous nature of these improvements, operators typically load these vehicles physically by hand. The inefficiencies associated with loading these trucks or trailers by hand, instead of using mechanical equipment, effectively negates the increased capacity advantages of these vehicles. Hand loading cannot achieve compaction levels comparable to mechanically loaded vehicles. Further, the unit cost for transporting debris is based on mechanical loading of trailers and trucks.

B. FEMA performed studies throughout the State of Florida following the four devastating hurricanes in 2004 and determined that a mechanically-loaded vehicle had a weight-to-volume ratio at least twice that of hand-loaded vehicles. In other words, vehicles of the same measured capacity that were loaded by mechanical equipment and reasonably compacted carried at least

twice the volume of debris as those loaded physically by hand. FEMA has therefore determined it is not reasonable to reimburse applicants - for hand-loaded vehicles and mechanically loaded vehicles – at the same rate.

VII. POLICY:

A. Debris monitors located at temporary or final debris disposal sites will reduce the observed capacity of each hand-loaded truck or trailer load by 50% because of the low compaction achieved by hand-loading. For example, if a 40 cubic-yard (CY) hand-loaded truck or trailer arrives at a debris management or disposal site, and it appears to be 100 percent full, the actual quantity of debris in the truck or trailer will be recorded as 20 CY [(40 CY / 2) * 100%]. In the same manner, if the truck or trailer appears half full, the load will be recorded as 10 CY [(40 CY / 2) * 50%]. The maximum amount recorded for a hand-loaded vehicle will be 50% of its measured capacity.

B. FEMA will reimburse applicants on the basis of capacities calculated in VII-A.

VIII. ORIGINATING OFFICE: Recovery Division (Public Assistance Branch)

IX. SUPERSESSION: Not applicable.

X REVIEW DATE: Three years from the date of publication.

David Garratt
Acting Director of Recovery
Federal Emergency Management Agency

I. TITLE: Debris Removal from Private Property

II. DATE: JUL 18 2007

III. PURPOSE:

This policy describes the criteria that the Federal Emergency Management Agency (FEMA) will use to evaluate the eligibility of debris removal work from private property under the Public Assistance Program.

IV. SCOPE AND AUDIENCE:

The policy is applicable to all major disasters and emergencies declared on or after the date of publication of this policy. It is intended for FEMA personnel involved in the administration of the Public Assistance Program.

V. AUTHORITY:

Sections 403(a)(3)(A), 407, and 502 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), 42 U.S.C. 5170b, 42 U.S.C. 5173, 42 U.S.C. 5192, and 44 CFR 206.224.

VI. BACKGROUND:

A. Sections 403(a)(3)(A) and 407 of the Stafford Act, 42 U.S.C. 5170b and 5173, respectively, provide FEMA authority to fund debris removal from private property provided that the State or local government arranges an unconditional authorization for removal of the debris, and agrees to indemnify the Federal government against any claim arising from the removal.

B. The regulations implementing Sections 403 and 407 of the Stafford Act at 44 CFR 206.224 establish the requirement that debris removal be in the "public interest" in order to be eligible for reimbursement. "Public interest" is defined as being necessary to:

1. eliminate immediate threats to life, public health, and safety; or

2. eliminate immediate threats of significant damage to improved public or private property; or

3. ensure economic recovery of the affected community to the benefit of the community-at-large.

C. Generally, debris removal from private property following a disaster is the responsibility of the property owner. However, large-scale disasters may deposit enormous quantities of debris on private property over a large area resulting in widespread immediate threats to the public-at-large. In these cases, the State or local government may need to enter private property to remove debris to: eliminate immediate threats to life, public health, and safety; eliminate immediate threats of significant damage to improved property; or ensure economic recovery of the affected community to the benefit of the community-at-large. In these situations, debris removal from private property may be considered to be in the public interest and thus may be eligible for reimbursement under the Public Assistance Program (44 CFR 206.224).

VII. POLICY:

A. Definitions.

1. Disaster-generated debris: Any material, including trees, branches, personal property and building material on public or private property that is directly deposited by the disaster.

2. Improved property: Any structure, facility, or equipment that was built, constructed, or manufactured. Examples include houses, sheds, car ports, pools, and gazebos. Land used for agricultural purposes is not improved property (44 CFR 206.221(d)).

3. Legal responsibility: A statute, formally adopted State or local code, or ordinance that gives local government officials responsibility to enter private property to remove debris or to perform work to remove an immediate threat (44 CFR 206.223(a)(3), 44 CFR 206.221(c), and 44 CFR 206.225(a)(3)).

4. Private property: Land and structures, to include contents within the structures, built on land that is owned by non-governmental entities (44 CFR 206.224(b)).

5. Private road: Any non-public road for which a subdivision of the State is not legally responsible to maintain. Private roads include roads owned and maintained by homeowners associations, including gated communities, and roads for which no entity has claimed responsibility. Local police, fire, and emergency medical entities may use these roads to provide services to the community (44 CFR 206.224(b)).

B. **Approval for FEMA Assistance.** FEMA will work with states affected by a disaster to designate those areas where the debris is so widespread that removal of the debris from private property is in the "public interest" pursuant to 44 CFR 206.224, and thus is eligible for FEMA Public Assistance reimbursement on a case-by-case basis.

1. Any State or local government that intends to seek reimbursement to remove debris from private property within a designated area will, prior to commencement of work, submit a written request for reimbursement to, and receive approval from, the Federal Coordinating Officer (FCO). The written request will include the following information:

a. Public Interest Determination (44 CFR 206.224(a)):

i. Immediate Threat to Life, Public Health, and Safety Determination. The basis of a determination by the State, county or municipal government's public health authority or other public entity that has legal authority to make such a determination that disaster-generated debris on private property in the designated area constitutes an immediate threat to life, public health, and safety; or

ii. Immediate Threat to Improved Property Determination. The basis of the determination by the State, county, or municipal government that the removal of disaster-generated debris is cost effective. The cost to remove the debris should be less than the cost of potential damage to the improved property in order for the debris removal to be eligible; or

iii. Ensure Economic Recovery of the Affected Community to the Benefit of the Community at Large Determination. The basis of the determination by the State, county, or municipal government that the removal of debris from commercial properties will expedite economic recovery of the community-at-large. Generally, commercial enterprises are not eligible for debris removal.

b. Documentation of Legal Responsibility (44 CFR 206.223(a)(3)).

A detailed explanation documenting the requesting State or local government's authority and legal responsibility at the time of disaster to enter private property to remove debris, and confirmation that all legal processes and permission requirements (e.g., right-of-entry) for such action have been satisfied.

i. The eligible applicant requesting assistance must demonstrate the legal basis as established by law, ordinance, or code upon which it exercised or intends to exercise its responsibility following a major disaster to remove disaster-related debris from private property. Codes and ordinances must be germane to the condition representing an immediate

threat to life, public health, and safety, and not merely define the applicant's uniform level of services. Typically, solid waste disposal ordinances are considered part of an applicant's uniform level of services.

States and local governments ordinarily rely on condemnation and/or nuisance abatement authorities to obtain legal responsibility prior to the commencement of debris removal work. There may be circumstances, however, where the State or local government determines that ordinary condemnation and/or nuisance abatement procedures are too time-consuming to address an immediate public health and safety threat. In such circumstances, applicants do not have to precisely follow their nuisance abatement procedures or other ordinances that would prevent the State or local government from taking emergency protective measures to protect public health and safety (44 CFR 206.225(a)).

ii. The applicant's legal responsibility to take action where there is an immediate threat to life, public health, and safety must be independent of any expectation, or request, that FEMA will reimburse costs incurred for private property debris removal. In addition, legal responsibility is not established solely by an applicant obtaining signed rights-of-entry and hold harmless agreements from property owners.

c. Authorization for Debris Removal from Private Property (44 CFR 206.223(a)(3)). Confirmation that a legally-authorized official of the requesting applicant has ordered the exercise of public emergency powers or other appropriate authority to enter onto private property in the designated area in order to remove/reduce threats to life, public health, and safety threat via debris removal.

d. Indemnification (44 CFR 206.9). The requesting entity indemnifies the Federal government and its employees, agents, and contractors from any claims arising from the removal of debris from private property.

2. The FCO will approve or disapprove in writing each written request submitted by the State or local government for FEMA to designate areas eligible for private property debris removal. After receiving approval from the FCO, the State or local government may begin identifying properties and the specific scope of work for private property debris removal activities and apply for supplemental assistance through the Public Assistance Program.

C. Duplication of Benefits (44 CFR 206.191). FEMA is prohibited by Section 312 of the Stafford Act from approving funds for work that is covered by any other source of funding. Therefore, State and local governments must take reasonable steps to prevent such an occurrence, and verify that insurance coverage or any other source of funding does not exist for the debris removal work accomplished on each piece of private property.

1. When debris removal from private property is covered by an insurance policy, the insurance proceeds must be used as the first source of funding. Public Assistance grant funding may be used to pay for the remainder of the costs of debris removal from private property.

2. If FEMA discovers that a duplication of benefits from any other source of funding has occurred, FEMA will de-obligate funds from the Grantee in the amount that such assistance duplicates funding that the property owners received from other sources.

D. **Eligibility of Debris Removal Work from Private Property** (44 CFR 206.224(b)).

1. Eligible debris removal work from private property includes removal of:

a. Large piles of disaster-generated debris in the living, recreational, and working areas of properties in urban, suburban, and rural areas, including large lots.

b. Disaster-generated debris obstructing primary ingress and egress routes to improved property.

c. Disaster-damaged limbs and leaning trees in danger of falling on improved property, primary ingress or egress routes, or public rights-of-way.

i. Hazardous tree removal is eligible only if the tree is greater than six inches in diameter (measured at diameter breast height) and meets any of the following criterion: more than 50% of the crown is damaged or destroyed; the trunk is split or broken branches expose the heartwood; or the tree is leaning at an angle greater than 30 degrees and shows evidence of ground disturbance.

ii. Hazardous limb removal is eligible only if the limb is greater than two inches in diameter measured at the point of break.

d. Debris created by the removal of disaster-damaged interior and exterior materials from improved property.

e. Household hazardous wastes (such as household cleaning supplies, insecticides, herbicides, etc.)

f. Disaster-generated debris on private roads, including debris originating from private property and placed at the curb of public or private rights-of-way, provided that the

removal of the debris is the legal responsibility of an eligible applicant, on the basis of removing an immediate threat to life, public health, and safety.

2. Ineligible debris removal work on private property includes the removal of:

a. Debris from vacant lots, forests, heavily wooded areas, unimproved property, and unused areas.

b. Debris on agricultural lands used for crops or livestock.

c. Concrete slabs or foundations-on-grade.

d. Reconstruction debris consisting of materials used in the reconstruction of disaster-damaged improved property.

E. **Debris Removal from Commercial Property**. The removal of debris from commercial property is generally ineligible for Public Assistance grant funding. It is assumed and expected that these commercial enterprises retain insurance that can and will cover the cost of debris removal. However, in some cases as determined by the FCO, the removal of debris from private commercial property by a State or local government may be eligible for FEMA reimbursement only when such removal is in the public interest (44 CFR 206.224(a) and (b)).

Industrial parks, golf courses, commercial cemeteries, apartments, condominiums, and mobile homes in commercial trailer parks are generally considered commercial property with respect to Public Assistance funding.

F. **Environmental and Historic Review Requirements**. Eligible debris removal activities on private property must satisfy environmental and historic preservation compliance review requirements as established by 44 CFR Parts 9 and 10, the National Historic Preservation Act, the Endangered Species Act, and all other applicable legal requirements.

VIII. ORIGINATING OFFICE: Disaster Assistance Directorate (Public Assistance Division)

IX. SUPERSESSION: This policy supersedes Recovery Policies 9523.13 and 9523.14, dated October 23, 2005, and all previous guidance on this subject.

X. REVIEW DATE: Three years from date of publication.

Carlos J. Castillo
Assistant Administrator
Disaster Assistance Directorate

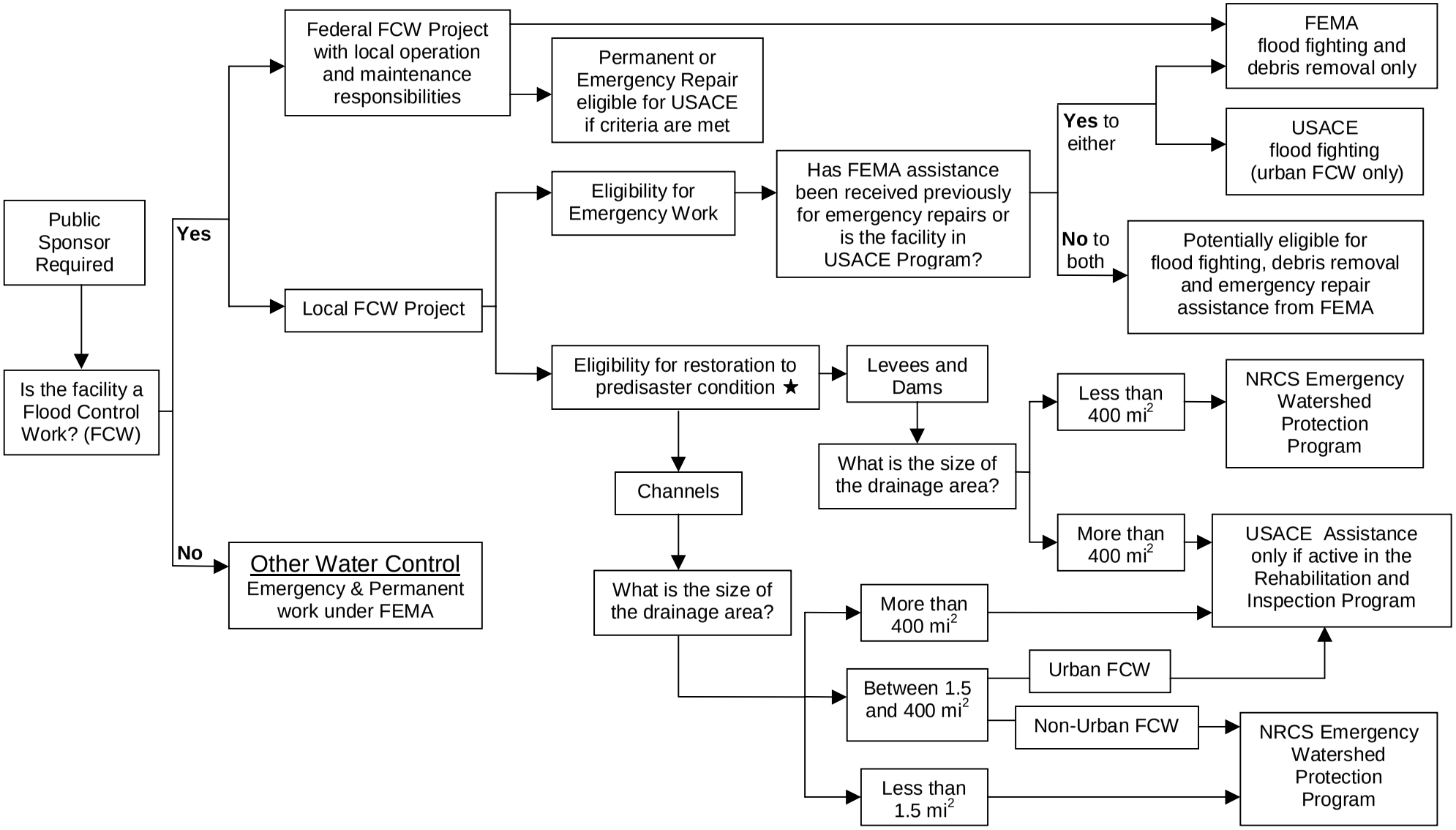
Federal Emergency Management Agency

US Army Corps of Engineers

USDA NRCS Natural Resource Conservation Service

Flood Control Works

Eligibility for Federal Assistance in Presidentially Declared Disasters



Contact the appropriate agency on the reverse side

★ No FEMA assistance in this category

March 1998

FEMA
RECOVERY POLICY – RP9525.7

I. TITLE: **Labor Costs - Emergency Work**

II. DATE: **November 16, 2006**

III. PURPOSE:

Provide guidance on the eligibility of labor costs for an applicant's permanent, temporary, and contract employees who perform emergency work under Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), 42 U.S.C. 5121-5206, as amended.

IV. SCOPE AND AUDIENCE:

This policy applies to all emergencies, major disasters, and fire management assistance declarations, declared on or after the publication date of this document.

V. AUTHORITY:

Sections 403, 407, 420 and 502 of the Stafford Act and 44 Code of Federal Regulations (CFR) §204.42, §206.224 and §206.225.

VI. BACKGROUND:

A. On October 14, 1993, FEMA published a regulation that made the force account labor straight-time salary for work under Section 403 and 407 ineligible under the Public Assistance Program. The 1993 regulation did not include emergency work accomplished under Section 502 (Federal Emergency Assistance) of the Stafford Act. The ineligibility of straight-time salaries for emergency work under Section 502 is included as a provision of the FEMA-State Agreement.

B. Labor (straight-time, overtime, and fringe benefits to the extent the benefits were being paid before the disaster) performed under Section 406 (permanent work) of the Stafford Act remains eligible for reimbursement.

VII. POLICY:

A. Under Sections 403, 407, and 502 of the Stafford Act, eligible emergency work labor costs are those costs incurred by an eligible applicant while performing eligible work. The cost of straight-time salaries and benefits of an applicant's permanently employed personnel is not eligible in calculating the cost of eligible emergency work. The FEMA-State Agreement will

stipulate the ineligibility of straight-time salaries and benefits of an applicant's permanently employed personnel performing emergency work (Categories A and B). For the purpose of this policy, "permanently employed personnel" will refer to those employees whose positions are already included in the applicant's budget.

B. Fixed-term employees, such as seasonally employed personnel, when covered under existing budgets and used for a disaster during the season of employment, are considered permanently employed for the purpose of cost eligibility.

C. Straight-time and overtime will be determined in accordance with the applicant's pre-disaster policies, which should be applied consistently in both disaster and non-disaster situations. For example, one applicant may define labor exceeding 8 hours a day as overtime, while another might define labor exceeding 40 hours a week as overtime. However, all costs, including premium pay, must be reasonable and equitable for the type of work being performed.

D. The actual costs of salaries and benefits for individuals sent home or told not to report due to emergency conditions are not eligible for reimbursement. Extraordinary costs for essential employees who are called back to duty during administrative leave to perform disaster-related emergency work are eligible if the costs were provided for in written policy prior to the disaster.

E. The costs for contract labor, mutual aid in accordance with an existing agreement, or temporary hires needed to accomplish emergency work are eligible for reimbursement. However, straight-time salary and benefits of force account labor overseeing contractors performing emergency work are not eligible in calculating the cost of eligible emergency work.

F. The reimbursement of force account or temporary labor to backfill regular staff who are performing eligible emergency work may be eligible. Backfill cost is defined as the straight-time salary and benefits and overtime of replacement personnel who perform the regular duties of other personnel while they are performing eligible emergency work under the Public Assistance Program. There are several circumstances which affect the eligibility of the backfill employee.

1. If the backfill employee is a contract or extra hire, the cost of this extra person represents an extra cost to the applicant. Regular and overtime are eligible. If the employee is permanently employed, straight time is not eligible. Only overtime costs are eligible.

2. The cost of straight-time salaries and benefits of an applicant's permanently employed personnel, of any department, regardless of any inter-departmental agreements, are not eligible.

3. If the backfill employee is a regular employee who is called in on his/her day off (weekend or other off day), there may be an extra cost to the applicant. Regular and overtime costs may be eligible.

4. If the backfill employee is called in from scheduled leave, there should be no extra cost as the leave can be rescheduled. Only the overtime is eligible.

5. Generally, exempt employees (i.e. those who are exempt from minimum wage and overtime provisions of the Fair Labor Standards Act) are not eligible for overtime, unless specified in an applicant's pre-disaster policy.

G. Permanent employees who are funded from an external source (e.g., by a grant from a Federal agency, statutorily dedicated funds, rate-payers, etc.) to work on specific non-disaster tasks may be paid for emergency work. However, the FEMA Region is to consult with FEMA headquarters before approving payment.

H. Reimbursement of labor costs for employees performing emergency work is limited to actual time worked, even when the applicant is contractually obligated to pay for 24 hour shifts. It is not reasonable for a person to work more than 48 hours continuously without an extended rest period. Therefore, FEMA will reimburse up to 24 hours for each of the first two days, and up to 16 hours for each of the following days for emergency work. All requested hours must be for actual time worked. Standby time is not eligible under the Public Assistance Program or Fire Management Assistance Grant Program. Pre-positioning under the Fire Management Assistance Grant Program is eligible if the resources were actually used to suppress a declared fire.

I. The value of volunteers accomplishing eligible emergency work can be credited toward the non-Federal cost share of the applicant's emergency work in accordance with Donated Resources Policy #9525.2.

VIII. ORIGINATING OFFICE: Recovery Division (Public Assistance Branch).

IX. SUPERSESSION: This policy updates and replaces all relevant provisions of previous Public Assistance policy documents or guidance on this subject.

X. REVIEW DATE: Three years from date of publication.

John R. D'Araujo, Jr.
Director of Recovery

FEMA 9580.4
January 19, 2001

PUBLIC ASSISTANCE PROGRAM

FACT SHEET
DEBRIS OPERATIONS - CLARIFICATION
EMERGENCY CONTRACTING VS. EMERGENCY WORK

SUMMARY: Contracting for debris operations, even though it is "emergency work" in FEMA operations, does not necessarily mean the contracts can be awarded without competitive bidding. Applicants should comply with State laws and regulations, but should be aware that non-competitive contracting is acceptable ONLY in rare circumstances where there can be no delay in meeting a requirement. In general, contracting for debris work requires competitive bidding. The definition of "emergency" in contracting procedures is not the same as FEMA's definition of "emergency work".

DISCUSSION: There appears to be some confusion regarding the awarding of some contracts, especially for debris, without competitive bidding. The reason cited for such actions is that the contract is for emergency work, and competitive bidding is not required.

Part 13 of 44 CFR is entitled "Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments". These requirements apply to all grants and subgrants to governments, except where inconsistent with Federal statutes or regulations authorized in accordance with the exception provisions of Section 13.6. In essence, these regulations apply to all Federal grants awarded to State, tribal and local governments.

Non-competitive proposals awarded under emergency requirements are addressed as follows:

"Procurement by non-competitive proposals may be used only when the award of a contract is infeasible under small purchase procedures, sealed bids, or competitive proposals and one of the following circumstances applies:

(A) …….

(B) The public exigency or emergency of the requirement will not permit a delay resulting from competitive solicitation." (44 CFR Part 13.36(d)(4)(1)(B))."

Staff of the Office of General Counsel and the Office of the Inspector General have expressed concern that contracts are being awarded under this section without an understanding of the requirement. Simply stated, non-competitive contracts can be awarded only if the emergency is such that the contract award **cannot be delayed by the amount of time required to obtain competitive bidding**.

FEMA's division of disaster work into "emergency" and "permanent" is generally based on the period of time during which the work is to be performed, and not on the urgency of that work. Therefore, the award of non-competitive contracts cannot be justified on the basis of "emergency work", as defined by FEMA.

In some situations, such as clearing road for emergency access (moving debris off the driving surface to the shoulders or rights-of-way), or removal of debris at a specific site, awarding a non-competitive contract for site-specific work may be warranted; however, normally, non-competitive bid awards should not be made several days (or weeks) after the disaster or for long-term debris removal. Obviously, the latter situations do not address a public exigency or emergency which "will not permit a delay resulting from competitive solicitation".

Regarding competitive solicitations, applicants can use an expedited process for obtaining competitive bids. In the past, applicants have developed a scope-of-work, identified contractors that can do the work, made telephone invitations for bids, and received excellent competitive bids. Again, applicants must comply with State and local bidding requirements.

Please remind applicants that no contractor has the authority to make determinations as to eligibility, determinations of acceptable emergency contracting procedures, or definitions of emergency work. Such determinations are to be made by FEMA.

FEMA

RECOVERY DIVISION

FACT SHEET

RP9580.201

DEBRIS REMOVAL

APPLICANT'S CONTRACTING CHECKLIST

Overview

To be eligible for reimbursement under the Public Assistance Program, contracts for debris removal must meet rules for Federal grants, as provided for in 44 CFR Part 13.36 *Procurement* (http://www.access.gpo.gov/nara/cfr/waisidx_04/44cfr13_04.html). Public Assistance applicants should comply with their own procurement procedures in accordance with applicable State and local laws and regulations, provided that they conform to applicable Federal laws and standards identified in Part 13. The following guidance is provided to assist Public Assistance applicants in the procurement process.

Contracting Process Checklist

- ☐ Use competitive bidding procedures. Complete and document a cost analysis to demonstrate price reasonableness on any contract or contract modification where adequate price competition is lacking, as detailed in 44 CFR 13.36(f).
- ☐ Provide a clear and definitive scope of work and monitoring requirements in the request for proposals/bids. Use acceptable emergency contracting procedures that include an expedited competitive bid process only if time does not allow for more stringent procedures.
- ☐ Require bidders to provide copies of references, licenses, financial records, and proof of insurance and bonding.
- ☐ Obtain review from your legal representative of your procurement process and any contract to be awarded to ensure they are in compliance with all Federal, State, and local requirements.
- ☐ Document procedures used to obtain/award contracts (procurement information, bid requests and tabulations, etc).
- ☐ Use load ticket requirement to record with specificity (e.g., street address) where debris is picked up and the amount picked up, hauled, reduced and disposed of.

FEMA will, when requested by applicants, assist in the review of debris removal contracts. However, such a review does not constitute approval.

FEMA

RECOVERY DIVISION

FACT SHEET

RP9580.201

DEBRIS REMOVAL

APPLICANT'S CONTRACTING CHECKLIST

Contract Provisions Checklist

All contracts must contain/reflect the following provisions:

- ☐ All payment provisions must be based on unit prices.
- ☐ No payments may be based on time and material costs unless limited to work performed during the first 70 hours of actual work following a disaster event.
- ☐ That payment will be made only for debris that FEMA determines eligible, referencing FEMA regulations and Public Assistance guides and fact sheets. (This is an optional provision to protect the applicant, and is used only following a major disaster declaration.)
- ☐ An invoice provision requiring contractors to submit invoices regularly and for no more than 30-day periods.
- ☐ A "Termination for Convenience" clause allowing contract termination at any time for any reason.
- ☐ A reasonable limit on the period of performance for the work to be done.
- ☐ A subcontract plan including a clear description of the percentage of the work the contractor may subcontract out and limiting use of subcontractors to only those you approve.
- ☐ The preference that the contractor use mechanical equipment to load and reasonably compact debris into the trucks and trailers.
- ☐ The requirement that the contractor provide a safe working environment, including properly constructed monitoring towers.
- ☐ Option of a unit price for extracting from ground and removing FEMA-eligible stumps (only for stumps with diameters larger than 24 inches, measured 24 inches above the ground, and with 50% or more of the root ball exposed), or including all stumps in the unit price.

FEMA

RECOVERY DIVISION

FACT SHEET

RP9580.201

DEBRIS REMOVAL

APPLICANT'S CONTRACTING CHECKLIST

Contract Provisions Checklist - Continued

All contracts must contain/reflect the following provisions:

- ☐ Requirement that all contract amendments and modifications be in writing.
- ☐ Requirement that contractor obtain adequate payment and performance bonds and insurance coverage.

Pre-Disaster and Stand-By Contracts Checklist

- ☐ It is recommended that you pre-qualify contractors prior to an event and solicit bid prices from this list of contractors once an event has occurred.
- ☐ The solicitation for pre-qualifying contractors must adequately define in the proposed scope of work all the potential types of debris, typical haul distances, and size of events for which a contract may be activated.
- ☐ To ensure reasonable debris removal costs, award debris removal contracts based on unit prices (volume or weight).
- ☐ If the contract is awarded on a time and material basis, it should be limited to no more than 70 hours of actual clearance and removal operations.
- ☐ After the initial 70-hour period, payment should be on a unit price basis (volume or weight).

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RECOVERY DIVISION

FACT SHEET

RP9580.201

DEBRIS REMOVAL

APPLICANT'S CONTRACTING CHECKLIST

Avoidance Checklist

- ☐ **DO NOT**: Award a debris removal contract on a sole-source basis.
- ☐ **DO NOT**: Sign a contract (including one provided by a contractor) until it has been thoroughly reviewed by your legal representative.
- ☐ **DO NOT**: Allow any contractor to make eligibility determinations, since only FEMA has that authority.
- ☐ **DO NOT**: Accept any contractor's claim that it is "FEMA certified." FEMA does not certify, credential, or recommend debris contractors.
- ☐ **DO NOT**: Award a contract to develop and manage debris processing sites unless you know it is necessary, and have contacted the State for technical assistance concerning the need for such operations. Temporary debris storage and reduction sites are not always necessary.
- ☐ **DO NOT**: Allow separate line item payment for stumps 24 inches and smaller in diameter; these should be treated as normal debris.
- ☐ **DO NOT**: "Piggyback" or utilize a contract awarded by another entity. Piggybacking may be legal under applicable state law; however, the use of such a contract may jeopardize FEMA funding.
- ☐ **DO NOT**: Award pre-disaster/stand-by contracts with mobilization costs or unit costs that are significantly higher than what they would be if the contract were awarded post-disaster. Such contracts should have variable mobilization costs depending upon the size of the debris work that may be encountered.

FEMA RECOVERY DIVISION

FACT SHEET 9580.202

DEBRIS REMOVAL
AUTHORITIES OF FEDERAL AGENCIES

Overview

This fact sheet identifies and describes the authorities of federal departments and agencies in support of debris operations following a presidential emergency or major disaster declaration. The following nine Federal agencies and departments are invested with authorities (described in detail below) addressing various aspects of debris management.

- Department of Homeland Security
  - *Federal Emergency Management Agency*
  - *United States Coast Guard*
- Department of Defense: *U.S. Army Corps of Engineers*
- Department of Agriculture
  - *Natural Resources and Conservation Service*
  - *Farm Service Agency*
  - *Animal Plant and Health Inspection Service*
- Department of Transportation: *Federal Highway Administration*
- Department of Commerce: *National Oceanic and Atmospheric Administration*
- Environmental Protection Agency

Department of Homeland Security

Federal Emergency Management Agency (FEMA)

- FEMA is authorized in Sections 403, 407 and 502 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act to provide assistance to eligible applicants to remove debris from public and private property following a Presidential disaster declaration, when in the public interest.

- Removal must be necessary to eliminate immediate threats to lives, public health and safety; eliminate immediate threats of significant damage to improved public or private property; or ensure

the economic recovery of the affected community to the benefit of the community-at-large. The debris must be the direct result of the disaster and located in the disaster area, and the applicant must have the legal responsibility to remove the debris.

- FEMA will (1) reimburse applicants to remove eligible debris, or (2) through a mission assignment to another Federal agency (and upon request of the State) - provide *direct Federal assistance* when it has been demonstrated that the State and local government lack the capability to perform or contract for the requested work.

- Assistance will be cost-shared (at no less than 75% Federal and 25% non-Federal). In extreme circumstances, FEMA will provide up to 100% funding for a limited period of time.

United States Coast Guard (USCG)

- Under the National Contingency Plan (NCP), the USCG and Environmental Protection Agency (EPA) are responsible for providing pre-designated Federal On-Scene Coordinators (FOSCs) to conduct emergency removals of oil and hazardous materials.

- USCG is responsible for the coastal zone, and the EPA is responsible for the inland zone. The delineation between coastal and inland zones is by mutual agreement between the USCG and the EPA, and the geographic limits are indicated in Area Contingency Plans.

- Under the Comprehensive Environmental Response, Compensation, and Liability Act, or CERCLA (also known as Superfund), and the Clean Water Act, USCG has the authority to respond to actual or potential discharges of oil and actual or potential releases of hazardous substances, pollutants and contaminants that may endanger public health or the environment.

- Response actions may include containment, stabilization, decontamination, collection (e.g., orphan drums tanks and drums), and final disposal. Debris may be mixed with, or contain, oil or hazardous materials that are subject to USCG response authorities. Oil removal is funded from the Oil Spill Liability Trust Fund, while hazardous materials removal is conducted using CERCLA funds.

- USCG, under the Ports and Waterways Safety Act (33 U.S.C. §§1221), is responsible for keeping waterways safe and open. While there is no specific language stating that the USCG is responsible for debris removal from waterways, the USCG has been tasked - in the past - to assist in waterway and marine transportation system recovery.

DEBRIS REMOVAL
AUTHORITIES OF FEDERAL AGENCIES

Department of Defense

United States Army Corps of Engineers (USACE)

- USACE is authorized by Section 202 of Water Resources Development Act (WRDA) of 1976 (PL 94-587) to develop projects for the collection and removal of drift and debris from publicly maintained commercial harbors, and from land and water areas immediately adjacent thereto.

- Specific and limited local programs for continuing debris collection and disposal have been authorized (on an individual basis, with the authorized work carried out at each locality as a separate, distinct project) by Congress for:

  - New York Harbor
  - Baltimore Harbor
  - Norfolk Harbor
  - Potomac and Anacostia Rivers, in the Washington, D.C. Metropolitan area
  - San Francisco Harbor/Bay, California.

- Sections 15, 19, and 20 of the River and Harbor Act of 1899, as amended, authorize USACE to remove sunken vessels or other obstructions from navigable waterways under emergency conditions. A navigable waterway is one that has been authorized by Congress, and which USACE operates and maintains for general (including commercial and recreational) navigation. Funding for operation and maintenance of these "Federal" waterways is through USACE's annual Operations and Maintenance General Appropriation. USACE's policy is to oversee removal of sunken vessels by an identifiable owner, operator or lessee if the sunken vessel is in or likely to be moved into a Federal navigation channel. USACE will remove a vessel using its emergency authorities only if the owner, operator, or lessee cannot be identified or they cannot effect removal in a timely and safe manner.

- USACE is also authorized, under Flood Control and Coastal Emergencies (PL 84-99), to provide assistance for debris removal from flood control works, i.e., structures designed and constructed to have appreciable and dependable effects in preventing damage by irregular and unusual rises in water level. Under this authority, USACE requires that an applicant, to be eligible for assistance, be an active participant in its PL 84-99 Rehabilitation and Inspection Program at the time of the disaster.

DEBRIS REMOVAL
AUTHORITIES OF FEDERAL AGENCIES

United States Department of Agriculture

Natural Resources Conservation Service (NRCS)

- NRCS' Emergency Watershed Protection Program (EWP) is authorized by Section 216 of the Flood Control Act of 1950, PL 81–516, 33 U.S.C. 701b–1; and Section 403 of the Agricultural Credit Act of 1978, PL 95–334, as amended by Section 382, of the Federal Agriculture Improvement and Reform Act of 1996, PL 104–127, 16 U.S.C. 2203.

- Debris clean up must be for either runoff retardation or soil erosion prevention that is causing a sudden impairment in the watershed creating an imminent threat to life or property. Typically, this includes debris within channels but could also include debris in close proximity to a channel or situated where the next event could create an imminent threat to life or property. There is no size limit to the watershed except that EWP assistance is not eligible for coastal erosion restoration.

- The EWP is funded through specific Congressional appropriations.

- Public and private landowners are eligible for assistance but must be represented by a project sponsor (a state or political subdivision thereof, qualified Indian tribe or tribal organization, or unit of local government).

- Work can be done either through Federal or local contracts. Sponsors are responsible for the 75% local cost share.

- NRCS can provide assistance when the President declares an area to be a major disaster area or when an NRCS State Conservationist determines that a watershed impairment exists.

- NRCS will not provide funding for activities undertaken by a sponsor prior to the signing of an agreement between NRCS and the sponsor.

Farm Service Agency (FSA)

- Emergency Conservation Program (ECP) is authorized by Sections 401 - 406 of the Agricultural Credit Act of 1978, PL 95–334, and provides emergency assistance for debris removal from privately-owned land following a natural disaster. It is funded through Congressional supplemental appropriations.

DEBRIS REMOVAL
AUTHORITIES OF FEDERAL AGENCIES

- The damage must be so costly that Federal assistance is or will be required to return the land to productive agricultural use or to provide emergency water for livestock.

- The ECP provides emergency cost share funding (up to 75% federal share) and technical assistance for farmers and ranchers to remove debris (other than animal carcasses).

Animal, Plant and Health Inspection Service (APHIS)

- APHIS has two programs under which it can provide debris removal assistance:

  - Veterinary Services (VS) program authorized by Animal Health Protection Act (7 U.S.C. 8301–8317) which provides for removal and burial of diseased animal carcasses.

  - Plant Protection and Quarantine (PPQ) program authorized by Plant Protection Act (Title IV, Pub. L. 106–224, 114 Stat. 438, 7 U.S.C. 7701–7772). This program manages issues related to the health of plant resources. Primary objective is to regulate and monitor in order to reduce the risk of introduction and spread of invasive species, including planning, surveillance, quick detection, containment, and eradication.

- Both public and private lands are eligible under these programs which provide assistance to Federal, State, tribes, local jurisdictions, and private landowners to manage animal and plant health by collecting and providing information, conducting or supporting treatments, providing technical assistance for planning and program implementation (removal).

Environmental Protection Agency (EPA)

- EPA's primary authorities related to debris removal fall into two categories: (1) authorities related to cleaning up debris that is mixed with or contains oil or hazardous materials; and (2) authorities related to establishing standards for proper management of debris (hazardous and non-hazardous). EPA generally does not remove non-hazardous debris after emergencies/disasters.

- Under the Comprehensive Environmental Response, Compensation, and Liability Act, or CERCLA (also known as Superfund), and the Clean Water Act, EPA and the United States Coast Guard (USCG) have the authority to respond to actual or potential discharges of oil and actual or potential discharges of hazardous substances, and to actual or potential discharges of pollutants and contaminants that may present an imminent and substantial danger to the public health or welfare.

DEBRIS REMOVAL
AUTHORITIES OF FEDERAL AGENCIES

- EPA has responsibility for responses in the inland zone and USCG has responsibility for responses in the coastal zone. The delineation between the inland and coastal zone is determined by mutual agreement by the EPA and USCG, and the geographic boundaries are indicated in Area Contingency Plans.

- EPA and USCG carry out these responsibilities under implementing regulations known as the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). EPA and USCG pre-designate Federal On-Scene Coordinators (FOSCs) to direct and coordinate response actions.

- Response actions may include containment, stabilization, decontamination, collection (e.g., orphan tanks and drums), and disposal. Debris may be mixed with, or contain, oil or hazardous materials that are subject to these response authorities.

- CERCLA requires that the State in which the site is located fund 10% of remedial action costs, with the other 90% drawn from the Superfund. However, where the potentially responsible party is a political subdivision of a State, the State must agree to fund 50% of the remedial action costs, with the other 50% drawn from the Superfund.

- The Resource Conservation and Recovery Act established a framework for Federal, State, and local cooperation in controlling the management of hazardous and non-hazardous solid waste. The EPA role is to establish minimum regulatory standards that are, in most cases, implemented by the States and to provide technical assistance. EPA administers other laws as well that may impact the management of debris (e.g., Clean Air Act requirements that apply to asbestos-containing debris). Again, some of these programs may be delegated to the States.

- FEMA may mission assign the EPA through the United States Army Corps of Engineers to dispose of household hazardous waste following a major disaster declaration from the President.

Department of Transportation

Federal Highway Administration (FHWA)

- The Emergency Relief (or ER) program is authorized in Title 23, United States Code, Section 125, from the Highway Trust Fund, and supports repair or reconstruction of Federal-aid highways and roads on Federal lands which have suffered serious damage as a result of natural disasters or catastrophic failures from an external cause.

- Debris removal from Federal-aid roads is eligible for 100% reimbursement during the first 180 days following an emergency event that qualifies and is approved for the ER program.

DEBRIS REMOVAL AUTHORITIES OF FEDERAL AGENCIES

- The ER program is funded $100 million in annual authorizations. If the annual authorization is expended, FHWA will reimburse eligible costs when ER funds become available.
- The State must incur a cost of at least $700,000 statewide to qualify for ER assistance. The cost of individual projects (sites) must be $5,000.
- It is the responsibility of individual States to request ER funds for assistance in the cost of necessary repair of Federal-aid highways damaged by natural disasters or catastrophic failures.

Department of Commerce

National Oceanic and Atmospheric Administration (NOAA)

- The Coastal and Geodetic Survey Act of 1947 and the Hydrographic Services Improvement Acts of 1998, 2002, authorize NOAA to be directly involved in programs to assess and remove hazards and debris. NOAA does not fund debris removal.
- NOAA's Office of Coastal Survey is responsible for surveying and charting the nation's waters and coast, and has been heavily involved in hydro-surveying using side-scan and multi-beam sonar to identify hazards and debris and dangers to navigation along the Gulf Coast for the last three years.

David Garratt
Acting Director of Recovery
Federal Emergency Management Agency

1/27/07
Date

FEMA

DISASTER ASSISTANCE DIRECTORATE

FACT SHEET 9580.203

DEBRIS MONITORING

Overview

When a disaster event occurs that produces large amounts of debris, effective coordination is required between the Public Assistance applicant, State, and FEMA to ensure that debris removal operations are efficient, effective, and eligible for FEMA Public Assistance grant funding. Eligible Public Assistance applicants are encouraged to monitor debris removal operations and document eligible quantities and reasonable expenses to ensure that the work is eligible for Public Assistance grant funding. Failure to do so properly may jeopardize this funding.

Public Assistance applicants can use force account resources or contractors to monitor debris removal operations, or a combination of both. Regardless of the method, the applicant is responsible for ensuring that applicant-managed debris removal work (either force account or contract) being funded through Public Assistance grants is eligible in accordance with Public Assistance guidelines. This Fact Sheet provides Public Assistance applicants with information on how to properly monitor applicant-managed debris removal operations to ensure compliance with these guidelines. It also provides information on debris monitoring responsibilities and duties that apply to both force account and contractor operations; however, some information provided only applies to debris operations performed under contract.

Debris Monitoring Roles and Responsibilities

Monitoring debris removal operations requires comprehensive observation and documentation by the Public Assistance applicant of debris removal work performed from the point of debris collection to final disposal. Monitoring debris removal work involves constant observation of crews to ensure that workers are performing eligible work in accordance with Public Assistance guidelines, and helps to verify compliance with all applicable Federal, State, and local regulations.

A number of different entities play a role in monitoring debris removal operations to ensure that they are efficient, effective and eligible for FEMA Public Assistance funding. It is important that these entities work together to communicate and resolve issues in the field so that reimbursement funding for debris removal operations is not jeopardized. Below is a table which addresses the general monitoring responsibilities and tasks of different partners in the debris removal operation. The table is followed by specific monitoring responsibilities and duties for both force account and contractor debris monitors in the field.

DISASTER ASSISTANCE DIRECTORATE FACT SHEET - DAP9580.203

DEBRIS MONITORING

Entity	Responsibilities	Tasks
Debris Removal Contractor	Conduct debris removal operations per the terms of the contract.	▪ Monitor its own day-to-day operations to ensure its contractual obligations are being met.
Public Assistance Applicant Monitoring Contractor	Works for Applicant to monitor debris contractor's day-to-day operations to ensure the applicants expectations and contractual requirements are being met.	▪ Provide debris monitoring personnel who are trained in eligibility. ▪ Monitor operations in accordance with the contract requirements. ▪ Provide all monitoring documents as required in the monitoring contract.
Public Assistance Applicant (subgrantee)	Provide oversight and quality assurance of both the debris removal contract and the monitoring contract (if applicable). Request PA funds for eligible work. Ensure performance measures are met and eligible work is documented. Understand eligibility requirements and ensure work performed under the contract meets these requirements.	▪ Designate project manager. *If debris removal is performed by force account labor:* ▪ Provide documentation to substantiate eligible debris quantities. ▪ Ensure compliance with subgrant requirements. *If debris removal is performed under contract:* ▪ Ensure that debris removal contractors and monitoring contractors (if applicable) understand eligibility requirements for the debris removal operations. ▪ Ensure that only eligible debris quantities are being claimed for Public Assistance. ▪ Resolve issues or discrepancies associated with the contract.
State (Grantee)	Ensure grant requirements outlined in the 44 CFR are being met and that PA applicants are receiving funds for eligible costs. Responsible for monitoring the grant and subgrant to ensure compliance with Federal, State and local laws and regulations.	▪ Monitor the grant and subgrant requirements. ▪ Ensure that the applicant is sufficiently monitoring the debris removal operation (FEMA\Grantee effort). ▪ Conduct random monitoring at load sites and disposal sites to ensure compliance with grant requirements (FEMA\Grantee effort). ▪ Notify subgrantee of compliance issues and outline corrective actions (FEMA\Grantee effort).
FEMA	Ensure grant requirements outlined in 44 CFR are being met. Fund eligible work. Responsible for the preparation of large project worksheets, development of the scope of work and the obligation of funds. Responsible for monitoring the grant to ensure compliance with Federal, State and local laws and regulations.	▪ Develop large project worksheets in coordination with the Grantee and subgrantee. ▪ Utilize monitors to ensure that the applicant is sufficiently monitoring the debris removal operation. (FEMA\Grantee effort) ▪ Conduct random monitoring at load sites and disposal sites to ensure compliance with grant requirements. (FEMA\Grantee effort). ▪ Notify Grantee/subgrantee of compliance issues and outline corrective actions (FEMA\Grantee effort). ▪ Increase or decrease monitoring efforts as necessary to ensure corrective actions are in place and operations are being effectively monitored.

DEBRIS MONITORING

The specific responsibilities and duties of individual debris monitors in the field are the same for both force account and contracted debris monitoring operations. They are:

- Report issues to their direct supervisor which require action (such as safety concerns, contractor non-compliance and equipment use)
- Accurately measure and certify truck capacities (recertify on a regular basis)
- Properly and accurately complete and physically control load tickets (in tower and field)
- Ensure that trucks are accurately credited for their load
- Ensure that trucks are not artificially loaded (ex: debris is wetted, debris is fluffed—not compacted)
- Validate hazardous trees, including hangers, leaners, and stumps
- Ensure that hazardous wastes are not mixed in loads
- Ensure that all debris is removed from trucks at Debris Management Sites (DMS)
- Report if improper equipment is mobilized and used
- Report if contractor personnel safety standards are not followed
- Report if general public safety standards are not followed
- Report if completion schedules are not on target
- Ensure that only debris specified in the contract is collected (and is identified as eligible or ineligible)
- Assure that force account labor and/or debris contractor work is within the assigned scope of work
- Monitor site development and restoration of DMSs
- Report to supervisor if debris removal work does not comply with all local ordinances as well as State and Federal regulations (i.e., proper disposal of hazardous wastes)
- Record the types of equipment used (Time & Materials contract)
- Record the hours equipment was used, include downtime of each piece of equipment by day (Time & Materials contract)

Applicants may request FEMA/State assistance with debris monitoring or monitor training.

Only FEMA has the authority to make eligibility decisions; contractors cannot make eligibility determinations. Information on eligibility can be found in the Public Assistance Debris Management Guide FEMA 325, the Public Assistance Policy Digest FEMA 321, the Public Assistance Applicant Handbook FEMA 323, and the Public Assistance Guide FEMA 322.

Monitoring Requirements by Type of Contract

Unlike other categories of work eligible for Public Assistance grants, initial debris removal project worksheets typically do not have a defined scope of work, since precise quantities of debris are difficult to attain. Therefore, unit price contracts which pay by debris volume or weight removed are typically implemented. Unit price contracts require extensive monitoring to determine accurate quantities of eligible debris removed and disposed. As load tickets are compiled and accurate quantities are determined through monitoring, the scope of work for the project worksheet, or version, is established.

DEBRIS MONITORING

In some cases, time and materials contracts may be more cost effective and appropriate for the amount and type of eligible work to be performed. For both time and materials and lump sum contracts, debris monitors must still document and quantify eligible debris amounts in order to determine reasonableness of costs.

The table below includes a breakdown of monitoring requirements by contract type.

Type of Contract	Project Worksheet Scope of Work	Subgrantee Monitoring Required					Comments
		Crew Efficiency	Load site	DMSs	Disposal sites	Fraud	
Lump Sum	Defined debris quantities and reasonable costs. Estimate is basis for contract costs.		√		√		Quantities are still required to determine reasonable costs.
Unit Price - CY	Based on eligible debris listed on load tickets	√	√	√	√	√	
Unit Price - Ton	Based on actual weight measurements of eligible debris listed on load tickets.		√		√	√	
Time and Materials	Based on labor, equipment and materials records. Reasonable costs evaluated by determining costs per unit.	√	√		√	√	Typically used for road clearance. If used for debris removal, quantities are still required to determine reasonable costs. Eligible costs are restricted to up to 70 hours.

Monitoring Contracts

The request for proposal (RFP) for debris monitoring contracts should outline the qualification of debris monitors. The qualifications should be appropriate for the individual responsibilities and duties listed above, and debris monitors should have experience working on construction sites and be familiar with safety regulations. It is not necessary to have professional engineers and other certified professionals perform these duties. Debris monitors primarily should have the ability to estimate debris quantities, differentiate between debris types, properly fill out load tickets, and follow all site safety procedures.

The RFP should also outline possible locations to be monitored and reporting requirements to document eligible debris quantities.

DEBRIS MONITORING

Monitoring contracts are typically time and materials and must contain a *not-to-exceed* clause per the requirements of Part 13 of 44 CFR. The subgrantee should ensure the level of monitoring and overhead claimed is commensurate with the level of effort required to effectively monitor the debris removal and monitoring operation. In addition to the costs for the monitors, the subgrantee can claim as part of its monitoring project worksheet reasonable costs for the debris monitoring contractor to provide training, oversight, and data compilation as required by the terms of the contract. Architectural and engineering service overhead should not be claimed. Additional information on costs that are eligible can be found in the *Public Assistance Debris Management Guide FEMA 325.*

The monitoring contractor costs associated with compiling data to verify costs invoiced by the debris removal contractor can be an eligible expense. Costs associated with attending meetings with FEMA and/or the Grantee and compiling documentation for the production of project worksheets are funded through the administrative allowance as stated in 44 CFR, Part 206.228 and cannot be a direct charge to a Public Assistance grant.

Reporting Requirements & Performance Measures

If FEMA is providing grant assistance for the applicant's monitoring contract, a sample of the reporting requirements outlined in the contract will be required to substantiate the eligible costs. This sample must be adequate to demonstrate that sufficient measures were taken to ensure eligibility and accurate quantities are being reported as part of the grant. Applicants should require debris monitors to submit daily reports on load quantities, debris management site operations, and operational and safety issues in the field. Regular reporting helps to promote quality assurance and provides the applicant with a consistent accounting of operations in the field.

If a time and materials monitoring contract is used, the contractor will have to supply labor, equipment and material records to the subgrantee in order to substantiate the actual costs in the project worksheet.

Continuous monitoring of all activities of a debris contractor can help promote efficiency and effectiveness in the debris removal operation. In evaluating a contractor's performance, primary interest is in the progress toward completion of the services called for and the financial status of the contract. It is important that the contract provide for submission of reports and payment estimates to aid in evaluating the contractor's progress.

Applicant debris monitoring responsibilities may include tracking performance measures used to assess the progress of debris removal operations in the field. Specific debris contract performance measures may include:

- Percentage completion tracking
- Adherence to contract time schedules
- Adherence to contract cost schedules

DEBRIS MONITORING

Contract Procurement Requirements

To be eligible for reimbursement under the Public Assistance Program, contracts for debris monitoring must meet rules for Federal grants, as provided for in 44 CFR Part 13.36 *Procurement* (http://www.access.gpo.gov/nara/cfr/waisidx_04/44cfr13_04.html). Public Assistance applicants should comply with their own procurement procedures in accordance with applicable State and local laws and regulations, provided that they conform to applicable Federal laws and standards identified in Part 13.

5/3/07

David Garratt
Acting Assistant Administrator
Disaster Assistance Directorate

Date

Disaster recovery assistance is available without regard to race, color, national origin, sex, age, religion, disability, or economic status. Anyone who believes he/she has been discriminated against should contact the FEMA Helpline at: 1-800-525-0321.

Report fraud, waste, and abuse to FEMA's Office of Inspector General on the Hotline at 1-800-323-8603.

Seattle Urban Area Security Initiative Region

Disaster Debris Management Plan

May 2008

CH2MHILL

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List of Preparers

Agency/Organization	Name of Preparer
Allied Waste Services	Joe Casalini
City of Bellevue	Rebecca Clark Chris Hagen
City of Bellevue Emergency Management	Steve Thomas
City of Bellevue Utilities Department	Tom Spille
Emergency Services Coordinating Agency	Chandra Fox Lyn Gross
City of Kent	Alex Senecaut Bill Thomas
Federal Emergency Management Agency Region X	Andy Hendrickson
King County Solid Waste Division	Mike Long Jim Neely
King County Office of Emergency Management	Kathryn Howard
King County Zone One Coordinator	Mike Ryan
King County Zone Three Coordinator	Dominic Marzano Ed Reed
LeMay, Inc.	Charlie Maxwell
Pierce County Recycling, Composting and Disposal	Rusty Cole
Pierce County Department of Emergency Management	Richard Schroedel
Pierce County Department of Public Works and Utilities	Steve Wamback Yvonne Reed
Pierce County Sheriff	Rustin Wilder
Puget Sound Clean Air Agency	Elizabeth Gilpin
Seattle Office of Emergency Management/King County Zone 5 Representative	Erica Lund
Seattle Public Utilities	Jeff Neuner Laurie Van Leuvan Robin Friedman
Port of Seattle	Rod Hilden
Public Health Seattle & King County	Jim Henriksen
Snohomish County Solid Waste	Leo Kypuros
Snohomish County Dept of Emergency Management	Stephen Hagberg Mark Murphy

Agency/Organization	Name of Preparer
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Snohomish Health District	Aran Enger
Suburban Cities Association Representative	Gail Marsh
Tacoma Solid Waste Utility	Gary Kato
Tacoma-Pierce County Health Department	Andy Comstock John Sherman
United States Army Corps of Engineers	Gretchen Martinsen Mamie Brouwer
United States Environmental Protection Agency	Josie Clark
Washington Refuse and Recycling Association	Brad Lovaas
Washington State Department of Ecology	Peter Christiansen
Washington State Department of Transportation	John Himmel
Washington State Emergency Management Division	Chuck Hagerhjelm Dave Hall
Washington Utilities and Transportation Commission	Layne Demas Gene Eckhardt Penny Ingram
Waste Connections	Keith Kovalenko
Waste Management	Steve Goldstein Susan Robinson

Acronyms and Abbreviations

AAR	After-Action Report
APHIS	Animal, Plant and Health Inspection Service
CAMU	Corrective Action Management Unit
CDL	Construction, Demolition, and Land-clearing
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environment Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CRT	Cathode Ray Tube
DHS	Department of Homeland Security
DOD	Department of Defense
DOH	Department of Health
Ecology	Washington State Department of Ecology
EMAC	Emergency Management Assistance Compact
EPA	United States Environmental Protection Agency
ESF	Emergency Support Function
FCO	Federal Coordinating Officer
FEMA	Federal Emergency Management Agency
GA	General Administration
HHW	Household Hazardous Waste
HIVA	Hazard Identification and Vulnerability Assessment
HSPD	Homeland Security Presidential Directive
ICS	Incident Command System
ISO	International Organization for Standardization
JIC	Joint Information Center
JIS	Joint Information System
KCC	King County Code

LEPC	Local Emergency Planning Committee
LHWMP	Local Hazardous Waste Management Program
MOU	Memorandum of Understanding
MSW	Municipal Solid Waste
NEPA	National Environmental Policy Act
NGO	Nongovernmental Organization
NIMS	National Incident Management System
NRCS	Natural Resource Conservation Service
NRF	National Response Framework
NRP	National Response Plan
NWWARN	Northwest Warning Alert and Response Network
PCB	Polychlorinated Biphenyl
PDA	Preliminary Damage Assessment
PIO	Public Information Officer
PPDR	Private Property Debris Removal
PSCAA	Puget Sound Clean Air Agency
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
RHMP	Regional Hazard Mitigation Plan
ROE	Right-of-Entry
RPIN	Regional Public Information Network
SCC	Snohomish County Code
SME	Subject Matter Expert
Stafford Act	Robert T. Stafford Disaster Relief and Emergency Assistance Act
SWD	Solid Waste Division
TDSR Site	Temporary Debris Sorting and Reduction Site
TSCA	Toxic Substances Control Act
Seattle UASI Region	Seattle Urban Area Security Initiative Region
USACE	United States Army Corps of Engineers

U.S.C.	United States Code
USCG	United States Coast Guard
USDA	United States Department of Agriculture
WAC	Washington Administrative Code
WAEMD	Washington Emergency Management Division
WSP	Washington State Patrol
WUTC	Washington Utilities and Transportation Commission

Glossary

Debris-causing Incident: An unplanned incident caused by natural or human means that creates debris.

Debris Clearance: Clearing roads and other critical infrastructure by pushing debris to the roadside to accommodate emergency traffic.

Debris Monitoring: Actions taken by applicants in order to document eligible quantities and reasonable expenses during debris activities to ensure that the work complies with the contract scope-of-work and/or is eligible for Public Assistance grant reimbursement.

Debris Removal: Picking up debris and taking it to a Temporary Debris Sorting and Reduction (TDSR) site, composting facility, recycling facility, permanent landfill, or other reuse or end-use facility.

Disaster Debris: Items and materials broken, destroyed, or displaced by a natural or human-caused disaster. Examples of debris include, but are not limited to, vegetative waste, construction and demolition material, and personal property.

Disaster Debris Management: Actions related to the management of disaster debris including assessment, clearance, removal, sorting, reduction, hauling, and disposal.

Force Account: The Federal Emergency Management Agency (FEMA) uses the term "Force Account" to refer to a jurisdiction's own personnel and equipment.

Hazardous Waste: Waste with properties that make it potentially harmful to human health or the environment. Hazardous waste is regulated under the Resource Conservation and Recovery Act (RCRA). In regulatory terms, a RCRA hazardous waste is a waste that (1) appears on one of the four hazardous wastes lists or (2) exhibits at least one of the following four characteristics: ignitability, corrosivity, reactivity, or toxicity. See http://www.epa.gov/osw/hazwaste.htm.

Initial Damage Assessment: The initial damage assessment is used to determine the magnitude and impact of an incident's damage. Also referred to as a "pre-Presidential Damage Assessment," it is often the first assessment a jurisdiction does to determine the impact of an incident.

National Response Framework: A framework developed to facilitate the delivery of all types of federal assistance to states following a disaster. It outlines the planning assumptions, policies, concept of operations, organizational structures, and specific assignments and agencies involved in federal assistance to supplement state, tribal, and local efforts.

Preliminary Damage Assessment (PDA): A joint assessment used to determine the magnitude and impact of an event's damage. A FEMA/state team will usually visit local applicants and view their damage first-hand to assess the scope of the damage

and estimate repair costs. The state uses the results of the PDA to determine if the situation is beyond the combined capabilities of the state and local resources and to verify the need for supplemental federal assistance. The PDA also identifies any unmet needs that may require immediate attention.

Recovery: The phase of emergency management that encompasses activities and programs implemented during and after response that are designed to return the entity to its usual state or to a "new normal."

Response: Activities that address the short-term, direct effects of an incident. Response includes immediate actions to save lives, protect property, and meet basic human needs. Response also includes the execution of emergency operations plans and mitigation activities designed to limit the loss of life, personal injury, property damage, and other unfavorable outcomes.

Right-of-Entry: The document by which a property owner confers to a jurisdiction or their contractor the right to enter onto private property for a specific purpose without committing trespass.

Right-of-Way: The portions of land over which facilities such as highways, railroads, or power lines are built. It includes land on both sides of the facility up to the private property line.

Seattle Urban Area Security Initiative (UASI) Region: Geographic region of King, Pierce, and Snohomish counties and the jurisdictions, special purpose districts, private and public organizations, cities, and tribes that make up the counties.

Temporary Debris Sorting and Reduction (TDSR) Site: A location where debris is sorted, processed, reduced in volume, and/or disposed of.

Solid Waste Collection Company: Private entities that provide daily municipal solid waste service through the transportation and/or disposal of solid waste.

1. Introduction

1.1 Mission

The Seattle Urban Area Security Initiative Region (Seattle UASI Region), composed of King, Pierce, and Snohomish counties and the core cities of Seattle and Bellevue, recognizes that natural and human-caused disasters have the potential to create debris that can disrupt the quality of life for citizens living in the Region, and that can complicate disaster response and recovery following such disasters. The Region also recognizes that planning for such disasters can lessen the impact on the community, economy, and the environment. This Disaster Debris Management Plan provides guidance to the Region that will help with planning, mobilizing, organizing, and controlling a disaster debris-causing incident. This guidance applies to all jurisdictional levels within the Region. Local officials are encouraged to review their community's vulnerability to a disaster and to plan how they and their regional partners would manage a debris clearance, removal, and disposal operation if the need arises.

1.2 Purpose

This Disaster Debris Management Plan is designed to assist emergency response and recovery staff with planning for and managing debris clearance, handling, and recycling or disposal. This plan identifies recommendations for regional priorities, roles, responsibilities, and resources to address debris-causing incidents that might overwhelm the normal capabilities of the Seattle UASI Region. This plan also includes a template for an operational plan in Appendix D, *Operational Debris Management Plan Template,* for jurisdictions to use when preparing their own operational plans.

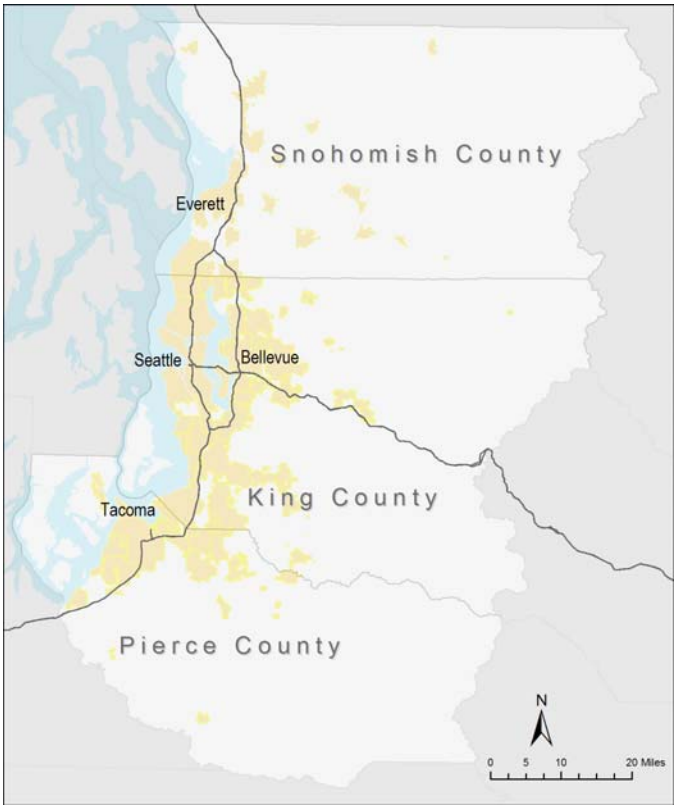

FIGURE 1-1
Seattle UASI Region

1.3 Scope

This Disaster Debris Management Plan covers the geographic region of King, Pierce, and Snohomish counties (Figure 1-1), including individual

jurisdictions, special purpose districts, private and public organizations, cities, and tribes within these counties. This plan describes regional priorities, roles, and responsibilities, but does not address these issues at a local level. Operational plans should be developed by local jurisdictions to address the specific issues of their individual jurisdictions, special purpose districts, and tribal nations.

1.4 Alignment with Other Plans and Documents

National Response Framework

In February of 2003, Homeland Security Presidential Directive (HSPD) 5 directed the Secretary of Homeland Security to develop the National Incident Management System (NIMS) and the National Response Plan (NRP) to provide a consistent national approach for federal, state, and local governments to work effectively and efficiently during a domestic incident response. In March 2008, the NRP was revised and reissued as the National Response Framework (NRF). The NRF improves on the NRP by systematically incorporating public-sector agencies at all levels, the private sector, and nongovernmental organizations (NGOs). The NRF also emphasizes the importance of personal preparedness by individuals and households.

This plan supports the Emergency Support Functions (ESF) #3: Public Works and Engineering Annex, and ESF #14: Long-Term Community Recovery and Mitigation Annex of the Department of Homeland Security's (DHS) National Response Framework (DHS 2004a; 2004b) by providing for coordination of disaster debris operations through all levels of government using a NIMS organization structure.

Washington Comprehensive Emergency Management Plan

This Disaster Debris Management Plan supports the Washington Comprehensive Emergency Management Plan ESF #3: Public Works and Engineering Annex, and ESF #14: Long-Term Community Recovery and Mitigation Annex, by providing a framework to organize disaster debris operations through all levels of government. Currently, Washington state does not have a statewide plan for managing disaster debris incidents.

Operational Disaster Debris Management Plans for Individual Jurisdictions

This Disaster Debris Management Plan supports individual jurisdictions in the Seattle UASI Region by providing a framework and making recommendations that can be used by the jurisdictions to develop their own operational disaster debris management plans. This plan provides the jurisdictions with the flexibility to develop a plan that best addresses their individual needs, but still ensures continuity within the region.

1.5 Plan Organization

This plan consists of 14 chapters, and 12 appendices.

- Chapter 1 – Introduction: Outlines the mission, scope, and purpose of this plan and how this plan aligns with other documents. Summarizes the structure for the entire plan.

- Chapter 2 – Organization and Concept of Operations: Identifies the stakeholders in this Disaster Debris Management Plan, and discusses the roles of stakeholders and various outside agencies when implementing debris removal after a debris-causing incident.
- Chapter 3 – Legislation and Policies: Discusses federal, state, and local legislation, policies, and plans, including policies adopted by King, Snohomish and Pierce counties, that affect debris management in a disaster scenario.
- Chapter 4 – Debris Clearance, Processing, and Disposal Priorities: Discusses how to prioritize debris collection after a major or catastrophic debris-causing incident in a manner that will hasten incident response times, as well as short- and long-term recovery efforts.
- Chapter 5 – Types of Hazards: Discusses the types of natural or human-caused disasters that may occur in the Region.
- Chapter 6 – Types of Debris: Lists classifications of debris according to composition, source, and disposal methods.
- Chapter 7 – Regional Capacities: Outlines the Region's normal and surge capacity to handle waste.
- Chapter 8 – Disaster Debris Operations: Discusses the various steps that must be taken to respond to and recover from a debris-causing incident.
- Chapter 9 – Mutual Aid and Interlocal Agreements: Discusses various resources available through mutual aid or interlocal agreements.
- Chapter 10 – Contract Management and Pre-identified Contractors: Outlines the process for pre-qualifying debris removal contractors to ensure immediate availability of assistance after a debris-causing incident.
- Chapter 11 – Eligibility for Funding: Defines the current funding eligibility requirements for debris removal under the Federal Emergency Management Agency (FEMA) Public Assistance Program.
- Chapter 12 – Public Notification and Communication Plan: Discusses ways to communicate effectively with other jurisdictions and agencies, contractors, and the public before, during, and after a debris-causing incident.
- Chapter 13 – Staff Development and Responsibilities: Lists the staff who will be needed to manage debris removal in the event of a disaster, and describes the specific roles that jurisdictional staff may assume when planning, responding to, and recovering from a debris-causing incident.
- Chapter 14 – References: A list of the references used throughout this report.
- Appendix A – Additional Debris Resources
- Appendix B – Online Resources
- Appendix C – Debris Mitigation Strategies

- Appendix D –Operational Debris Management Plan Template
- Appendix E – Temporary Debris Sorting and Reduction Site Planning
- Appendix F – Sample Forms for Debris Tracking
- Appendix G – Example of Time and Materials Contract for Debris Removal
- Appendix H – Example of Unit Price Contract for Debris Removal
- Appendix I – Example of Lump Sum Contract for Debris Removal
- Appendix J – Example of Right-of-Entry Permit
- Appendix K – Washington Public Assistance Damage Assessment
- Appendix L – Mutual Aid Agreement Sample Template

2. Organization and Concept of Operations

This chapter identifies the sponsors and stakeholders of this Disaster Debris Management Plan and discusses the roles and responsibilities of the plan sponsors, stakeholders, and various outside agencies when maintaining the plan and implementing debris removal after a debris-causing incident.

2.1 Plan Administration

This plan is owned and managed by the Seattle UASI Region Disaster Debris Stakeholders and Plan Sponsors. The Seattle UASI Region Disaster Debris Management Plan was accepted by the plan sponsors on March 20, 2008.

Identification of Plan Stakeholders and Sponsors

Plan stakeholders include city, county, state, and tribal organizations and entities in the Seattle UASI Region that have an active role in debris management, including municipal solid waste agencies, local emergency management entities, and local public health departments/districts. Stakeholders should be responsible for or have a major interest in disaster debris management. A subset of plan stakeholders, the Disaster Debris Management Plan sponsors (the "plan sponsors"), is composed of the four agencies that administer Washington State comprehensive solid waste management plans for their jurisdictions. These agencies include:

- Seattle Public Utilities Solid Waste Utility
- Snohomish County Solid Waste Division
- King County Solid Waste Division
- Pierce County Public Works and Utilities

The Seattle UASI Region Disaster Debris Management stakeholders that assisted in developing this plan are listed on page v of this plan.

Plan Administration Roles and Responsibilities of Plan Stakeholders

Stakeholder participation is voluntary, but active involvement from a wide range of stakeholders is key to ongoing success of the plan. Plan stakeholders (stakeholders) will participate in semiannual disaster debris management plan maintenance meetings. These meetings will be used to adjust and define the overall function of the plan and review changes and updates to the plan.

Plan Sponsorship

Plan sponsorship will rotate annually among the four plan sponsors (sponsors) indicated above. The sponsor will be responsible for identifying a location for the two semiannual meetings that year and developing the agendas for the following fall and spring meetings, and will have primary responsibility for any administrative duties during the plan year,

including maintenance and updates to the plan. For the two meetings that year, the sponsor, in coordination with the representative identified for each of the other two counties, will compile changes suggested by the stakeholders and will add these to the meeting agenda for discussion.

Plan Ownership and Maintenance

The stakeholders will meet semiannually to discuss items of regional disaster debris management significance and review any suggested changes proposed by all the stakeholders. Semiannual meetings will be hosted by the current sponsor; these meetings will be held in preparation for the winter storm season and the summer fire season. Following a debris management incident that impacts more than one jurisdiction in the Region, the current sponsor will contact the stakeholders to determine the need for a special meeting to discuss any newly identified disaster debris management issues. Based on the response from the stakeholders, the sponsor will decide if a special meeting is necessary or if concerns can be addressed at the next regularly scheduled meeting.

Suggested changes to the plan may be contributed by any stakeholder and will be submitted to the sponsor at least one month before the next semiannual meeting so that issues can be placed on the meeting agenda. The sponsor will send the meeting agenda, with any suggested plan changes, to all stakeholders two weeks prior to the meeting.

Plan changes will be accepted with the support of 50 percent of all stakeholders in attendance at the meeting. At least ten stakeholders need to be present in order to vote on plan changes. The sponsor is responsible for tallying and recording the results of all proposed plan changes. The sponsor, with support from one stakeholder from each of the other two counties (three persons in all) will be responsible for (1) updating the plan in accordance with the changes accepted during the semiannual debris management maintenance meetings, and (2) sending meeting summaries to all the stakeholders.

Inclusion in After-Action Reports

Following an incident or event, if applicable, stakeholders should evaluate the performance of this plan as part of the development of their jurisdictional after-action report (AAR). Any suggested changes or adjustments to this plan should be brought to the next semiannual debris management maintenance meeting for consideration by the stakeholders and sponsors.

Inclusion in Regional Joint Debris Task Forces

Any debris-causing incident that requires a federal disaster declaration will trigger the creation of a regional joint debris task force by the Federal Emergency Mamangement Agency (FEMA). Following such an incident, the current sponsor will work with the Washington Emergency Management Division (WAEMD) and the plan stakeholders to ensure at least one stakeholder is included in the regional joint debris task force.

2.2 Response to Debris-Causing Incidents

Jurisdictions in the Seattle UASI Region respond to emergencies daily using their own resources. They also rely on mutual aid and assistance agreements with neighboring

jurisdictions when they need additional resources. When these jurisdictions cannot meet incident response needs with their own resources or with help available from other local jurisdictions, they may ask the state for assistance.

If additional resources beyond what the state can provide are required, the state may request assistance from other states through interstate mutual aid and assistance agreements such as the Emergency Management Assistance Compact (EMAC). Administered by the National Emergency Management Association, EMAC is a congressionally ratified organization that provides form and structure to the interstate mutual aid and assistance process. (See Appendix B, *Online Resources*, for more information on the services provided by EMAC.) If an incident is beyond local and state capabilities, the governor can seek federal assistance. The state will collaborate with the impacted communities and the federal government to provide the needed help. Figure 2-1 shows the expected escalation of operations as an incident grows larger and exceeds a jurisdiction's ability to respond effectively.

2.3 Role of Debris Management Agencies

During a debris-causing incident, the following agencies may be directly involved in the management of debris.

Local Solid Waste and Public Works Agencies

Local solid waste agencies provide solid waste service to their communities through their own employees or via contract with a solid waste collection company. In a jurisdiction, this group is most likely to be tasked with creating an operational disaster debris management plan and directing disaster debris clearance and removal operations during an incident.

Local Emergency Management Agencies

Local emergency management agencies plan for, respond to, and mitigate the impact of hazards in order to protect the lives, property, economy, and environment of their jurisdictions. During a debris-causing incident, these agencies would provide planning and logistical support for disaster debris clearance and removal operations.

Local Public Health Agencies

Public health agencies manage programs and create regulations to protect citizens' health by limiting exposure to environmental hazards. During debris-causing incidents, public health agencies work with local solid waste agencies to protect public health. This may include inspecting and approving temporary debris sorting and reduction (TDSR) sites, evaluating the enforcement of public health regulations to hasten debris response and recovery operations, and developing best practices to process and dispose of debris.

FIGURE 2-1
Response Concept of Operations

2.4 Roles of External Agencies

External agencies include local, state, federal, and tribal agencies that provide guidance or assistance in debris management planning and operations, but do not have a lead role at the local level. Depending on their mission, each external agency will have different roles and responsibilities related to debris management planning and operations.

Solid Waste Collection Companies

Solid waste collection companies are private entities that provide daily municipal solid waste service through the transportation and/or disposal of solid waste. During debris-causing incidents, these companies can be tasked with maintaining existing municipal solid waste service, as well as potentially providing additional resources to assist with debris clearance, processing, and disposal activities.

Debris Management Contractors

Debris management contractors may provide additional resources to assist with debris clearance, removal, separation, and disposal during debris-causing incidents. These contractors can be contracted with prior to an incident to ensure efficient response during or after the incident or event. Federal agencies such as the United States Army Corps of Engineers (USACE) and U.S. Environmental Protection Agency (EPA) may also have contract resources available to assist with debris management operations.

Washington State Department of Ecology (Ecology)

Ecology is responsible for the protection of Washington's environment. Ecology provides statewide regulation of municipal solid waste and hazardous waste. During a disaster, Ecology may support and advise local health departments and solid waste agencies, as needed, regarding disaster debris operations. Ecology may also issue temporary permits or recommend to the governor that certain regulations be suspended if necessary, to hasten response and recovery.

Washington State Department of Health (DOH)

The DOH manages programs and creates regulations to protect citizens' health by limiting exposure to environmental hazards. During a debris-causing incident, DOH will assist local health authorities as requested to ensure appropriate steps are being taken to maintain the health of the state's citizens and workers.

Washington State Emergency Management Division (WAEMD)

The WAEMD may assist local jurisdictions by facilitating the governor's disaster proclamations, facilitating EMAC requests, requesting Federal Disaster Declarations, and administering FEMA public and individual assistance requests. During the response phase of debris management, the WAEMD can ensure that facilities are operating in compliance with federal and state regulations and can determine priorities for handling/removal.

Washington State General Administration (GA)

GA is the primary state agency responsible for Emergency Support Function (ESF) #3: Public Works and Engineering under the Washington State Comprehensive Emergency Management Plan, which includes coordination of logistical and engineering support for state facilities. During a debris-causing incident, GA primarily supports state agencies, but would also provide resources to local requests that are coordinated through the Washington State Military Department, Division of Emergency Management.

Washington National Guard

The Washington National Guard may provide equipment, personnel, and technical assistance to protect the State of Washington. During debris-causing incidents, National Guard resources provide security for equipment staging and debris sorting and reduction sites, limited electrical power and sheltering, traffic control, and aerial reconnaissance. Washington National Guard resources are available after local resources have been exhausted through a request to the State Emergency Management Division.

Washington State Patrol (WSP)

WSP is the lead law enforcement agency within the state of Washington. During a debris-causing incident, WSP supports local law enforcement with evacuation of persons and property, coordination (along with the Washington Department of Natural Resources) of disaster firefighting and state firefighting resources through the Washington State Fire Mobilization Plan, and augmentation of local law enforcement resources.

Local Emergency Planning Committees (LEPC)

LEPCs are made up of representatives from private industry, government agencies, and citizens. The primary mission of LEPCs is to assist in the development of plans, procedures, and communications material for routine and emergency handing of hazardous materials. Because debris-causing incidents have the potential to generate large amounts of hazardous debris, LEPC plans should be reviewed and incorporated into each jurisdiction's operational disaster debris management plans.

There are currently nine LEPCs in the Seattle UASI Region (U.S. EPA 2008), including:

- City of Kent
- City of Puyallup
- City of Seattle
- Town of Steilacoom
- Fort Lewis
- King County
- Pierce County
- Snohomish County
- Southwest Snohomish County

Puget Sound Clean Air Agency (PSCAA)

The PSCAA is responsible for regulating air quality in Puget Sound. During debris-causing disasters, the PSCAA provides advice on outdoor burning of debris and the removal and disposal of debris containing asbestos. They also provide information and possible monitoring of air quality for debris operations that create large quantities of dust. Depending on the disaster severity, PSCAA can suspend part or all of the Washington Clean Air Act or Regulations I, II, and III.

United States Department of Agriculture (USDA)

The USDA Natural Resource Conservation Service (NRCS) provides technical and financial assistance to private land owners, land users, communities, and state and local governments in planning and implementing conservation systems that conserves soil, water, and other natural resources. NRCS is limited in its authority with debris-related activities and is limited to either runoff retardation or soil erosion prevention in response to a sudden impairment in the watershed which creates an imminent threat to life or property. Typically, this includes debris within or in close proximity to a channel.

The USDA Animal, Plant and Health Inspection Service (APHIS) may provide support under the Veterinary Service Program and the Plant Protection and Quarantine Program.

Both public and private lands are eligible under these programs, which provides assistance to federal and state agencies, tribes, local jurisdictions, and private landowners to manage animal and plant health by collecting and providing information, conducting or supporting treatments, and providing technical assistance for planning and program implementation (removal).

United States Coast Guard (USCG)

The USCG, under the Ports and Waterways Safety Act (33 U.S.C. § 1221), is responsible for keeping waterways safe and open. While there is no specific language stating that the USCG is responsible for debris removal from waterways, the USCG has been tasked in the past to assist in waterway and marine transportation system recovery.

United States Department of Defense (DOD)

The Seattle UASI Region has numerous DOD facilities with equipment and personnel that may be requested in response to a debris-causing incident. Requests for these assets are coordinated through the Washington State Military Department, Division of Emergency Management and are only available after all local private and public resources have been exhausted or are soon to be exhausted.

United States Army Corps of Engineers (USACE)

The USACE is the lead agency for ESF #3, Public Works and Engineering, of the NRF, which includes debris management. During a Presidentially declared disaster, the USACE may supply technical assistance to local responders for completing debris removal. The USACE also has contract resources available to support local debris management operations.

United States Environmental Protection Agency (EPA)

EPA may provide technical assistance and advice on collection, reduction, and disposal of contaminated debris and other hazardous materials during debris management operations. EPA also has contract resources available to assist with collection, management, and disposal of hazardous materials.

Federal Emergency Management Agency (FEMA)

FEMA is the federal agency charged with coordinating emergency management functions in the federal government. In catastrophic disasters, FEMA may provide direct federal assistance to support local, tribal, and state governments in performing some of the activities related to debris clearance, removal, and disposal. The response capabilities of local, tribal, and state governments must be exceeded before this level of assistance can be provided. Following a Presidential declaration, FEMA may elect to use its mission assignment authority to task other federal agencies with debris clearance, including the USACE and EPA.

2.5 Interaction with Neighboring Jurisdictions

Disaster debris-causing incidents may have a regional scope that would require cooperation with jurisdictions outside the Seattle UASI Region. Coordinating debris management

incidents with neighboring jurisdictions will follow standard NIMS Incident Command System (ICS) protocols. If the Region's resources are overwhelmed by a disaster, it is possible that neighboring jurisdictions may provide resources. Jurisdictions within the Region should enter into mutual aid agreements to address resource gaps and ensure adequate resources and support following a disaster.

3. Legislation and Policies

This chapter discusses federal, state, and local legislation, policies, and plans. The section also includes policies adopted by King, Snohomish, and Pierce counties that affect disaster debris management planning, response, and recovery.

3.1 Federal Legislation and Policies Impacting Debris Operations

Application of Environmental Laws during the Response Phase of a Disaster and Possible Exemptions

In the event of a disaster, efforts should be made by responders to comply with all federal and state environmental regulations. However, due to the sudden onset of disasters and the need to respond quickly, preservation of public health and safety is paramount, which may result in the governor and FEMA invoking exemptions to regulations during the response phase of a disaster. When disaster debris operations move from response to recovery, all applicable federal, state, and local regulations should be followed.

There are currently 50 applicable exemptions to federal environmental laws. These exemptions typically allow either the President or the EPA Administrator to waive, suspend, or modify existing requirements. These exemptions are given on a case-by-case basis for emergencies, disasters, or matters of national security, or if the action is of paramount importance to the country (American Bar Association 2005). For example, the Stafford Act exempts immediate response actions from National Environmental Policy Act (NEPA) requirements (see the following section for more information). The Council on Environmental Quality's (CEQ) implementing regulations exempt emergencies and disasters from NEPA altogether, or from its environmental impact statement requirements. (Note that NEPA itself does not contain any exemptions.) In addition, all the federal laws listed in Table 3-1 below provide specific exemptions that can be invoked in the aftermath of disasters.

Application of Environmental Laws during the Recovery Phase of a Disaster and Possible Exemptions

Before initiating recovery efforts after a disaster, NEPA, and other applicable federal regulations must be addressed if any of the following conditions occur:

- Debris disposal other than to a permitted landfill
- Projects whose footprint differs from pre-disaster conditions
- Public assistance projects with hazard mitigation proposals
- Projects affecting a historic or potentially historic site or structure
- Projects affecting a current or proposed threatened or endangered species
- Projects affecting a wetland

TABLE 3-1
Federal Environmental Laws and Washington State Equivalent Legislation

Federal Legislation	State Legislation
National Environmental Policy Act	Chapter 43.21C RCW, State Environmental Policy
Endangered Species Act	Title 77 RCW; Chapter 77.12.020 Designation of Threatened and Endangered Species; Chapter 77.85 RCW, Salmon Recovery
National Historic Preservation Act	Chapter 27.53 RCW, Archaeological Sites and Resources
Resource Conservation and Recovery Act	Chapter 70.95 RCW, Solid Waste Management – Reduction and Recycling
Comprehensive Environmental, Response, Compensation, and Liability Act	Chapter 70.105D RCW, Model Toxics Control Act
Coastal Zone Management Act	Chapter 90.58 RCW, Shoreline Management Act of 1971
Clean Water Act (Section 404)	Chapter 90.48 RCW, Water Pollution Control
Clean Air Act	Chapter 70.94 RCW, Washington Clean Air Act
Rivers and Harbors Act (Section 10)	No counterpart statue
Executive Order 11990, Wetlands Protection	WAC 365-190-080, Critical Areas
Executive Order 11988, Floodplain Management	Chapter 86.16 RCW, Floodplain Management
Executive Order 12898, Environmental Justice	No counterpart statue
Executive Order 12941, Seismic Safety	Chapter 38.52 RCW, Emergency Management

RCW = Revised Code of Washington
WAC = Washington Administrative Code

- Projects affecting a floodplain
- Cleanup and/or disposal of oil and hazardous materials
- Projects with known or suspected environmental concerns

The following actions, whether approved by the state or FEMA, must undergo an environmental review by FEMA before construction can begin:

- Improved projects
- Alternate projects
- Other projects in which the already approved scope of work has been changed

In the event of a federally declared disaster and if FEMA provides federal funding, applicants must comply with federal environmental and historic preservation laws. Washington state has counterpart legislation for many of these federal environmental laws (state statutes modeled after federal statutes typically incorporate the federal requirements). These laws are listed in Table 3-1 below.

Exemptions to federal environmental laws can occur during the recovery phase only with specific guidance from FEMA. The following emergency work may be done without triggering federal environmental laws (Greenbook, FEMA and State of Washington 2003).

- Emergency actions (e.g., search and rescue, emergency care, issues of life and safety)
- Debris clearance (not necessarily disposal or storage/staging)
- Repair and restoration to pre-disaster conditions, provided there is no significant change in the construction footprint (unless the structure is older than 50 years)
- Temporary repairs (unless the structure is older than 50 years)

Stafford Act

The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) (as amended by Public Law 106-390 in 2000) is designed to simplify the process of providing federal assistance to state and local governments in the event of a natural disaster. The Stafford Act is an amended version of the Disaster Relief Act of 1974, which allows a Presidential Disaster Declaration in the case of an emergency. This declaration triggers financial and disaster response activities through FEMA.

The Disaster Mitigation Act of 2000 added a new provision to the Stafford Act. This provision emphasizes mitigation planning, and requires local governments to develop and submit mitigation plans as a condition of receiving Hazard Mitigation Grant Program and Pre-Disaster Mitigation Program funds. Mitigation planning is defined by FEMA as "any sustained action taken to reduce or eliminate long-term risk to life and property from a hazard event."

Excerpt from Stafford Act Regarding Statutory Exemptions to the National Environmental Policy Act (NEPA):

In responding to emergencies and major disasters, existing provisions of the Stafford Act or CEQ's regulations either statutorily exempt certain activities from NEPA or allow for alternative means of complying with CEQ's regulatory provisions. Certain response actions specifically excluded from NEPA by the Stafford Act (at 42 U.S.C. § 5159) include:

- The provision of certain federal resources or assistance essential to meeting immediate threats to life and property resulting from a major disaster. (See actions specified under 42 U.S.C. §§ 5170a and 5170b.)
- The repair, restoration, and replacement of public facilities or certain private non-profit facilities, damaged or destroyed by a major disaster. (See 42 U.S.C. § 5172.)
- Debris removal from public or private land after a major disaster. (See 42 U.S.C. § 5173.)

It is important to understand that, as with actions that are categorically excluded, an action statutorily excluded from NEPA is not exempt from the requirements of other environmental statutes. An agency would still be responsible for complying with all other applicable local, state, and federal laws and regulations relating to health, safety, and the environment. This would encompass federal environmental statutes including, among others: the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act (RCRA), the Coastal Zone Management Act, the Coastal Barrier Resources Act, the Endangered Species Act, and the National Historic Preservation Act.

In addition to statutory exclusions to NEPA, CEQ regulations allow for "alternative arrangements" in the event of an emergency. In such circumstances, the federal agency taking an action should consult with CEQ about what those arrangements may be and the time frame within which they must be completed. These alternative arrangements do not waive the requirement to comply with NEPA regulations, but establish an alternative means of compliance. Agencies and CEQ are to limit such arrangements to actions necessary to control the immediate impacts of the emergency.

3.2 State Legislation and Policies Impacting Debris Operations

Emergency Powers and Management

Washington state's governor can circumvent some normal operating procedures in the event of an emergency (Revised Code of Washington [RCW] 43.06.210, Emergency Powers). This regulation authorizes the governor to proclaim a "State of Emergency," which then allows for expeditious resource procurement and directs maximum use of state assets. Recommendations for a proclamation of emergency are generally made by the Director of the Military Department or from a state agency through the state Emergency Management Division. Many local jurisdictions have similar ordinances for expediting emergency resources procurement in the event of a locally proclaimed disaster.

RCW 38.52.040, Emergency Management, creates the Washington State Emergency Management Council; the Council provides the governor and the director of the Washington State Emergency Management Division (WAEMD) with an annual assessment of statewide emergency preparedness, including hazard mitigation, seismic safety improvements, flood hazards reduction, hazardous materials planning, and response activities. The objectives of the Emergency Management Council are to: (1) establish state funding sources to support emergency planning and mitigation efforts, and (2) increase public awareness and participation in emergency preparedness.

RCW 38.52.050(3)(a), Emergency Management, authorizes and empowers the governor to create, amend, and rescind the necessary orders, rules, and regulations to carry out the provisions in the event of a declared emergency, with due consideration of the plans of the federal government. In comparison, state agencies have the authority to suspend rules stipulated in the Washington Administrative Code (WAC) that they have promulgated, but do not have the authority to waive statutes.

Air Quality

A potential method for debris disposal in an emergency is outdoor burning.

The Puget Sound Clean Air Agency (PSCAA) regulates air emissions in King, Snohomish, and Pierce counties. RCW 70.94, Clean Air Act. The Clean Air Act stipulates that, in general, outdoor burning is not allowed in any urban growth area or city with a population greater than 10,000 people, if state or federal air quality standards are exceeded, alternative disposal practices consistent with good solid waste management are reasonably available, or practices eliminating production of organic refuse are reasonably available. The Washington State Department of Ecology (Ecology), local air quality authorities (including the PSCAA), and local fire departments also discourage open burning as a primary disposal technique. Because of this, outdoor burning of disaster debris would be considered a last resort.

In extreme cases, the PSCAA may allow outdoor burning for the exclusive purpose of managing storm or flood-related debris. The regulations governing outdoor burning (WAC Chapter 173-425, Outdoor Burning) establish a permit program for limited burning that is applicable to storm or flood debris burning (RCW 70.94.743). "Storm or flood debris

burning" means fires consisting of natural vegetation deposited on lands by storms or floods that:

1. Have occurred in the previous 2 years;
2. Are the result of an emergency declared by the city, county, or state government; and
3. Are burned on such lands by the property owner or his or her designee (RCW 70.94.743 (1)(c)).

The PSCAA also regulates hazardous particulates, including asbestos, and may examine the operations at temporary debris staging areas for dust suppression measures. A notice of intent to do any demolition work involving asbestos must be filed with the PSCAA. The PSCAA may also provide contractors with guidance relative to asbestos removal and disposal in the event of demolition of structures.

Solid Waste

RCW 70.95, Solid Waste Management – Reduction and Recycling, provides the overarching framework for establishing a comprehensive statewide program for solid waste handling. The statute addresses permitting of solid waste handling facilities and authorizes counties to prepare comprehensive solid waste management plans. The 1989 Waste Not Washington Act (ESHB 1671) revisions to RCW 70.95 established waste reduction and recycling as the priority methods of managing waste in the state.

There are two key implementing regulations for RCW 70.95 that address performance standards for solid waste facilities. Municipal solid waste landfills are regulated under Chapter 173-351 WAC, Criteria for Municipal Solid Waste Landfills. Chapter 173-350 WAC, Solid Waste Handling Standards replaces and expands upon Chapter 173-304 WAC, Minimum Functional Standards, and applies to energy recovery and incineration facilities, limited purpose landfills, inert landfills, composting facilities, land application sites, and intermediate solid waste handling facilities (e.g., transfer stations, drop boxes, piles for treatment and storage, surface impoundments and tanks, waste tire storage facilities, and moderate risk waste facilities). Chapter 173-350 WAC establishes reduction and recycling as priorities in handling solid waste over landfilling and incineration.

There are no state provisions in the regulations for addressing interim staging sites or temporary storage sites for sorting disaster debris. When developing a plan for identifying and permitting temporary disaster debris sites, the counties should rely on guidance for meeting solid waste standards specified in Chapter 173-350 WAC, as well as the local health department and district regulations.

Washington Utilities and Transportation Commission

The Washington Utilities and Transportation Commission (WUTC) regulates the collection and transportation of solid waste from commercial and residential customers in unincorporated areas of the state, and within cities and towns that do not contract for or provide solid waste collection services themselves (RCW 81.77). The WUTC does not regulate solid waste collection in a city that provides solid waste collection itself or contracts for solid waste collection within the city limits (RCW 81.77.020).

"Solid waste" includes collecting and transporting source-separated recyclable materials collected from residences, but does **not** include collecting or transporting recyclable materials by or on behalf of a commercial or industrial generator of recyclable materials to a recycler for use or reclamation. A solid waste collection company must have a certificate of public convenience and necessity issued by the WUTC to provide solid waste collection services (RCW 81.77.040).

The WUTC does not regulate as solid waste (RCW 81.77) the transportation of solid waste that is incidental to the overall purpose and intent of restoration, reclamation, or salvage services. The commission regulates that transportation under RCW 81.80. (Refer to Private Carriage, WAC-480-70-041, Commission Order M.V. No. 130721.)

The WUTC's authority is limited to the collection and transportation of solid waste (including source-separated recyclable materials collected from residences) from generators to the disposal or recycling site. The WUTC's authority does not extend to the transportation of solid waste from transfer stations identified in the county's comprehensive solid waste management plan (RCW 36.58.50). The WUTC's authority does apply to the transportation of solid waste from sites that are not identified in the county's comprehensive solid waste management plan (RCW70.95.090(1)).

The WUTC has an established process to receive and process "expedited solid waste applications" to meet urgent and immediate needs. The applicant would need to prove the services it wants to provide are in the public interest. If approved, the company would receive a certificate of public convenience and necessity to collect and transport solid waste for no more 30 days (WAC 480-70-136).

Chapter 8, *Disaster Debris Operations,* of this plan describes how solid waste is handled by jurisdictions within the Seattle UASI Region.

3.3 Local Legislation and Policies Impacting Debris Operations

King County

King County Code (KCC) Chapter 12.52, Emergency Powers

This code authorizes the King County executive to proclaim an emergency in the event of a disaster. The county executive is charged with directing the overall recovery efforts and ensuring that all state laws and county ordinances are enforced. KCC 030.B.3 authorizes the county executive to direct evacuation and/or clearing of debris and wreckage caused by an emergency or disaster from publicly and privately owned lands and waters.

King County Comprehensive Emergency Management Plan, Emergency Support Function 3 (ESF #3) for Public Works

This plan addresses how to handle surface water management, wastewater treatment, and solid waste management systems in unincorporated King County in the event of an emergency (King County 2003). The plan states that in an emergency, solid waste haulers will provide services as outlined in their emergency plans. Free disposal of solid waste is

determined by a motion of the King County Council and the county executive's office. The plan acknowledges that in the event of major damage to county-owned solid waste facilities, it may be beyond the capacity of the remaining system to handle all incoming solid waste. Individual jurisdictions in King County have similar comprehensive emergency management plans.

2001 King County Comprehensive Solid Waste Management Plan

Consistent with Chapter 70.95 RCW, waste reduction and recycling are the priority methods for managing King County's solid waste. The waste reduction and recycling policy (WRR-38) in the plan states that the county shall implement programs to provide for affordable collection and recycling of woody debris generated by major storms and for residents in areas affected by PSCAA burn bans.

King County banned construction debris, and land-clearing (CDL) waste at its facilities in 1993; CDL is directed to the private sector. The exception is small amounts of CDL delivered to county transfer stations by residential customers. These amounts are accepted only when delivered in vehicles without mechanical unloading (dump bed) capabilities.

An update to the plan is scheduled to be completed by King County at the end of 2008 and will address disaster debris management.

PUT 7-1-5 (PR) Waste Acceptance Rules for King County Solid Waste Division Solid Waste Handling Facilities (2005)

This policy document describes in detail the acceptance rules for a wide array of materials other than mixed municipal solid waste. Some wastes are accepted at the county transfer stations with conditions, some wastes require a waste clearance, and some materials are prohibited outright. In an emergency, the director of the Department of Natural Resources and Parks or his/her designee may authorize the disposal of materials that otherwise would require condition or clearance under this rule, which could pose a threat to public health or the environment if not disposed of immediately.

King County Title 10, Solid Waste

Title 10 governs aspects of solid waste handling, collection, transporting, processing, treatment, utilization, and final disposal of all solid waste generated within King County. It also includes issuance of permits and enforcement (Section 10.02.020). Title 10 adopts Chapter 173-350 WAC as performance standards for solid waste facilities.

Title 10 does not specifically address disaster debris or regulatory requirements and criteria for TDSR sites. As such, a formal approval by Public Health Seattle & King County is not feasible at this time. However, under the general provisions of protecting and preserving public health in the context of solid waste emergency operations, proposed TDSR sites must be reviewed and authorized by public health as part of the planning process and before being activated. This includes all phases of TDSR site selection, activation, operation, and closure as recognized in the King County Disaster Debris Operating Plan (see next section for a description of this plan).

King County Disaster Debris Management Operating Plan – 2006 (Draft)

According to the operating plan, municipal solid waste disposal remains the responsibility of the King County Solid Waste Division in the event of a disaster.

Depending on the type and severity of the disaster, alternatives to standard collection and processing may be necessary. In the event of a declared state of emergency, the governor is authorized to waive or exempt state statutes to allow for haulers not certificated by WUTC to handle the collection and transportation of disaster debris (RCW 38.52.050).

Temporary disposal sites may be required for short-term staging of materials, even if the current infrastructure remains essentially intact, because of the extraordinary volume of material often associated with disasters. The selection of these sites is dictated by the type of materials involved, volumes, transport access, and other factors. Materials handled at these staging areas may require collection and separation of specific materials for later recycling, volume reduction, or simply as a holding mechanism to allow the collection and disposal system to "catch up" with the demand. Sites may be designated by the type of material they receive.

The operating plan identifies potential temporary debris collection staging areas or sites. Staging areas must be appropriate to the type of material to be handled, accessibility, volumes, and anticipated holding times. The King County Solid Waste Division, with concurrence from the Health Department and Ecology, is responsible for designating these staging areas. Activation of the sites requires that each be appropriately staffed, including systems for load checking and determining waste amounts, either by volume or weight.

When the emphasis shifts to collection, handling, and/or disposal during the later stages of disaster response and recovery, the operating plan recognizes that private haulers and contractors will continue to serve as the primary force for collecting and transporting municipal solid waste, recyclables, and CDL. The operating plan underscores the high priority given to diversion programs to reduce impacts on landfills and to maximize reuse and recycling of debris. The King County Recycling Policy (KCC 10.04.020) states that:

> It is King County's goal to achieve maximum feasible reduction of solid wastes going into its landfills and other processing facilities by diverting as much as possible from the waste stream. It is recognized that waste reduction and recycling are the highest priority of the viable solid waste management options.

In the event of a disaster, waste reduction and recycling should be attempted as long as life safety and the environment can be preserved. Due to potential contamination, waste characterization will be an important issue during a disaster since contaminated materials cannot be recycled.

King County Regional Hazard Mitigation Plan (2004)

King County developed its first Regional Hazard Mitigation Plan (RHMP) in partnership with participating cities, school districts, utility districts, and emergency service providers. This effort was one step in creating a community that is more resilient to natural, technological, and societal hazard events and disasters. The RHMP provides the

groundwork for obtaining financial assistance for recovery operations from FEMA under the Stafford Act.

Local Hazardous Waste Management Program

The Local Hazardous Waste Management Program (LHWMP) brings together resources from four local government agencies and thirty-seven suburban cities to protect and enhance public health and environmental quality by reducing threats posed by the production, use, storage, and disposal of hazardous materials. The LHWMP is a regional partnership comprised of King County Water and Land Resources Division, King County Solid Waste Division, Seattle Public Utilities, Public Health—Seattle and King County, and the Suburban Cities Association. This program was established in 1990 with the adoption of the Local Hazardous Waste Management Plan for Seattle and King County.

The LHWMP provides a broad range of services that helps residents, businesses, agencies, and other organizations reduce and properly manage hazardous wastes. The LHWMP focuses on helping residents and businesses that are considered small quantity generators exempt from Washington's Dangerous Waste Regulations to use fewer and less toxic materials, properly use and store hazardous materials, and properly dispose of hazardous wastes.

Snohomish County

Emergency Powers

Snohomish County Code (SCC), Chapter 2.36, Emergency Management, authorizes formation of the Department of Emergency Management, and states that the Snohomish County executive has the authority to exercise emergency powers. This code allows the county executive to have general supervision and control of emergency county services in the event of an emergency or disaster.

Snohomish County Code, Chapter 7.41, Reduction or Elimination of Disposal Fees

SCC, Chapter 7.41, Operating Rules and Disposal Fees for Snohomish County Solid Waste Sites, authorizes the county executive to reduce or eliminate any or all disposal fees in the event of a state of emergency that has been declared by a state of federal official (SCC 7.41.022).

Snohomish County Code, Chapter 3.04, Purchases and Contracts

The Snohomish County Council or the county executive is authorized to issue a notice to proceed for any debris management contractors working on behalf of the county under an emergency declaration (SCC 3.04.200).

Snohomish County Comprehensive Solid Waste Management Plan (2004)

The plan does not specifically address the handling of disaster debris; however, it does acknowledge the priorities of waste reduction and recycling with source separation of recyclable materials as the top two priorities for handling solid waste.

Snohomish County Debris Management Plan (2008)

The plan contains a coordinated response and recovery blueprint for the county and Solid Waste Management Division to provide for efficient management of disaster debris following a debris-causing incident. While the plan identifies TDSR sites, it also recognizes that availability of these sites is subject to the location, size, and severity of the incident, which may render some of these sites unusable. Snohomish County is continuing to refine the plan and is adding more TDSR sites for consideration. The plan also gives Snohomish County the option to open and operate debris drop-off stations where residents can self-haul debris. The debris drop-off stations would be a completely separate operation from the county's current residential drop-box stations. This plan is scheduled to be finalized in 2009.

Snohomish County Health District

The Health District must be involved in all phases of TDSR site selection, activation, operation, and closure. A Health District representative must review the TDSR sites and authorize these sites prior to engaging in debris removal operations.

Snohomish County Natural Hazards Mitigation Plan (2005)

Under the provisions of the Disaster Mitigation Act (Public Law 106-390), Snohomish County, 12 cities, and 30 special purpose districts established this pre-disaster hazard mitigation plan. The plan provides the groundwork for obtaining financial assistance for recovery operations from FEMA under the Stafford Act.

Snohomish County Household Hazardous Waste Program

Snohomish County's Public Works Department has implemented a program for accepting hazardous waste from residents and businesses that are small quantity generators. The program identifies local resources that will accept and properly dispose of specific hazardous products that may be found in disaster debris.

Pierce County

Emergency Powers

Pierce County Code Title 2, Chapter 118, authorizes the formation of the Department of Emergency Management and gives the Director authority to request the Pierce County executive to proclaim an emergency.

Pierce County Solid Waste Plan (2000) and 2007 Supplement (Stepping Up to the Challenges)

The plan reiterates Washington state's priorities for waste reduction and recycling with source separation as a guiding principle in managing solid waste. As the first of seven integrated courses of action, the 2007 Supplement identifies the need to prepare debris management guidelines and a regional emergency waste management plan. Pierce County is in a unique position because it has the only landfill that is expected to continue operating after closure of King County's Cedar Hills Landfill. The privately owned LRI Landfill is not permitted to accept out-of county waste under normal circumstances, but there are provisions that allow for a waiver in an emergency.

Pierce County Natural Hazard Mitigation Plan (2004)

Similar to Snohomish County, the Pierce County Department of Emergency Management, in association with other planning partners, established this pre-disaster hazard mitigation plan in accordance with the provisions of the Disaster Mitigation Act (Public Law 106-390). The plan provides the groundwork for obtaining financial assistance for recovery operations from FEMA under the Stafford Act.

Tacoma-Pierce County Health Department

Tacoma-Pierce County Board of Health Regulation, Chapter 28, Solid Waste Handling Standards, adopts Chapter 173-350 WAC for performance standards for solid waste facilities. The Tacoma-Pierce County Board of Health has jurisdiction for issuing solid waste handling permits in the county. This regulation does not specifically address disaster debris or temporary sites for debris collection and sorting.

Pierce County Household Hazardous Waste Program

Pierce County's Public Works and Utilities Department has implemented a program designed to educate residents about proper handling and disposal of household hazardous materials. The program identifies local resources available to accept household hazardous materials that may be a component of disaster debris and to dispose of them properly.

City of Seattle

Seattle Comprehensive Solid Waste Plan (2004)

The City of Seattle owns and operates two recycling and transfer stations and manages a wide array of waste reduction, recycling, and composting programs for residential and business customers. The most recent comprehensive planning effort is documented in Seattle's Solid Waste Plan: On the Path to Sustainability, 2004 Plan Amendment (SPU 2004). Because the city has its own solid waste system and comprehensive plan, the city completed a Disaster Debris Management Plan in 2007.

Seattle Disaster Debris Management Plan (Final Draft) (2007)

The City of Seattle plan contains the blueprint for managing debris in the event of a disaster, including an operational plan, communications strategies, resources and logistics, training and exercises, and plan maintenance. The final plan will include identification of potential TDSR sites located throughout the city and a list of debris contractors that have been procured by the city.

4. Debris Clearance, Processing, and Disposal Priorities

This chapter suggests how the Seattle UASI Region prioritizes debris clearance, processing, and disposal after a major or catastrophic debris-causing incident in a manner that improves incident response times, as well as short- and long-term recovery efforts. The debris removal process must be initiated promptly in order to protect public health and safety. The Seattle UASI Region has developed a method for prioritizing debris removal, including a list of priorities to be used when planning debris removal operations. Each jurisdiction is encouraged to use this guidance along with knowledge from their local area to identify individual debris removal priorities for their area.

4.1 Methodology for Prioritizing Debris Clearance and Removal

The Seattle UASI Region has developed the following guidance for prioritizing debris removal:

1. Life Safety
2. Situation Stabilization
3. Property Protection
4. Economic Stability and Environmental Protection

4.2 Debris Clearance Priority List

The Seattle UASI Region has developed the following recommended priority list for debris clearance. When planning for debris clearance operations, jurisdictions should consider circumstances such as crime scene preservation and accident investigation that may require a delay of debris clearing until approved by local or federal law enforcement officials.

1. **Clear Emergency Access Routes – Lifelines**. Lifelines are those routes in a traffic network that provide access for emergency responders, alternate and evacuation routes, and damage assessment routes. Lifelines should include areas identified for potential staging, temporary shelters, and other resources available in the community that support emergency response.

2. **Clear Access to Critical Facilities and Infrastructure**. Defined as "those physical and cyber-based systems essential to the minimum operations of the economy and government" (Clinton 1998) These typically include hospitals, fire stations, police stations, emergency operation centers, cellular and land-line telephone services, drinking water and power utilities, and sanitation facilities.

3. **Clear Major Freeways or Arterial Routes**. Major freeways and arterial routes are portions of the public transportation network that are needed to aid in response and recovery operations, but may not have been cleared as an emergency access route.
4. **Clear Areas Necessary for Movement of Goods and Services/Economic Restoration**. These areas include those portions of the public transportation network needed to effectively transport goods and services throughout the Region that are not included in one of the previous categories. These may include access to warehouses, airports, seaports, and major business districts.
5. **Clear Minor Arterial Routes**. These routes include those portions of the public transportation network that receive moderate traffic flows, but are not included in one of the previous categories.
6. **Clear Local Routes**. These areas include those portions of the public transportation network in residential neighborhoods that are not included in one of the previous categories.

It is the responsibility of each jurisdiction to identify and map their jurisdiction's lifelines and access to critical facilities and infrastructure, and to identify debris clearance and removal priorities for their jurisdiction.

4.3 Debris Reduction and Disposal Priorities

During the initial response phase of any debris-causing incident, removal and processing of disaster debris will be based on the collection and removal priorities established in this chapter. It may be difficult to practice debris reduction and recycling techniques because efforts will be focused on preserving life, safety, and property. Once an incident has moved from the response phase to recovery phase, processing and disposal of debris should follow established guidelines for processing debris as documented in each jurisdiction's solid waste management plan in a manner that encourages reuse/recycling of material and limits the amount of material disposed in area landfills.

5. Types of Hazards

This chapter discusses the types of natural or human-caused incidents that may occur in the Seattle UASI Region (Table 5-1). The type and amount of debris produced by an incident depend on the magnitude, the duration, and the intensity of the incident itself. Because of specific regional hazards such as seiches, floods, and landslides, this is only a partial list of possible debris-causing incidents. Individual jurisdictions are responsible for consulting their local hazard identification and vulnerability assessment (HIVA) to determine specific incidents that pose the greatest threat to their area and have the potential to create the greatest amount of debris.

TABLE 5-1
Characteristics of Disaster Events Possible in the Seattle UASI Region[a]

Incident	Debris Characteristics	Regional Probability	Debris Impact
Wind Storm	Primarily vegetative waste; may also include construction/demolition materials from damaged or destroyed structures, some municipal solid waste from damaged structures. Extended power outages may result in large amounts of putrescible waste from private homes and grocery stores.	High	Moderate
Flooding	Construction/demolition waste, municipal solid waste, and problem waste, including sediment, vegetative waste, animal carcasses, and hazardous materials deposited on public and private property. Much of the debris from flooding events may be considered problem waste because of contamination from wastewater, petroleum, or other substances.	High	Moderate
Earthquake	Primarily construction/demolition waste and municipal solid waste intermixed with problem waste.	Moderate	High
Urban, Wildland, and Wildland/Urban Interface Fires	Burned vegetative waste, burned construction/ demolition waste, and problem waste, including ash and charred wood waste and ash-covered items.	Moderate	Low
Ice Storms	Primarily vegetative waste from broken tree limbs and branches. May also include construction/demolition waste and putrescible waste from extended power outages.	Moderate	Moderate
Volcano	Primarily ash, mud, and ash-covered items. May also include construction/demolition waste.	Low	High
Tsunami or Seiche	Sediment and construction/demolition waste possibly contaminated with problem waste, including wastewater, petroleum, or other hazardous materials.	Low	Moderate
Landslides	Sediments and construction/demolition waste possibly contaminated with problem waste.	High	High

TABLE 5-1
Characteristics of Disaster Events Possible in the Seattle UASI Region[a]

Incident	Debris Characteristics	Regional Probability	Debris Impact
Plant Disease	Variable amounts of vegetative debris that might require special handling as problem waste with specific disposal characteristics.	Low	Moderate
Animal Disease	Variable amounts of putrescible waste that might require special handling as problem waste with specific disposal instructions.	Low	Moderate
Nuclear, Chemical, or Biological Accident	Various amounts of contaminated soil, water, construction/demolition waste, and/or municipal solid waste that would require special handling as problem waste with specific disposal instructions.	High	Moderate
Nuclear, Chemical, or Biological Attack	Various amounts of contaminated soil, water, construction/demolition waste, and/or municipal solid waste that would require special handling as problem waste with specific disposal instructions.	Moderate	High

[a] Hazard data compiled from the 2004 King County Regional Hazard Mitigation Plan. High-probability incidents occur yearly, moderate probability incidents occur every 2 to 10 years, and low probability incidents occur once every 10 to 50 years.

6. Types of Debris

This chapter provides a partial list of debris descriptions that may require consideration during a debris-causing incident in the Seattle UASI Region. When developing an operational disaster debris management plan, each jurisdiction should consider any unique type of debris that is not included in Table 6-1, but may occur in their area.

TABLE 6-1
Types of Debris

Type	Description	
Construction Demolition Waste	FEMA 325[a] defines construction and demolition waste as damaged components of buildings and structures such as lumber and wood, gypsum wallboard, glass, metal, roofing material, tile, carpeting and floor coverings, window coverings, pipe, concrete, fully cured asphalt, equipment, furnishings, and fixtures. Plaster (i.e., sheetrock or plaster board) or other material likely to produce gases or a leachate during the decomposition process, asbestos, and lead may be found in construction and demolition waste.	
Municipal Solid Waste	WAC 173-350, Solid Waste Handling Standards, defines municipal solid waste as a subset of solid waste, which includes unsegregated garbage, refuse, and similar solid waste material discarded from residential, commercial, institutional, and industrial sources and community activities, including residue after recyclables have been separated.	
Problem Waste	Waste created by residential, commercial, or industrial sources that requires special handling before it can be disposed of. Problem waste is often found in the municipal waste stream, but may also be generated during remodeling, construction, demolition, or routine property maintenance activities. Examples of problem waste include the following:	
	Chemical, Biological, Radiological, and Nuclear-Contaminated Debris	Chemical, biological, radiological, and nuclear-contaminated debris resulting from a natural or human-caused disaster, such as a weapon of mass destruction incident.
	E-Waste	WAC 173-350 defines electronic waste as computers, computer monitors, televisions, and other electronics which contain CRTs (cathode ray tubes) and separated computer circuit boards that contain hazardous materials such as lead, cadmium, and mercury. These wastes are not to be disposed of a landfill.
	Hazardous Waste	WAC 173-303 defines hazardous waste as those solid wastes designated by 40 Code of Federal Regulations (CFR) Part 261, and regulated as hazardous and/or mixed waste by EPA.

TABLE 6-1
Types of Debris

Type		Description
	Household Hazardous Waste	WAC 173-350 defines household hazardous waste as any waste which exhibits any of the properties of dangerous wastes that is exempt from regulation under Chapter 70.105 RCW, Hazardous Waste Management, solely because the waste is generated by households. Household hazardous waste also includes other solid waste identified in the local hazardous waste management plan prepared pursuant to Chapter 70.105 RCW, Hazardous Waste Management. Examples of this include small quantities of normal household cleaning and maintenance products, latex and oil-based paint, cleaning solvents, gasoline, oils, swimming pool chemicals, pesticides, and propane gas cylinders.
	Infectious Waste	FEMA 325 defines infectious waste as waste capable of causing infections in humans, including contaminated animal waste, human blood and blood products, isolation waste, pathological waste, and discarded sharps (needles, scalpels, and broken medical instruments).
	Orphaned Tanks	Orphaned tanks, drums, and cylinders that contain unknown substances found in industrial settings. These wastes have been a significant problem during incidents that involve flooding.
	Putrescibles	WAC 173-350 defines putrescibles as solid waste which contains material capable of being readily decomposed by microorganisms and which is likely to produce offensive odors. This may include food waste and animal/livestock waste and carcasses (cows, chickens, etc.).
	Soil, Mud, and Sand	Large deposits of sand, mud, and soil that are often deposited after flooding or landslide incidents.
	Vegetative Waste	Whole trees, tree stumps, tree branches, plants, tree trunks, and other plant material.
	Vehicles and Vessels	Abandoned automobiles and floating watercraft located in public use areas.
	White Goods	FEMA 325 defines white goods as discarded household appliances such as refrigerators, freezers, air conditioners, heat pumps, ovens, ranges, washing machines, clothes dryers, and water heaters.

[a]Source: FEMA (2007); see also Appendix B, *Online Resources*, for access information on the Debris Management Guide.

Hazardous Waste

Hazardous waste materials and hazardous waste are transported, used, and stored extensively throughout the Seattle UASI Region and could be released during a debris-causing incident. It is important for jurisdictions to work with their Local Emergency Planning Committees (LEPC) and consult their local hazardous materials mitigation plans to identify any special disaster debris management planning considerations. A listing of LEPCs in the Seattle UASI Region is included in Chapter 2, *Organizations and Concept of Operations*, of this plan.

Recycled Material

WAC 173-350 defines recyclable materials as those solid wastes that are separated for recycling or reuse, including, but not limited to, papers, metals, and glass, that are identified as recyclable material pursuant to a local comprehensive solid waste plan. It is important to note that many different types of debris can be recycled, but they are not considered "recyclables" unless they are actually recycled.

Comingled Waste

Debris-causing incidents such as floods and earthquakes often cause different types of waste to be mixed together contaminating other types of debris with household hazardous waste. This complicates processing and can prevent reuse, recycling, or other processing methods.

7. Regional Capacities

This chapter summarizes the UASI regional solid waste handling, processing, and disposal capacities for the geographical areas of King, Pierce, and Snohomish counties using the existing waste stream (Table 7-1). While these are not regionally shared resources, this information is provided so that the region can identify at what level outside resources may be necessary in the event of a disaster debris-causing incident.

Table 7-2 includes an inventory of regional landfills that may be used to dispose of disaster debris following an incident. Ownership and administration of each landfill is different, and landfills may not be willing or able to accept debris following an incident.

TABLE 7-1
Summary of Regional Capacities Using Existing Waste Stream

	MSW Collection Capacity		Processing Capacity		Disposal Capacity		Recycling Capacity		Composting Capacity	
	Normal	**Surge**	**Normal**	**Surge**	**Normal**	**Surge**	**Normal**	**Surge**	**Normal**	**Surge**
Snohomish County	Contractor: Allied Waste Waste Mgmt. City of Marysville Sound Disposal Rubatino	1 day capacity in trucks	1,800 tons/day	3 days worth of garbage	Rail unk*		10,000 tons of wood/month 8,000 tons of metal/month	unk*	Contractor: Bailey Compost Cedar Grove Lenz Enterprises	
King County	Contractor: Allied Waste Waste Management		King County Solid Waste Division (KCSWD) hauls from: 8 transfer stations 2 drop boxes Capacity unk*		Cedar Hills Regional Landfill		unk*	unk*	Contractor: Cedar Grove and others	
Bellevue	Contractor: Allied Waste		Contractor: Allied Waste		Contractor: King County		Contractor: Allied Waste		Contractor: Cedar Grove	
Seattle	Contractor: Allied Waste Waste Mgmt		1,250 tons/day	37,500 tons/day	Contractor: Waste Management		Contractor: Allied Waste		Contractor: Cedar Grove	
Pierce County	Contractor: unk*		Contractor: unk*		Contractor: LRI		Contractor: Tacoma Recycling (Waste Connections) SP Recycling (Lemay)		Contractor: LRI 350 tons/ day	
Tacoma	unk*	unk*	550 tons/day	600 tons/day	LRI		Contractor: JMK Fibres		Contractor: LRI unk	
Contract and Franchise Resources										
Allied Rabanco	10,000 tons/day	15,000 tons/day	N/A	N/A	14,000 tons/day	Additional rail chassis to hold 8,400 tons of trash	15,000 tons/month	18,000 tons/ month	N/A	
Bailey Compost	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	50 tons/day	

TABLE 7-1
Summary of Regional Capacities Using Existing Waste Stream

	MSW Collection Capacity		Processing Capacity		Disposal Capacity		Recycling Capacity		Composting Capacity	
	Normal	**Surge**	**Normal**	**Surge**	**Normal**	**Surge**	**Normal**	**Surge**	**Normal**	**Surge**
Cedar Grove	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Everett Facility: 220,000 tons/year	
JMK Fibres	N/A	N/A	N/A	N/A	N/A	N/A	unk*	1,000 tons storage capacity		
Lenz Enterprises	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	40,000 tons/year	
LRI	unk*	unk*	unk*	unk*	unk*	unk*	unk*	unk*	unk*	
Waste Mgmt.	unk*	unk*	unk*	unk*	~2,500 tons/day	~5,000 tons/day	unk*	unk*	N/A	
MUNI TOTALS	10,550 tons/day	23,000 tons/day	X	X	16,500 tons/day	27,400 tons/day	500 tons/day	600 tons/day	500 tons/day	X

unk = Data not provided at time of publishing of this plan.
N/A = Not applicable

TABLE 7-2
Regional Landfills

Landfill Name	Owner	Type	Other Features	Rail Access	Capacity	Expected Life	Contact Info
Cedar Hills Regional Landfill	King County Solid Waste Division	Subtitle D Compliant (nonhazardous) Municipal Solid Waste Landfill Prohibited from accepting large volumes of CDL waste			9 million tons	2016	16645 228th Ave. SE Maple Valley, WA 98038
Chemical Waste Management of the Northwest	Waste Management Inc.	TSCA, RCRA, Non-RCRA, CERCLA CAMU Eligible Materials		Unknown			17629 Cedar Springs Lane Arlington, OR 97812 541-454-2030 Fax 541-454-3247
City of Tacoma Landfill	City of Tacoma	Subtitle D Compliant (nonhazardous) Municipal Solid Waste Landfill, Special Waste	Recycling Area	No	397,181 cubic yards remaining in the Central Area	Currently 2009 – anticipate extending to 2013 with required approvals.	3510 S. Mullen St. Tacoma, WA 98409 (253) 591-5543
Columbia Ridge Recycling and Landfill	Waste Management Inc.	Municipal Solid Waste Nonhazardous Special Waste Asbestos		Unknown			18177 Cedar Springs Lane Arlington, OR 97812 541-454-2030 Fax 541-454-3312
Graham Road Recycling & Disposal	Waste Management Inc.	Limited Purpose Facility Construction and Demolition Landfill Nonhazardous Special Waste	Recycling Area Crushed Concrete and Asphalt Resale	Unknown			1820 S. Graham Road Medical Lake, WA 99022 509-244-0151 Fax 509-244-0207
Greater Wenatchee Landfill	Waste Management Inc.	Subtitle D Compliant (nonhazardous)	Recycling Area	Unknown			191 Webb Road East Wenatchee, WA 98802 509-884-2802

TABLE 7-2
Regional Landfills

Landfill Name	Owner	Type	Other Features	Rail Access	Capacity	Expected Life	Contact Info
		Municipal Solid Waste Landfill					Fax 509-884-3724
Hillsboro Landfill	Waste Management Inc.	Construction and Demolition Landfill Nonhazardous Special Waste All Principle Recyclable Materials (i.e., cardboard, newspaper, scrap metal, yard debris, wood wastes) Asbestos		Unknown			3205 SE Minter Bridge Road Hillsboro, OR 97123 503-640-9427 Fax 503-648-3942
LRI Landfill	Pierce County Recycling, Composting, Disposal LLC – dba LRI	Subtitle D Compliant (nonhazardous) Municipal Solid Waste		No	29.2 million cubic yards	2028	17925 Meridian Street East Puyallup, WA Main Office 253-847-7555 Fax 253-847-7713
Rabanco Roosevelt Regional Landfill	Rabanco Allied			Yes	120 million tons over 40 years		500 Roosevelt Grade Road Roosevelt, WA 99356, Klickitat County Phone: 1-800-275-5641
Riverbend Landfill	Waste Management Inc.	Subtitle D Compliant (nonhazardous) Municipal Solid Waste Landfill		Unknown		2027 – 2037	13469 SW Highway 18 McMinnville, OR 97128 503-472-8788 Fax 503-434-9770

CAMU = corrective action management unit
CDL = construction, demolition, and land-clearing
CERCLA = Comprehensive Environment Response, Compensation, and Liability Act
RCRA = Resource Conservation and Recovery Act
TSCA = Toxic Substances Control Act

8. Disaster Debris Operations

This chapter outlines the various steps that the Seattle UASI Region may take to respond to and recover from a debris-causing incident. Depending on the size and severity of the incident, these actions may be accomplished using local resources or may require assistance from contractors and outside jurisdictions. Disaster debris management operations generally include the following components:

- Damage assessment
- Debris clearance and removal
- Debris processing
- Debris hauling
- Debris disposal

8.1 Damage Assessment

Damage assessment is the systematic process of gathering preliminary estimates of disaster debris quantities and composition; damage costs; and general descriptions of the locale, type, and severity of damage sustained by both the public and private sectors. Initial damage assessments are usually completed within 36 hours of an incident by local, state, federal, and volunteer organizations and provide an indication of the loss and recovery needs. The initial damage assessment is the basis for determining the level of state and federal assistance needed, as well as the types of assistance necessary for recovery. The assessment and may take longer depending on the Region's ability to respond to life, safety, and property concerns. Information about the Washington Emergency Management Division's (WAEMD) Public Assistance Damage Assessment program, including the applicable forms to complete the assessment, are included in Appendix K, *Washington Public Assistance Damage Assessment*, of this plan.

The debris assessment should accomplish all of the following:

- Estimate the quantity and mix of debris.
- Estimate damage costs.
- Determine impact on critical facilities.
- Identify impact on residential and commercial areas.
- Identify what additional resources are needed for response and recovery.

FEMA Preliminary Damage Assessment

A preliminary damage assessment (PDA) report is a more detailed assessment that is completed following the initial damage assessment if it is suspected that the incident has or will overwhelm local resources and require federal assistance. The PDA serves two purposes, as follows:

- It provides reliable damage estimates, which are used as a basis in applying for assistance, and where justified, the governor's request for a Presidential Disaster Declaration.
- It provides for the effective implementation of state and federal disaster relief programs, if a Declaration is made.

The PDA is completed by a team of officials from FEMA, the Washington Emergency Management Division, county and local officials, and the U.S. Small Business Administration. Usually it takes approximately thirty days to complete and compile a PDA and route it through the Governor's office to FEMA.

8.2 Debris Clearance and Removal

Debris-clearing operations predominately focus on public roads and other critical infrastructure and should be prioritized based on the methodology in Chapter 4, *Debris Removal, Processing, and Disposal Priorities*, of this plan. Prior to contracting with these resources, jurisdictions should review the Washington Utilities and Transportation Commission (WUTC) regulations discussed in Chapter 3, *Legislation and Policies*, of this plan, along with additional contracting concerns detailed in Chapter 10, *Contract Management and Pre-identified Contractors*. Items to be considered during debris clearance and collection include the following:

- **Debris composition**: Commingling of debris creates problems with reduction and recycling techniques, which may impact future reimbursement. Whenever possible, immediate action should be taken to prevent or reduce commingling of debris during debris collection operations.
- **Location of debris**: There will often be different reimbursement and operational guidelines for debris clearance on public property and private residential and private commercial property. While debris clearance on private property is not usually a reimbursable expense, during past incidents, some jurisdictions have cleared debris from private property when it presents a health or safety risk to the community.
- **Right-of-Entry (ROE) form**: An ROE form must be completed in order to remove debris from private property. An ROE form must be signed by the homeowner before the jurisdiction representative can enter the property to complete the damage and debris assessment. The ROE form often contains a hold harmless agreement, which documents the property owner's promise that he or she will not bring legal action against the applicant if there is damage or harm done to the property. A sample ROE form is included in Appendix J, *Example of Right-of-Entry Permit*, of this plan.
- **Pre-established facilities for citizen debris drop-off**: Residents may be asked to bring disaster debris to collection sites for processing and disposal. If possible, the sites should remain at the same location for each debris-causing incident and should be included in the incident communication strategy. Facilities that can be used for drop-off facilities include debris drop boxes, TDSR sites, landfills, and transfer stations.

Appendix A, *Additional Debris Resources*, lists additional resources that can be used to collect and haul disaster debris following an incident. These firms are available on an emergency basis; however, to ensure rapid response, jurisdictions are encouraged to establish pre-positioned contracts for debris clearance and hauling prior to an emergency.

FEMA Mission Assignments

When an impacted state or local government does not have the capability required to respond to a Presidentially declared disaster, a request for Technical or Direct Federal Assistance may be made (FEMA 2007; see also Appendix B, *Online Resources*, for information on accessing this Web site). The approved request is called a Mission Assignment. A Mission Assignment is a work order issued by FEMA to another federal agency directing completion of a specific assignment in anticipation of, or response to, a Presidential declaration of a major disaster or emergency.

There are two Emergency Support Functions (ESFs) that perform debris-related activities under FEMA Mission Assignments:

- **ESF #3 – Public Works and Engineering** is responsible for infrastructure protection, emergency repair, and restoration. This group provides engineering services and construction management, and serves as a critical infrastructure liaison. The United States Corps of Engineers is the lead agency for ESF #3.
- **ESF #10 – Oil and Hazardous Material Response** is responsible for responding to oil and hazardous material issues, environmental safety, and short- and long-term cleanup. The two most commonly deployed agencies that deal with these debris-related activities are the United States Environmental Protection Agency (EPA) and the United States Coast Guard (USCG).

All Mission Assignments have the following requirements:

- The Mission Assignment must be requested by the state.
- The community must demonstrate that required disaster-related efforts exceed state and local resources.
- The scope of work must include specific quantifiable measurable tasks.
- FEMA must issue the Mission Assignment.

8.3 Debris Processing

Debris-causing incidents create a mix of debris that must be managed properly in order for a community to recover and return to normal. Often the processing, reduction, and disposal of debris extends long after the initial response period. If these actions are not planned for prior to a debris-causing incident, debris that could have been reused, recycled, or processed to reduce landfill impact may have to be disposed of in order to hurry recovery operations. Plans for processing disaster debris may also be affected by the type of disaster and the amount of contamination in the debris. For example, flood debris will often contain multiple types of waste, including household hazardous waste, that are impossible to sort.

Developing reuse, reduction, and disposal priorities prior to an incident will help to reduce an incident's impact on finite disposal resources. The following subsections provide categories of debris that call for different processing methods.

Recycling and Reuse

Recycling involves diverting material from the disposal stream and reusing it. The recycling of disaster debris is most often limited to metals, soil, and construction and demolition debris.

Metals

Most nonferrous and ferrous metal debris is suitable for recycling. Metal maulers and shredders can be used to shred trailer frames, trailer parts, appliances, and other metal items. Ferrous and nonferrous metals are separated using an electromagnet and then sold to metal recycling firms.

Soil

Soil can be combined with other organic materials that will decompose over time. This procedure produces significant amounts of material, which can be sold, recycled back into the agricultural community, or stored onsite to be used as cover when the site is returned to its pre-incident state. In agricultural areas where chemical fertilizers are used heavily, recovered soil may be too contaminated for use on residential or existing agricultural land. Jurisdictions should consult with their local health department to establish what monitoring and testing is necessary to ensure that soil is not contaminated with chemicals. If the soil is not suitable for agricultural or residential use, it may ultimately need to be disposed of at a permitted landfill.

Construction and Demolition

Concrete, asphalt, and masonry products can be crushed and used as base material for certain road construction products or as trench backfill. Debris targeted for base materials needs to meet certain size specifications as determined by the end user.

Clean wood products used in construction can also be chipped or ground and used as mulch or hog fuel.

Composting

Composting is the controlled decomposition of organic materials, such as leaves, grass, wood, and food scraps, by microorganisms. The result of this decomposition process is compost, a crumbly, earthy smelling, soil-like material. Yard trimmings and food scraps make up about 25 percent of the waste generated in the average household, so composting can greatly reduce the amount of waste that ends up in landfills or incinerators. A section of the TDSR sites should be reserved to receive compost material after a disaster. Composting can be used not only for soil additives for backyard gardens, farmlands, highways, and other landscaping projects, but also for many innovative uses. Jurisdictions using composting to reduce organic material need to be aware of and mitigate several hazards, including spontaneous combustion of piles and vector control for rodents.

Chipping and Grinding

Chipping and grinding reduces the volume of some debris types by as much as 75 percent. This method is commonly used to reduce the volume of disaster debris, including vegetative debris, construction demolition debris, plastics, rubber, and metals. Clean wood can also be reduced and used for mulch, and other debris such as plastic and metals can be chipped to reduce the overall volume of the material prior to transportation or disposal. The benefit of using a reduction method can be increased by identifying alternate uses for the residual material. The ability to use recycled wood chips as mulch for agricultural purposes, fuel for industrial heating, or in a cogeneration power plant helps to offset the cost of the chipping and grinding operations. Jurisdictions using chipping and grinding to reduce the volume of vegetative debris must be careful to ensure that contaminants such as plastics, soil and rocks, and special wastes are not present in the vegetative debris to be processed. Care must also be taken when reducing construction and demolition debris to ensure that it does not contain hazardous materials such as asbestos. Appendix A, *Additional Debris Resources*, lists resources that provide chipping and grinding services.

Hog Fuel Incinerators

Hog fuel is made up of a specific grade of ground-up wood and bark. It varies in size but is generally between 1/2-inch and 6-inch screen size. In the Pacific Northwest, wood and paper processing companies that use hog fuel to fuel boilers have facilities for storing hog fuel. These companies may purchase surplus storm debris that is processed into hog fuel, depending on market conditions and their existing supply, which is lowest in the spring. Depending on the quality of the material used to create the hog fuel, the Puget Sound Clean Air Agency (PSCAA) may need to relax the permit restrictions for any hog fuel burners that burn hog fuel processed from disaster debris. Appendix A, *Additional Debris Resources*, includes a list of hog fuel burners in the Region.

Incineration

Curtain pit incineration, portable incinerators, and controlled incineration in rural areas are all methods for reducing disaster debris. Because of air quality concerns in the Region, incinerating debris is not generally considered a viable reduction strategy. The decision to use incineration as a reduction strategy for some types of debris would be made by the PSCAA, as outlined in Chapter 3, *Legislation and Policies*, of this plan. The following subsections discuss the various incineration methods.

Air Curtain Pit Incineration

Air curtain pit incineration offers an effective means to expedite the volume reduction process, while substantially reducing the environmental concerns caused by open-air incineration. The air curtain incineration method uses a pit constructed by digging below grade or building above grade (if a high water table exists) and a blower unit. The blower unit and pit comprise an engineered system that must be precisely configured to function properly. The blower units deliver air at predetermined velocities and capacities. The blower unit must have adequate air velocity to provide a "curtain effect" to hold smoke in and to feed air to the fire below. A nozzle 20 feet long provides air at a velocity of over 120 miles per hour and will deliver over 20,000 cubic feet of air per minute to the fire. The

air traps smoke and small particles and recirculates them to enhance combustion, which takes place at over 2,500 degrees Fahrenheit.

Pre-permitted Portable Incinerators

Portable incinerators use the same methods as air curtain pit incinerator systems. The only difference is that portable incinerators use a pre-manufactured pit instead of an onsite constructed earth/limestone pit. Portable air curtain incinerators are the most efficient incineration systems available because the pre-manufactured pit is engineered to precise dimensions to complement the blower system. The pre-manufactured pit requires little or no maintenance compared to earth or limestone constructed pits, which are susceptible to erosion. Portable air curtain units are ideal for areas with high water tables and sandy soils and areas where smoke opacity must be kept to a minimum.

Rural Controlled Incineration

Controlled open-air incineration is a cost-effective method for reducing clean, woody debris in rural areas. Jurisdictions should consult with their local fire departments and the PSCCA to determine what permits are necessary for rural incineration. Ash from rural incineration may be used as a soil additive; however, local health departments and agricultural extension personnel should be consulted to confirm whether this is allowed in a jurisdiction. A listing of Agricultural Extensions is listed in Appendix B, *Online Resources*. The controlled open-air incineration option should be terminated if mixed debris enters the waste stream.

Contract Debris Processors

Jurisdictions within the Region may identify contractors to perform such work as recycling, special waste processing, composting, and TDSR site management. It is recommended that jurisdictions evaluate the establishment of pre-positioned contracts for the following services prior to an emergency:

- Vegetation clearance and removal (tree trimming)
- Debris clearance and removal
- TDSR site management and monitoring
- Structure demolition and removal
- Debris reduction
- Debris recycling
- Problem waste disposal
- Hazardous materials disposal

Chapter 10, *Contract Management and Pre-identified Contractors*, discusses contract management in detail, including the possible regulation of debris collection by the WUTC. These issues need to be investigated and resolved before a jurisdiction attempts to prequalify contractors for debris operations.

Additional Contract Resources

Appendix A, *Additional Debris Resources*, lists resources that can be used to process disaster debris following an incident. These firms are available on an emergency basis and can also be contracted via on-call or pre-positioned contracts to handle debris clearance and hauling.

8.4 Problem Waste Processing and Disposal

Problem waste, such as pathogenic waste, white goods, household hazardous waste, or biological or nuclear waste, requires additional handling before it can be processed or disposed of, and will vary depending on the type and scope of the debris-causing incident. During debris processing, problem waste should be removed and stored in a secure location until it can be disposed of properly. Because of their prevalence during debris-causing incidents, several types of waste warrant further discussion:

- **Household Hazardous Waste (HHW)**: As noted in Chapter 6,*Types of Debris*, HHW is prevalent in disaster debris. Strategies need to be developed to collect and store HHW during disaster debris operations.
- **White Goods**: White goods (including refrigerators) are commonly discarded after debris-causing incidents because they no longer function or because of extended power outages that cause their contents to decompose. Refrigerators are often processed in groups to remove the refrigerant along with any food waste, and then recycled.
- **Electronic Waste (E-waste)**: E-waste may contain a variety of potentially toxic chemicals, including heavy metals and polychlorinated biphenyls (PCBs). EPA has specifically classified cathode ray tube (CRT) monitors as hazardous waste, and other electronic components may also qualify. Whenever possible, E-waste should be separated from other waste and recycled by an E-waste processor.
- **Treated Wood**: Treated wood includes different types of building material, including telephone poles, railroad ties, fence posts, and wood used to construct docks. Care needs to be taken to ensure treated wood is not chipped, shredded, mulched, composted, incinerated, or disposed of in unlined landfills during processing and disposal.
- **Gypsum Drywall**: When gypsum deteriorates in landfills it can create hydrogen sulfide gas, which poses an explosion and inhalation hazard. Large amounts of drywall are often created during storms and floods. Landfill managers need to be aware of this so the proper precautions can be implemented. If possible, gypsum drywall should be recycled rather than disposed of in a landfill (CIWMB 2001).
- **Asbestos**: Regulations for asbestos handling are well established by several different local, state, and federal agencies, including Ecology and the PSCAA. After a major debris-causing incident, asbestos inspections may not be possible prior to demolition, resulting in an increased risk to public health. Jurisdictions should work with the PSCAA and local public health agencies to ensure waste that possibly contains asbestos is properly handled and disposed of.
- **Human Waste**: Following a disaster that disables water, sewer, or septic systems, citizens may have human waste stored in containers that requires disposal. This is considered biohazardous waste that cannot be included in the debris stream. Close cooperation is necessary between emergency managers, local public health officials, and utility personnel to properly collect and dispose of this waste.

Whenever possible, jurisdictions should try to segregate hazardous substances from the waste stream as early in processing as possible in order to prevent contamination of larger

amounts of waste. Jurisdictions undergoing any cleanup effort that includes hazardous waste should consult with their local hazardous waste staff, public health officials, and EPA to ensure the protection of public health. A list of contractors who process and dispose of problem waste is included in Appendix A, *Additional Debris Resources*, of this plan.

8.5 Temporary Debris Storage and Reduction Sites

TDSR sites are used to temporarily store, sort, and reduce, debris collected during an incident. It is the responsibility of each jurisdiction to locate possible TDSR sites prior to an incident and, if possible, develop a site plan and perform a baseline environmental study for each site. An ideal TDSR site would have the following characteristics:

- Entrance and exit routes that allow for optimal traffic flow
- Inspection towers that allow close inspection of trucks
- Scales to weigh all load when entering and leaving the site
- Clearly identified reduction sites
- A completed site plan
- A complete traffic management plan
- Full utility survey
- Historical assessment
- A completed baseline environmental study

Because the establishment and operation of TDSR sites is a recovery function, it is imperative that all local, state, and federal regulations be followed during site operation. Pre-identifying and assessing TDSR sites prior to an incident will ensure appropriate regulations and permits have been addressed.

Figure 8-1 is an example of a TDSR site layout. FEMA recommends that a standard TDSR site be approximately 100 acres, but the size and layout of individual TDSR sites will vary depending on available locations and the amount of debris created by an incident. Additional information on locating and operating TDSR sites is provided in Appendix E, *Temporary Debris Staging and Reduction Site Planning,* of this plan.

8.6 Debris Hauling and Disposal Operations

Disaster debris that cannot be reduced, reused, or recycled using other strategies must be disposed of in landfills. The most cost-efficient strategy for disaster debris disposal is usually to make use of the region's own or typically used landfills, but disaster debris could easily overwhelm existing landfill capacity. As an example, the 1994 Northridge earthquake in California generated 7 million cubic yards of disaster debris and the 2001 attack on the World Trade Center generated 5 million cubic yards of debris. For comparison, the LRI Landfill in Pierce County, Washington, has a total capacity of 29 million cubic yards and the Rabanco Roosevelt landfill has a total capacity of 120 million cubic yards. If local landfills are not adequate, regional staff should attempt to locate landfills close to the disaster area. A list of area landfills is included in Chapter 7, *Regional Capacities*.

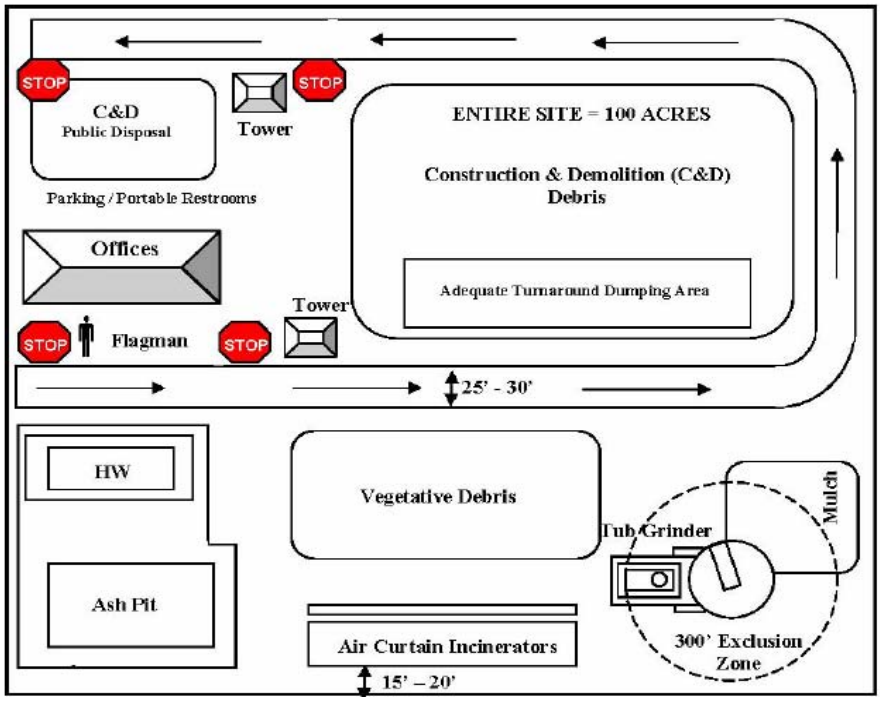

FIGURE 8-1
Example of a TDSR Site Layout

Waste Transportation Alternatives

Alternative transportation methods vary, depending on the size and scope of a disaster. The following subsections describe some alternative transportation methods that may be used.

Rail Transport

A portion of the Region's waste is transported by rail to landfills in Eastern Washington and Eastern Oregon, creating a possible transportation vulnerability following an incident. As displayed in Figure 8-2, there are three primary transportation routes east of the Cascades—Stampede Pass, Cascade Tunnel, and the Columbia Gorge. Because there are multiple rail routes over the Cascade Mountains, there is some redundancy built into this method and rail transport may be combined with long-haul truck transport to bypass rail disruptions.

Extended Debris Storage

If transportation of debris is only disrupted for a short period of time, it may be most efficient to store and transport waste when normal methods are restored. Pre-identified TDSR sites may be used to store debris if proper handling procedures are used. Proper handling procedures may include limiting debris piles to 15 feet in height, providing 50-foot lanes between piles for fire control access, and ensuring appropriate local health district/department regulations are followed. If extended storage is used, debris transport should be prioritized to remove problem waste and putrescibles. Other waste types, such as inert waste, may be stored for extended lengths of time.

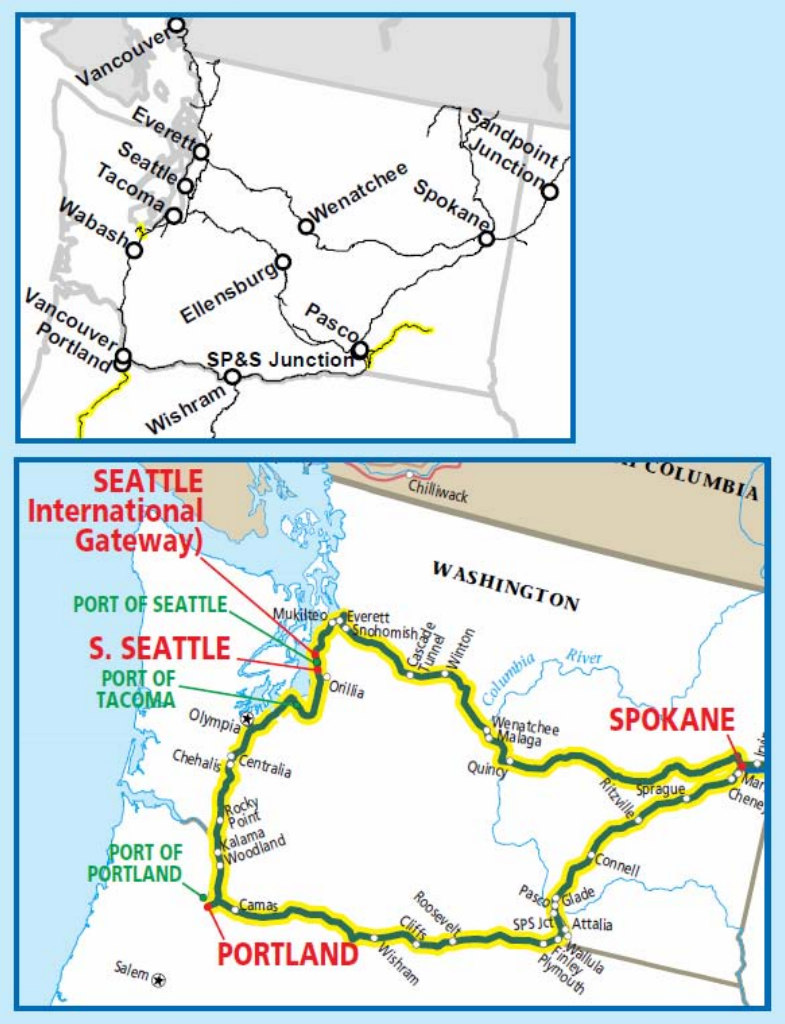

FIGURE 8-2
Rail Transportation Routes and Intermodal Hubs

Long-Haul Truck Transport

If rail transport is disrupted for a significant amount of time, existing truck and container equipment could be used to transport waste to landfills or to an alternate location with access to rail traffic. Container rail-loading facilities include the Ports of Tacoma, Seattle, Everett, and Wenatchee, Washington; Portland, Oregon; and Vancouver, British Columbia, Canada. Figure 8-2 shows major intermodal railroad facilities that could be used to transfer solid waste containers from truck to rail for transport to disposal locations. The major problem with this strategy is the limited number of containers and the additional time it would take to transport waste to its processing or disposal site.

Transportation of Waste via Container Ship

Some jurisdictions (Snohomish County, the City of Seattle) use open-top containers to transport waste from a transfer station to a disposal site. These containers meet International Organization for Standardization (ISO) standards and can be shipped to a seaport, including

the ports of Portland, Oregon; Olympia, Tacoma, Seattle, Everett, and Bellingham, Washington; and Vancouver, British Columbia, Canada. Average container ship capacity varies from 3,000 to 7,000 containers, depending on the size of the port facilities available to load and unload it. Logistical problems associated with this method include the limited number of containers available to haul debris, the equipment needed to offload and transport containers from the seaport from which they are shipped to the final disposal location, and the additional time it would take to transport waste to its disposal site. Because it is difficult to keep water out of open-top containers, sealed containers would be better suited to transport waste.

Transportation and Storage of Waste via Barge

Waste can be stored and transported via barge, but because of logistical challenges this should be considered a last-resort method for handling waste. Transporting and storing bulk waste via barge requires handling resources at both loading and unloading locations. Ports in the Seattle UASI Region are not equipped with these resources, but are outfitted to load waste in sealed containers onto barges. Loading these containers is not as efficient and the space needed to load containers may be at a premium because of other commercial and disaster response uses.

9. Mutual Aid and Interlocal Agreements

This chapter outlines the types of agreements that can be entered into with outside resources to provide additional assistance in the aftermath of a debris-causing incident. A request for mutual aid starts at the local level, after a jurisdiction has exhausted existing resources, and moves up through all levels of government. Jurisdictions should inventory their existing resources and agreements as required by the National Incident Management System (NIMS) and then develop the necessary agreements with outside resources prior to an incident to speed response and recovery efforts. Table 9-1 below lists applicable regional agreements.

9.1 Types of Agreements

There are several types of agreements that jurisdictions can use to share resources; each comes with a different level of commitment by the parties (WAEMD 2001). Table 9-1 provides more details about the availability of existing agreements within the Region.

- **Memorandum of Understanding:** A memorandum of understanding (MOU) is an agreement that specifies mutually agreed-upon expectations between two (or more) entities to collaborate on a project without exchange of funds. MOUs take many forms and may be referred to by other titles (for example, Memorandum of Agreement).
- **Mutual Aid Agreement:** A Mutual Aid Agreement is a written understanding between any type of organization and typically used by local emergency management organizations to provide reciprocal emergency management aid and assistance. Such arrangements are authorized in Chapter 38.52.091 RCW. Mutual Aid Agreements must be consistent with the state comprehensive Emergency Management Plan and program. In an emergency, each signatory local jurisdiction is responsible for providing assistance within their capabilities in accordance with the signed agreement.
- **Interlocal Agreement:** The purpose of an Interlocal Agreement is to permit local jurisdictions to make the most efficient use of their powers by enabling them to cooperate with other local jurisdictions on a basis of mutual advantage. An Interlocal Agreement allows local jurisdictions to provide or receive services and facilities from other local jurisdictions. Interlocal Agreements are in effect a contract and are discussed in Chapter 39.34 RCW.

9.2 Administration of Agreements

Individual jurisdictions may have their own mutual aid or interlocal agreements, which can be used to provide assistance during or after a disaster debris-causing incident. It is the responsibility of each jurisdiction to inventory their current agreements and evaluate their possible use during a debris-causing incident. Because these agreements are legal contracts, they require support from jurisdiction authorities, jurisdiction attorneys, and legal counsel during their creation and ongoing use and maintenance.

TABLE 9-1
Existing Agreements

Agreement	Type	Participants	Participation Requirement	Service Requirement	How Activated	Types of Resources Available
Washington Public Works Emergency Response Mutual Aid Agreement	Mutual Aid	Washington state and jurisdictions	Voluntary	Voluntary		Public Works equipment and staff
Emergency Management Assistance Compact	Mutual Aid	All 50 U.S. states	Voluntary	Assistance is obligatory "provided that it is understood that the state rendering aid may withhold resources to the extent necessary to provide reasonable protection for such state."	Governor declares state of emergency, resources requested through WAEMD.	All types of resources, including debris clearance equipment and staff
Washington State Intercounty Mutual Aid Agreement	Mutual Aid	King, Pierce, and Snohomish counties, along with various other counties in Washington, Oregon, and Idaho	Voluntary	Lending county acts as an independent contractor of borrowing county in the performance of voluntary emergency assistance during any type of emergency. Reimbursement will be made by Borrower to Lender for costs and labor incurred by Lender beyond the first 8 hours of an asset's use.	Requests for emergency assistance shall be directed to the designated contact person(s) on the contact list provided by the Party Counties.	Equipment, supplies, personnel, or direct provision of services
Washington State Fire Mobilization Plan	Mutual Aid	Statewide		Voluntary	The local fire chief, through the regional coordinator, makes a request for mobilization to the State Emergency Operations Center. The chief of the Washington State Patrol makes a decision on mobilization in consultation with the governor's chief of staff. Reimbursement by the WSP will take place for any labor or resources	Firefighters and equipment needed to manage fires, disasters, or other incidents – this is an all-risk agreement.

TABLE 9-1
Existing Agreements

Agreement	Type	Participants	Participation Requirement	Service Requirement	How Activated	Types of Resources Available
					expended after a mobilization is declared. Plan expressly notes that it is not a replacement for local mutual aid agreements and the resources available from such agreements must be expended before a mobilization request will be granted.	
Draft Washington State Law Enforcement Mobilization Plan	Mutual Aid	Unknown	Unknown	Unknown	Unknown	Unknown
King County: Solid Waste Interlocal Agreements	Interlocal Agreement	37 jurisdictions	Unknown	Unknown	Unknown	Solid Waste Disposal Resources
King County: Regional Disaster Plan for Private and Public Agencies in King County	Mutual Aid	Plan with 145 signatory private, public, nonprofit, and tribal partners	Voluntary, signatures on file	Resource lending and borrowing are defined in the Omnibus Financial and Legal Agreement.	Local emergency proclamation by jurisdiction. Then request is made.	Any type requested. Must have expended local and zone resources first.

10. Contract Management and Pre-identified Contractors

FEMA encourages all jurisdictions to pre-qualify debris removal contractors to ensure that assistance is available immediately after a debris-causing incident. This chapter outlines the process for pre-qualifying these contractors.

Before entering into contract agreements for disaster debris removal, jurisdictions should review and understand the WUTC's role in regulating solid waste collection within its jurisdiction. Chapter 3, *Legislation and Policies*, of this plan summarizes the role of the WUTC in contract waste collection.

10.1 Existing Solid Waste Collection Companies

Jurisdictions should first discuss disaster debris operations with their existing solid waste collection companies to identify what additional resources these companies have available for debris clearance and removal activities beyond their normal capacity to maintain municipal solid waste services. This is especially important for jurisdictions whose solid waste collection is regulated by the WUTC.

10.2 Establishing Additional Pre-Positioned Contracts

After evaluating the resources that solid waste collection companies can provide to assist with disaster debris operations, jurisdictions may need to pre-establish contracts for additional resources to ensure efficient response and recovery following a debris-causing incident. These resources may include the following:

- Rights-of-way and public property debris clearance
- Vegetation clearance and removal (tree trimming)
- Debris clearance and removal
- Collection and processing of problem waste, including white goods
- Debris reduction
- Management of contract debris hauling
- Management and monitoring of TDSR sites

It is important to note that in jurisdictions where solid waste collection is regulated by the WUTC, contracting with additional resources for debris collection may only be pursued if the WUTC-certified hauler is unable to provide service, and only after the contractor has been issued a temporary garbage certificate by the WUTC. The provision of temporary garbage certificates is discussed in RCW 81.77.110.

When selecting companies for pre-positioning contracts, jurisdictions should consider both local and regional contractors to ensure coverage that is appropriate to the scope of the disaster.

10.3 Types of Pre-positioned Contracts

Master and Individual Contracts

Jurisdictions may decide to create a master contract for all phases of debris management or smaller individual contracts for individual tasks. If a master contract is created, a prime contractor may allocate individual portions of work out to subcontractors. Master contracts are advantageous because they can reduce contract administration costs for a jurisdiction, but individual contracts provide jurisdictions with more flexibility to change contract provisions as debris operations are better defined.

Time and Materials Contract

Under a time and materials contract, the contractor is paid based on time spent and resources used in accomplishing debris management tasks. Time and materials contracts are extremely flexible and especially suitable for early debris right-of-way clearance jobs and hot spot cleanups.

For reimbursement purposes, FEMA recommends that the use of time and materials contracts be limited to the first 70 work hours after a disaster. There may be situations where it is practical to use time and materials contracts for periods longer than 70 hours; however, FEMA should review those situations on a case-by-case basis to determine if it is reasonable to extend reimbursement beyond the 70-hour period. An example of a time and materials contract is provided in Appendix G, *Example of Time and Materials Contract for Debris Removal*.

Unit Price Contract

A unit price contract is based on weight (tons) or volume (cubic yards) of debris hauled. This kind of contract should only be used when the scope of work is not well defined. It requires close monitoring of debris collection, transportation, and disposal to ensure that quantities are accurate. A unit price contract may be complicated by the need to segregate debris for disposal. An example of a unit price contract is provided in Appendix H, *Example of Unit Price Contract for Debris Removal*.

Lump Sum Contract

A lump sum contract is used when the scope of work is clearly defined and the areas of work are specifically quantified. Lump sum contracts require the least monitoring by the contracting jurisdiction. An example of a lump sum contract is provided in Appendix I, *Example of Lump Sum Contract for Debris Removal*.

10.4 Contracts Not Eligible for Reimbursement by FEMA

Cost Plus Percentage of Cost

A cost-plus-percentage-of-cost contract is one whereby the contractor is compensated for work performed, such as a time and materials contract, but also compensated an additional percentage of that compensation.

Conditional upon Federal Reimbursement

This kind of contract only reimburses contractors if the region receives federal funding and is not an eligible contract under FEMA guidelines.

Contracts with Debarred Contractors

Debarred contractors are contractors who were found to be in non-compliance with prevailing wage law. The Region will not be reimbursed on contracts made with companies that are on the Washington State Department of Labor and Industries Debarred Contractors list (see Appendix B, *Online Resources*, for the link to this Web site).

10.5 Pre-incident Activities

Prior to an incident, jurisdictions should identify internal and external resources required for debris operations and establish contracts with any external resources, as follows:

- Identify trained debris monitors to observe and document contractor activities. At a minimum, these monitors must be stationed at all pickup and disposal sites. Monitors may be full-time employees or hired as temporary workers during an incident. Because of FEMA reimbursement regulations, it is suggested that contract employees be used to fill these positions.
- Identify contractors with sufficient resources to assist with debris cleanup and hauling, including capabilities for equipment and personnel, bonding and insurance, availability, and geographic location.
- If possible, establish on-call contracts for debris cleanup and hauling services.

Pre-qualifying Contractors

While it may not be feasible to enter into contracts prior to an incident, FEMA recommends jurisdictions develop a list of pre-qualified contractors that provide disaster debris management services and can be called after an incident has occurred. At a minimum, jurisdictions should consider the following factors when prequalifying contractors:

- Contractor's ability to perform debris operations
- Amount and location of equipment and employees
- Level of availability
- After-hours contact information
- Appropriate insurance and bonding

10.6 Operational Contract Monitoring

All jurisdictions that contract for debris operations should establish a contract monitoring plan. The purpose of this plan is to protect a municipality's financial interest. Monitoring debris removal operations achieves two objectives:

- Verifies that the work completed by the contractor is in the contract scope of work.
- Provides the required documentation for Public Assistance grant reimbursement.

Failure to document eligible work and costs may jeopardize Public Assistance Program grants. In federally declared disasters, FEMA periodically validates a region's monitoring efforts to ensure that eligible debris is being removed and processed efficiently. Debris eligibility requirements are discussed in Chapter 11, *Eligibility for Funding*, of this plan.

Unit Price Contracts

A unit price contract requires that all trucks be accurately weighed or measured and numbered, and that all truckloads be documented. Full-time trained contract monitors are usually necessary for this type of contract because an accurate account must be kept of the actual quantities of debris transported (in either cubic yards or tons). Monitors must be available at debris pickup locations to ensure the debris being picked up is eligible. In addition, this type of contract requires the contractor to provide or construct an observation stand at all reduction and disposal sites so the contract monitor can certify the load. If scales are used, monitors must also ensure that proper weights are registered before and after trucks have been emptied. The following conditions for unit price payments also apply:

- If unit price payments are based on weight, a truck scale must be available at the disposal site for weighing trucks. The weight of an empty truck must also be confirmed.
- If unit price payments are based on volume, monitors must verify truck capacities and inspect trucks for proper loading and compaction.

Load Tickets

The term "load ticket" refers to the primary debris-tracking document. A load ticket system tracks the debris from the original collection point to the TDSR site or landfill. By positioning debris monitors at each point of the operations (collection, TDSR site, and/or final disposition), the eligible scope of work can be properly documented. This is how jurisdiction should document and track debris from the initial collection location to the TDSR and final disposal locations. If a jurisdiction uses a contract hauler, this ticket often verifies hauling activities and can be used for billing purposes. Load tickets should be multi-copy and sequentially numbered. All copies of load tickets presented for payment must match in order for payments to be made.

Truck Certification and Periodic Measuring of All Trucks to Calculate Capacity

Prior to beginning contract work, each truck must be certified. Certification includes recording the following:

- Volume of the truck bed in cubic yards or empty truck weight
- Truck license number
- Any identification number assigned by the owner
- Short description of the truck

Monitors may need to be trained in order to measure truck capacities for certification purposes. Recertification of the hauling trucks on a random and periodic basis should be implemented for contract compliance and reimbursement considerations. A listing of certified trucks should be maintained by debris monitors to ensure that truck identifications have not been altered. A sample truck certification form is included in Appendix F, *Sample Forms for Debris Tracking*.

Awareness of Improper Contractor Strategies

Monitors must be aware of the following techniques, which have been used by contractors to take advantage of unit price contracts during the debris cleanup process:

- Reporting improper truck volumes
- Adding improper debris to a load to increase weight (i.e., steel, boulders, excess soil, or concrete)
- Soaking debris with water
- Tipping half of the load
- Switching a truck number
- Using large fuel tanks that are almost empty on initial weigh-in and full when delivering debris
- Adding steel plates or other weights to the bottom of the truck bed

Considerations for Time and Materials Contracts

For time and materials contracts, jurisdictions must document the length of time that equipment and personnel is used, and must ensure that equipment and personnel are being used efficiently. FEMA does not reimburse for "down time" of equipment or personnel.

10.7 Post-incident Activities

Following an incident, jurisdictions will need to ensure that all reimbursement documentation is completed and that documentation is filed in accordance with the reimbursing agency's record-keeping policy. Jurisdictions must keep all records for 3 years after the last application for assistance is submitted to FEMA (14 CFR § 13.42). The performance of debris contractors and contract vehicles should be reviewed as part of the incident AAR and any necessary changes implemented.

11. Eligibility for Funding

This chapter outlines the current funding eligibility requirements for debris removal under the Public Assistance Program, as described in FEMA 325 Debris Management Guide (FEMA 2007; see also Appendix B, *Online Resources*). The information may in some cases be different from local requirements, and is meant to provide baseline guidance to jurisdictions within the Seattle UASI Region when drafting their own funding eligibility requirements. Note that FEMA's funding policy changes over time, so it is important to consult FEMA's debris management documentation during every incident or during annual plan review.

11.1 Debris Removal from Public Property

Debris removal work from public property is usually eligible for FEMA assistance under the Public Assistance Program. Eligible debris removal work must meet the following criteria:

- The debris was generated by a major disaster.
- The debris is located within a designated disaster area on an eligible applicant's improved property or right-of-way.
- The debris removal is the legal responsibility of the city or the county.

Debris on public property that is not eligible for FEMA assistance under the Public Assistance Program includes the following:

- Unimproved property or undeveloped land
- Debris removal from a facility that is not eligible for funding under the Public Assistance Program
- Debris on federal lands or facilities that are the authority of another federal agency or department

11.2 Debris Removal from Private Property

Private property debris removal (PPDR) is generally not eligible for reimbursement under FEMA's Public Assistance Program because debris on private property does not typically present an immediate health and safety threat to the public. Additionally, debris removal from private property is generally the responsibility of individual private property owners and other sources of funding such as insurance are commonly available to property owners to cover the cost of work. However, if private property owners move disaster-generated debris to the public right-of-way, the costs associated with removing that debris from the right-of-way may be eligible under the Public Assistance Program. Debris management planners need to consider when and how private property owners can dispose of their disaster debris and make appropriate plans prior to a debris-causing incident including collection and public communication strategies.

When large-scale debris-causing incidents cause mass destruction and generate large quantities of debris over vast areas, debris on private property may pose health and safety threats to the public-at-large. If private property owners are not available because they have evacuated, state or local government may need to enter private property to remove debris considered to be an immediate threat to the life, health, and safety of its residents. In such situations, the FEMA Federal Coordinating Officer (FCO) is authorized to approve the provision of public assistance for removal of debris from private property when it is considered to be in the public interest.

Eligible debris removal work from private property may include removal of the following:

- Large piles of disaster-generated debris in the living, recreational, and working areas of properties
- Disaster-generated debris obstructing primary ingress and egress routes to improved property
- Debris created by removal of damaged interior and exterior materials from improved property
- Household hazardous wastes
- Disaster-generated debris on private roads and/or streets of a gated community, provided that the removal of the debris has become the legal responsibility of an eligible jurisdiction

Eligibility also includes disaster-damaged limbs and leaning trees in danger of falling on improved property, primary ingress or egress routes, or public rights-of-way. However, tree removal carries some qualifying conditions described below:

- Hazardous tree removal is eligible only if the tree is greater than 6 inches in diameter and:
  - The tree has more than 50 percent of the crown damaged or destroyed
  - The tree has split trunk or broken branches that expose heartwood
  - The tree itself is leaning at an angle greater than 30 degrees and shows evidence of ground disturbance
- Hazardous limb removal is eligible only if the limb (hanger) is greater than 2 inches in diameter measured at the point of break.

Ineligible debris removal on private property includes the removal of the following:

- Debris from vacant lots, forests, heavily wooded areas, unimproved property, and unused areas
- Agricultural debris used for crops or livestock
- Concrete slabs or foundations-on-grade

- Reconstruction debris consisting of materials used in the reconstruction of disaster-damaged improved property

11.3 Debris Removal from Private Commercial Property

Debris removal from commercial property and the demolition of commercial structures generally are not eligible for public assistance grant funding. Commercial enterprises are the exception because they have insurance that will cover the cost of debris removal and/or demolition. However, in some cases, as determined by the FCO, debris removal from private commercial property and/or the demolition of private commercial structures by a state or local government may be eligible for FEMA reimbursement only when the removal is in the public interest.

Industrial parks, private golf courses, commercial cemeteries, apartments, condominiums, and mobile homes in commercial trailer parks are generally considered commercial property.

11.4 Processing and Disposal

Landfill tipping fees usually include fixed and variable costs along with some special taxes or fees assessed by the jurisdiction. Examples of variable costs include costs for labor, supplies, maintenance, utilities, and gas or recovery systems. Fixed costs generally include equipment, construction, permits, landfill closure, post closure, and amortized costs for ancillary landfill building structures.

Eligible landfill costs are limited to the variable and fixed costs that are directly related to landfill operations. Jurisdictions may incorporate special taxes or fees into the landfill tipping fee to fund government services or public infrastructure. When tipping fees include such costs, those costs are not eligible for public assistance grant funding.

12. Public Notification and Communication Plan

This section is designed to help jurisdictions in the Seattle UASI Region develop a plan to communicate effectively with the public before, during, and after a debris-causing incident, and to collaborate with neighboring jurisdictions to deliver coordinated public messages.

12.1 Communication and Public Education Strategy Prior to an Incident

Prior to an event, Jurisdictions should develop a public information campaign around disaster debris-causing incidents. The campaign is a coordinated effort to provide information to jurisdiction employees, stakeholders, and the public prior to, during, and after a debris-causing incident. Jurisdictions should develop a public information campaign that introduces debris-causing incidents and includes the following:

- Identification of a debris-causing incident communications strategy
- Creation of debris management presentation designed for different audiences including policy makers, jurisdiction employees, and community groups.
- Development of material to be passed out prior to a disaster including pamphlets and fact sheets, press releases and tie-ins with other jurisdiction public information campaigns.
- Identification of anticipated issues during an event through message mapping, and creation of talking points, press releases, and disaster specific information.

Message Mapping

Message mapping is a technique used to identify anticipated issues during a debris-causing incident and creates key messages that officials can use when providing information to the public prior to, or during an event. Ideally, public information officers throughout the Seattle UASI region work together to develop common message maps for debris causing events.

To begin a message map, a group of staff identifies types of debris causing incidents, such as an earthquake and flood. Next the group brainstorms all the possible questions the public may ask during the identified incident. After that the questions are grouped into similar topics and related categories. Finally, three key messages are created, including at least two supporting facts for each category. These messages should be used when creating communications prior to and during an emergency to create continuity in debris management communications.

Identification of Public Information Processes and Protocols

Identification of common process and protocols is important in providing a coordinated public message. Public Information Officers (PIO) in the Seattle UASI Region should

consider the following questions when planning within their jurisdiction and at a regional level with neighboring jurisdictions:

- Who will have the lead responsibility for public messaging?
- Who will have decision-making authority for public messaging?
- Which department within a jurisdiction will release messages to the public?
- What guidelines will be used when crafting public information messages?
- How will messages be coordinated between jurisdictions?
- How will consistency be maintained between jurisdictions?

Develop Materials to be used During an Event

Another element that supports success of this plan is to develop types of public information prior to an incident that helps to ensure communication with the public is systematic, consistent, and relevant. In this way, the public receives clear and consistent messages throughout the incident and recovery phases of the operation.

The first step for developing public information and messages is to define the communication objective. Consider the following questions:

- Who are your audiences, both primary and secondary?
- What behaviors of your audience do you want to influence?
- What knowledge of your audience do you want to influence?
- What attitudes of your audience do you want to influence?
- What will help manage the public health threat?
- What do you need to accomplish?

At times, the use of different communications procedures by different jurisdictions can frustrate and confuse the public. To prevent this, common language and coordinated messages should be used in communications. Messages, at a minimum, should be:

- Clear, direct, and simple so that all residents in the Seattle UASI Region understand their meaning
- Free of technical jargon and acronyms
- Consistent with expert understanding of the crisis
- Distributed in more than one language
- Appropriate in tone and appeal for the intended audience; and
- Responsive to audience concerns

The following elements should be avoided when developing public messages:

- Technical jargon or unnecessary filler. It only complicates your message and alienates the audience.
- Condescending or judgmental phrases.
- Attacks. Avoid attacks against individuals and organizations—stay focused on issues.

- Promises or guarantees. For example, rather than, "We are protecting the public," say, "We are working to protect the public."
- Speculation that could be mistaken for fact.
- Discussion of money. Don't give the appearance that financial considerations outweigh concerns and obligations to public health and safety.
- Humor. The public may believe you don't take the situation seriously or that you don't care about their safety and health. Or they may get the impression that the risk is not serious. Or they may be offended that you can joke about a serious concern.

Developing Messages in Alternate Languages and Formats

When developing message materials, a jurisdiction should include languages likely to be spoken in the community. Based on community demographics in the Seattle UASI Region, messages may need to be developed in the following languages:

- English
- Spanish
- Korean
- Ukrainian
- Chinese
- Vietnamese
- Russian
- Somali
- Tagalog

Messages should also be crafted in alternate formats to target members of the community with special needs.

Distribution Strategy

Another key step in effective messaging is identifying methods for disseminating information to the public. The following is a list of suggested ways to communicate pertinent information:

- Regional Media – Local television, radio, newspapers, or community newsletters
- State and City Internet Sites – Displays of clear links to debris information flyers for printing
- Online Web sites and notification systems such as the Regional Public Information Network (RPIN), or the Northwest Warning Alert and Response Network (NWWARN) (see Appendix B, *Online Resources*, for information about accessing these networks)
- Public Forums – Interactive meetings at town hall or shopping mall kiosks
- Direct Mail Products – Door hangers, direct mail, fact sheets, flyers within billings, and billboards

- Hand delivery of messages, fact sheets, flyers to homes, shelters, community centers, or other temporary housing locations
- A hotline available both in and/or outside the Region for the public to call for debris management information, including pickup locations and disposal sites open to the public for various types of debris
- Megaphones and public address systems
- Posting on Web sites or bulletin boards at libraries, fire stations, and other public areas

Developing and maintaining a current contact list for the media (television, radio, cable access, ham operators, newspapers, neighborhood newsletters), public information officers, jurisdictional leads, and key decision-makers will make message distributing during an incident much easier.

Depending on the nature of an incident, some modes of communication will be more appropriate than others. For example, people may not have access to television or the Internet if the power is out; public forums may not be appropriate if roads are not passable.

Key Issues to Consider

Jurisdictions should use a technique such as message mapping to identify all issues that may require messaging during an event. Listed below are some ideas for ideas for creating message maps:

- How will contaminated waste be collected?
- What kind of health threat does contaminated waste pose for citizens?
- How should citizens collect human waste if the sewer system is inoperable?
- How will waste such as putrescibles, household hazardous waste, and human waste be handled and disposed of?
- How will debris be collected?

If curbside collection:

- Will only certain types of debris be collected (will specific debris such as putrescibles be collected in the days following a disaster)?
- How will the debris be collected?
- How should citizens sort or separate their debris, especially hazardous waste?
- What are the schedules and the routes for collection?
- What is the final collection date for streets, sectors, or subdivisions?

If collection centers:

- Where are the collection centers?
- Will residents be charged a fee to use the collection center?

- What are the daily collection center hours?
- Is debris to be segregated at the collection centers?
- What types of debris will be accepted at the centers?
- How long will the collection centers accept disaster-related debris?

For TDSR sites:

- Where can a resident find a map of the TDSR sites for public debris drop-off of household hazardous waste, construction and demolition debris, etc.? Are these areas segregated and well marked for vehicular traffic?
- Will residents be charged a fee to use the TDSR sites?
- Will residents be restricted as to how much disaster-related debris can be dropped off at the TDSR sites?
- Will the TDSR sites have burning, chipping, or grinding operations? If so, during which hours will these activities take place? Address any environmental concerns the public may have as well.
- How long will residents be able to bring their disaster-related debris to the TDSR sites?
- How long will the TDSR sites be open to process (reduce/recycle) debris?
- Are there traffic changes that will impact the general public due to the location or operation of the TDSR sites?

Addressing Concerns and Complaints

How well a jurisdiction identifies and responds to the public's issues and concerns following an event is important for building long term trust within the community. Prior to an event, jurisdictions should identify strategies for addressing public concerns during an incident including:

- A toll-free number that can be activated during an event and staffed to provide information and route requests.
- An information center at an accessible location for walk-up questions and requests.
- Teams of jurisdiction staff who can travel through neighborhoods distributing information.

12.2 Public Information Strategy during an Incident

The jurisdiction's public information staff will provide information to media outlets and the public during an incident. These activities may be provided solely by a single jurisdiction or through cooperation of multiple jurisdictions.

Coordination with the Joint Information Center (JIC)

Communications should be coordinated through the Joint Information Center (JIC) or Joint Information System (JIS); if a JIC or JIS has not been established, coordination should take place through each jurisdiction's Public Information Officers (PIOs).

If a JIC is established during a debris-causing incident, a debris liaison or technical specialist should be available to the JIC to assist the PIOs. The debris operations liaison can provide current information on such topics as:

- Cleanup instructions
- Status of cleanup
- Locations of drop-off or collection sites
- How to source-separate waste
- Handling procedures
- Illegal dumping provisions
- Addressing complaints regarding debris piles or illegal dumping

12.3 Reviewing and Updating Public Information Strategy

The public information strategy should be evaluated after each disaster. Planning staff should assess whether the public information strategy addressed the needs of the community in a clear and timely manner.

Changes should be made in the public information strategy to reflect lessons learned from a disaster. The strategy should also be updated annually to reflect advances in communications technology and major policy changes in solid waste processing.

It is important to note that the public will likely assume the strategy used in one incident will be appropriate for use in the next one. If changes are made to the debris management program, these changes will need to be communicated to the public as part of a public information campaign.

13. Staff Development and Responsibilities

This chapter lists staff roles that jurisdictions in the Seattle UASI Region will need to manage debris removal in the event of a disaster. This chapter describes the specific roles that jurisdiction staff may assume to plan for and respond to debris-causing incidents in order to ensure efficient response and recovery operations.

13.1 Staff Development

Each jurisdiction should assign staff to develop and maintain their operational disaster debris management plans and support debris management operations during an incident. Staff should be assigned to these roles prior to an incident so that proper training and planning can take place.

Plan Ownership and Maintenance

A single person or group within each jurisdiction should be responsible for the creation and maintenance of an operational disaster debris management plan for their jurisdiction. This person or group is responsible for directing the creation of the plan and ensuring it is updated and exercised based on the specifications within the plan. Appendix D, *Operational Debris Management Plan Template*, provides jurisdictions with a template to being the creation of their jurisdiction's operational disaster debris management plan.

Debris Operations Staff

Debris operations staff are responsible for directing debris operations during and after an incident. During an incident, staff with debris management experience may need to assume one or more roles, including the following:

- **Debris Management Subject Matter Expert (SME):** A debris management SME provides information and advice to incident command staff working in the operations and planning sections to guide disaster operations.
- **Debris Collection Supervisor**: A Debris Collection Supervisor oversees collection activities prior to arrival at the disposal site and coordinates the debris routing, staffing, and field reporting activities.
- **Debris Removal Manager**: A Debris Removal Manager manages and coordinates debris removal activities related to an incident, and ensures communication among other members of the disaster management team, communication of project status activity and reporting, and dissemination and implementation of policy directives to debris removal personnel.
- **Debris Site Supervisor**: A Debris Site Supervisor manages a TDSR site and is responsible for overseeing waste separation and environmental protection concerns, as well as filling out paperwork and reporting documentation.

- **Finance, Administration, and Logistical Staff:** Tracks time for personnel and equipment, tracks incident costs, assists with contracting and purchasing resources, completes documentation required for reimbursement of expenses, and checks in and demobilize resources.

13.2 Other Specialized Staff Resources

Additional specialized staff may be needed to act as technical specialists during planning, response, and recovery for a debris-causing incident. These include the following:

- **Quality Assurance Personnel**: Quality Assurance Personnel ensures the cost-effective and efficient monitoring of response and recovery operations.
- **Structural Engineer**: A Structural Engineer oversees, inspects, and assesses impacted structures and makes appropriate recommendations on condemnation and demolition of buildings.
- **Legal Staff**: Legal staff leads review and all legal matters in the debris management planning process. In addition to advising the debris management planning staff, the following tasks must also be performed by the legal department:
  - Contract review
  - Rights-of-entry permits
  - Community liability
  - Indemnification
  - Condemnation of buildings
  - Land acquisition for TDSR sites
  - Site closure/restoration and insurance
- **Public Information Officer**: A PIO familiar with debris management issues should be assigned to the Incident Command staff, JIC or JIS, as necessary. Responsibilities include coordinating with other public information officers of other agencies to keep the public informed about all debris removal activities and schedules. Immediately after a disaster and continually throughout the removal and disposal operation, the PIO should arrange for public notification of all ongoing and planned debris clearance, removal, and disposal activities. Additional information on public information strategies in included in Section 12, *Public Notification and Communications Plan.*

13.3 Training and Exercises

To ensure consistent and comprehensive debris management operations, all jurisdictions in the Seattle UASI Region should periodically review the Disaster Debris Management Plan with all potential plan participants, including private companies franchised or contracted to provide debris management service during a disaster.

General Emergency Management Training

Staff participating in disaster debris management operations should have general emergency management training, as well as position-specific training depending on their roles and as identified in their jurisdiction's NIMS implementation and training plan.

General emergency management training requirements are developed as part of the NIMS. Identified staff should complete the following courses:

- IS-700 NIMS: An Introduction (available online)
- IS-800 NRP: An Introduction (available online)
- ICS-100: Introduction to NIMS ICS for Operational First Responders (available online)
- ICS-200: Basic All-Hazards NIMS ICS for Operational First Responders (classroom)
- ICS-300: Intermediate NIMS ICS[1] (classroom)

These requirements are listed as part of the Fiscal Year 2007 NIMS Training Requirements and the 2008 Five-Year NIMS Training Plan. Additional information on position-based NIMS training requirements is available from FEMA (see Appendix B, *Online Resources*, for more information on NIMS training requirements).

Position-Specific Training

Specific training may be required depending on specific staff roles and positions. FEMA provides several online classes that may be applicable to debris management staff, including *IS-632, Introduction to Debris Operations, in FEMA's Public Assistance Program*, and *IS-630, Introduction to the Public Assistance Program. FEMA's Emergency Management Institute* offers classroom training in debris management *(E202 Debris Management).*

Exercises

Procedures for disaster debris removal can be tested and exercised through discussion-based or operational-based exercises. The purpose of these types of tests and exercises is to determine the overall efficiency and effectiveness of the operational procedures in a disaster scenario. These procedures can be exercised separately, or as part of another exercise. At a minimum, operational exercises should be conducted every 4 years. Plans should be modified based on AARs and corrective-action reports.

13.4 Credentialing and Resource Typing

As part of federal NIMS compliance objectives (FEMA 2008b), the United States Department of Homeland Security (DHS) is currently developing a nationwide credentialing system and position-specific resource typing metrics that will provide positive identification and verify baseline knowledge and experience criteria for emergency response and recovery professionals. Some of these criteria will be specific to debris management. Jurisdictions should work with the WAEMD to adopt a credentialing system that is compatible with the NIMS and s tracks the position descriptions and proposed qualifications of all staff who will participate in emergency management operations and disaster debris operations.

[1] ICS-300 is recommended for strike team leaders, task force leaders, unit leaders, division/group supervisors, and branch directors, and is recommended for emergency operations center staff (FEMA 2008a).

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APPENDIX A

Additional Debris Resources

APPENDIX TABLE A-1
List of Additional Debris Processing and Disposal Resources – Construction and Demolition Waste

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
Allied Waste - Third & Lander Recycling & Transfer Station	2733 3rd Ave S Seattle, WA	206-332-7700	Wood recycling	
Allied Waste - Black River Facility	501 Monster Road SW Renton, WA	206-332-7700	Wood recycling	
American Roofing Recyclers	1426 Bonneville Ave. Snohomish, WA	360-563-6114	Asphalt Roofing recycling	20,000 tons/year
Armstrong World Industries	2500 Columbia Ave. Lancaster, PA	877-276-7876	Acoustic Ceiling Tile recycling	
Bedrock Industries	1401 W. Garfield St Seattle, WA	206-283-7625	Brick, Concrete recycling	2 tons a day
Building Busters, Inc.	13001 Martin Luther King Jr Way S Seattle, WA	206-772-6556	Concrete recycling	20 tons a day
Cedar Grove Composting - Everett	3620 36th PL. NE Everett, WA	877-764-5748	Clean Wood recycling	
Cedar Grove Composting - Maple Valley	17825 Cedar Grove Rd SE Maple Valley, WA	877-764-5748	Clean Wood recycling	
deConstructor	5341 SW Dash Point Rd. Federal Way, WA	253-335-3132	Reusable Building Materials	
Dick's Chipping Service	17316 North Rd Bothell, WA	425-743-9640	Wood recycling	
Earthwise	2462 1st Ave. S Seattle, WA	206-624-4510	Reusable Building Materials	
Fruhling Sand and Topsoil	1010 228th St. SW Bothell, WA	425-485-1442	Asphalt, Concrete recycling	4-5 tons a day
GTS Interior Supply	10858 117th Pl NE Kenmore, WA	425-828-6761	Acoustic Ceiling Tile recycling	
Habitat for Humanity		206-292-5240	Reusable Building Materials	
Holroyd Concrete Recycling	3733 South 34th St Tacoma, WA		Inert Waste Recycling	
Icon Materials	King and Pierce Counties	Contracting: 206-574-3903	Asphalt	30,000 tons a year

APPENDIX TABLE A-1
List of Additional Debris Processing and Disposal Resources – Construction and Demolition Waste

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
Land Recovery Incorporated	17925 Meridian St E Puyallup, WA	253-847-7555	Wood recycling	4100 tons a month
Marathon Wood Recovery	32300 148th Ave SE Auburn, WA	253-939-5497	Wood recycling	
Purdy Topsoil	5819 133d St NW		Inert waste recycling	
Resource Woodworks Inc.	627 E 60th St Tacoma, WA	253-474-3757	Reusable Building Materials, Wood recycling	
R. W. Rhine, Inc.	1313 112th St E Tacoma, WA	253-537-5852	Reusable Building Materials	
Rainier Wood Recyclers - Fall City	33216 Redmond Fall City Rd SE (St Rt 202) Fall City, WA	425-222-0008	Wood recycling	
Randall Sand and Gravel	19209 Canyon Rd E Tacoma, WA		Inert waste recycling	
Recovery 1, Inc.	1630 E 18th St. Tacoma, WA	253-627-1180	All types of non-hazardous CDL	Limited by 15,000 cubic yards on-site capacity
Resource Recovery Services, Inc.	8625 219th St SE Woodinville, WA	425-486-2761	Drywall recycling	
Second Use Building Materials	7953 2nd Ave S Seattle, WA	206-763-6929	Reusable Building Materials recycling	100 tons a month
Rinker Materials-Snohomish	19000 Yew Way Snohomish, WA	425-348-6396	Asphalt, Brick, Concrete	4 to 5 tons a day
Seegert Inc.	595 Waynes Ridge Cir Camano Island, WA	360-387-7533	Asphalt, Brick, Concrete recycling	
Squak Mountain Materials, Inc.	10430 Renton - Issaquah Rd SE Issaquah, WA	425-392-1433	Asphalt, Concrete, Wood recycling	
Stoneway Concrete	6808 S 140th Tukwila, WA	425-226-1000	Asphalt, Concrete, Porcelain recycling	
The ReStore	1440 NW 52nd St Seattle, WA	206-297-9119	Brick, Reusable Building Materials, Wood recycling	

APPENDIX TABLE A-1
List of Additional Debris Processing and Disposal Resources – Construction and Demolition Waste

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
The ReUse People of America	P.O. Box 2655 Renton, WA	206-423-9789	Reusable Building Materials recycling	
Timberlake Forest Products	3808 N. Sullivan Rd. Spokane, WA	800-686-0865	Wood recycling	
Tucci	1105 26th Ave S Tacoma, WA		Inert waste recycling	
Waste Management - Cascade Recycling Center	14020 NE 190th St. Woodinville, WA	425-485-8145 x14	Asphalt, Concrete, Wood recycling	
Waste Management - Commercial Recycling Services	7201 W Marginal Way Seattle, WA	866-962-9253	Asphalt Roofing, Concrete, Wood recycling	
Waste Management - Eastmont Recycling Center	7201 W Marginal Way SW Seattle, WA	206-763-8943	Asphalt, Concrete, Wood recycling	
Waste Management - Recycling Northwest	355 H St. NW Auburn, WA	866-962-9253	Asphalt, Concrete, Wood recycling	
Watson Asphalt and Paving Inc.	19220 NE 80th Redmond, WA	425-868-4377	Asphalt recycling	
Wm. Dickson Waller Road Inert Waste Landfill	2839 48th S E Tacoma, WA	253-922-3296	Inert waste recycling Inert Landfill	
Woodworth & Company	2800 104th St S Lakewood, WA	253-582-5181	Asphalt, Asphalt Roofing, Concrete recycling	2,000 tons/day

APPENDIX TABLE A-2
List of Additional Debris Processing and Disposal Resources –Vegetative Waste

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
A&J Development	5219 200th St E		Land clearing debris	
Allied Waste - Commercial Services & Sales	54 S Dawson St. Seattle, WA	206-332-7700	Brush/Woody Waste, Yard Waste	
Benchmark Recycling, Inc.	3024 S Mullen St. Tacoma, WA	253-565-1565	Brush/Woody Waste	
Cedar Grove Composting - Everett	3620 36th PL. NE Everett, WA	877-764-5748	Brush/Woody Waste, Yard Waste	222,000 Tons/year
Cedar Grove Composting - Maple Valley	17825 Cedar Grove Rd SE Maple Valley, WA	877-764-5748	Brush/Woody Waste, Yard Waste	
Concrete Recyclers/JS&S Trucking, Inc.	2831 Black Lake Blvd. SW Tumwater, WA	360-951-0999	Yard Waste	
Dick's Chipping Service	17316 North Rd Bothell, WA	425-743-9640	Brush/Woody Waste	
DRS Inc.	PO Box 726 Bothell, WA	866-991-9960	Brush/Woody Waste, Yard Waste	1000 tons a month
Fruhling Sand and Topsoil	1010 228th St. SW Bothell, WA	425-485-1442	Brush/Woody Waste	
Goodnight Construction	PO Box 1347 Monroe, WA	360-794-6220	Brush/Woody Waste	
Grayhawk Construction	9606 NE 180th St. Bothell, WA	425-402-4122	Brush/Woody Waste, Yard Waste	
Holroyd Concrete Recycling	3733 South 34th St Tacoma, WA		Brush/Woody Waste	
Land Recovery Incorporated: Sales Road	10308 Sales Road Tacoma, WA	253-589-6993	Grass clippings, leaves, brush, sod, branches, wood chips, clean lumber Clean stumps, branches larger than 4" in diameter, brush, untreated wood products and unpainted wood	

APPENDIX TABLE A-2
List of Additional Debris Processing and Disposal Resources –Vegetative Waste

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
Land Recovery Incorporated: Purdy Transfer Station	14515 54th Avenue NW Gig Harbor, WA		Grass clippings, leaves, brush, sod, branches, wood chips, clean lumber Clean stumps, branches larger than 4" in diameter, brush, untreated wood products and unpainted wood	
Land Recovery Incorporated: Hidden Valley Transfer Station	17925 Meridian Street East Puyallup, WA	253-847-7555	Grass clippings, leaves, brush, sod, branches, wood chips, clean lumber Clean stumps, branches larger than 4" in diameter, brush, untreated wood products and unpainted wood	
Lenz Enterprises	5212 SR532 Stanwood, WA 98292	360-629-2933	On-site and mobile grinding of vegetative waste.	40,000 tons/year Has 12-foot tub grinder
Lloyd Enterprises	80 5th Ave. Milton, WA	253-874-6692	Brush/Woody Waste	
Pacific Topsoils, Inc. - Bellevue	1733 127th Ave NE Bellevue, WA	800-884-7645	Brush/Woody Waste	
Pacific Topsoils, Inc. – Issaquah	9830 Renton Issaquah Rd SE Issaquah, WA	800-884-7645	Brush/Woody Waste	
Pacific Topsoils, Inc. – Maltby	8616 219th St SE Woodinville, WA	800-884-7645	Brush/Woody Waste	
Pacific Topsoils, Inc. - Maple Valley	21501 SE Lake Francis Rd. Maple Valley, WA	800-884-7645	Brush/Woody Waste	
Pacific Topsoils, Inc. - Mill Creek	13517 35th Ave. SE Mill Creek, WA	800-884-7645	Brush/Woody Waste	
Pacific Topsoils, Inc. - Smith Island	3000 W Frontage Rd. Everett, WA	800-884-7645	Brush/Woody Waste	
Pacific Topsoils, Inc. - Kenmore	7500 NE 175th St Kenmore, WA	800-884-7645	Brush/Woody Waste, Yard Waste	53,000 tons a year
Pacific Topsoils, Inc. - Seattle	1212 N 107th Seattle, WA	800-884-7645	Brush/Woody Waste, Yard Waste	53,000 tons a year
Pacific Topsoils, Inc. - Tukwila	6000 S 129th St Seattle, WA	206-772-3091	Brush/Woody Waste, Yard Waste	53,000 tons a year

APPENDIX TABLE A-2
List of Additional Debris Processing and Disposal Resources –Vegetative Waste

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
Purdy Topsoil	5819 133d St NW		Brush/Woody Waste, Yard Waste	
Rainier Wood Recyclers - Fall City	33216 Redmond Fall City Rd SE (St Rt 202) Fall City, WA	425-222-0008	Brush/Woody Waste, Yard Waste	Unlimited amount
Randall Sand and Gravel	19209 Canyon Rd E Tacoma, WA		Brush/Woody Waste, Yard Waste	
Rivers Edge Services Inc.		253-872-8988	Brush/Woody Waste, Yard Waste	
Recovery 1, Inc.	1630 E 18th St. Tacoma, WA	253-627-1180	Brush/Woody Waste	
Simon and Sons	2202 E River St Tacoma, WA , 98421-1502	253-272-9364	Wholesales Ferrous & Nonferrous Scrap Metals Recycling services, Refuse treatment, Scrap and waste materials,	
Sunset Materials Inc. - Issaquah Road	18011 SE Renton - Issaquah Rd. Renton, WA	425-226-4140	Brush/Woody Waste	
Sunset Materials Inc. - Maple Valley Road	18825 SE Renton Maple Valley Rd. Renton, WA	425-226-3653	Brush/Woody Waste, Yard Waste	
Squak Mountain Materials, Inc.	10430 Renton - Issaquah Rd SE Issaquah, WA	425-392-1433	Brush/Woody Waste	
Topsoils, Inc.	18827 Yew Way Snohomish, WA	425-485-0355	Brush/Woody Waste	
Waste Management - Commercial Recycling Services	7201 W Marginal Way Seattle, WA	866-962-9253	Brush/Woody Waste	

APPENDIX TABLE A-3
List of Additional Debris Processing and Disposal Resources – Recycling

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
AAA Recycling & Salvage - Enumclaw	2099 2nd St Enumclaw, WA	360-802-4544	Aluminum Cans, Ferrous Metals, Nonferrous Metals	
Allied Waste - Commercial Services & Sales	54 S Dawson St. Seattle, WA	206-332-7700	Aluminum Cans, Ferrous Metals, Nonferrous Metals, Steel/Tin Cans	
Allied Waste - Third & Lander Recycling & Transfer Station	2733 3rd Ave S Seattle, WA	206-332-7700	Aluminum Cans, Steel/Tin Cans	
American Data Guard	7272 W Marginal Way S Seattle, WA	206-285-5955	Confidential Documents	
Arrow Metals Corp	6014 238th St. SE Woodinville, WA	425-481-1828	Ferrous Metals, Nonferrous Metals	300 tons/day
AtWork!	970 7th Ave. NW Issaquah, WA	425-274-4000	Cardboard, Mixed Paper, Newspaper, Office Paper, Phone Books, Aluminum Cans	
Binford Metal Recycling	26133 78th Ave. S Kent, WA	253-854-8000	Aluminum Cans, Ferrous Metals, Nonferrous Metals	*No processing, material sorting and transfer only*
Benchmark Recycling, Inc.	3024 S Mullen St. Tacoma, WA	253-565-1565	Ferrous Metals, Nonferrous Metals, Cardboard	
Calbag Metals	1602 Marine View Dr. Tacoma, WA 98422	(800) 801-5732	Metal recycling	
Carton Service, Inc.	1141 Andover Park W Tukwila, WA	206-575-9111	Cardboard	
Commercial Metals, Inc.	117 Frontage Rd. N Pacific, WA	253-833-4146	Aluminum Cans, Steel/Tin Cans	
Construction Waste Management		425-402-1972	Ferrous Metals, Cardboard	
Democon		206-652-1381	Ferrous Metals, Nonferrous Metals	
DRS Inc.	PO Box 726 Bothell, WA	866-991-9960	Clean Sheetrock, Cardboard	
Ecodisk	601 Valley Ave. NE Puyallup, WA	253-471-1800	Confidential Documents	

APPENDIX TABLE A-3
List of Additional Debris Processing and Disposal Resources – Recycling

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
Fletcher Distributing and Recycling	18407 Renton-Maple Valley Rd Maple Valley, WA	425-432-3960	Aluminum Cans, Ferrous Metals, Nonferrous Metals	Cans: 100,000 pounds/year Ferrous: 600,000 pounds/year
Full container recovery	1702 Port of Tacoma Rd Tacoma, WA 98421	253-272-7726	Food container and liquid recycling	
G.C. Recycle	WA	206-819-8785	Nonferrous Metals	
Have Art Will Travel	11410 NE 124th St, PMB 224 Kirkland, WA	425-488-6511	Mixed Paper	
Independent Metals Company	747 S Monroe St. Seattle, WA	206-763-9033	Ferrous Metals, Nonferrous Metals	
JMK Fiber	1440 Port of Tacoma Road Tacoma, WA 98421	253-272-6208	Mixed paper, cardboard	
Keppler Feed and Recycling	16442 SE Renton- Issaquah Rd Renton, WA	425-226-5239	Aluminum Cans, Nonferrous Metals, Cardboard, Mixed Paper, Newspaper, Office Paper	
Non-Ferrous Metals, Inc.	230 S Chicago St. Seattle, WA	206-762-3600	Nonferrous Metals	
Omegareign Corporation		206-501-6529	Aluminum Cans, Ferrous Metals, Nonferrous Metals	
Pacific Iron and Metal	2230 4th Ave S Seattle, WA	206-628-6232	Nonferrous Metals	
Pearson Metal Salvage	10403 Portland Ave E Tacoma, WA	253-535-4809	Metal Recycling	
Recycling Depot	851 Rainier Ave. S Seattle, WA	206-325-7288	Aluminum Cans, Nonferrous Metals, Steel/Tin Cans, Cardboard, Newspaper	Capacity of approximately 2,400 cubic yards
ReNu Recycling Services	35131 SE Center St Snoqualmie, WA	877-444-7368	Cardboard	
Rivers Edge Services Inc.		253-872-8988	Cardboard	

APPENDIX TABLE A-3
List of Additional Debris Processing and Disposal Resources – Recycling

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
Schnitzer Steel	1902 Marine View Drive Tacoma, WA		Ferrous Metals, Nonferrous Metals	
Seattle Iron & Metals Corp.	601 S Myrtle St. Seattle, WA	206-682-0040	Ferrous Metals, Nonferrous Metals	
Simpson Tacoma Kraft	917 E. 11th St. Tacoma WA 98421	(253) 779-6400	Paper and paperboard recycling	
Skagit River Steel & Recycling, Inc.	1265 S Anacortes St Burlington, WA	360-757-6096	Ferrous Metals, Nonferrous Metals	
Sno-King Recycling	16123 Highway 99 Lynnwood, WA	425-745-8282	Aluminum Cans, Ferrous Metals, Nonferrous Metals, Cardboard, Newspaper, Office Paper	
Sonoco Products Recycling	1802 Steele Avenue Sumner, WA 98390-0489	253-863-6366	Paper and paperboard recycling	
SP Recycling	4109 192nd St East Tacoma, WA 98466	253-846-9010	Aluminum Cans, Ferrous Metals, Nonferrous Metals, Cardboard, Mixed Paper, Newspaper, Office Paper	
Sutta Company	2400 6th Ave. Seattle, WA	206-447-4120	Confidential Documents	
Tacoma Metals	1754 Thorne Road Tacoma, WA 98421	253 627-1440	Recycler of non-ferrous metals	
Tacoma Recycling Co.	2318 S. Tacoma Way Tacoma, WA 98409	253-474-9559	Aluminum Cans, Ferrous Metals, Nonferrous Metals, Cardboard, Mixed Paper, Newspaper, Office Paper	
West Seattle Recycling, Inc.	3881 16th Ave SW Seattle, WA	206-935-4255	Aluminum Cans, Ferrous Metals, Nonferrous Metals, Cardboard, Mixed Paper, Newspaper, Office Paper	
Weyerhaeuser Recycling	1225 6th Ave. N Kent, WA	253-372-1360	Phone Books, Pulltabs	

APPENDIX TABLE A-4
List of Additional Debris Processing and Disposal Resources – Pathogenic Waste

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
Baker International	PO Box 58368 Seattle, WA		Pathogenic waste	Can take whole livestock carcasses
Darling International	2041 Marc St. Tacoma, WA		Pathogenic waste	500,000 pounds a week of non-domestic animals Darling mostly renders fat – can't accept full carcasses
QAR Rendering Services	23123 Meridian Ave. E Graham, WA		Pathogenic waste	Only hauling service, does not process waste

APPENDIX TABLE A-5
List of Additional Debris Processing and Disposal Resources – White Goods

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
AAA Recycling & Salvage - Enumclaw	2099 2nd St Enumclaw, WA	360-802-4544		
Accurate Service	7440 159th Pl NE Redmond, WA	425-885-6001		
All-Affordable Appliances	10730 Myers Way S Seattle, WA	206-241-0300		
Arrow Metals Corp	6014 238th St. SE Woodinville, WA	425-481-1828		250 tons/day
Bob's Maytag Home Appliance Center	33029 Pacific Hwy S Federal Way, WA	253-661-5345		
Bloch Steel	4580 Colorado Ave S Seattle, WA	206-763-0200	No refrigerators or products with CFCs. Only items such as washers, dryers, water heaters, etc.	Capacity of 50 tons a day
E.I.R. Enterprise	Redmond, WA	425-392-8990		50 refrigerators/year
Fletcher Distributing and Recycling	18407 Renton-Maple Valley Rd Maple Valley, WA	425-432-3960		125,000 pounds/year
G.C. Recycle		206-819-8785		
Grayhawk Construction	9606 NE 180th St. Bothell, WA	425-402-4122		
Independent Metals Company	747 S Monroe St. Seattle, WA	206-763-9033		
Intechra	2940 Eisenhower St Carrolton, TX	972-389-5865		
Jaco Environmental		800-414-5072		
Keppler Feed and Recycling	16442 SE Renton- Issaquah Rd Renton, WA	425-226-5239		
King & Bunny's Appliance	4608 NE Sunset Blvd. Renton, WA	425-277-0600		
L&L Appliance	1336 W Main St. Auburn, WA	253-939-9338		

APPENDIX TABLE A-5
List of Additional Debris Processing and Disposal Resources – White Goods

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
Major Brand Appliances	34419 Pacific Hwy S Federal Way, WA	253-838-7056		
Mom's Appliance	13429 Highway 99 Everett, WA	425-335-3535		
Re-Use Consulting	2421 St Clair St. Bellingham, WA	360-201-6977		
Total Reclaim	2200 6th Ave. S Seattle, WA	206-343-7443		
West Seattle Recycling, Inc.	3881 16th Ave SW Seattle, WA	206-935-4255		

APPENDIX TABLE A-6
List of Additional Debris Processing and Disposal Resources – Vehicles

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
Arrow Metals Corp	6014 238th St. SE Woodinville, WA	425-481-1828	Vehicles and Major Vehicle Parts	250 tons/day
Independent Metals Company	747 S Monroe St. Seattle, WA	206-763-9033	Vehicles and Major Vehicle Parts	
Sam's Recycling	19215 Winesap Rd Bothell, WA	425-776-6265	Vehicles and Major Vehicle Parts	
Turbo Transport Towing and Recovery	623 Shelton Ave NE Renton, WA	425-830-3532	Vehicles and Major Vehicle Parts	Hauling only – max 32 cars/day

APPENDIX TABLE A-7
List of Additional Debris Cleanup and Processing Resources – Soil, Mud, and Sand

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
Allied Waste - Commercial Services & Sales	54 S Dawson St. Seattle, WA	206-332-7700	Clean Soil, Contaminated Soil	
Allied Waste - Third & Lander Recycling & Transfer Station	2733 3rd Ave S Seattle, WA	206-332-7700	Contaminated Soil	
Benchmark Recycling, Inc.	3024 S Mullen St. Tacoma, WA	253-565-1565	Clean Soil	
Bobby Wolford Trucking & Demolition	8625 219th St. SE Woodinville, WA	425-481-1800	Clean Soil	
E.I.R. Enterprise	Redmond, WA	425-392-8990	Clean Soil	
Fruhling Sand and Topsoil	1010 228th St. SW Bothell, WA	425-485-1442	Clean Soil	
Grayhawk Construction	9606 NE 180th St. Bothell, WA	425-402-4122	Clean Soil, Contaminated Soil	
LaFarge North America, Inc.	5400 W. Marginal Wy SW Seattle, WA	206-937-8025	Contaminated Soil	
Lloyd Enterprises	80 5th Ave. Milton, WA	253-874-6692	Clean Soil	
Pacific Topsoils, Inc. - Bellevue	1733 127th Ave NE Bellevue, WA	800-884-7645	Clean Soil	
Pacific Topsoils, Inc. - Issaquah	9830 Renton Issaquah Rd SE Issaquah, WA	800-884-7645	Clean Soil	
Pacific Topsoils, Inc. - Kenmore	7500 NE 175th St Kenmore, WA	800-884-7645	Clean Soil	
Pacific Topsoils, Inc. - Maltby	8616 219th St SE Woodinville, WA	800-884-7645	Clean Soil	
Pacific Topsoils, Inc. - Maple Valley	21501 SE Lake Francis Rd. Maple Valley, WA	800-884-7645	Clean Soil	
Pacific Topsoils, Inc. - Mill Creek	13517 35th Ave. SE Mill Creek, WA	800-884-7645	Clean Soil	
Pacific Topsoils, Inc. - Seattle	1212 N 107th Seattle, WA	800-884-7645	Clean Soil	

APPENDIX TABLE A-7
List of Additional Debris Cleanup and Processing Resources – Soil, Mud, and Sand

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
Pacific Topsoils, Inc. - Smith Island	3000 W Frontage Rd. Everett, WA	800-884-7645	Clean Soil	
Pacific Topsoils, Inc. - Tukwila	6000 S 129th St Seattle, WA	206-772-3091	Clean Soil	
Palmer Coking Coal Co.	31407 Hwy 169 Black Diamond, WA	360-886-2841	Clean Soil	
Rinker Materials-Everett	6300 Glenwood Ave. Everett, WA	425-355-2113	Clean Soil	
Rinker Materials-Snohomish	19000 Yew Way Snohomish, WA	425-348-6396	Clean Soil	
Rivers Edge Services Inc.		253-872-8988	Clean Soil	
Topsoils, Inc.	18827 Yew Way Snohomish, WA	425-485-0355	Clean Soil	

APPENDIX TABLE A-8
List of Additional Debris Processing and Disposal Resources – Putrescibles

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
Contact Local Health Agency.				

APPENDIX TABLE A-9
List of Additional Debris Processing and Disposal Resources – Infectious Waste

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
Consult Local Health Agency				
Steriecycle	830 Westland Avenue Morton, WA 98356	360-496-5988	Medical Waste Recycling	

APPENDIX TABLE A-10
List of Additional Debris Processing and Disposal Resources – Hazardous Waste

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
AmeriGas	Various Locations	253-872-7613	Propane Tanks	
Blue Rhino	Various Locations	360-273-2971	Propane Tanks	
City of Seattle North Hazardous Waste Facility		206-296-4692	Cleaners, paints and solvents, pesticides and herbicides, pool chemicals, medicines, and cosmetics.	1,000 gallons a day assuming ability to transport waste daily. Limited by size of site
City of Seattle South Hazardous Waste Facility	8105 5th Ave. S. Seattle, WA	206-296-4692	Cleaners, paints and solvents, pesticides and herbicides, pool chemicals, medicines, and cosmetics.	2,000 gallons a day assuming ability to transport waste daily. Limited by size of site.
Ecolights Northwest, LLC	1915 S. Corgiat Drive Seattle, WA			
Emerald Services		206-832-3000	Oil, batteries, light bulbs, paint	
Factoria Household Hazardous Waste Drop-Off Service	13800 SE 32nd St Bellevue, WA	206-296-4692	Cleaners, paints and solvents, pesticides and herbicides, pool chemicals, medicines, and cosmetics.	2,500 gallons a day
LRI Hidden Valley Household Hazardous Waste Facility	17925 Meridian Street East Puyallup, WA	253-847-7555	Moderate Risk Waste	
Phillips Services Corporation	5400 Denver Ave. Seattle, WA	253-872-8030	Cleaners, paints and solvents, pesticides and herbicides, pool chemicals, medicines, and cosmetics.	Can process 800 drums (55 gallon) of paint, 40 drums of batteries, 500 drums of aeresol, 900 drums of household cleaners
Phillips Services Corporation	1701 E. Alexander Ave Tacoma WA 98421	253-627-7568	Service Area: ID, MT, OR, WA Permitted TSDF & Moderate Risk Waste Facility	
Snohomish Moderate Risk Waste Facility	3434 McDougal Ave Everett, WA 98201	425-388-6050	Moderate risk waste	
City of Tacoma Household Hazardous Waste	3510 South Mullen St Tacoma, WA	253-591-5418	Household hazardous waste	

APPENDIX TABLE A-11
List of Additional Debris Processing and Disposal Resources – Electronics

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
3RTechnology, LLC		206-957-2682	Audio/Video, Cameras/Supplies, CDs/Floppies, Cell Phones, Circuit Boards, Computer Monitors, Computer Printers/Peripherals, Computers and Laptops, Copier/Fax Machines, PDAs/Pagers, TVs	200 tons a year
Allied Waste - Third & Lander Recycling & Transfer Station	2733 3rd Ave S Seattle, WA	206-332-7700	Computer Monitors, TVs	
Allied Waste - Black River Facility	501 Monster Road SW Renton, WA	206-332-7700	Computer Monitors, TVs	
AMS Laser and Copier Systems	15106 10th Ave. SW Burien, WA	206-764-3344	Computer Printers/Peripherals	
Catharine Blaine Charity	PO Box 77425 Seattle, WA	206-367-8097	Computer Printers/Peripherals, Computers and Laptops	
Computer Recycling Service, Inc.	7507 Aurora Ave N. Seattle, WA	425-957-1211	CDs/Floppies, Cell Phones, Circuit Boards, Computer Monitors, Computer Printers/Peripherals, Computers and Laptops	
Computer Equipment Resources Corp.	20212 87th Ave S Kent, WA	425-880-4602	Audio/Video, Cell Phones, Computer Monitors, Computer Printers/Peripherals, Computers and Laptops, Copier/Fax Machines, PDAs/Pagers, TVs	
George Electronix (NW Vacuum TV & VCR)	15015 Main St #109 Bellevue, WA	425-643-0726	Audio/Video, Computer Monitors, Computer Printers/Peripherals, Computers and Laptops, Copier/Fax Machines, TVs	
GreenDisk Inc.	1988 18th Avenue NE Issaquah, WA	800-305-3475	Audio/Video, CDs/Floppies, Cell Phones, Computer Monitors, Computer Printers/Peripherals, Computers and Laptops, PDAs/Pagers	
Ecodisk	601 Valley Ave. NE Puyallup, WA	253-471-1800	Cameras/Supplies, CDs/Floppies	

APPENDIX TABLE A-11
List of Additional Debris Processing and Disposal Resources – Electronics

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
Hallmark Refining	1016 Dale Lane Mt. Vernon, WA		Computer Monitors, Computers and Laptops	
Happy Hauler, LLC	Seattle, WA	206-784-0313	Cell Phones, Computer Monitors, Computer Printers/Peripherals, Computers and Laptops, Copier/Fax Machines, PDAs/Pagers, TVs	
InterConnection Computer Reuse and Learning Center	2222 N Pacific St Seattle, WA	206-633-1517	Cell Phones, Computer Monitors, Computer Printers/Peripherals, Computers and Laptops, PDAs/Pagers	
Office Depot	Various		Cameras/Supplies, Cell Phones, Computer Monitors, Computer Printers/Peripherals, Computers and Laptops, Copier/Fax Machines, PDAs/Pagers	
Offshore Scrap Iron		206-730-2592	CDs/Floppies, Cell Phones, Circuit Boards, Computer Monitors, Computer Printers/Peripherals, Computers and Laptops	
Omegareign Corporation 206-501-6529			Audio/Video, Cameras/Supplies, CDs/Floppies, Cell Phones, Circuit Boards, Computer Monitors, Computer Printers/Peripherals, Computers and Laptops, Copier/Fax Machines, PDAs/Pagers, TVs	
PC Recycle - Federal Way	29100 Pacific Hwy. S Federal Way, WA	253-839-9377	Audio/Video, Cell Phones, Computer Monitors, Computer Printers/Peripherals, Computers and Laptops, Copier/Fax Machines, PDAs/Pagers, TVs	Company handles approximately 2,000 units a day. Sorting facility is in Bellevue.
PC Recycle - Bellevue	13107 NE 20th Bellevue, WA	425-881-4444	Audio/Video, Cell Phones, Computer Monitors, Computer Printers/Peripherals, Computers and Laptops, Copier/Fax Machines, PDAs/Pagers, TVs	Company handles approximately 2,000 units a day. Sorting facility is in Bellevue.

APPENDIX TABLE A-11
List of Additional Debris Processing and Disposal Resources – Electronics

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
PC Recycle – Marysville	11603 State Ave. Suite D Marysville, WA 98270	360-659-6131		
PC Trades	30012 24th Ave. SW Federal Way, WA	253-661-1083	Computer Monitors, Computer Printers/Peripherals, Computers and Laptops	
Philip Services Corp - Georgetown Site	5400 Denver Ave. Seattle, WA	800-228-7872	CDs/Floppies, Cell Phones, Circuit Boards, Computer Monitors, Computer Printers/Peripherals, Computers and Laptops, Copier/Fax Machines, PDAs/Pagers, TVs	
Philip Services Corp - Kent Site	20245 77th Ave. S Kent, WA	800-228-7872	CDs/Floppies, Cell Phones, Circuit Boards, Computer Monitors, Computer Printers/Peripherals, Computers and Laptops, Copier/Fax Machines, PDAs/Pagers, TVs	
RE-PC Recycled Computers and Peripherals	510 Andover Park W Tukwila, WA	206-575-8737	Audio/Video, Cell Phones, Computer Monitors, Computer Printers/Peripherals, Computers and Laptops, Copier/Fax Machines, PDAs/Pagers, TVs	
RE-PC Recycled Computers and Peripherals	510 Andover Park W Tukwila, WA	206-623-9151	Audio/Video, Cell Phones, Computer Monitors, Computer Printers/Peripherals, Computers and Laptops, Copier/Fax Machines, PDAs/Pagers, TVs	
Santamaria and Sons, Inc.	Ravensdale, WA	360-886-2064	Cell Phones, Computer Monitors, Computer Printers/Peripherals, Computers and Laptops, Copier/Fax Machines, PDAs/Pagers	
Total Reclaim	2200 6th Ave. S Seattle, WA	206-343-7443	Audio/Video, Cell Phones, Computer Monitors, Computer Printers/Peripherals, Computers and Laptops, Copier/Fax Machines, PDAs/Pagers, TVs	Capacity of around 1,000 tons a month

APPENDIX TABLE A-11
List of Additional Debris Processing and Disposal Resources – Electronics

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
Vashon Reclaim and Recycle	Vashon Island, WA	206-734-4815	Cell Phones, Computer Monitors, Computer Printers/Peripherals, Computers and Laptops, Copier/Fax Machines, PDAs/Pagers, TVs	
Wilderness Technology Alliance	206 SW 112th St Seattle, WA	206-242-9505	Computer Monitors, Computers and Laptops	
World Village Network	1203 NE 96th Street Seattle, WA	206-661-1909	Cell Phones, PDAs/Pagers	

APPENDIX TABLE A-12
List of Additional Debris Processing and Disposal Resources – Chemical, Biological, Radiological, and Nuclear Contaminated Debris

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
EPA National Response Center		1-800-424-8802	Detection, Assessment, Removal	EPA has access to contractors who can assist with all types of contaminated debris.

APPENDIX TABLE A-13
List of Additional Debris Processing and Disposal Resources – Hog Fuel Burners

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
Grays Harbor Paper	Aberdeen, WA	877-340-9335		
Hampton Lumber Mills	Darrington, WA Morton, WA Randle, WA	Doug Cooper 503-545-7167	Hampton doesn't usually need to purchase additional hog fuel but may be able to handle excess hog fuel at the Darrington mill depending on the time of year and market conditions.	Storage: Unlimited Usage: 2,000 tons/day
Kimberly Clark	Everett, WA	Jim Short 425-259-7469	Limberly Clark purchases hog fuel for their Everett mill.	Storage: 100,000 tons Usage: 2,000 tons/day
Longview Fiber	Longview, WA	360-425-1550		
Sierra Pacific Industries	Burlington, WA	530-378-8000		
Simpson Tacoma Kraft	Tacoma, WA	Greg Narim 253-596-0234 Steve Reglin 253-596-0323	Simpson purchases hog fuel for a regeneration boiler located on the Tacoma Tide Flats.	Storage 20,000 tons Usage: 6,000 tons/day

APPENDIX TABLE A-14
List of Additional Debris Processing and Disposal Resources – Debris Clearance Resources

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
Atkinson Construction	Pacific Northwest	Emergency: 206-730-1828 Contracting: Forrest Dill 425-255-7551	Heavy construction and material clearance Subcontractor management	Available for Emergency and Pre-Contract Debris Clearance
Icon Materials	King and Pierce Counties	Contracting: 206-574-3903	Heavy construction and material clearance Subcontractor management	30,000 tons a year Available for Emergency and Pre-Contract Debris Clearance
Scarsella Brothers	Pacific Northwest	Contracting: 253-872-7173 Emergency: 206-817-0978	Heavy construction and material clearance Subcontractor management	Available for Emergency and Pre-Contract Debris Clearance
Tucci	Pierce County	Contracting: Dan Glover 253-922-6676 Emergency: Josh LeJeune 253-922-6676 253-377-0791	Heavy construction and material clearance	Available for Emergency and Pre-Contract Debris Clearance
Wilder Construction Company	Pacific Northwest	Emergency: 866-551-6089 Contracting: Steve Harding 425-551-3100	Heavy construction and material clearance Subcontractor management	Available for Emergency and Pre-Contract Debris Clearance

APPENDIX TABLE A-15
List of Additional Debris Processing and Disposal Resources – Inert Waste Landfills

Name	Address	Phone	Type	Verified Processing/Disposal Capacity
Hampton Lumber Mills - WA, Inc.	46921 Sauk Prarie Rd Darrington, WA 98241		Woodwaste landfill	
Rinker Materials	19000 Yew Way Snohomish, WA 98290	425-348-6396	Inert/Demolition Waste Facility	
Son Cedar Woodwaste Landfill	510 Clear Creek Road Darrington, WA 98241		Woodwaste landfill	
Wm. Dickson Waller Road Inert Waste Landfill	2839 48th SE Tacoma, WA	253-922-3296	Inert Landfill	
Wm. Dickson Tyler Street CDL Inert Waste Landfill	4925 S. Tyler Street Tacoma, WA	253-922-3296	Inert Landfill	
Woodworth & Company Inc.	2800 104th St Ct S	253-383-3585	Inert Landfill	

APPENDIX B

Online Resources

Sources of Applicable Legislation

Federal

CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act, U.S. Environmental Protection Agency:
http://www.epa.gov/superfund/policy/cercla.htm

Clean Air Act, U.S. Environmental Protection Agency:
http://www.epa.gov/air/caa/

Clean Water Act, U.S. Environmental Protection Agency:
http://www.epa.gov/r5water/cwa.htm

Coastal Zone Management Act, National Oceanic and Atmospheric Administration:
http://coastalmanagement.noaa.gov/czm/czm_act.html

Endangered Species Act, U.S. Fish and Wildlife Service:
http://www.fws.gov/endangered/

ESF #3: Public Works and Engineering Annex, Federal Emergency Management Agency, Department of Homeland Security: www.fema.gov/pdf/emergency/nrf/nrf-esf-03.pdf.

ESF #14: Long-Term Community Recovery and Mitigation Annex, Federal Emergency Management Agency, Department of Homeland Security: www.fema.gov/pdf/emergency/nrf/nrf-esf-14.pdf.

National Environmental Policy Act:
http://www.nepa.gov/nepa/regs/nepa/nepaeqia.htm

National Historic Preservation Act:
http://www.achp.gov/nhpa.html

RCRA (Resource Conservation and Recovery Act), U.S. Environmental Protection Agency:
http://www.epa.gov/rcraonline/

Stafford Act, Public Law 93-288, FEMA:
http://www.fema.gov/about/stafact.shtm

State of Washington

Clean Air Act, Puget Sound Clean Air Agency:
http://www.pscleanair.org/regulated/businesses/regulations.aspx

Clean Air Act, RCW 70.94:
http://www.pscleanair.org/regulated/businesses/regulations.aspx

Archaeological Sites and Resources, Department of Archaeology and Historic Preservation, RCW 27.53:
http://apps.leg.wa.gov/RCW/default.aspx?cite=27.53
http://www.dahp.wa.gov/pages/EnvironmentalReview/Laws.htm

Emergency Powers, RCW 43.06.210:
http://apps.leg.wa.gov/RCW/default.aspx?cite=43.06.210

Endangered Species Act, RCW 77.12.020, Designation of Threatened and Endangered Species:
http://apps.leg.wa.gov/RCW/default.aspx?cite=77.12

Endangered Species Act, RCW 77.85, Salmon Recovery:
http://apps.leg.wa.gov/RCW/default.aspx?cite=77.85

Shoreline Management Act of 1971:
http://apps.leg.wa.gov/RCW/default.aspx?cite=90.58

Solid Waste Management – Reduction and Recycling:
http://apps.leg.wa.gov/RCW/default.aspx?cite=70.95

State Environmental Policy Act, RCW 43.21C:
http://apps.leg.wa.gov/RCW/default.aspx?cite=43.21c

Water Pollution Control, RCW 90.48:
http://apps.leg.wa.gov/RCW/default.aspx?cite=90.48

Debris Management Resources

California Integrated Waste Management Board - Integrated Disaster Waste Management Plan: Incorporating guidance on disaster debris management for local governments
http://www.ciwmb.ca.gov/Disaster/DisasterPlan/default.htm

FEMA 322 Public Assistance Guide – June 2007:
http://www.fema.gov/government/grant/pa/pag07_t.shtm

FEMA 325 Debris Management Guide – July 2007:
http://www.fema.gov/government/grant/pa/demagde.shtm

FEMA 329 – Debris Management Brochure:
http://www.fema.gov/government/grant/pa/dmgbroch.shtm

FEMA Debris Management Pilot Program:
http://www.fema.gov/pdf/government/policy/pa_pilot_pg.pdf

Miscellaneous Resources

EMAC (Emergency Management Assistance Compact) – Through EMAC, a disaster-impacted state can request and receive assistance from other member states quickly and efficiently, resolving two key issues upfront: liability and reimbursement.
http://www.emacweb.org/

FEMA – Hazard Mitigation Planning home page provides guidance on a mitigation planning process; a complete list of approved local, state, and tribal FEMA-approved mitigation plans is available online.
http://www.fema.gov/plan/mitplanning/index.shtm

NIMS Training Requirements – available at FEMA Web site:
http://www.fema.gov/emergency/nims/nims_compliance.shtm

NIMS 5-Year Training Plan:
http://www.fema.gov/library/file?type=publishedFile&file=fiveyear_nims_training_plan__2008_final.pdf&fileid=d22c87b0-e4a6-11dc-ae21-001185636a87

NWWARN (Northwest Warning Alert and Response Network) – Web site:
http://nwwarn.org/

RPIN (Regional Public Information Network) – Web site:
http://www.rpin.org/rpinweb/

U.S. EPA – Search this EPA database to locate a Local Emergency Planning Committee (LEPC). An LEPC works to understand chemical hazards in the community, develop emergency plans in case of an accidental release, and look for ways to prevent chemical accidents.
http://yosemite.epa.gov/oswer/LEPCDb.nsf/HomePage?openform

Washington State Department of Labor and Industries – Debarred Contractors Web site:
http://www.lni.wa.gov/TradesLicensing/PrevWage/AwardingAgencies/DebarredContractors/

Washington Public Assistance Damage Assessment – For information on downloading Preliminary Damage Assessment (PDA) forms, click on the following link:
http://www.emd.wa.gov/

Washington State University Agricultural Extension:
http://ext.wsu.edu/locations/

APPENDIX C

Debris Mitigation Strategies

This appendix identifies mitigation strategies that can be taken prior to a debris-causing incident to decrease the amount of debris that will be created. Selected construction and safety standards can be incorporated into building codes and regulations that address protecting buildings from potential hazards and generating debris.

Building Codes

A building code requires that a building or facility be located, designed, and constructed so that any threat to life, health, and welfare of its occupants and the public is minimized or prevented. Over and over again, the enforcement of effective building codes has had the greatest impact on the quality of construction and how structures will withstand the forces of nature.

Structural Retrofitting

Retrofitting consists of upgrading the safety of a building through structural and nonstructural mitigation techniques. The technique is used on existing structures to make them more resistant to seismic activity, ground motion, or soil failure due to earthquakes. Retrofit techniques have also been applied to areas subject to tornadoes, severe winds, and flooding.

Examples of methods used for retrofitting are as follows:

- Structural reinforcement of unreinforced masonry buildings
- Raising structures located in a floodplain
- Requiring anchors for external storage tanks such as propane, heating oil, and diesel tanks

Zoning Regulations That Prevent Building in Floodplains

Floodplain regulations are a mitigation technique used to protect human life and health, minimize damage to public and private property, reduce public expenditures for both flood control works and flood damage relief, maintain the stability of the tax base, and reduce surface and groundwater pollution. Communities may adopt more stringent standards than those set forth by FEMA.

Elevating Structures in Floodplains

The elevation of a building above the base flood elevation is the best onsite protection strategy. Buildings can be raised to allow water to run underneath, or fill material can be used to elevate a site. Elevating a structure on posts or pilings does not remove a building

from the Special Flood Hazard Area. If the ground around the supporting posts or pilings is in the floodplain, the building is still at risk.

Relocating Structures in Floodplains

Moving structures out of the floodplain are the surest and safest way to protect against damage. Relocation can be expensive, but this approach has been used in the Seattle UASI Region in the past.

Tree and Vegetation Trimming

Vegetation is the primary source of debris from severe wind storms. Recycling or disposing of this debris after an incident can be costly, and residential burning may have a negative effect on air quality. Jurisdictions are encouraged to identify and remove hazardous vegetation that can impact critical access routes, utilities, and other infrastructure during a severe wind storm.

Special Waste Mitigation

Special waste, including industrial waste, white goods, and household hazardous waste (HHW), all require special handling during debris processing, which greatly increases the cost of debris operations and may decrease the amount of debris that can be recycled.

Household Hazardous Waste Roundups

HHW is a major consideration during debris processing and cleanup operations. Events such as household hazardous waste roundups, if scheduled on a regular basis, can help to reduce the amount of HHW that has to be processed during a debris-causing incident.

Securing Aboveground Tanks

Aboveground storage tanks are often not secured or secured poorly and can be displaced during flood incidents, causing their contents to spill. Securing these tanks is an easy way to protect the environment during flood incidents.

APPENDIX D

Operational Debris Management Plan Outline

I. Introduction

- A. Mission
- B. Scope
- C. Purpose
- D. Alignment with Other Plans

II. Situation and Assumptions

- A. Types of Hazards
- B. Debris Estimates
    1. Estimated Debris Types
    2. Estimated Debris Locations

III. Current Resources

- A. Staff
- B. Equipment
- C. Technology
- D. Private Contracts
    1. List of Standby or Pre-Qualified Contractors
- E. Mutual Aid Agreements
- F. Interagency Agreements
- G. Landfills
    1. Locations
    2. Capacity
    3. Types of Debris Accepted
- H. Recycling/Composting Facilities
    1. Locations
    2. Types of Debris Accepted

IV. Staff Roles and Responsibilities

A. Staffing Organizational Chart

B. Roles and Responsibilities

1. Staffing Assignments and Duties
2. Administration
3. Contracting and Procurement
4. Legal
5. Operations
6. Engineering

C. Emergency Communications Strategy

D. Health and Safety Strategy and Procedures

E. Training Schedule

V. Debris Collection Operations

A. Debris Removal Priorities

1. Transportation Routes
    a) Expected Conditions
    b) Priority Clearing Routes
2. Critical Infrastructure
3. Utility Corridors
4. Major Arterial Routes
5. Key Economic Routes
6. Minor Arterials
7. Residential/Rural Routes

B. Recovery Operations

1. Collection Methods
    a) Curbside
    b) TDSR Site or Drop Box

C. Temporary Debris Sorting and Reduction Sites

1. Site Management

a) Site Manager
b) Monitoring Staff and Assignments
c) Safety Personnel

D. Establishment and Operations Planning
1. Permits
2. TDSR Site Locations
a) Baseline Data for Each Location
b) Ingress/Egress for Sites
c) Individual Site Plans
3. Site Preparation
4. Volume Reduction Methods
a) Incineration
b) Grinding and Chipping
5. Recycling
6. Environmental Monitoring Program
7. Site Closure

VI. Contracted Services

A. Emergency Contracting/Procurement Procedures
B. Debris Operations to be Outsourced
C. General Contract Provisions
D. Qualification Requirements
E. Solicitation of Contractors

VII. Private Property Demolition and Debris Removal

A. Condemnation Criteria and Procedures
1. Legal Documentation
2. Demolition Permitting
3. Inspections
B. Mobile Home Park Procedures
C. Navigation Hazard Removal Procedures

VIII. Public Information Strategy

A. Public Information Officer

B. Pre-scripted Information

C. Distribution Strategy

D. Message Maps

IX. Appendix A: Maps

A. Lifeline Maps

B. Critical Infrastructure

C. Temporary Debris Sorting and Reduction Sites

D. Staging Areas

E. Landfills and Recycling Facilities

X. Appendix B: Decision Trees

A. TDSR Site Activation

B. Structure Removal

XI. Appendix C: Contact List

A. Employees

B. Contractors

C. State Contacts

D. Federal Contacts

XII. Appendix D: Sample Forms

A. Notice to Public

B. Intergovernmental Emergency Mutual Aid Agreement

C. Time and Materials Contract

D. Lump Sum Contract

E. Unit Price Contract

F. Right-of-Entry Agreement

G. Hold Harmless

H. Insurance Coverage

I. Debris Load Slips

J. Load Checking Form

APPENDIX E

Temporary Debris Sorting and Reduction Site Planning

Temporary debris sorting and reduction (TDSR) sites are used to temporarily store, sort, recycle, and reduce disaster debris. TDSR sites help control the operational, environmental, and public health cost and impact of processing debris by consolidating operations to pre-identified locations.

Site Selection

The location of possible TDSR sites should be identified prior to an event so appropriate steps can be taken to asses and inventory the site and ensure all relevant regulatory issues are addressed. Planning staff should consider public lands first to avoid costly land leases. Existing disposal or recycling facilities close to the disaster area are ideal TDSR sites. Nearby landfill and recycling center capacities need to be evaluated for site feasibility. City- or county-owned sites that will not require extensive repair costs, such as parks, vacant lots, or sports fields, should be considered as well. State-to-state or county-to-county agreements may provide solutions for public land use; however, if these are not available, planning staff should develop criteria for identifying potential private property locations for the TDSR sites. Private land easements should be reviewed by the legal staff to avoid extensive damage claims upon site closeout. Additional selection considerations for TDSR sites include the following:

- Location that is close to the sources of disaster debris
- Identify reuse and recycling possibilities, such as timber agreements, mulch and chip disposal in the agriculture community and fuel sources for incinerators or heating. Recycling success will depend on the types of debris and the local recycling environment.
- Hard preferably non-porous surface such as a paved parking lot
- Large enough to accommodate a storage area, a sorting area, and volume reduction operation area
- Accessible by main transportation routes with good ingress/egress to accommodate heavy truck traffic
- Outside of environmentally sensitive areas, such as wetlands or well-fields

Inventory of Possible TDSR Sites

Once possible TDSR sites have been identified, jurisdictions should conduct a thorough assessment of each site and develop plans to be implemented if the site is used during debris operations. Detailed information should be collected for each site, including:

- Exact location
- Size
- Available ingress and egress routes
- TDSR site plan
- Permits as outlined below
- Results of a baseline environmental assessment and initial data samples

Other things to consider during the site selection are the following:

- Identify nearby landfills and determine their present debris capacity and logistical capabilities. Also include any state-to-state or county-to-county agreements.
- Consider adjusting traffic signals to accommodate projected truck traffic on critical haul routes.
- Review local, tribal, and state ordinances covering such items as tarps and tailgates on trucks, traffic control, truck priority, curfew, defining roadway rights-of-way, and load limits. Coordinate with responsible agencies to develop waiver procedures if necessary to expedite emergency operations.
- Clearly show critical routes and priorities for clearing debris on local maps. Target emergency routes for local, tribal, state, or federal clearance efforts. Geographic information system (GIS) mapping should be used as a tool, if available.

Jurisdictions should review these lists of TDSR sites annually and update them, as necessary, as part of their routine plan maintenance.

Environmental Baseline Study

Land used as a TDSR site should be returned to its original condition following site closeout. Baseline data are essential to document the condition of the land before it was used as a debris storage and reduction site. As soon as a site is selected, the designated debris manager and staff should work closely with local, tribal, and state officials to develop baseline data. The following actions should be taken to develop baseline data on all selected sites:

- Videotape and photograph the site
- Document physical features
- Sample soil and water
- Sketch the site operation layout
- Document quality assurance issues
- Plan environmental remediation

In addition to the above actions, jurisdictions should work with local public health and environmental protection authorities to ensure all applicable permits are secured for each site.

Clearance by Local Health Department/District

Sites shall be selected, managed and monitored in cooperation with and in accordance with the jurisdiction's local health agency and following all applicable requirements in order to prevent threats to the environment or public health. In addition the local health agency should be notified as part of TDSR site activation.

Applicable National Environmental Policy Act (NEPA)/State Environmental Policy Act (SEPA) Guidelines

Because the establishment of TDSR sites is considered a recovery activity all applicable environmental and public health laws and regulations should be followed during the siting, operation, and closeout of TDSR sites.

Section 106 of the National Historic Preservation Act (NHPA) requires federal agencies to consider the effects of their proposals on historic properties, and to provide state historic preservation officers, tribal historic preservation officers, and, as necessary, the Advisory Council on Historic Preservation, with a reasonable opportunity to review and comment on these actions. Section 106 review and NEPA are two separate, distinct processes. Chapter 3 of this plan provides a more detailed discussion of legislative considerations prior to establishing TDSR site operations.

Permits

Environmental permits and land use variances may be required to establish a temporary TDSR site. Several agencies may be involved in issuing permits and granting land use approvals. The planning process should identify which permits would be required to establish a facility. A listing of the permits should be part of the debris management plan and may include the following, depending on local regulations:

- Temporary land use permits
- Land use variances
- Traffic circulation strategies
- Puget Sound Clean Air Agency air quality permits
- Water quality permits
- National Pollution Discharge Elimination System (NPDES) permits
- Household hazardous waste permits
- Fire department permits
- Solid waste handling permit

TDSR Site Design

Information gathered during the baseline data collection becomes important to the design of the site. Additional concerns, such as site operations and closure criteria, need to be

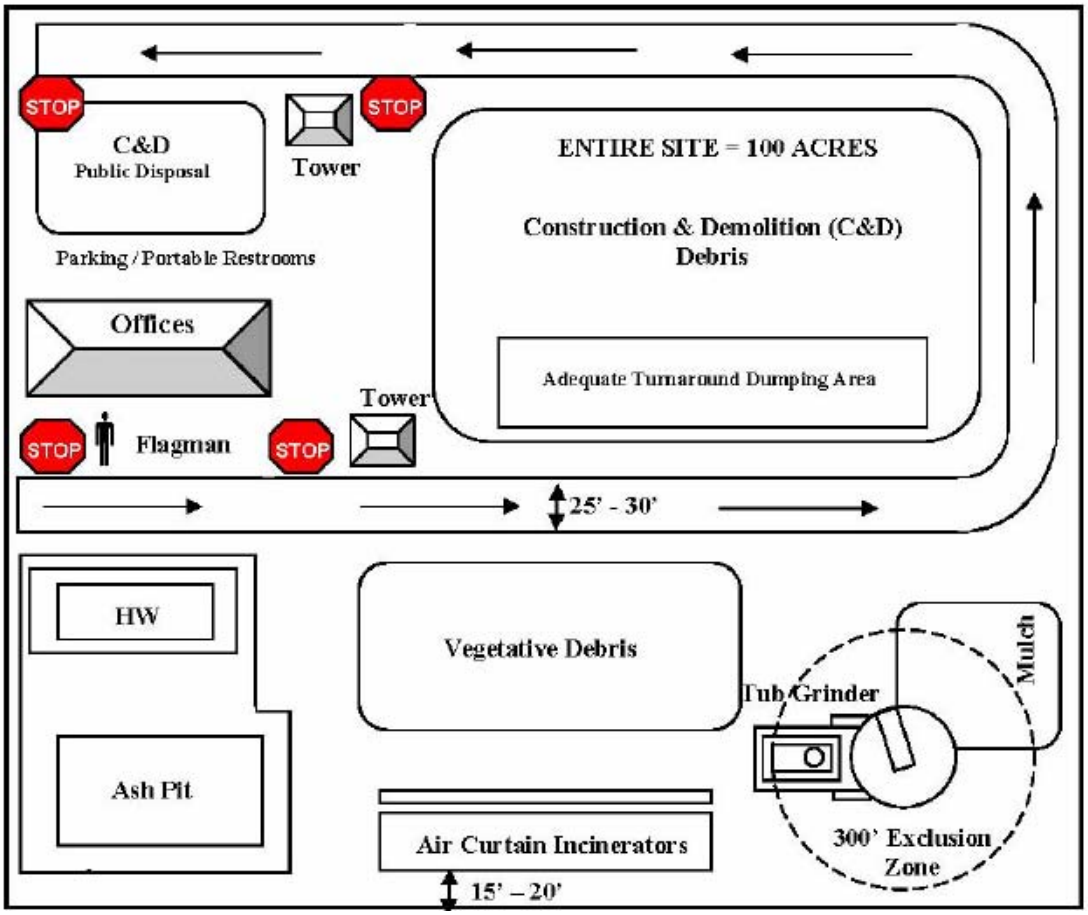
considered when the site is designed. Many of these issues can be addressed during planning, but will be implemented after the debris-generating event occurs.

Site Layout

The efficiency and the overall success of the TDSR site operations are determined by how the site is designed. Significant accumulation of debris should not be allowed to occur at temporary storage sites because of environmental and safety concerns, such as the risk of fire. Moreover, permits for such sites may impose maximum capacity restrictions. Additional debris management sites may be necessary if actual debris quantities flowing into the site are greater than the site storage and processing capacity.

Site Preparation

Develop a Memorandum of Understanding, a Memorandum of Agreement, or lease/use agreement if required. Establish lined temporary storage areas for materials (including ash, household hazardous waste, fuels, and other materials) that can contaminate soils, groundwater, and surface water. Set up plastic liners, when possible, under stationary equipment such as generators and mobile lighting plants. This should be included as a requirement in the scope of work if TDSR site preparation will be contracted out. The topography and soil/substrate conditions should be evaluated to determine the best site



Example of a TDSR site layout.

layout. When planning site preparation, the designer should consider ways to make site closure and restoration easier. Upon site closeout, the uncontaminated soil can be re-spread to preserve the integrity of the tillable soils. Operations that modify the landscape, such as substrate compaction and over-excavation of soils when loading debris for final disposal, adversely affect landscape restoration. Identify who would be responsible for updating the initial baseline data and develop an operation layout to include ingress and egress routes.

Operational Boundaries

Operational boundaries are the boundaries or areas that clearly define the different use areas on the TDSR site. In establishing the operational boundaries, the TDSR site design staff may consider using earthen berms, temporary barriers, or other physical restrictions. This aids traffic circulation and keeps the backlog of debris to a minimum.

Common operational areas include the following:

- Reduction
- Recycling
- Tipping areas (unloading)
- Loading areas for processed debris to go to its final disposition
- Drop-off centers for the public (this may include vegetative, recycling, or construction and demolition debris)
- Household hazardous waste storage
- Monitoring tower and/or scales locations at both the ingress and egress points
- Equipment, fuel, and water storage

Separation of the areas listed above should be clearly delineated and defined. Maximum separation helps to reduce conflicts in use. As operations proceed, these areas may change as the type of debris changes. The reduction, recycling, tipping, and loading areas need ample room for large equipment operations. The design should consider the possibility of multiple pieces of equipment engaging in the same activity at one time. Depending on the scale of operations, each debris stream may have its own tipping area and should be designed accordingly.

General public drop-off areas for recycling, reduction, and construction and demolition debris may be included within a TDSR site. These public use areas should be carefully designed for passenger vehicle traffic and public safety. Account for all weight or volume of materials received from public drop-off to ensure accurate and complete records for all debris received to the site by source.

Household hazardous waste storage should be located in a safe location close to the public drop-off center, yet restricted, so that qualified personnel can process the waste appropriately. The design staff may consider constructing an impermeable lining and earthen berms to contain spills and prevent surface water runoff from leaving the area.

Monitoring towers should be located at ingress and egress points. Monitoring towers should be constructed of durable structural materials. The structures should be designed to withstand active and static loads. A stepladder is not an acceptable monitoring tower.

Equipment and fuel should have a designated storage area and signs posted appropriately. The fuel storage areas need to be designed to contain spills. Water should be readily available throughout the site at all times for dust and fire suppression and identified appropriately.

Site Operation

Site preparation and operation may be managed by the jurisdiction or a contractor. To meet overall debris management strategy goals and to ensure that the site operates efficiently, site management should be under the direction of the local jurisdiction. In either situation, a site manager, debris monitors, and safety personnel are needed to ensure safe and efficient operations.

Site Manager

The site manager is responsible for supervising day-to-day operations, maintaining daily logs, preparing site progress reports, and enforcing safety and permitting requirements during site operations. The site manager is also responsible for scheduling the environmental monitoring and updating the site layout. The site manager has oversight of the activities of the debris removal contractors and the onsite debris processing contractors to ensure that they comply with the terms of their contracts.

Environmental Monitoring Program

Additional data should be collected continuously during site operations in support of site closeout and for quality assurance reasons. The data can be compared to the previously established information in order to determine any remediation that may be necessary.

TDSR site operations may grow, shrink, or shift on the site. It is important to track reduction, hazardous waste collection, fuel, and equipment storage in order to sample soil and water for contaminants. Periodically map or sketch activity locations so that areas of concern can be pinpointed later for additional sampling and testing.

If the site is also an equipment staging area, monitor fueling and equipment repair to prevent and mitigate spills (e.g., petroleum products and hydraulic fluids). Include clauses in the contract scope of work to require immediate cleanup by the contractor.

Traffic Patterns

Traffic circulation should be well defined throughout the entire TSDR site. Although traffic signs and barricades aid in directing traffic, the planning staff may also consider flag personnel to help direct traffic. Drivers unfamiliar with the new environments, routes, and rules will need assistance to safely navigate through the site.

Optimally, the designed traffic pattern should allow trucks to enter and exit through different access points, as long as each is monitored. Haulers are typically paid by the

volume or weight of a load. The load is evaluated when entering the site as a percentage of the full capacity of the truck. Stationing monitors at ingress and egress points ensures that every truck releases the entire load prior to leaving the site. This prevents debris left in a truck from a previous load from being counted again in a subsequent load. The empty trucks that enter the site to remove the processed (reduced) debris should enter and exit through an access point other than that of all other traffic. This reduces the site management and debris monitor confusion regarding debris being deposited or leaving the site.

Debris Monitors

Regional monitors (whether jurisdiction employees or contractors) should be placed at ingress and egress points to quantify debris loads, issue load tickets, inspect and validate truck capacities, check loads for hazardous waste, and perform quality control checks. The specific duties of the monitors would depend on how debris is collected.

Safety Personnel

Safety personnel are responsible for traffic control and ensuring that site operations comply with local, state, and federal occupational safety regulations.

Neighborhood Consideration

Be aware of and mitigate things that will irritate the neighbors such as:

- Smoke - proper construction and operation of incineration equipment.
- Dust - employ water trucks.
- Noise - construct perimeter beams.
- Traffic - proper layout of ingress and egress procedures to help traffic flow.

Document Quality Assurance Issues

During the operation of TDSR sites, document any operations that will have a bearing on site closeout, such as petroleum spills at fueling sites; hydraulic fluid spills at equipment breakdowns; discovery of household hazardous waste; and commercial, agricultural, or industrial hazardous and toxic waste storage and disposal. This information will be used during site closeout operations.

Site Closeout

After the site operations are complete, the property (either jurisdiction-owned or leased) must be restored to its pre-activity environmental state. Restoration of a site involves removing all traces of the operations and possible remediation of any contamination that may have taken place during the operations. Debris, processing equipment, storage tanks, protection berms, and other structures built on the site should be removed from the site upon completion of all debris removal and processing operations.

Site Evaluation and Restoration

Final restoration of the landscape must be acceptable to the landowner, but within reasonable expectations. Therefore, plan the landscape restoration as early as possible, preferably incorporating provisions within the lease.

The final environmental site evaluation is an extension of the environmental monitoring program. Testing similar to the testing done for the baseline study should be conducted to confirm that the site has been returned to its pre-activity state. Test samples should be taken at the same locations as those of the initial assessment and monitoring program. However, if warranted, additional test samples may be needed at other locations on or adjacent to the site.

Based on the results of the testing, additional remediation may be required before the owner takes final acceptance of the site. The lease agreement should have provisions to release the jurisdiction from future damages when the site is returned in its original condition or final acceptance is received from the owner.

APPENDIX F

Sample Forms for Debris Tracking

EXAMPLE OF DAILY OPERATIONAL REPORT

CONTRACT NO. _____

DAILY REPORT						
CONTRACTOR: CONTRACT NO:					DATE OF REPORT:	
Truck No.		Location of Work	Landfill Trips	Tonnage Totals	Local Collection Site Trips	Tonnage Totals
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
		DAILY TOTALS				

EXAMPLE OF DAILY OPERATIONAL REPORT

CONTRACT NO. _____

Date	Load Ticket #	Landfill Ticket #	Time	Truck #	Truck Weight	Actual Weight Minus Truck Weight	Eligible (Y/N)	Comments

LOAD TICKET SAMPLE

LOAD TICKET		
TICKET NUMBER:		
CONTRACT NUMBER		
CONTRACTOR		
DATE:		
DEBRIS QUANTITY		
Truck No:	**Truck Weight (ton):**	
Load Size (Tons):		
Truck Driver:		
DEBRIS CLASSIFICATION		
	Burnable	
	Non-Burnable	
	Mixed	
	Other	
LOCATION		
Section/Area:	Dumpsite	
	Time	**Inspector**
Loading		
Dumping		
Eligibility (Y/N):	Original: City/County/State Yellow: Contractor Pink: Driver Gold: FEMA	

SAMPLE TRUCK PLACARD

Company Name

Truck Number

Truck Weight

Weighed by and Date

APPENDIX G

Example of Time and Materials Contract for Debris Removal

EXAMPLE OF TIME AND MATERIALS CONTRACT FOR DEBRIS REMOVAL

ARTICLE 1.

AGREEMENT BETWEEN PARTIES

This contract is made and entered into on this the ____ day of _____, 20___, by and between the jurisdiction of_____, hereinafter called the ENTITY, and _____, hereinafter called the CONTRACTOR.

ARTICLE 2.

SCOPE OF WORK

This contract is issued pursuant to the Solicitation and Procurement on _____ for the removal of debris caused by the sudden natural or human-made disaster of _____ to _____. It is the intent of this contract to provide equipment and staff to remove all hazards to life and property in the affected communities. Cleanup, demolition, and removal will be limited to 1) that which is determined to be in the interest of public safety and 2) that which is considered essential to the economic recovery of the affected area.

The Work shall consist of the provision of equipment and labor to cleanup and remove debris as directed by the ENTITY.

ARTICLE 3.

SCHEDULE OF WORK

Time is of the essence for this debris removal contract.

Notice to proceed with the Work: The Work under this contract will commence on _____. The equipment shall be used for one hundred (100) hours, unless the ENTITY initiates additions or deletions by written change order. Based upon unit prices of equipment and labor, no minimum or maximum number of hours is guaranteed.

ARTICLE 4.

CONTRACT PRICE

The hourly rates for performing the work stipulated in the contract documents, which have been transposed from the low bidder's bid schedule, are as follows:

Equipment/Machine/Operator	Mobilization Cost	Hourly Rate	Demob. Cost	Manufacturer, Model

Total unit rate shall be given which includes maintenance. fuel, overhead, profit, and any other costs associated with the equipment.

Estimated Cost per unit of material. Only actual invoice amounts will be paid.

Labor Man-hours includes protective clothing, fringe benefits, hand tools, supervision, transportation, and any other costs.

ARTICLE 5.

PAYMENT

The ENTITY shall pay the CONTRACTOR for mobilization and demobilization if the Notice to Proceed is issued and will pay for only the Time that the equipment and manpower is actually being used in accomplishing the work. The CONTRACTOR shall be paid within thirty (30) days of the receipt of a pay estimate and verification of Work by the inspector.

ARTICLE 6.

CLAIMS

Not Applicable.

ARTICLE 7.

CONTRACTOR'S OBLIGATIONS

The CONTRACTOR shall supervise accomplishment of the Work effort directed by labor and proper equipment for all tasks. Safety of the CONTRACTOR's personnel and equipment is the responsibility of the CONTRACTOR. Additionally. the CONTRACTOR shall pay for all materials, personnel, taxes, and fees necessary to perform under the terms of the contract.

Caution and care must be exercised by the CONTRACTOR not to cause any additional damage to sidewalks, roads, buildings, and other permanent fixtures.

ARTICLE 8.

ENTITY'S OBLIGATIONS

The ENTITY's representative(s) shall furnish all information necessary for commencement of the Work and direct the Work effort. Costs of construction permits, disposal sites, and authority approvals will be borne by the ENTITY. A representative will be designated by the ENTITY for inspecting the work and answering onsite questions. This representative shall furnish the CONTRACTOR with daily inspection reports, including Work accomplished and certification of hours worked.

The ENTITY shall designate the public and private property areas where the Work is to be performed. Copies of complete "Right of Entry" forms, where they are required by State or local law for private property, shall be furnished to the CONTRACTOR by the ENTITY. The ENTITY shall hold harmless and indemnify the CONTRACTOR and his employees against any liability for any and all claims, suits, judgments, and awards alleged to have been caused by services rendered under this contract for disaster relief work unless such claims are the result of negligence on the part of the CONTRACTOR.

The ENTITY will terminate the contract for failure to perform or default by the CONTRACTOR.

ARTICLE 9.

INSURANCE AND BONDS

The CONTRACTOR shall furnish proof of Worker's Compensation Coverage, Automobile Liability Coverage, and Comprehensive General Liability Insurance (Premises-Operations. Personal Injury, etc.) as deemed necessary by the ENTITY.

Surety: The CONTRACTOR shall deliver to the ENTITY fully executed Performance and Payment Bonds in the amount of 100% of the contract amount, if required by the specifications, general or special conditions of the contract. The ENTITY will reimburse the CONTRACTOR for the costs of the bonds, the costs of which will be included in the base bid.

ARTICLE 10.

CONTRACTOR QUALIFICATIONS

The CONTRACTOR must be duly licensed in the State per statutory requirements.

THIS CONTRACT IS DULY SIGNED BY ALL PARTIES HERETO:

ENTITY (City, County, Town, Etc.)

_____ Seal CONTRACTOR
(Include Address, City, State)

by_____
the Principal of the Firm

APPENDIX H

Example of Unit Price Contract for Debris Removal

EXAMPLE OF UNIT PRICE CONTRACT FOR DEBRIS REMOVAL

ARTICLE 1.

AGREEMENT BETWEEN PARTIES

This contract is made and entered into on this the ____ day of_____, 20___, by and between the jurisdiction of _____, hereinafter called the ENTITY, and _____, hereinafter called the CONTRACTOR.

ARTICLE 2.

SCOPE OF WORK

This contract is issued pursuant to the Solicitation and Procurement on _____, for the removal of debris caused by the sudden natural or human-made disaster of _____ to _____. It is the intent of this contract to provide equipment and personnel to remove all hazards to life and property in the affected communities. Cleanup, demolition, and removal will be limited to 1) that which is determined to be in the interest of public safety, and 2) that which is considered essential to the economic recovery of the affected area.

The Work shall consist of cleanup or demolition and removal as outlined in the specifications, on drawings, and on block sector maps attached to the invitation for bid number _____.

ARTICLE 3.

SCHEDULE OF WORK

Time is of the essence for this debris removal contract.

Notice to proceed with the Work: The Work under this contract will commence on _____, 20__. Maximum allowable time for completion will be _____ calendar days, unless the ENTITY initiates additions or deletions by written change order. Subsequent changes in cost and completion time will be equitably negotiated by both parties pursuant to applicable State law. Liquidated damages shall be assessed at $_____/calendar day for any days over the approved contract amount.

ARTICLE 4.

CONTRACT PRICE

The unit prices for performing the Work stipulated in the contract documents, which have been transposed from the low bidder's bid schedule, are as follows:

Quantity	Unit of Measure	Description	Unit Cost	Total
Subtotal				$
Cost of Bonds				$
Grand Total				$

Debris shall be classified as one of the following units: cubic yards, each, square foot, Lineal foot, gallon, or an approved unit measure applicable to the specific material to be removed.

ARTICLE 5.

PAYMENT

The CONTRACTOR shall submit certified pay requests for completed Work. The ENTITY shall have ten (10) calendar days to approve or disapprove the pay request. The ENTITY shall pay the CONTRACTOR for his performance under the contract within twenty (20) days of approval of the pay estimate. On contracts over thirty (30) days in duration, the ENTITY shall pay the CONTRACTOR a pro-rata percentage of the contract amount on a monthly basis, based on the amount of work completed and approved in that month. The ENTITY will remunerate the CONTRACTOR within thirty (30) days of the approved application for payment, after which interest will be added at a rate of _____ per annum. Payments shall be subject to a retainage of _____ on each payment. Retainage shall be released upon substantial completion of the Work.

Funding for this contract is authorized pursuant to Public Law of the State of _____ _____ _____ (local statute or ordinance).

ARTICLE 6.

CLAIMS

If the CONTRACTOR wishes to make a claim for additional compensation for work or materials not clearly covered in the contract, or not ordered by the ENTITY as a modification to the contract, CONTRACTOR shall notify the ENTITY in writing. The CONTRACTOR and the ENTITY will negotiate the amount of adjustment promptly; however, if no agreement is reached, a binding settlement will be determined by a third party acceptable to both ENTITY and CONTRACTOR under the auspices of applicable State law.

ARTICLE 7.

CONTRACTOR'S OBLIGATIONS

The CONTRACTOR shall supervise and direct the Work, using skillful labor and proper equipment for all tasks. Safety of the CONTRACTOR's personnel and equipment is the responsibility of the CONTRACTOR. Additionally, the CONTRACTOR shall pay for all materials, equipment, personnel, taxes, and fees necessary to perform under the terms of the contract.

Any unusual, concealed, or changed conditions are to be immediately reported to the ENTITY. The CONTRACTOR shall be responsible for the protection of existing utilities, sidewalks, roads, buildings, and other permanent fixtures. Any unnecessary damage will be repaired at the CONTRACTORs expense.

ARTICLE 8.

ENTITY'S OBLIGATIONS

The ENTITY's representative(s) shall furnish all information, documents, and utility locations necessary for commencement of Work. Costs of construction permits and authority approvals will be borne by the ENTITY. A representative will be designated by the ENTITY for inspecting the work and answering and onsite questions.

The ENTITY shall designate the public and private property areas where the disaster mitigation Work is to be performed. Copies of complete "Right of Entry" forms, where they are required by State or local law for private property, shall be furnished to the CONTRACTOR by the ENTITY. The ENTITY shall hold harmless and indemnify the CONTRACTOR judgments and awards alleged to have been caused by services rendered under this contract for disaster relief work unless such claims are caused by the gross negligence of the CONTRACTOR, his subcontractors, or his employees.

The ENTITY will terminate the contract for failure to perform as specified. or for default by the CONTRACTOR.

ARTICLE 9.

INSURANCE AND BONDS

The CONTRACTOR shall furnish proof of Worker's Compensation Coverage, Automobile Liability Coverage, and Comprehensive General Liability Insurance (Premises-Operations, Personal Injury, etc., as deemed necessary by the ENTITY).

Surety: The CONTRACTOR shall deliver to the ENTITY fully executed Performance and Payment Bonds in the amount of one hundred percent (100%) of the contract amount, if required by the specifications. or general or special conditions of the contract. The ENTITY will reimburse the CONTRACTOR for the costs of the bonds, the costs of which will be included in the base bid.

THIS CONTRACT IS DULY SIGNED BY ALL PARTIES HERETO:

ENTITY (City, County, Town, Etc.)

_____ Seal CONTRACTOR
(Include Address, City, State)

by_____

the Principal of the Firm

APPENDIX I

Example of Lump Sum Contract for Debris Removal

EXAMPLE OF LUMP SUM CONTRACT FOR DEBRIS REMOVAL

A lump sum contract establishes a total price using a one item bid from a CONTRACTOR. It should be used only when a scope of work is clearly defined, with areas of work and quantities of material clearly identified. Lump sum contracts can be defined in one of two ways:

- *Area Method, where the scope of work is based on a one time clearance of a specified area, or*
- *Pass Method, where the scope of work is based on a certain number of passes through a specified area, such as a given distance along a right of way.*

ARTICLE 1.

AGREEMENT BETWEEN PARTIES

This contract is made and entered into on this the ____ day of_____, 20__, by and between the city/county of _____, hereinafter called the ENTITY, and _____, hereinafter called the CONTRACTOR.

ARTICLE 2.

SCOPE OF WORK

This contract is issued pursuant to the Solicitation and Procurement on _____. for the removal of debris caused by the sudden natural or human-made disaster of _____to _____. It is the intent of this contract to provide equipment and resources to remove all hazards to life and property in the affected communities. Cleanup, demolition, and removal will be limited to 1) that which is determined to be in the interest of public safety and 2) that which is considered essential to the economic recovery of the affected area.

The Work shall consist of cleanup or demolition and removal as outlined in the specifications on drawings and on block sector maps attached to the invitation for bid number _____.

ARTICLE 3.

SCHEDULE OF WORK

Time is of the essence for this debris removal contract.

Notice to proceed with the Work: The Work under this contract will commence on _____, 20___. Maximum allowable time for completion will be _____ calendar days, unless the ENTITY initiates additions or deletions by written change order. If the CONTRACTOR does not complete the work within the allotted time, liquidated damages will be assessed in the amount of _____ per day.

ARTICLE 4.

CONTRACT PRICE

The lump sum price for performing the Work stipulated in the contract documents is _____ _____.

ARTICLE 5.

PAYMENT

The CONTRACTOR shall submit certified pay requests for completed work. The ENTITY shall have ten (10) calendar days to approve or disapprove the pay request. The ENTITY shall pay the CONTRACTOR for his performance under the contract within twenty (20) days of approval of the pay estimate. On contracts over 30 days in duration, the ENTITY shall pay the CONTRACTOR a

pro-rata percentage of the contract amount on a monthly basis, based on the amount of work completed and approved in that month. The ENTITY will remunerate the CONTRACTOR within thirty (30) days of the approved application for payment, after which interest will be added at a rate of _____ per annum. Payments shall be subject to a retainer of_____ on each payment. Retainer shall be released upon substantial completion of the work.

Funding for this contract is authorized pursuant to Public Law of the State of Washington and _____ (local statute or ordinance).

ARTICLE 6.

CHANGE ORDERS

If the scope of work is changed by the ENTITY, the change in price and contract time will be promptly negotiated by the parties, prior to commencement of work.

ARTICLE 7.

CONTRACTOR'S OBLIGATIONS

The CONTRACTOR shall supervise and direct the Work, using skillful labor and proper equipment for all tasks. Safety of the CONTRACTOR's personnel and equipment is the responsibility of the CONTRACTOR. Additionally, the CONTRACTOR shall pay for all materials, equipment, personnel, taxes, and fees necessary to perform under the terms of the contract.

Any unusual, concealed, or changed conditions are to be immediately reported to the ENTITY. The CONTRACTOR shall be responsible for the protection of existing utilities, sidewalks, roads, buildings, and other permanent fixtures. Any unnecessary damage will be repaired at the CONTRACTOR's expense.

ARTICLE 8.

ENTITY'S OBLIGATIONS

The ENTITY's representative(s) shall furnish all information, documents, and utility locations necessary for commencement of Work. Costs of construction permits and authority approvals will be borne by the ENTITY. A representative will be designated by the ENTITY for inspecting the work and answering on-site questions.

THIS CONTRACT IS DULY SIGNED BY ALL PARTIES HERETO:

ENTITY (City, County, Town, Etc.)

_____ Seal CONTRACTOR
(Include Address, City, State)

by_____

the Principal of the Firm

APPENDIX J

Example of Right-of-Entry Permit

EXAMPLE OF RIGHT–OF–ENTRY PERMIT

(For providing Debris Removal and Clean-up on Private Property)

_____("Owner"), hereby permits the Jurisdiction of _____, its officers, employees, agents, contractors and subcontractors ("Jurisdiction"), to enter upon Owner's property commonly identified as _____ _____, City of _____, State of _____ ("Premises") upon the following terms and conditions:

1. **Grant of Right-of-Entry**. Owner hereby grants Jurisdiction a right-of-entry ("Permit") onto, over, in, and under the Premises for the purpose of inspecting the Premises, testing materials on the Premises, removing and clearing any or all incident-generated debris of whatever nature including but not limited to ash, foundations, vehicles, appliances, waste or other materials from the Premises, subject to the terms and conditions set forth in this Permit. It is fully understood that this Permit does not create any obligation on the part of Jurisdiction to perform inspection, testing or debris removal and clearance. Owner understands that the Jurisdiction will undertake no inspection, testing, or debris removal and clearance action until this Right-of-Entry Permit is completed in full, signed by Owner, and returned to the Jurisdiction.

2. **Private Insurance Coverage**. Most homeowner insurance policies include coverage to pay for the costs of removal of incident-generated debris. Owner agrees to cooperate with the Jurisdiction throughout the insurance claims process as set forth below:

(a) **Insurance Policy Information**. Check one: The Premises (_____were, ___were not) insured at the time of the incident.

If the Premises were insured, all of the information listed below must be provided. If the Premises were insured by more than one policy, the information listed below must be provided for each policy. Attach additional sheets if necessary:

Policy holder(s): _____
Insurance company name: _____
Insurance policy number: _____
Insurance company address for claims: _____
Agent's name and address: _____
Agent's phone number: _____
Has the insurer been notified of this loss? _____(yes or no)
If so, when was notice provided? _____
How and where was notice provided? _____

(b) Owner agrees to provide to Jurisdiction a complete copy of this policy as soon as possible.

(c) Owner agrees to provide to Jurisdiction a copy of any claim or loss statement tendered to insurer when that statement is provided to the insurer.

(d) Owner agrees to provide to Jurisdiction a copy of any settlement statement or agreement within five days after that statement or agreement is received from insurer.

(e) Owner agrees not to enter into any confidentiality agreement with insurer that would impede the ability of Owner to provide the information set about above.

(f) Owner agrees that Jurisdiction may request copies of any insurance policy, claim or loss statement, or settlement statement or agreement directly from insurer or from

Owner's attorney. Owner hereby instructs his or her insurer and attorney to provide such documents directly to Jurisdiction at Jurisdiction's request.

If Owner indicated in 2(a) above that the Premises were not insured, Owner certifies under penalty of perjury that there was no insurance in effect at the time of the incident which may provide coverage for the costs of inspection, testing or debris removal and clearance.

3. **Prohibition on Duplication of Benefits**. Owner understands that, pursuant to federal law, if Owner receives federal financial assistance to cover the costs of inspection, testing or debris removal and clearance, Owner will be required to reimburse such federal financial assistance to the extent those costs are covered by Owner's insurance policy or some other source. (42 USC §5155, et seq.)

Owner (_____ has, _____ has not) and (_____ will, ____will not) receive(d) any compensation for inspection, testing, and/or debris removal and clearance from any other public source including Small Business Administration (SBA), individual and family grant program, or any other public assistance program.

4. **Insurance Proceeds.**

(a) **Jurisdiction's Limited Right to Reimbursement from Insurance Proceeds**. Owner will advise Jurisdiction in writing within 10 days of Owner's receipt of any insurance settlement proceeds for incident-related inspection, testing, or debris removal and clearance. Owner further agrees to reimburse the Jurisdiction, within 30 days of Owner's receipt of such insurance proceeds, for the cost of the inspection, testing, and debris removal and clearance conducted by the Jurisdiction. In the event the insurance proceeds fairly allocated or awarded for the cost of incident-related inspection, testing, or debris removal and clearance are less than the costs of inspection, testing, and debris removal and clearance incurred by the Jurisdiction, Owner will not be responsible for the difference. If the insurance proceeds for the cost of incident-related inspection, testing, or debris removal and clearance exceed the Jurisdiction's cost of inspection, testing, and debris removal and clearance, Jurisdiction will have no right to any such excess proceeds.

(b) **Audit**. Owner understands that all disaster-related funding, including that for inspection, testing, or debris removal and clearance on private property is subject to audit.

5. **Hold Harmless**. Jurisdiction shall not be liable for, and Owner shall indemnify and hold harmless Jurisdiction, the United States Government, the Federal Emergency Management Agency (FEMA), the State of California and any of their officers, agencies, agents, contractors, subcontractors, employees, and volunteers, against any and all claims, deductibles, self-insured retentions, demands, liability, judgments, awards, fines, mechanics' liens or other liens, labor disputes, losses, damages, expenses, personal injury, charges or costs of any kind or character, including attorneys' fees and court costs (hereinafter collectively referred to as "Claims"), which arise out of or are in any way connected to actions arising out of this Permit, and hereby release, discharge and waive any claims and actions, in law or equity, arising therefrom.

6. **Notice of Hazards**. Owner is aware that the following **circled** items were present on the Premises immediately prior to the incident:

Propane tanks
Acetylene cylinders
Compressed gas cylinders
Guns
Ammunition

Hazardous substances
Septic tanks
Underground storage tanks
Other known hazards (describe): _____

The above-circled items were located in the following areas of the Premises (describe locations): _____

_____

_____

_____

_____

7. **Special Requests**. If Owner desires that any item(s) not be removed from the Premises pursuant to this Permit, Owner shall clearly mark those items in advance of the commencement of debris removal and clearance activities on the Premises. However, should the Jurisdiction determine that some or all of such items should be removed from the Premises and disposed of for health and safety reasons, Owner agrees that the Jurisdiction is authorized to remove and dispose of those items without compensation or other obligation to Owner.

8. **No Jurisdiction Assumption of Liability for Remediation.** In consideration of the assistance Jurisdiction is providing to Owner under the Permit, at no cost to Owner, Jurisdiction assumes no liability or responsibility, and Owner shall not seek to recover from Jurisdiction, the United States Government, FEMA, the State of California or any of their officers, agencies, agents, contractors, subcontractors, employees, and volunteers, the costs of remediating any damages to the Premises incurred as a result of acts or omissions taken pursuant to this Permit.

9. **Jurisdiction's Agents.** Any person, firm, corporation or other entity authorized by the Jurisdiction to work upon the Premises pursuant to this Permit shall be deemed to be Jurisdiction's agent, including but not limited to the California Environmental Protection Agency and its contractors, and shall be subject to all applicable terms of this Permit.

10. **Authority.** Owner represents and warrants that Owner has full power and authority to execute and fully perform Owner's obligations under this Permit. If Owner is an entity, Owner also represents and warrants that Owner has such power and authority pursuant to its governing instruments, without the need for any further action, and that the person(s) executing this Permit on behalf of Owner are the duly designated agents of Owner and are authorized to do so. Owner expressly represents and warrants that fee title to the Premises is vested solely in Owner.

11. **Entire Agreement**. This Permit constitutes the entire agreement between the parties with respect to the subject matter hereof, and all prior or contemporaneous agreements, understandings and representations, oral or written, are superseded.

12. **Modification**. The provisions of this Permit may not be modified, except by a written instrument signed by all parties to this Permit.

13. **Partial Invalidity**. If any provision of this Permit is determined by a court of competent jurisdiction to be invalid or unenforceable, the remainder of this Permit shall not be affected thereby. Each provision shall be valid and enforceable to the fullest extent permitted by law.

14. **Successors and Assigns**. This Permit shall bind and benefit the parties and their successors and assigns, except as may otherwise be provided herein.

15. **Notices**. Any notice required hereunder shall be provided as follows:

For the Jurisdiction:

Name: _____

Department: _____

Address: _____

_____

Cell Phone Number: _____

Work Phone Number: _____

Email Address: _____

For the Owner:

Name: _____

Department: _____

Address: _____

_____

Cell Phone Number: _____

Work Phone Number: _____

Email Address: _____

APPENDIX K

Washington Public Assistance Damage Assessment

This information is provided by the Washington Emergency Management Division (EMD) at http://www.emd.wa.gov/disaster/WashingtonMilitaryDepartmentEmergencyManagementDivision-DisasterAssistance-PublicAssi.shtml

Purpose

At the onset of an emergency or disaster, before any federal funding is provided, the *Washington Emergency Management Division (EMD) must determine the extent of the damages sustained by state and local public facilities*. Through the Preliminary Damage Assessment (PDA) process EMD obtains the information necessary to determine if the criteria has been met to forward a request through the governor to FEMA for a Presidential Disaster Declaration for Public Assistance.

The intent of the PDA process is to depict the magnitude, impact, dollar damage, and the actions that are needed to deal with and recover from the event.

The PDA process is necessary to request federal assistance for the state and each affected county. If damage assessment information is not received when needed, we are unable to include a county's information in the initial assessment of needs for public facilities.

Assessment of Damages

In order to determine the extent of an event, state agencies and county emergency management offices complete an initial assessment of the damages affected jurisdictions sustained in an impacted county. Each county emergency management office coordinates the data collection for all potential applicants within their county - their jurisdictions.

Who are the Applicants / Jurisdictions?

Applicants (jurisdictions) are defined as: state agencies, all local public agencies – counties, cities, towns, utilities (water, sewer, electrical) and other special-purpose districts to include school districts and fire districts, Indian tribes, and certain private non-profit organizations that provide essential governmental-type services.

How Does the Assessment Process Start?

Each local agency/jurisdiction completes the *Preliminary Damage Assessment Estimates – Site/Category (PA-2)* form for each category of work (type of damage) they incurred as a result of the disaster. The cost estimates from each category of work are included in the total cost estimates that are listed on the *Preliminary Damage Assessment Summary (PA-1)* form. The forms are then forwarded to the County Emergency Management Office.

Please remember - the County is the coordination point for all local jurisdictions. The information the counties submit to EMD should include completed forms for each jurisdiction that sustained damages within their county.

Each impacted county emergency management office is responsible for notifying all jurisdictions in their county to complete a PDA. Counties are requested to complete a PDA of the county-owned damages sustained in their county and to coordinate the PDA data collection from all jurisdictions in their county. The PDAs submitted from all jurisdictions within the county are submitted to EMD, Public Assistance Program. **The counties are not responsible for completing the forms for their jurisdictions.**

We ask that each county emergency manager:

1. Advise us of their primary point of contact. This is very important when we coordinate the follow-on joint PDA with FEMA.

2. Notify us if their county did *NOT* experience extensive damages to public roads, sewers, water systems, schools, utility districts, etc., *or*

3. Notify us if their county *did* sustain extensive damages by completing and *submitting* the PDA forms (PA-1 and PA-2) to EMD Public Assistance.

Each local jurisdiction and Indian Tribe is asked to forward the completed PDA forms to their county emergency management office for coordination and submission to the state.

The counties need to send the forms to:
Email: publicassist@emd.wa.gov, or
Fax: (360) 570-6350

Preliminary Damage Assessment (PDA) Forms

To prepare the initial assessment, each public agency should complete a PA-2 worksheet for each category of damage incurred by the disaster and a PA-1 summary sheet.

The PDA forms are in one Excel workbook. You should save a copy of the workbook to your computer and then fill in the forms on this saved copy. **The forms cannot be completed online.** We also recommend that you keep a paper copy of the forms in case you do not have power or access to a computer when you need the forms.

The **PDA Form** includes:

- **Data Sheet.** This is the 1st page in the Excel workbook. Completion of this page automatically fills the demographic information on each PA-1 and PA-2 form.

- **PA-1**, Preliminary Damage Assessment Summary. This is required and provides the totals of each damage category and an overview of the event's effects.

- **PA-2**, Preliminary Damage Assessment Estimates - Site/Category. The PA-2 forms are required and should be completed before the PA-1 summary form. There is a PA-2 form for each Category of Work.

- **PA-3**, PDA Totals – County's Use. This is a project tracking tool for county emergency managers and is not a required form.

The **Instructions** for the PDA forms are listed below. These are in a separate Word document.

- PA-1, Preliminary Damage Assessment Summary - Form Instructions
- PA-2, Preliminary Damage Assessment Estimates - Site/Category - Form Instructions
- PA-3, PDA Totals – County's Use - Form Instructions

Timeline

If it is determined that a formal PDA will be pursued, federal/state PDA teams will arrive in each county. These teams will coordinate directly with the county's emergency management office. A representative knowledgeable about the damages should be available to help the teams verify the damages.

In general, the following timeline exists:

- One week for each jurisdiction to complete their forms, submit to their county emergency manager, and
- The county submits to EMD. State agencies submit directly to EMD.
- One week for EMD to send out joint FEMA/State teams to verify all damage.
- One week for EMD to collate all data, prepare request for disaster declaration, submit to the governor for approval, and forward approved request package to FEMA.
- Thirty days total to complete PDA and submit through governor to FEMA.

Contact

For more information, please contact the Program Manager at (253) 512-7078.

PDA DATA SHEET

Date:					
County:					
Applicant:					
Contact Name/E-mail:					
Phone:					
Local Inspector (Rep):		E-mail:		Phone:	
State Inspector:		E-mail:		Phone:	
Federal Inspector:		E-mail:		Phone:	

Complete this sheet first. The information will automatically enter on each page in the workbook. NOTE: These data cells are not protected on the worksheets. If you need to change this demographic data for a specific category of work, you can do this on the applicable page. Complete each Category of Work page that you need for your damages, the information that is needed on each page is shaded light yellow.

ALL applicants with damages must complete a set of PDA forms for each county in which they sustained damages. Each local applicant must submit these forms to the county's emergency manager. Each county emergency manager is responsible for submitting all PDAs within their county to the WA Emergency Management Division (EMD). All state agencies must complete a set of PDA forms for each county where they sustained damages and submit the forms directly to EMD. EMD will total each county's damages to determine if thresholds are met.

When Printing: Text boxes are formatted to word wrap. However, if you enter more information than the cell will show, you will need to adjust the cell's size in order to print all entered information. Print margins are formatted to print all pages as they are currently formatted. If you only have four sites out of a possible 15 sites, the informational blocks for 15 sites will still print.

Instructions for the PA-1 and PA-2 PDA forms are available in a separate Word document. The instructions are available at our web site: http://emd.wa.gov. If you need assistance, please contact the Public Assistance Program at 360-570-6305. Submit the forms via e-mail to: publicassist@emd.wa.gov, or fax 360-570-6350.

Submit the PA-1 and PA-2 PDA forms via e-mail to: publicassist@emd.wa.gov, or fax to 360-570-6350. If you need assistance, please contact the Public Assistance Program at 360-570-6305.

APPENDIX L

Mutual Aid Agreement Sample Template

Mutual Aid Agreement Sample Template

(This document is a Sample Template to be used as a guide in drafting an Intrastate Mutual Aid Agreement and is not intended to represent a mandatory format or to encompass every potential contract clause. Such document is intended merely to serve as a guide and should be tailored to each municipality's circumstances and requirements)

INTRASTATE MUTUAL AID AND ASSISTANCE AGREEMENT FOR DISASTERS AND OTHER RELATED EMERGENCIES

WHEREAS, the safety of the citizens of the State of Washington is of the utmost importance to all levels of state and local government;

WHEREAS, the Jurisdiction of _____ (the "Jurisdiction") and _____ ("XXXX") seek to enter a Mutual Aid and Assistance Agreement in order to provide for the sharing of resources, personnel, and equipment in the event of a local disaster or other emergency;

WHEREAS, the State of Washington and the Federal Emergency Management Agency (FEMA) have recognized the importance of the concept of written mutual aid agreements between all levels of government to facilitate reimbursement; and

WHEREAS, pursuant to the Constitution of the State of Washington, municipalities are allowed to enter into mutual aid and assistance agreements, which may include provisions for the furnishing and exchanging of supplies, equipment, facilities, personnel, and services during a natural or human-made disaster and/or other emergency; now

THEREFORE, the parties agree as follows:

SECTION I.

DEFINITIONS

A. "Agreement" shall mean this document, the "Intrastate Mutual Aid Agreement for Disasters and Other Emergencies."

B. "Aid and Assistance" shall include, but not be limited to, personnel, equipment, facilities, services, supplies, and other resources.

C. "Authorized Representative" shall mean an official of a party to this Agreement who has been authorized in writing by that party pursuant to the terms of this Agreement, to request, offer, or provide assistance under the terms of this Agreement.

D. "Disaster or other emergency" shall mean the occurrence or imminent threat of widespread or severe damage, injury, loss of life or property resulting from an intentional, accidental, or unintended release of any substance in or material in any form or quantity which poses an unreasonable risk to the safety and health and to the property when released, natural incidents, explosions, fires, collapses, or any other incident which directly affects public safety.

E. "Provider" means a party to this Agreement that has received a request to furnish aid and assistance to the party in need ("Recipient").

F. "Recipient" means a party to this Agreement receiving aid and assistance from another party.

SECTION II.

OBLIGATIONS OF THE PARTIES

A. Provision of Aid and Assistance – Pursuant to the terms and conditions set forth in this Agreement, the parties hereto shall provide each other with aid and assistance in the event of a local disaster or emergency. It is mutually understood that each party's foremost responsibility is to its own citizens. This Agreement shall not be construed to impose an absolute obligation on any party to this Agreement to provide aid and assistance pursuant to a request from another party. Accordingly, when aid and assistance have been requested, a party may deem itself unavailable to respond and shall so inform the party setting forth the request.

B. Procedures for Requesting Assistance – Requests for assistance shall be made by the Authorized Representative of a party to the Authorized Representative of the other party. Such request must indicate that it is made pursuant to this Agreement. Such request may be made by telephone, to be followed as soon as practicable by a written confirmation of that request.

C. Designation of Authorized Representative – Each party to this Agreement shall designate an Authorized Representative. Such designation shall be communicated, in writing, to the Chief Executive Officer of the other party upon the execution of this Agreement. Such designation may be amended at any time by the Chief Executive Officer of a party upon timely notice.

D. Traveling Employees – Unless otherwise specified by Recipient or agreed by the parties in writing, it is mutually understood that Recipient will provide for the needs of the Provider's traveling employees. Recipient shall pay for all reasonable out-of-pocket costs and expenses of Provider's personnel, including, without limitation, transportation expenses for travel to and from the disaster area, food, and, if necessary, lodging. If Recipient cannot provide such food and/or lodging at or near the disaster area, the Recipient shall so advise the Provider, and shall specify in its request for assistance that only personnel who can provide for their own needs are requested.

E. Supervision and Control – The Provider shall designate supervisory personnel amongst its employees sent to render aid and assistance to the Recipient. Recipient shall provide necessary credentials to the Provider's personnel authorizing them to operate on behalf of the Recipient. Recipient shall assign work tasks to Provider's supervisory personnel, and unless specifically instructed otherwise, Recipient shall have the responsibility for coordination between Provider's supervisory personnel and Recipient. Based upon such assignments set forth by Recipient, Provider's supervisory personnel shall have the authority to:

    1. Assign work and establish work schedules for Provider's personnel;

    2. Maintain daily personnel time records, material records, and a log of equipment hours;

    3. Report work progress to Recipient at regular intervals as specified by Recipient.

F. Period of Service; Renewability; Recall – Unless agreed otherwise, the duration of the Provider's assistance shall be for an initial period of twenty-four (24) hours, starting from the time of arrival. Thereafter, assistance may be extended in increments agreed upon by the Authorized Representatives of Provider and Recipient. Provider's personnel, equipment, and other resources shall remain subject to recall by Provider to provide for its own citizens if circumstances so warrant. Provider shall make a good faith effort to provide at least eight (8) hours advance notification to Recipient of Provider's intent to terminate such assistance, unless such notice is not practicable, in which case as much notice as is reasonable under the circumstances shall be provided.

SECTION III.

REIMBURSEMENT

A. Except as otherwise provided below, it is understood that Recipient shall reimburse Provider for the following documents costs and expenses incurred by Provider as a result of extending aid and assistance to Recipient.

1. Personnel – During the period of assistance, Provider shall continue to pay its employees according to its then prevailing ordinances, rules, regulations, and agreements.

2. Equipment – Provider shall be reimbursed by Recipient for the use of its equipment during the period of assistance according to established FEMA equipment rates.

3. Material and Supplies – Provider shall be reimbursed for all materials and supplies furnished by it, used, or damaged during the period of assistance. The Recipient shall not be responsible for reimbursing Provider for the costs of any damage caused by gross negligence, willful and wanton misconduct, intentional misuse, or recklessness of Provider's personnel. Provider's personnel shall use reasonable care at all times in the use and control of all materials and supplies used by them during the period of assistance. The measure for reimbursement for materials and supplies shall be determined in accordance with FEMA and Washington State reimbursement policies. In the alternative, the parties may agree in writing that Recipient will replace the materials and supplies used or damaged, with materials and supplies of like kind and quality.

B. Record Keeping – Recipient shall provide information, directions, and assistance for record keeping to Provider's personnel; Provider shall maintain records and invoices for reimbursement.

C. Billing and Payment – Provider shall send an invoice for reimbursable costs and expenses, together with appropriate documentation as required by Recipient, as soon as practicable after said costs and expenses are incurred, but not later than forty-five (45) days following the period of assistance. Recipient shall pay the bill, or advise of any disputed items, not later than forty-five (45) days following the billing date.

D. Inspection of Records – Provider agrees that it shall make its records regarding costs and expenses for assistance provided under this Agreement available for audit and inspection upon request by the Recipient, Washington State, and the federal government, and shall maintain such records for at least seven (7) years after the date of final payment under this Agreement.

SECTION IV.

PROVIDER'S EMPLOYEES

A. Rights and Privileges - Whenever Provider's employees are rendering aid and assistance pursuant to this Agreement, such employees shall remain the responsibility of the Provider and retain the same powers, duties, immunities, and privileges they would ordinarily possess if performing their duties within the geographic limits of the Provider.

B. Workers' Compensation - Recipient shall not be responsible for reimbursing any amounts paid or due as benefits to Provider's employees due to personal injury or death occurring during the periods of time such employees are engaged in the rendering of aid and assistance under this Agreement. It is mutually understood that Recipient and Provider shall be responsible for payment of such workers' compensation benefits only to their own respective employees.

SECTION V.

NONDISCRIMINATION

In accordance with Article 15 of the Executive Law ("Human Rights Law") and all other applicable local, State, and Federal constitutional, statutory, and administrative nondiscrimination provisions, the parties to this Agreement shall not discriminate against any employee or the region for employment on account of race, creed, color, sex, national origin, disability, Vietnam Era Veteran status, or marital status.

SECTION VI.

HOLD HARMLESS

To the extent permitted by law, each party (as Indemnitor) agrees to protect, defend, indemnify, and hold the other party (as Indemnitee), and its offices, employees, and agents, free and harmless from and against any and all losses, penalties, damages, assessments, costs, charges, professional fees, and other expenses or liabilities of every kind and nature arising out of or relating to any and all claims, liens, demands, obligations, actions, proceedings, or causes of action of every kind in connection with or arising out of Indemnitor's negligence, acts, errors and/or omissions. To the extent that immunity does not apply, each party shall bear the risk of its own actions, as it does with its day-to-day operations, and determine for itself what kinds of insurance, and in what amounts, it should carry. Each party understands and agrees that any insurance protection obtained shall in no way limit the responsibility to indemnify, keep, and save harmless the other parties to this Agreement.

SECTION VII.

AMENDMENTS

This Agreement may be modified at any time upon the mutual written consent of the parties. Additional municipalities may become parties to this Agreement upon the acceptance and execution of this Agreement.

SECTION VIII.

DURATION OF AGREEMENT

A. Term – This Agreement shall be for a term of five (5) years from the date of execution by both parties, unless the Agreement is renewed or terminated as set forth in this section.

B. Renewal – This Agreement may be extended for an additional five (5) year term by written agreement of the parties hereto.

C. Termination – Any party may terminate this Agreement upon thirty (30) days written notice. A termination shall not affect the obligation of any party to reimburse the other for the costs and expenses of rendering aid and assistance incurred prior to the effective date of termination.

SECTION IX.

HEADINGS

The headings of various sections and subsections of this Agreement have been inserted for convenient reference only and shall not be construed as modifying, amending, or affecting in any way the express terms and provisions of this Agreement.

SECTION X.

SEVERABILITY

Should any clause, sentence, provision, paragraph, or other part of this Agreement be adjudged by any court of competent jurisdiction to be invalid, such judgment shall not affect, impair, or invalidate the remainder of this Agreement. In the event that parties to this Agreement have

entered into other aid and assistance agreements, those parties agree that, to the extent a request for aid and assistance is made pursuant to this Agreement, those other aid and assistance agreements are superceded by this Agreement.

SECTION XI.

EFFECTIVE DATE

This Agreement shall take effect upon its execution by both parties.

NOAA Technical Memorandum OAR PMEL-132

TACOMA, WASHINGTON, TSUNAMI HAZARD MAPPING PROJECT: MODELING TSUNAMI INUNDATION FROM TACOMA AND SEATTLE FAULT EARTHQUAKES

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January 2007

UNITED STATES DEPARTMENT OF COMMERCE

Carlos M. Gutierrez
Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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Under Secretary for Oceans and Atmosphere/Administrator

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Tacoma, Washington, Tsunami Hazard Mapping Project: Modeling tsunami inundation from Tacoma and Seattle Fault earthquakes

Angie J. Venturato[1], Diego Arcas[1], Vasily V. Titov[1], Harold O. Mofjeld[2], Chris D. Chamberlin[1], Frank I. González[2]

Abstract. As part of a tsunami hazard mapping project funded by the National Tsunami Hazard Mitigation Program, the NOAA Center for Tsunami Research (formerly known as the NOAA Center for Tsunami Inundation Mapping Efforts) modeled tsunami inundation for the at-risk coastal community of Tacoma, Washington. Three tsunamigenic moment magnitude 7.3 earthquake source scenarios within the lower Puget Sound region were investigated: one along the Seattle Fault, and two along the Tacoma fault based on the most recent geophysical evidence. A high-resolution tsunami model was applied to estimate tsunami propagation in the southern Puget Sound region and inundation along the greater Tacoma area. These model results (Appendix A) were provided to the State of Washington for use in tsunami hazard maps to assist in the design of evacuation plans for the at-risk study area.

1. Background

Puget Sound has a rich history of natural hazards, including large earthquakes, landslides, and delta failures. Geologic and historic evidence have shown that some of these past events have generated tsunamis (Johnson *et al.*, 1999; Brocher *et al.*, 2004; Sherrod *et al.*, 2004). A 2002 workshop reviewed these historic events and recommended potential sources for tsunami inundation modeling to further assess the coastal hazard (González *et al.*, 2003). These recommendations included sources for the Tacoma region.

Though historic tsunamis within the region suggest a higher recurrence rate for a landslide source (Table 1, Fig. 1), workshop participants suggested that the "worst-case" scenario would likely have a seismic trigger (González *et al.*, 2003). Therefore, this study focuses on tsunamigenic earthquakes from Seattle and Tacoma fault sources based on the parameters established by workshop participants and further refined by Tom Brocher and Tom Pratt from the U.S. Geological Survey.

2. Study Area

The study area (Fig. 2) covers the coastal communities of Tacoma, Ruston, Gig Harbor, northern University Place, and the Puyallup Nation reservation in Pierce County and Federal Way, southern Vashon and Maury Islands of King County, Washington. Dash Point State Park and several regional parks (including Point Defiance, Titlow Beach, Sunrise Beach, and Ruston Way) lie along the shores of the study area. The region also supports several

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recreational marinas, a major commercial port, two state ferry terminals, and the Tacoma Narrows Bridge.

Maritime activity in Commencement Bay includes eight privately owned marine terminals and the publicly owned Port of Tacoma. The Port of Tacoma, the sixth largest commercial port in North America and the major economic engine for Pierce County (Port of Tacoma, 2005), lies at the edge of the Puyallup River delta. Eight waterways along the delta (Fig. 2b) are maintained by the U.S. Army Corps of Engineers. A public esplanade lines the western side of Thea Foss Waterway where several local outdoor events take place.

The Puyallup River delta has a history of damaging submarine landslides (Table 1). A landslide in 1894 generated a 10-foot wave that led to three deaths, destroyed freight docks, and caused significant damage in historic downtown Tacoma (Pierce County, 2004). In 1943, another submarine landslide produced a tsunami that destroyed jetties at the mouth of the Puyallup River (González *et al.*, 2003). Several smaller, non-tsunamigenic landslides have occurred on the delta since these events (Gardner *et al.*, 2001).

The Narrows is a major recreational and commercial transit waterway nested between Tacoma and the Kitsap Peninsula (Fig. 2a). High current velocities occur in this channel with a range of 2–5 knots at ebb and flood tides (National Ocean Service, 2006). The Tacoma Narrows Bridge, a primary thoroughfare, spans the midsection of The Narrows and is currently under construction. The new bridge will consist of two suspension spans and is scheduled for completion in 2008 (Washington State Department of Transportation, 2005).

A tsunamigenic subaerial landslide at Salmon Beach occurred in 1949 three days after a surface-wave magnitude (Ms) 7.1 Olympia earthquake. Estimated 6- to 8-foot tsunami waves were generated in The Narrows, damaging piers and boats in Gig Harbor and Salmon Beach (Lander, 1993; Chleborad, 1994).

3. Tsunami Sources

Three source scenarios were investigated for this study. One is based on a moment magnitude (Mw) 7.3 earthquake along the Seattle Fault as described in Titov *et al.*, 2003. The other source scenarios are based on Mw 7.3

Table 1: Known historic tsunami events in the study area. Event numbers are associated with estimated locations displayed in Fig. 1 (Chleborad, 1994; Gardner *et al.*, 2001; González *et al.*, 2003).

Event Number	Date	Type
1	1894	Deltaic submarine landslide
2	1943	Deltaic submarine landslide
3	16 April 1949	Subaerial landslide

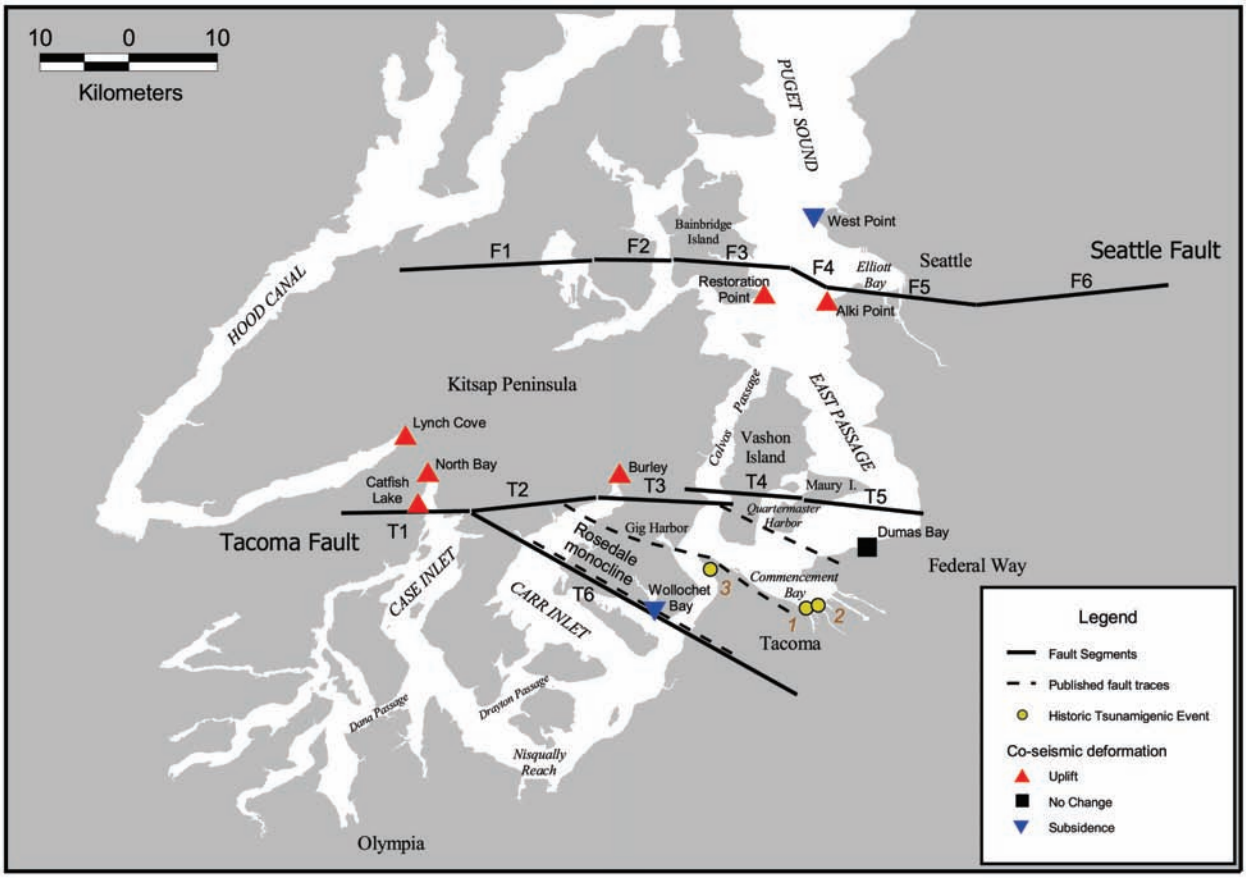

Figure 1: Seattle and Tacoma fault segments used for the study (Brocher *et al.*, 2004). Published fault traces, co-seismic deformation, and known historic tsunami events are also displayed (Sherrod *et al.*, 2004; Johnson *et al.*, 1999, 2004; González *et al.*, 2003; Gardner *et al.*, 2001).

earthquakes along the Tacoma Fault provided by Brocher and Pratt based on recent fault scarps detected through LIDAR mapping (Sherrod *et al.*, 2004). The detailed structure of both the Seattle and Tacoma faults are under much debate; however, tsunamigenesis depends primarily on surface displacement, which is fairly well determined by recent work in the field to provide reasonable assessments of these fault structures (Pratt *et al.*, 1997; Johnson *et al.*, 1999; Sherrod *et al.*, 2004).

Brocher *et al.* (2004) suggest that the Seattle and Tacoma faults are linked, such that a seismic event on one fault may trigger movement on the other. Recent field evidence suggests displacements occurred along both faults approximately 1100 years ago (Sherrod *et al.*, 2004). Though the scenarios are constrained by these measured vertical displacements, this duality was not considered in this study. Each fault model is described in detail in the following subsections.

3.1 Seattle Fault Scenario

The Seattle Fault scenario is based on six segments of varying length, strike, and slip (Table 2). The length and strike parameters are well within the

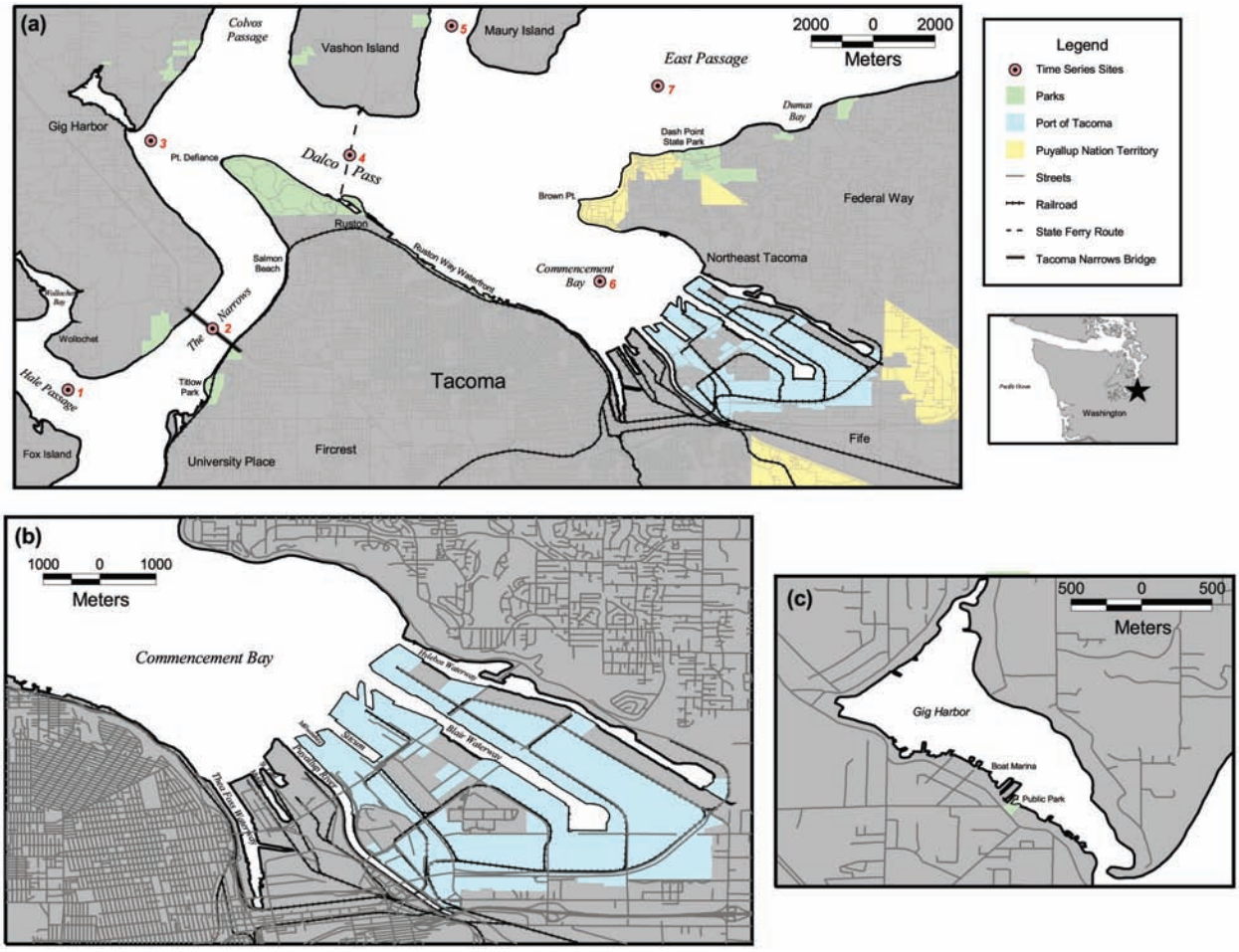

Figure 2: Study area of the tsunami hazard mapping project for Tacoma, Washington (a). Details of the (b) Puyallup Delta region and (c) Gig Harbor. Seven sites were selected to delineate time series of tsunami wave heights and current speeds (Fig. 6).

range of possibilities described in González *et al.*, 2003. The slip distribution was constrained to match vertical displacement estimates at Restoration Point, Alki Point, and West Point (Fig. 1) from a Seattle Fault earthquake in A.D. 900–930 (Bucknam *et al.*, 1992; Atwater, 1999). Table 3 provides a comparison of the computed model displacement (Fig. 3) with field estimates.

3.2 Tacoma Fault Scenarios

The Tacoma Fault scenarios were prepared by Tom Pratt and Tom Brocher. Two scenarios of equal probability are considered due to geophysical evidence (Brocher *et al.*, 2004; Sherrod *et al.*, 2004). The west end (fault segment T1) of both scenarios is based on a prominent geophysical lineament that extends through Case Inlet as evidenced by seismic tomography and trenching (Sherrod *et al.*, 2004). The eastern end from Case Inlet to Dumas Bay is less defined, with at least three fault lines found north and

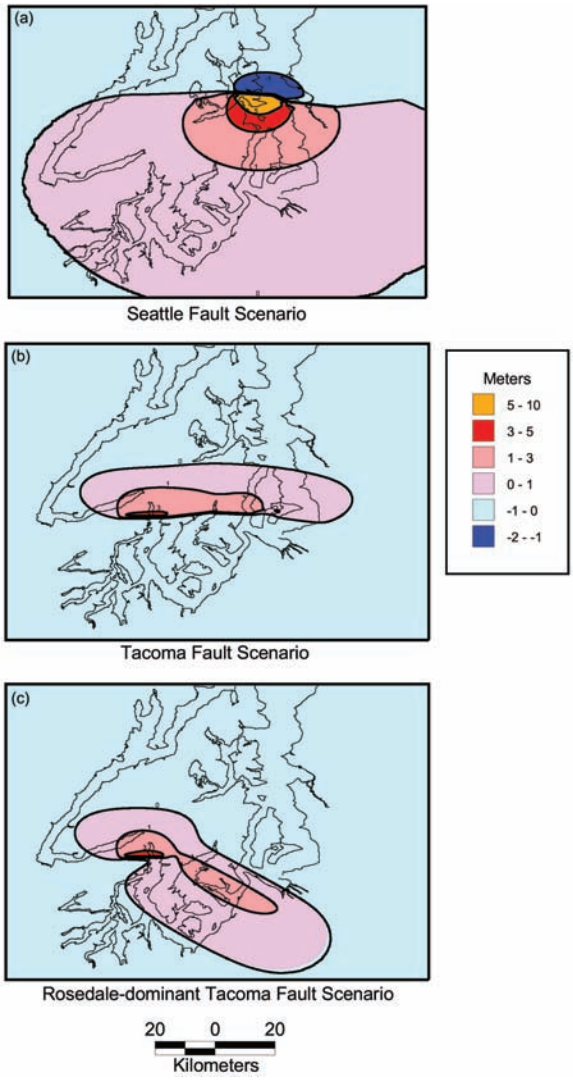

Figure 3: Modeled source scenarios for the (a) Seattle Fault, (b) Tacoma Fault, and (c) Rosedale-dominant Tacoma Fault. Vertical ground displacements are shown in meters.

south of Commencement Bay (Fig. 1). Given the uncertainty, two fault scenarios are considered: (1) the Tacoma Fault scenario based on published fault traces from Johnson *et al.* (1999, 2004) and (2) the Rosedale-dominant Tacoma Fault scenario based on an inferred wedge tip along the Rosedale monocline (Brocher *et al.*, 2004). The Tacoma Fault scenario is based on fault segments T1 through T5 and the Rosedale-dominant Tacoma Fault scenario is based on fault segments T1 and T6 (Table 4). The modeled slip distribution (Fig. 3) for each scenario matches fairly well with preliminary vertical displacement estimates at six field stations (Table 5) described by Sherrod *et al.* (2004).

Table 2: Seattle Fault segment seismic parameters as described in Titov *et al.* (2003) and displayed in Fig. 1.

Fault Segment	Length (km)	Width (km)	Strike (deg.)	Dip (deg.)	Displacement (m)
F1	15.2	35.0	87.9	60.0	1.0
F2	6.3	35.0	86.6	60.0	1.0
F3	8.9	35.0	96.0	60.0	12.0
F4	3.3	35.0	128.8	60.0	11.0
F5	11.5	35.0	99.3	60.0	4.0
F6	14.9	35.0	81.0	60.0	1.0

Table 3: Vertical deformation comparison based on field estimates and the Mw 7.3 Seattle Fault model. Vertical deformation sites are displayed in Fig. 1.

Site	Field (m)	Model (m)
Alki Point	4–6.5	3.6
Restoration Point	7	7.2
West Point	-1 ± 0.5	-1.1

Table 4: Tacoma fault segment seismic parameters based on Sherrod *et al.* (2004) and displayed in Fig. 1. The Tacoma Fault scenario is based on segments T1–T5; the Rosedale-dominant Tacoma Fault is based on segments T1 and T6 only.

Fault Segment	Length (km)	Width (km)	Strike (deg.)	Dip (deg.)	Displacement (m)
T1	10.0	14.1	268.9	45.0	5.6
T2	10.0	14.1	260.8	45.0	4.2
T3	10.0	14.1	274.0	45.0	2.8
T4	8.0	14.1	276.3	45.0	1.4
T5	8.0	14.1	279.5	45.0	1.4
T6	33.0	14.1	129.2	45.0	3.0

Table 5: Vertical deformation comparison based on preliminary field estimates (Sherrod *et al.*, 2004 and Sherrod, personal communication) and the Mw 7.3 Tacoma and Rosedale-dominant Tacoma Fault models. Vertical deformation sites are displayed in Fig. 1.

Site	Field (m)	Tacoma Fault Model (m)	Rosedale-dominant Model (m)
Lynch Cove	3	1.1	1.0
North Bay	4	2.3	2.2
Catfish Lake	4	3.2	3.4
Burley	1	1.3	-0.1
Wollochet Bay	-1	-0.1	1.3
Dumas Bay	0	-0.1	-0.1

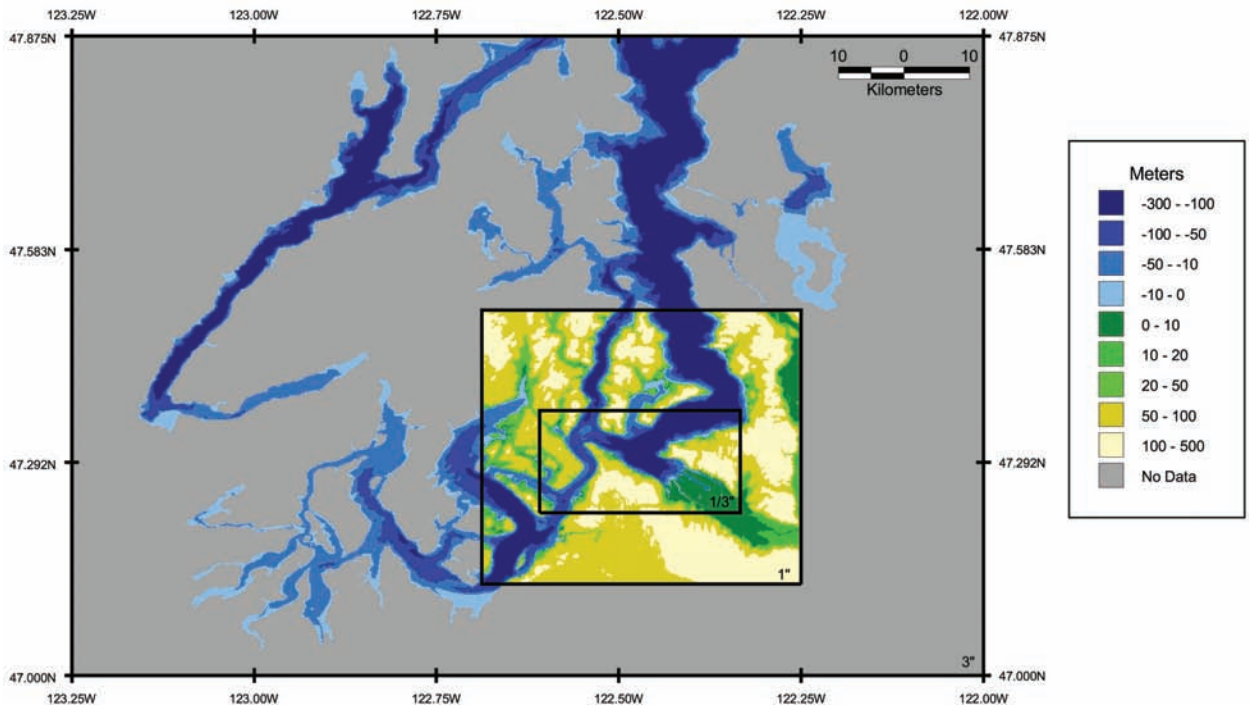

Figure 4: Extent and resolution of each digital elevation model (DEM) used in the study. The low-resolution DEM consists of only bathymetric depth values; the medium- and high-resolution DEMs consist of both bathymetric depth and topographic elevation values relative to Mean High Water.

4. Tsunami Model

Tsunami propagation and inundation for the study region is computed using the Method of Splitting Tsunami (MOST) model (Titov and González, 1997; Titov and Synolakis, 1995). MOST is a finite-difference long wave approximation model that has been extensively tested against laboratory experiments (Titov and Synolakis, 1998) and field data from historic tsunamis (Titov *et al.*, 2004). Titov *et al.* (2003) describes the application of the MOST model for a tsunami in Puget Sound. The following sections briefly describe the computational grids and specific modeling parameters used for this inundation study.

4.1 Digital Elevation Model Development

The MOST model requires nested computational grids to calculate the complicated wave dynamics of tsunami generation, propagation, and inundation. Three digital elevation models (DEMs) were developed for this study (Fig. 4). Bathymetric and topographic data were collected from government agencies and analyzed to select sources of the best quality (Appendix B). The spatial density of the selected data ranged from 0.6 to 30 m.

The selected data were converted to geographic decimal degrees (North American Datum of 1983) with vertical units of meters with respect to Mean High Water. Bathymetric data were converted to Mean High Water using

Table 6: Vertical control. Values are with respect to Mean Lower Low Water based on the Tacoma National Ocean Service secondary water-level control station 944-6484.

Datum	Meters
TIDE22 (Local datum)	5.901
Mean High Water	3.336
Mean Sea Level	2.094
North American Vertical Datum 1988	0.758
Port datum (Local datum)	0.137
Mean Lower Low Water	0.000

Table 7: Quantitative root mean square (RMS) error estimate of the DEMs. Estimated RMS error was calculated based on source references (Hess and Smith, 2004; Snyder, 1987) and methods described in Venturato (2005). The total error is the sum of the quantitative values. Subjective interpretation due to combining multiple data sources adds unknown error to the DEMs.

Error Type	Horizontal Error Range (m)	Vertical Error Range (m)
Projection/datum conversion	0.15–0.25	0.03–0.20
Comparison with vertical control benchmarks	N/A	0.27–1.81
Comparison with original data sources	0.67–10	0.35–0.98
Total known quantitative error	0.82–10.25	0.65–2.99

local datum conversions from the U.S. Army Corps of Engineers, the Port of Tacoma, and the vertical datum conversion tool known as VDatum (Hess and White, 2004). Topographic data were converted to Mean High Water using tidal and geodetic benchmark information from the National Ocean Service. Table 6 provides more information about vertical datum conversion values.

A shoreline file representing the Mean High Water line was generated based on data from the Washington State Department of Ecology and the Port of Tacoma. Piers with open pile foundations were removed from the shoreline data since tsunami waves can propagate under them.

DEMs of 1/3-, 1-, and 3-arc-second resolution for tsunami inundation, propagation, and generation regions, respectively, were developed using Delauney triangulation and natural neighbor interpolation. Though assessing the quality of a DEM based on multiple data sources is difficult, an attempt to quantify some factors of error (Table 7) were made using methods described in Venturato (2005).

4.2 Model Setup

The 1/3-, 1-, and 3-arc-second DEMs were converted to ASCII raster grids and then sub-sampled to 1-, 3-, and 9-arc-second grids to ease the computational load on the MOST model. Since the grids are based on a "bald-earth" (Venturato *et al.*, 2005), a bottom friction coefficient is used in the model. The Manning parameter for this study was set to 0.055.

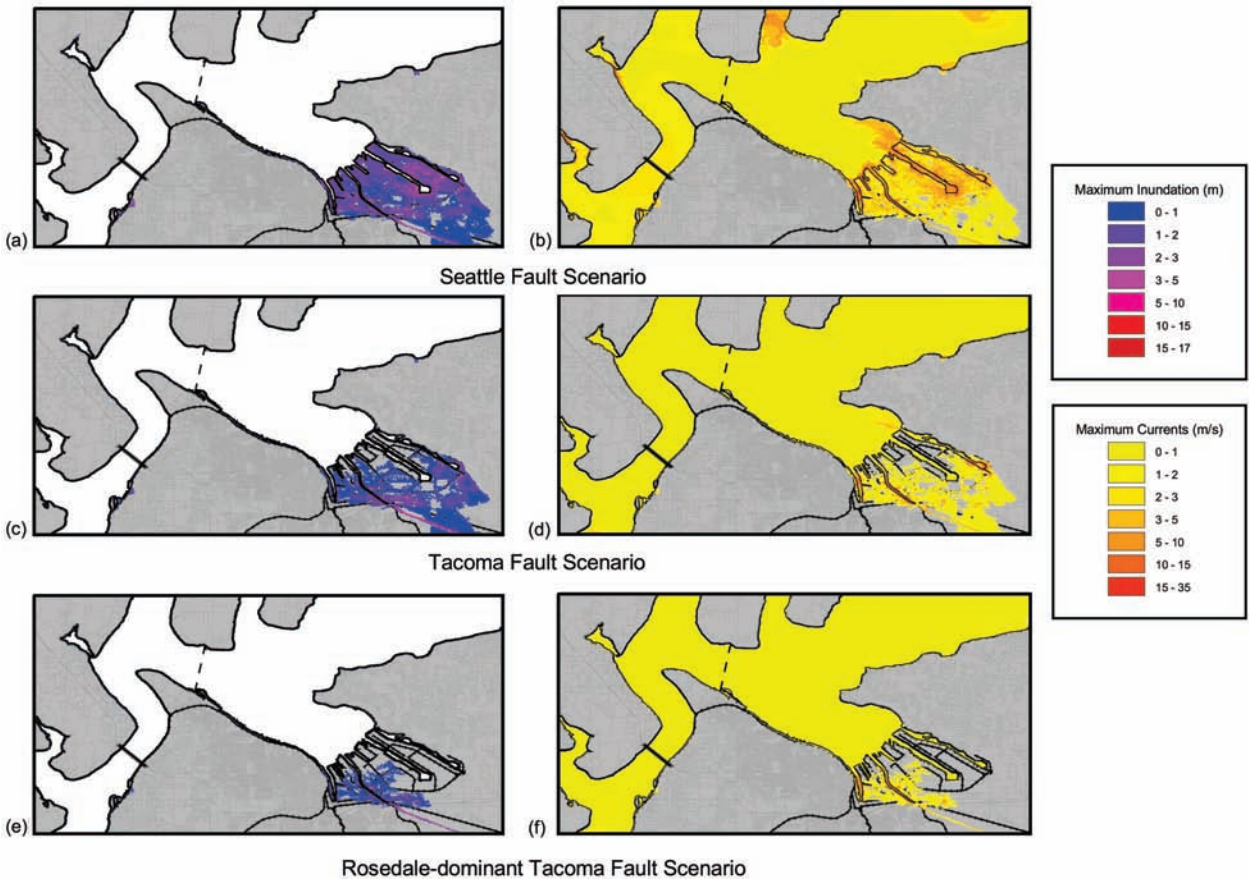

Figure 5: Maximum inundation (a, c, e) and maximum wave speeds (b, d, f) for each source scenario. The Seattle Fault scenario has the most inundation and highest currents. The Tacoma Fault scenario has significant inundation in the Port of Tacoma region, but with smaller amplitudes. The Rosedale-dominant Tacoma Fault scenario depicts the least inundation and lowest current speeds.

5. Discussion of Modeling Results

All three scenarios create significant vertical displacements along their respective fault surfaces. The Seattle Fault scenario creates the most intense currents and inundation (Figs. 5, 6) within the study area due to the large displacement of water in the deepest and widest region of Puget Sound. The Tacoma Fault scenario causes less inundation overall since much less water is displaced in the narrower and shallower regions of Carr Inlet, Colvos Passage, and East Passage. The Rosedale-dominant Tacoma Fault scenario causes the least amount of inundation in the study region due to relatively small displacements in the regional channels.

Most inundation occurs within low-lying, relatively flat regions of the study area such as the Port of Tacoma harbor in Commencement Bay. Minimal inundation occurs along steep topographical slopes. Consequently, the inundation is determined primarily by local topography rather than offshore wave dynamics. This correlates well with previous observations of long period tsunami waves, which lose their energy via bottom friction over long

penetration distances (Titov *et al.*, 2003). The following sections provide more details on the offshore wave dynamics and inundation of each tsunamigenic scenario.

Due to constraints of the inundation grid, the model does not cover the full extent of wave propagation in the upper Puyallup River; subsequently, the wave reflects off the edge of the grid boundary leading to potentially nonphysical inundation within the City of Fife and Puyallup Nation territory.

5.1 Seattle Fault Scenario

Offshore Dynamics

The Seattle Fault source creates a sharp dislocation along the fault plane extending across northern Kitsap Peninsula and eastward through south Seattle. Minor subsidence occurs on the north side of the fault. South of the fault, a large uplift occurs with a maximum 8 m in the southern Bainbridge Island region and diminishing in intensity throughout the southern Puget Sound region (Fig. 3). This rupture forms the initial tsunami wave between Alki Point and Restoration Point, which is one of the deepest regions of central Puget Sound. Two wave fronts are formed: one traveling north impacting Elliott Bay and northern Puget Sound, and the other traveling south toward Tacoma and southern Puget Sound. The southern wave front splits into two upon striking the northern tip of Vashon Island 4 min after initial deformation. The eastern and more intense front travels down East Passage striking northern Maury Island and Dumas Bay and then reflecting off the Ruston Way waterfront and southern Vashon Island 12 min after generation (Fig. 7). The weaker west front travels down Colvos Passage striking Point Defiance before joining with the stronger reflected wave in Dalco Pass. Maximum wave crests of approximately 3.5 m amplitudes reach Commencement Bay and Gig Harbor approximately 19 min after generation (Fig. 6). Part of the primary front's reflected wave energy travels north into Quartermaster Harbor and back up East Passage toward Elliott Bay and northern Puget Sound. The remaining wave energy travels into The Narrows and then dissipates in southern Puget Sound. Smaller though still significant waves continue to reflect back and forth within the study region for 3 hr.

High (>1.5 m/s) wave velocities occur within Commencement Bay, Gig Harbor, East Passage, Quartermaster Harbor, The Narrows, and Wollochet Bay. Since the model does not dynamically include tidal currents, the current speeds may be more substantial if these events occurred during a flood tide.

Inundation Details

Dumas Bay Park is the first area to be inundated in the study region approximately 10 min after tsunami generation (Fig. 8). Tsunami vertical runup reaches 3.2 m with inundation extending 250 m inland.

Inundation along the Ruston Way waterfront starts approximately 12 min after earthquake generation. This popular recreational area would be struck

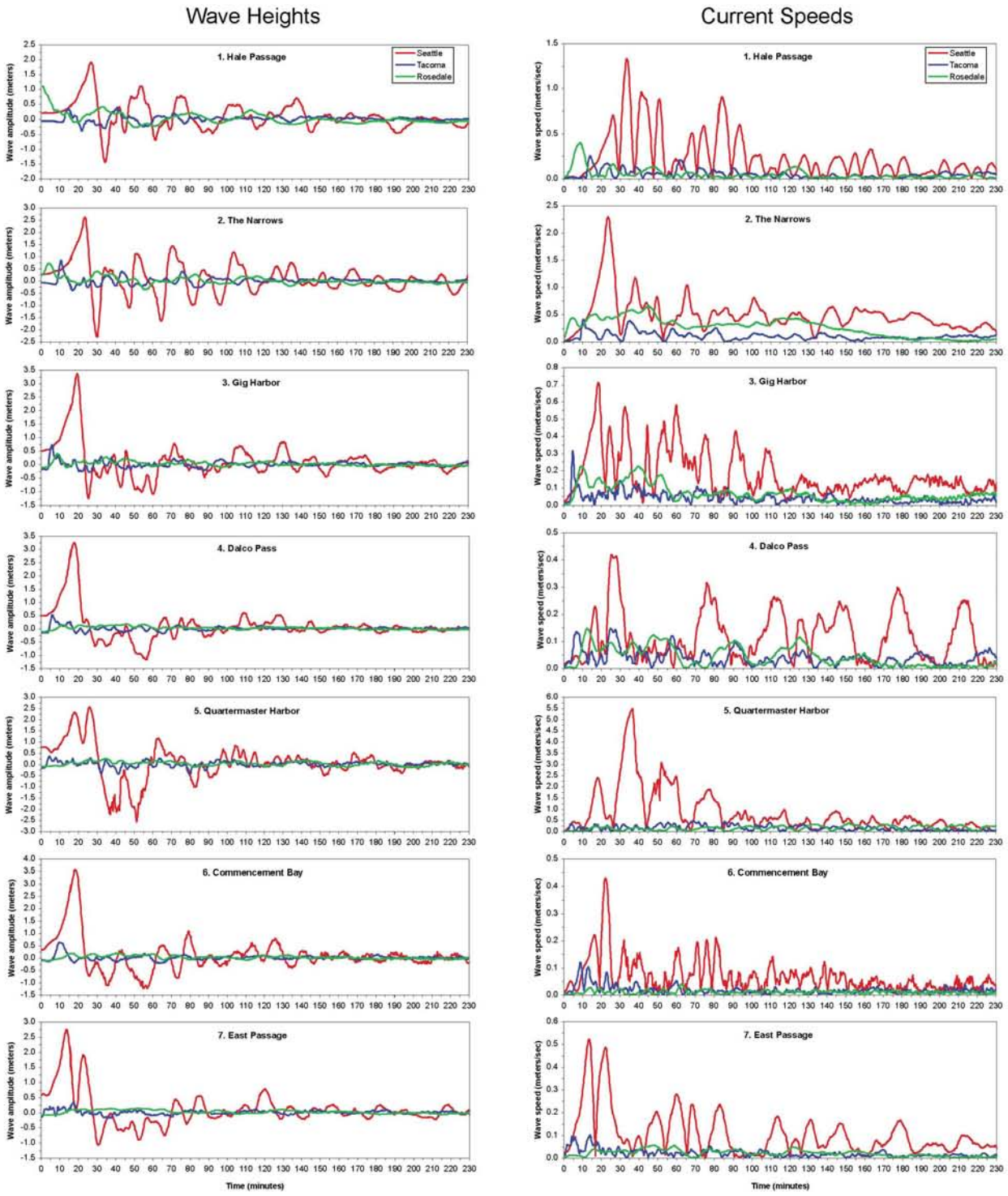

Figure 6: Time series of tsunami wave heights and current speeds at select sites of the study region. Figure 1 displays the associated site locations.

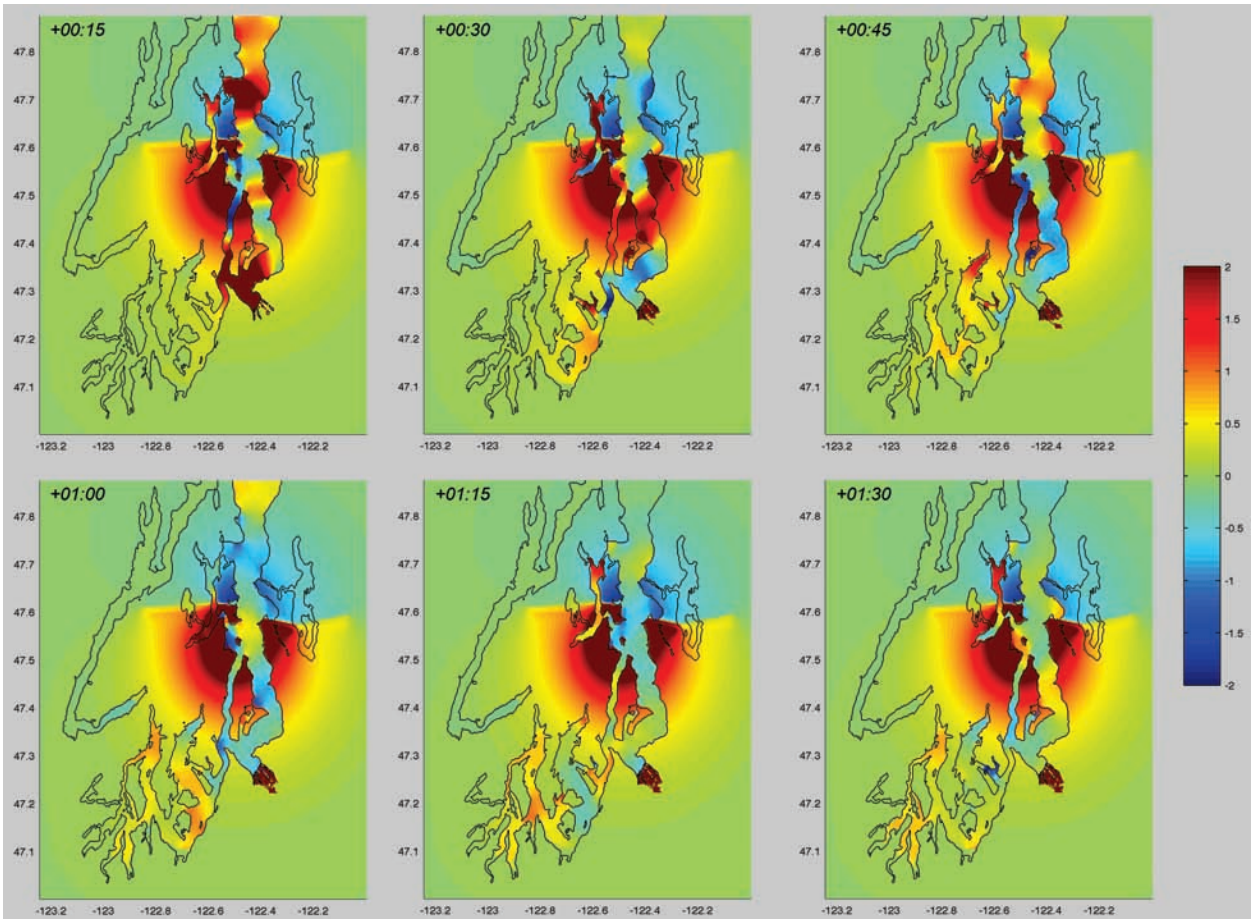

Figure 7: Modeled tsunami propagation in Puget Sound from the Seattle Fault scenario. Snapshots are in 15-min intervals with wave amplitudes in meters.

with an initial maximum 3.2-m wave overtopping several piers and inundating the sole roadway along the waterfront.

Approximately 14 min after generation, the tsunami starts to inundate the Port of Tacoma and the Thea Foss Waterway, building to a 3.5-m wave that overtops port facilities, the public esplanade, and adjacent low-lying neighborhoods as harbor channels and the Puyallap River flood. The total inundation area extends over 5 km inland along the Puyallup River delta.

Inundation occurs at both State ferry terminals approximately 18 min after tsunami generation. The Tahlequah terminal at the southern point of Vashon Island is hit with an initial 3.3-m wave with speeds ranging from 5–7 m/s and overtopping the dock and staging area. A 3.9-m wave strikes the Point Defiance terminal and marina at speeds of approximately 3 m/s. Inundation extends 80 m inland on a slag fill peninsula, an Environmental Protection Agency Superfund site (Washington State Department of Transportation, 2006), flooding the main marina access road northeast of the terminal.

The tsunami wave arrives at Gig Harbor approximately 19 min after

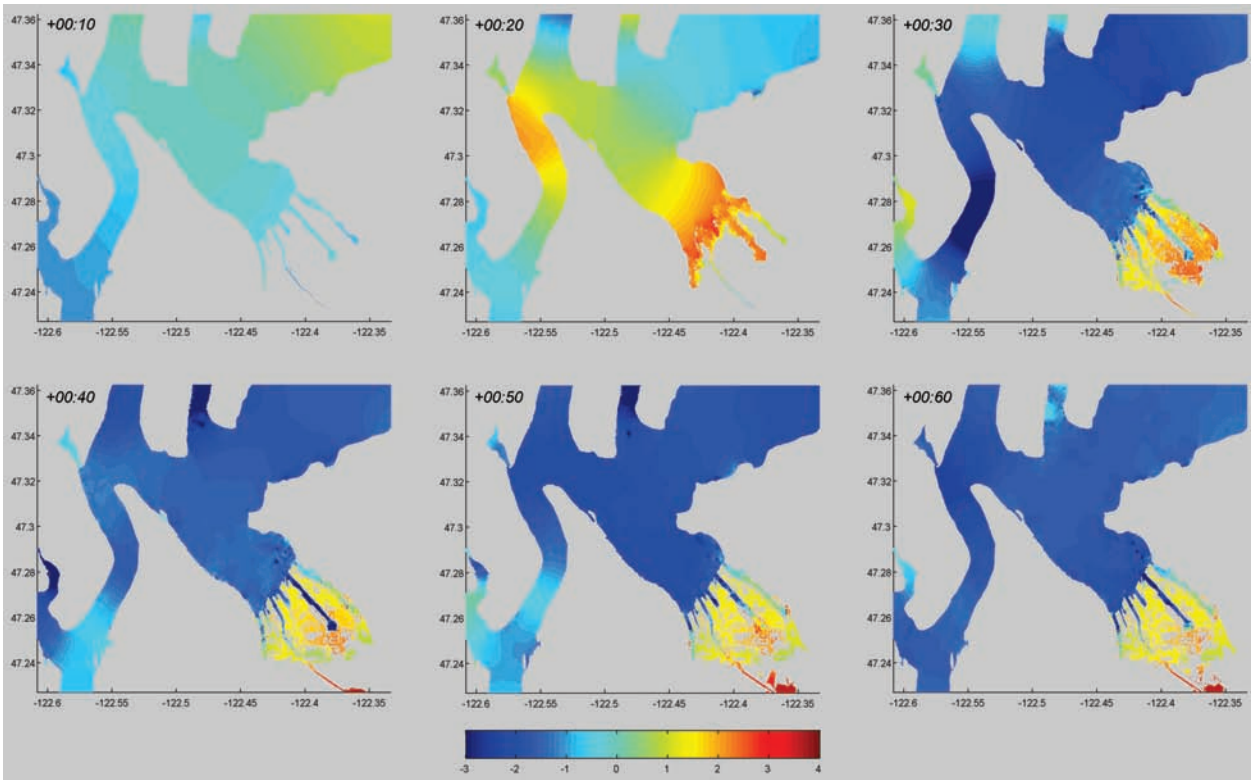

Figure 8: Modeled tsunami inundation in the study region from the Seattle Fault scenario. Snapshots are in 10-min intervals starting near the time of initial inundation at the Port of Tacoma. Wave heights are in meters with respect to Mean High Water.

generation. Tsunami vertical runups above 2 m occur along the northernmost tip of the harbor, inundating a local park. Current speeds are 1–2 m/s within the harbor, and reach above 5 m/s at the harbor entrance.

High current speeds ranging from 2–3 m/s also occur in the Narrows (Fig. 6). The initial wave reaches Titlow Park approximately 20 min after tsunami generation. The southern half of Titlow Park and a rail line are completely inundated with maximum wave runups reaching 3 m.

5.2 Tacoma Fault Scenario

Offshore Dynamics

The Tacoma Fault scenario creates a moderate uplift north of the fault plane with minimal subsidence (<0.5 m) south of the fault. The sharpest dislocation (3.4 m) occurs along the western edge of the fault, with diminishing intensity eastward. Much of the dislocation occurs on land and the shallow regions of Lynch Cove, North Bay, and Burley Lagoon. Smaller ruptures (0.7–2 m) along the eastern edge of the fault form the primary tsunami wave energy within Colvos Passage, Quartermaster Harbor, and East Passage (Fig. 3).

The initial displacement splits the wave energy into northbound and

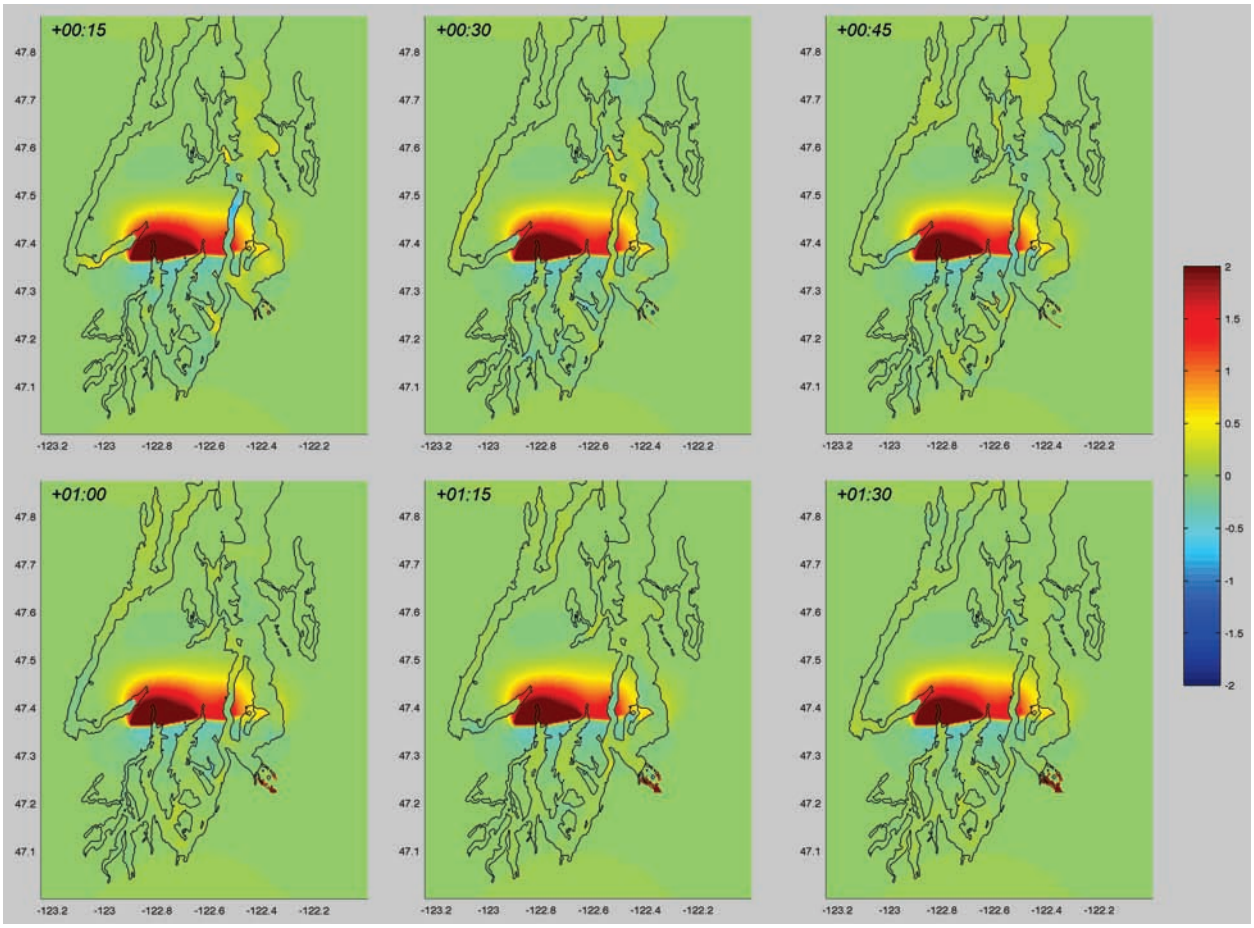

Figure 9: Modeled tsunami propagation in Puget Sound from the Tacoma Fault scenario. Snapshots are in 15-min intervals with wave heights in meters.

southbound fronts. The southbound front in Colvos Passage strikes Point Defiance 5 min after tsunami generation and subsequently splits further into a 0.5-m wave traveling into Dalco Pass, a 0.7-m wave into Gig Harbor, and a 0.8-m wave down The Narrows (Fig. 6).

The southbound front in East Passage creates a 1-m wave crest that strikes Dumas Bay 3 min after generation before joining the wave in Dalco Pass and a smaller wave from Quartermaster Harbor before reaching Commencement Bay. Part of the combined wave energy is reflected off the Ruston wave waterfront and travels back into East Passage. The remaining wave energy strikes the Port of Tacoma with a wave crest of 0.6 m approximately 10 min after generation.

The wave traveling down The Narrows reaches Fox Island 15 min after generation and then splits into a wave front traveling up Hale Passage and another toward Nisqually Reach dissipating in south Puget Sound (Fig. 9). Wave crests of 0.8 m amplitudes reach Wollochet Bay 20 min after generation. Smaller wave activity is witnessed throughout the study region for approximately 1.5 hr.

High current speeds (>1.5 m/s) occur at the entrance to Gig Harbor, both ferry terminals, Port of Tacoma waterways, and the recreational area of Dumas Bay.

Inundation Details

Dumas Bay Park is inundated approximately 3 min after tsunami generation with vertical runups reaching 3.5 m (Fig. 5). The waterfront promenade along the north side of Point Defiance Park is struck 5 min after generation with maximum vertical runups reaching 2 m.

Inundation along both ferry terminals occur approximately 7 min after generation with runups reaching 1.5 m and current speeds ranging from 2–3 m/s. Gig Harbor is struck next at 8 min with maximum vertical runups reaching 2 m and inundating the local boat marina. Inundation along the Ruston Way waterfront starts approximately 8 min after generation with the highest runup values of 2.4 m inundating the promenade and roadway.

The tsunami hits the Thea Foss Waterway and Port of Tacoma with an initial 0.6-m wave 10 min after generation. The initial wave front does not overtop port facilities; instead, the wave crest builds up in the waterways and begins overflowing port banks at 15 min. Resonance in the waterways and Puyallup River continue to overflow the channels, and the port and public esplanade are slowly inundated over a period of 3 hr (Fig. 10). The majority of the port has runup values around 1 m, though maximum vertical runups reach 3 m at the termini of Blair and Thea Foss waterways and along Puyallup River banks. The total inundation area extends over 3 km inland.

Current speeds are relatively low in The Narrows, ranging from 0.2–0.4 m/s (Fig. 6). The initial wave crest inundates Titlow Park approximately 12 min after generation with maximum runups reaching 2.5 m and washing over the rail line.

5.3 Rosedale-Dominant Tacoma Fault Scenario

Offshore Dynamics

The Rosedale-dominant Tacoma Fault scenario creates moderate uplift (3.6 m) north of the fault plane. Like the Tacoma Fault scenario, the sharpest dislocation occurs primarily on land and shallow waters along the western edge of the fault. A smaller rupture (1.3 m) on the 33-km fault segment along the Rosedale monocline initiates the primary water displacement within Carr Inlet, Wollochet Bay, Hale Passage, and The Narrows (Fig. 3).

Within the primary rupture zone, high currents (>1.5 m/s) occur within Wollochet Bay and along the shores of Titlow Park. Moderate current speeds (0.5–1.2 m/s) occur within Hale Passage and The Narrows. Most of the initial tsunami energy is directed toward Nisqually Reach traveling into Case Inlet and Dana Passage (Fig. 2) where it dissipates in the shallow waters of southwestern Puget Sound. A strong wave also strikes Burley lagoon at the terminus of Carr Inlet within 10 min of generation (Fig. 11).

Remaining wave energy travels north up The Narrows with the initial wave front diminishing from 0.8 to 0.4 m before reaching the entrance to

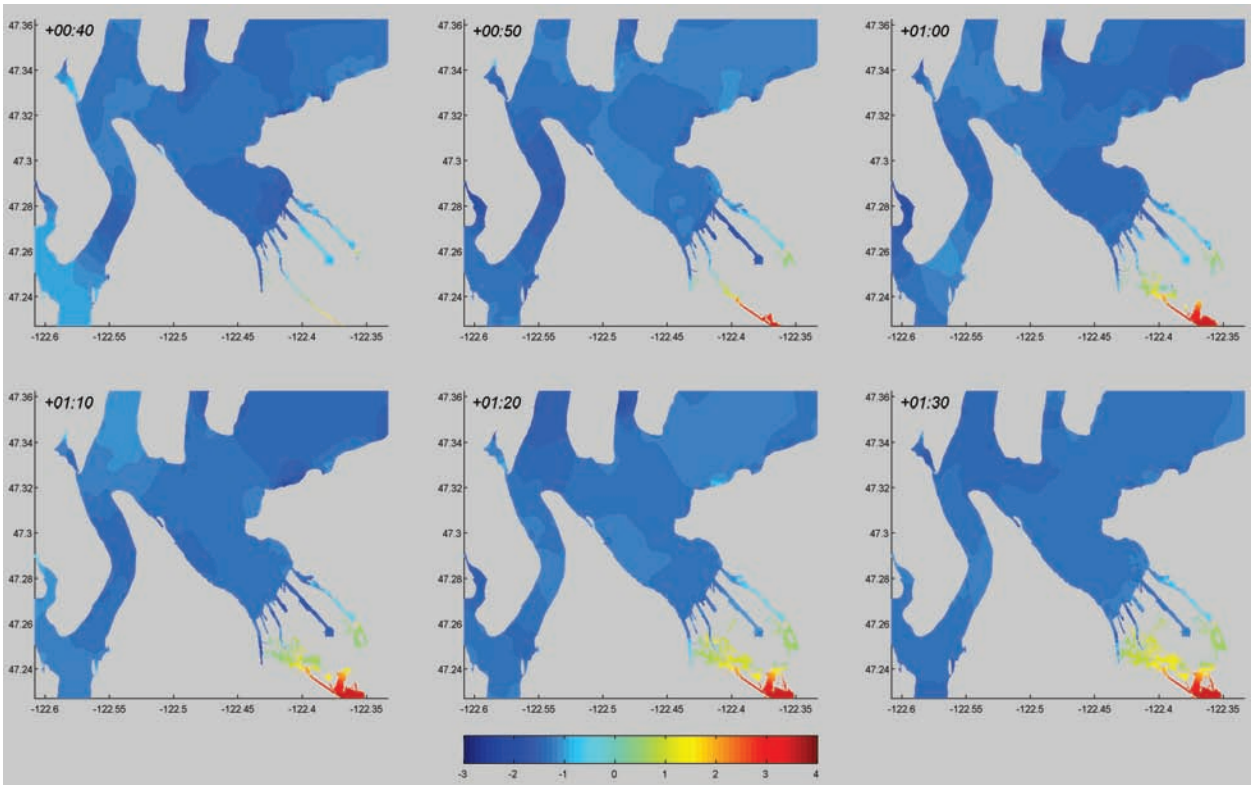

Figure 10: Modeled tsunami inundation in the study region from the Tacoma Fault scenario. Snapshots are in 10-min intervals starting near the time of initial inundation at the Port of Tacoma. Wave heights are in meters.

Gig Harbor 9 min after generation. Part of the wave continues up Colvos Passage and dissipates in central Puget Sound. A 0.2-m wave front reaches Commencement Bay 19 min after generation. This tsunami energy does not dissipate quickly, but sloshes back and forth between the shores of the study region (Fig. 6), starting inundation along the Port of Tacoma 30 min after generation.

A second smaller wave front (0.4 m) travels up The Narrows due to reflected energy from Carr Inlet, Wollochet Bay, and Nisqually Reach approximately 30 min after generation (Fig. 11). This wave combines with the complicated wave activity within Dalco Pass, leading to a second minor wave (0.2 m) striking the Port of Tacoma 40 min after generation. The tsunami continues to dissipate within the region for 4 hr.

Inundation Details

The shores along Wollochet Bay and southern Titlow Park are inundated within 5 min of tsunami generation with maximum runups of 1 m (Fig. 5). Gig Harbor marina is inundated with 1.3 m vertical runups 12 min after generation. The promenade along the north side of Point Defiance Park and Point Defiance ferry terminal are inundated with a 1-m wave at the same

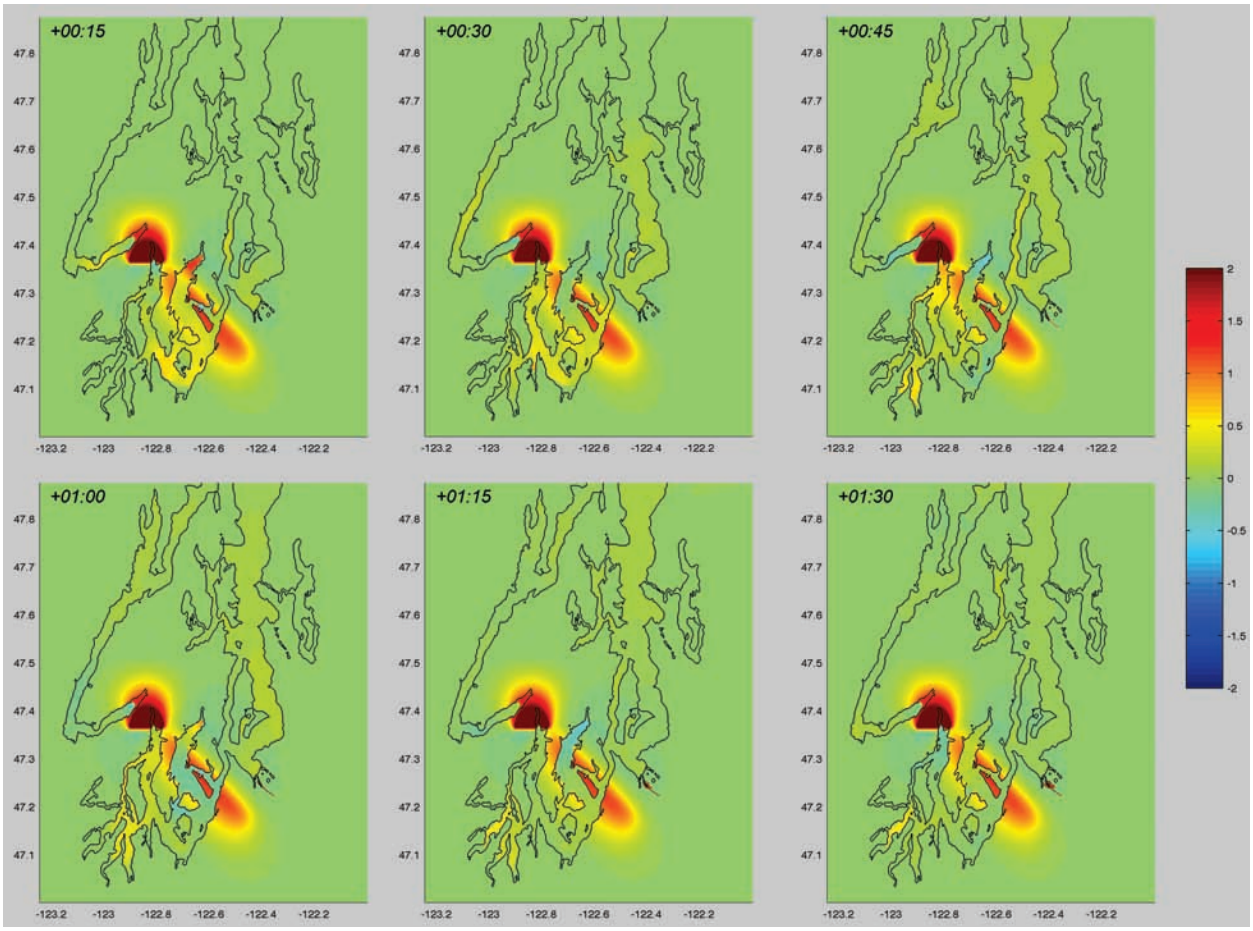

Figure 11: Modeled tsunami propagation in Puget Sound from the Rosedale-dominant Tacoma Fault scenario. Snapshots are in 15-min intervals with wave heights in meters.

time. The Tahlequah ferry terminal receives minor inundation and current speeds at both terminals are small (<0.3 m/s).

Inundation at the Port of Tacoma begins 30 min after generation as tsunami energy builds up in the Puyallup River overtopping its banks. The region around the river is slowly flooded with average vertical runups of 0.5 m (Fig. 12). This flooding starts to spill into Thea Foss Waterway 2 hr after the earthquake, just as another round of minor tsunami waves reaches the waterway. This causes resonant activity within the waterway that builds up, eventually overflowing the channel and causing minor inundation (0.3 m) along the Thea Foss esplanade 3 hr after the earthquake. The remaining waterways do not contribute to the inundation.

6. Summary and Conclusions

This project studied local tsunami inundation and regional propagation effects in the greater Tacoma and Gig Harbor region based on three modeling scenarios simulating tsunamigenic earthquakes along the Seattle and

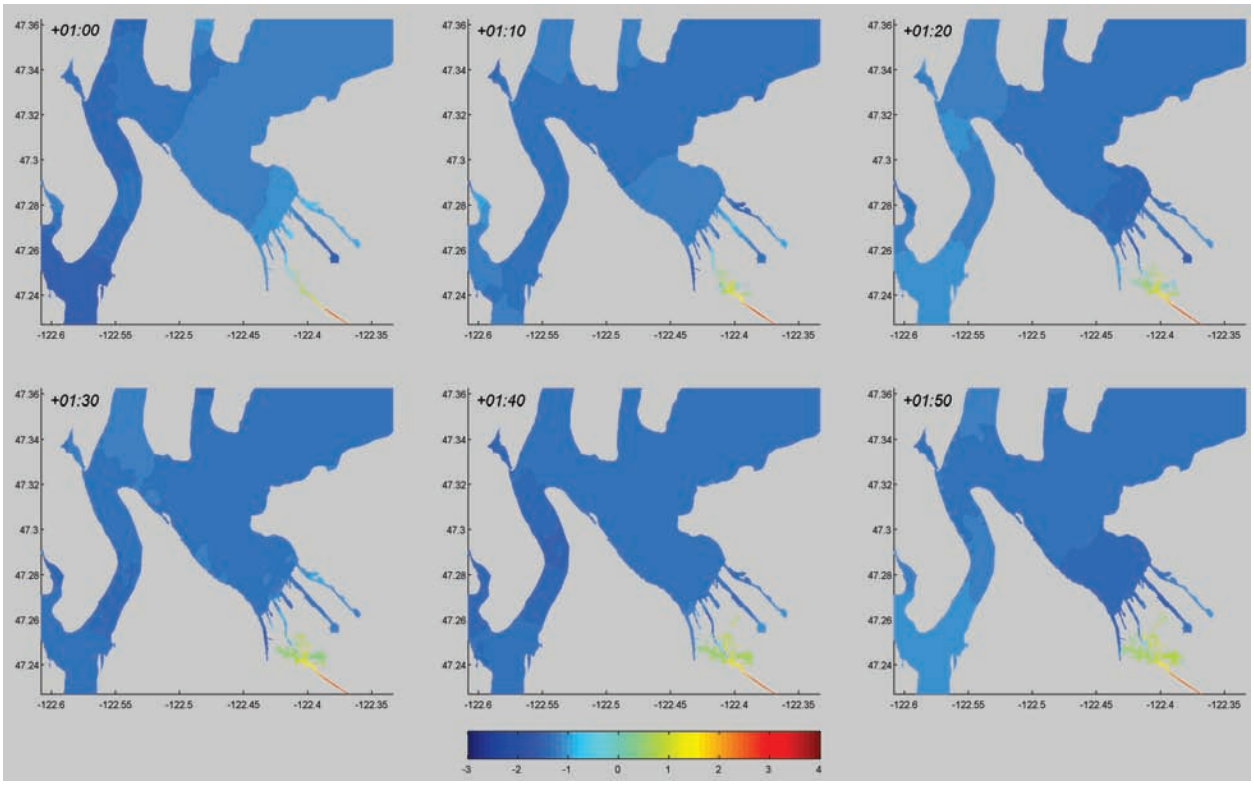

Figure 12: Modeled tsunami inundation in the study region from the Rosedale-dominant Tacoma Fault scenario. Snapshots are in 10-min intervals starting near the time of initial inundation at the Port of Tacoma. Wave heights are in meters.

Tacoma faults. The results of this study (Appendix A) are being used to develop tsunami hazard maps for the area.

The results show that a Mw 7.3 earthquake along the Seattle Fault would generate the most inundation at Tacoma and Gig Harbor. This conclusion is credible given that the Seattle Fault displaces a significantly greater volume of water than either Tacoma Fault model. Additionally, the deep East Passage acts like a one-dimensional channel allowing significant wave energy to reach the lower Puget Sound region. Both Tacoma Fault scenarios displace less water and the wave series must travel through several shallower channels, causing significant energy dissipation before reaching the shores of Tacoma or Gig Harbor.

All three scenarios cause inundation along the Port of Tacoma and Puyallup River. However, the wave action causing the inundation is significantly different for the Seattle Fault scenario in that the initial wave overtops the port due to a high amplitude. The Tacoma scenarios cause inundation by overflowing the harbor waterways over time.

Model results also show significantly high currents in the major marine transit channels and ports for all three scenarios. Tidal currents were not included in the tsunami simulations but may add to the tsunami hazard. Mean

High Water is used as a background level for the inundation model, with the assumption that tides interact linearly with the propagating tsunami wave.

This study provides a good first step toward analyzing the impact of tsunamigenic earthquakes within Puget Sound on Tacoma and Gig Harbor. However, this study does not consider tsunamigenic landslides that occur due to earthquakes or other mechanisms. Lower Puget Sound has a history of tsunamigenic subaerial and submarine landslides along the Puyallup delta and The Narrows (Fig. 1, Table 1). Slope stability maps also suggest a high probability of subaerial or submarine landslides within the study region. González *et al.* (2003) suggest that a deltaic submarine landslide associated with a major earthquake would produce a credible "worst-case" scenario for the study region.

The results of this study led to recommendations for future research in tsunamigenic hazards within lower Puget Sound:

- Research the inclusion of dynamic tidal interaction with the model.
- Characterize the geometry of potential deltaic and non-deltaic landslides within the study region.
- Review the tsunamigenic sources for the hazard every few years as new research adds to the understanding of the Seattle-Tacoma fault structures and their possible relationship.

7. Acknowledgments

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The authors thank George Crawford (Washington State Emergency Management Division), Tim Walsh (Washington State Department of Natural Resources), Tom Brocher (U.S. Geological Survey), Brian Sherrod (U.S. Geological Survey), Tom Pratt (U.S. Geological Survey), and Craig Weaver (U.S. Geological Survey) for assistance with the tsunamigenic sources for this study.

We also thank Rene Rodriguez (University of Washington), Jon Kulju (Port of Tacoma), and Lonnie Reid-Pell (U.S. Army Corps of Engineers) for assistance with data sources and processing.

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Appendix A: Modeling Products

Model results, metadata, and documentation were provided to the Washington State Division of Geology and Earth Resources and the Washington State Military Department Emergency Management Division, which are responsible for redistribution of these products. A list of the data series is provided in Table A1. All geospatial data are in ESRI ArcGIS© format with the following parameters:

- Projection: State Plane Coordinate System Zone 5626 (Washington South)
- XY Units: feet
- Z Units: meters or meters/second
- Horizontal Datum: North American Datum of 1983
- Vertical Datum: Mean High Water

Table A1: Product summary.

Item	Name	Type
0	Presentations, Product Report, Grid Report	Documentation
1	sea_animation, tac_animation, tacrd_animation	Animations of tsunami propagation and inundation
2	DEMs, Legends, Shoreline, Timeseries_sites, Model Grids, Source Scenarios	Geospatial data in ESRI ArcGIS© shapefile or ASCII Raster format
3	hi_res_images, low_res_images	Images for use in maps or general distribution
4	wa_tacoma	FGDC-compliant metadata
5	tac_timeseries	Tsunami time series at selected points of interest

Appendix B: Data Credit

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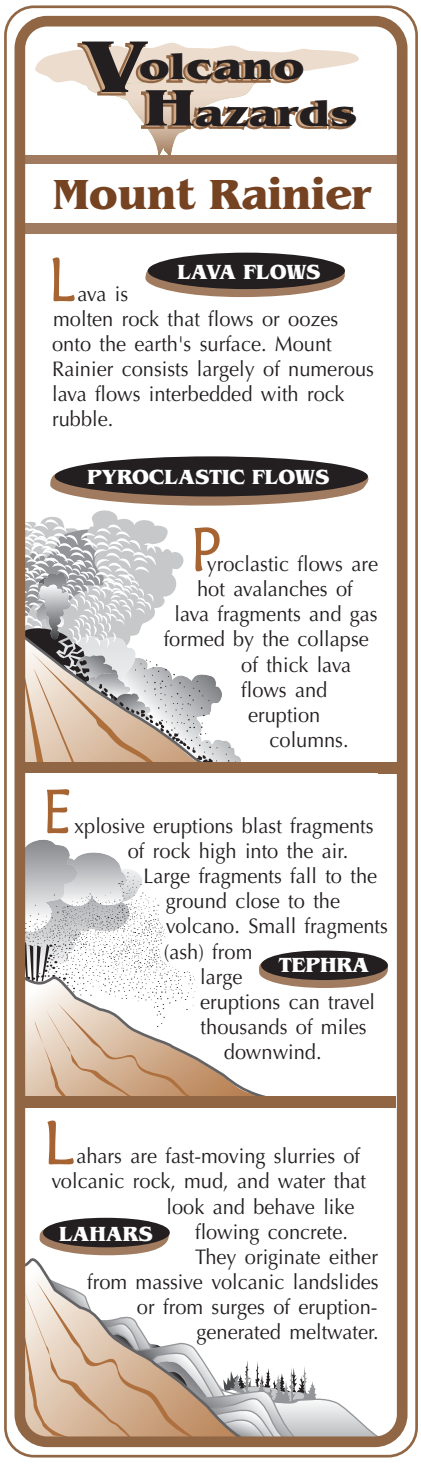
U.S. GEOLOGICAL SURVEY— REDUCING THE RISK FROM VOLCANO HAZARDS

Mount Rainier–
Learning to Live with Volcanic Risk



Mount Rainier in Washington state is an active volcano reaching more than 2.7 miles (14,410 feet) above sea level. Its majestic edifice looms over expanding suburbs in the valleys that lead to nearby Puget Sound. USGS research over the last several decades indicates that Mount Rainier has been the source of many volcanic mudflows (lahars) that buried areas now densely populated. Now the USGS is working cooperatively with local communities to help people live more safely with the volcano.

Lahars are the greatest hazard

Mount Rainier (fig. 1) is an active volcano that is currently at rest between eruptions. Its next eruption might produce volcanic ash, lava flows, or pyroclastic flows. The latter can rapidly melt snow and ice, and the resulting meltwater torrent could produce lahars (a word of Indonesian origin that has come to mean volcanic mudflow) that travel down valleys beyond the base of the volcano to areas now densely populated. Lahars caused by large landslides can also occur during non-eruptive times–without the seismicity and other warnings that normally precede eruptions.

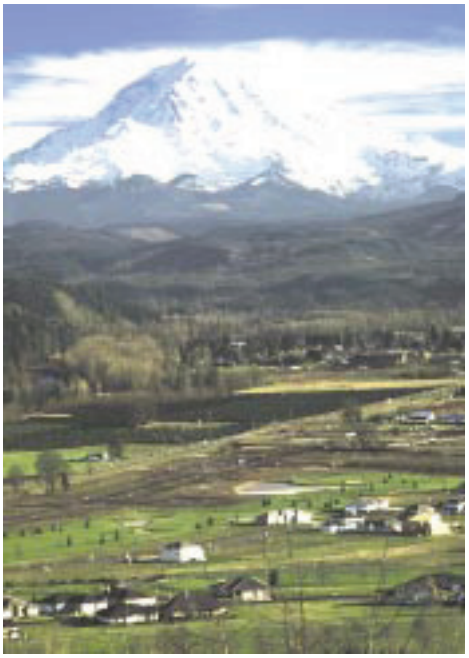


FIGURE 1.—*View across Puyallup River valley toward Mount Rainier (Photograph by David Wieprecht, U.S. Geological Survey.)*

Lahars look and behave like flowing concrete, and their impact forces destroy most man-made structures. At Mount Rainier, they have traveled 45-50 miles per hour at depths of 100 feet or more in confined valleys, slowing and thinning in the wide, now-populated valleys.

At Mount Rainier, lahars are a greater hazard than other volcanic products such as lava and poisonous gases that have been popularized by TV and film. Lava flows and pyroclastic flows are unlikely to extend more than a few miles beyond the National Park boundaries. Volcanic ash (tephra) will be distributed downwind, 80 percent of the time toward the east away from large populations (fig. 2).

The USGS, in cooperation with the University of Washington, monitors many Cascade Range volcanoes, including Mount Rainier, to detect precursors to

U.S. Department of the Interior
U.S. Geological Survey

USGS Fact Sheet 034-02
2002

eruptive activity. Mount Rainier last erupted in the 19th century; one or more small eruptions from one of the summit craters produced local ashfall.

Mount Rainier is one of the most hazardous volcanoes in the United States

Although Mount Rainier has erupted less often and less explosively in recent millennia than its neighbor, Mount St. Helens, the proximity of large populations makes Mount Rainier a far greater hazard to life and property.

1. *The population at risk*—More than 150,000 people reside on the deposits of previous lahars.
2. *The size and frequency of lahars*—During the past few millennia lahars that have reached the Puget Sound lowland have occurred, on average, at least every 500 to 1,000 years. Smaller flows not extending as far as the lowland occur more frequently. If lahars of the future happen at rates similar to those of the past, there is at least a one in seven chance of a lahar reaching the Puget Sound lowland during an average human life-span.
3. *We may not have advance warning*–USGS research shows that some lahars occur with little or no warning. Our only warning could be a report that a flow is under way.

Past lahars indicate future

Geologists determine the size and timing of past lahars and use this information to indicate future hazard potential. For example, in figure 3, the areas inundated by the 2,300 year-old National Lahar in the Nisqually Valley, and the 500 year-old Electron Mudflow in the Puyallup Valley are superimposed on all valleys surrounding Mount Rainier. They illustrate areas that could be inundated if flows of those sizes occurred in each valley.

A lahar flowing downvalley from Mount Rainier leaves a thick valley-bottom deposit of boulders and hardened mud that may envelop stumps and logs, forming a buried forest. Some of the deposits can be traced upstream to the volcano's flanks, and all contain volcanic fragments unique to Mount Rainier. Geologists map the deposits and determine the tree ages to learn when the trees were engulfed and killed by the lahar. Old-timers recall encountering huge buried stumps and logs when plowing fields and digging wells. The youngest such forest was buried about 500 years ago and uncovered during excavations for new homes in the Puyallup River valley.

Probability of Tephra Accumulation

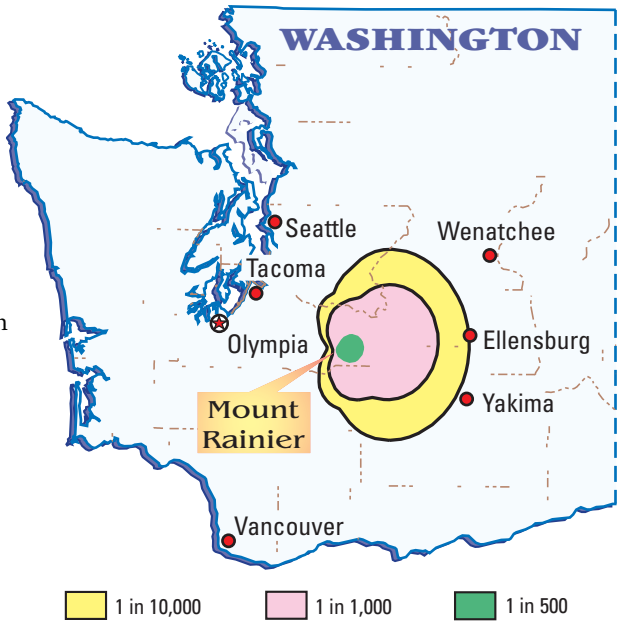


Figure 2.—*Map showing the annual probability that volcanic ash will be deposited to a thickness of 1/3 inch or more from an eruption of Mount Rainier. Volcanic ash, of this thickness or less, can cause disruption of ground and air transportation, and can cause damage to electronics and machinery.*

Lahars form in several ways

Some of the largest lahars have originated by collapse of weakened rock from the flanks of the volcano—a large landslide known as a flank collapse. During eruptions, molten rock is injected into cracks of the volcano and solidifies as slabs of rock called dikes. The cooling magma releases gases and heat into groundwater, making it hot and acidic. The hot, acidic waters convert hard volcanic rock into soft, clay-rich rock by a process called hydrothermal alteration. When masses of water-rich rock collapse, they transform rapidly into a muddy slurry—a clay-rich (also called cohesive) lahar that is funneled into one or more surrounding valleys.

Sand-rich lahars, also known as noncohesive lahars, form during eruptions of Mount Rainier when hot pyroclastic flows melt snow and ice. (Mount Rainier supports more than one cubic mile of glacial ice—as much as all other Cascade Range volcanoes combined.) Because sand-rich lahars occur during eruptive activity, they are likely to be preceded by events that will warn of an impending eruption, and thus of increased lahar potential.

Small lahars, traveling only a few miles, are caused by local avalanches of rock debris, sudden releases of glacial meltwater, or intense rainfall. These lahars occur many times each century.

New lahar deposits may get redistributed downstream over a period of many years as the disrupted drainage network is re-established. Thus, valley-floor areas that were not inundated by the initial lahar deposits may suffer enhanced flooding and progressive burial by remobilized sediment (zone of post-lahar sedimentation in figure 3).

Weakened rock and rising magma can cause flank collapse

Flank collapses can be triggered when magma intrudes into a volcano and destabilizes it, as happened at Mount St. Helens in 1980.

A neighboring volcano—Mount Baker—produced flank collapses in the 1840's that were apparently triggered by steam explosions related to volcanic activity. Steam explosions at Mount Rainier could trigger flank collapses and lahars with little or no advance warning. Although many flank collapses occur during eruptive periods, it is possible for them to be triggered by earthquakes or they may be the result of progressive weakening of the rock, saturation by groundwater and the continuing pull of gravity.

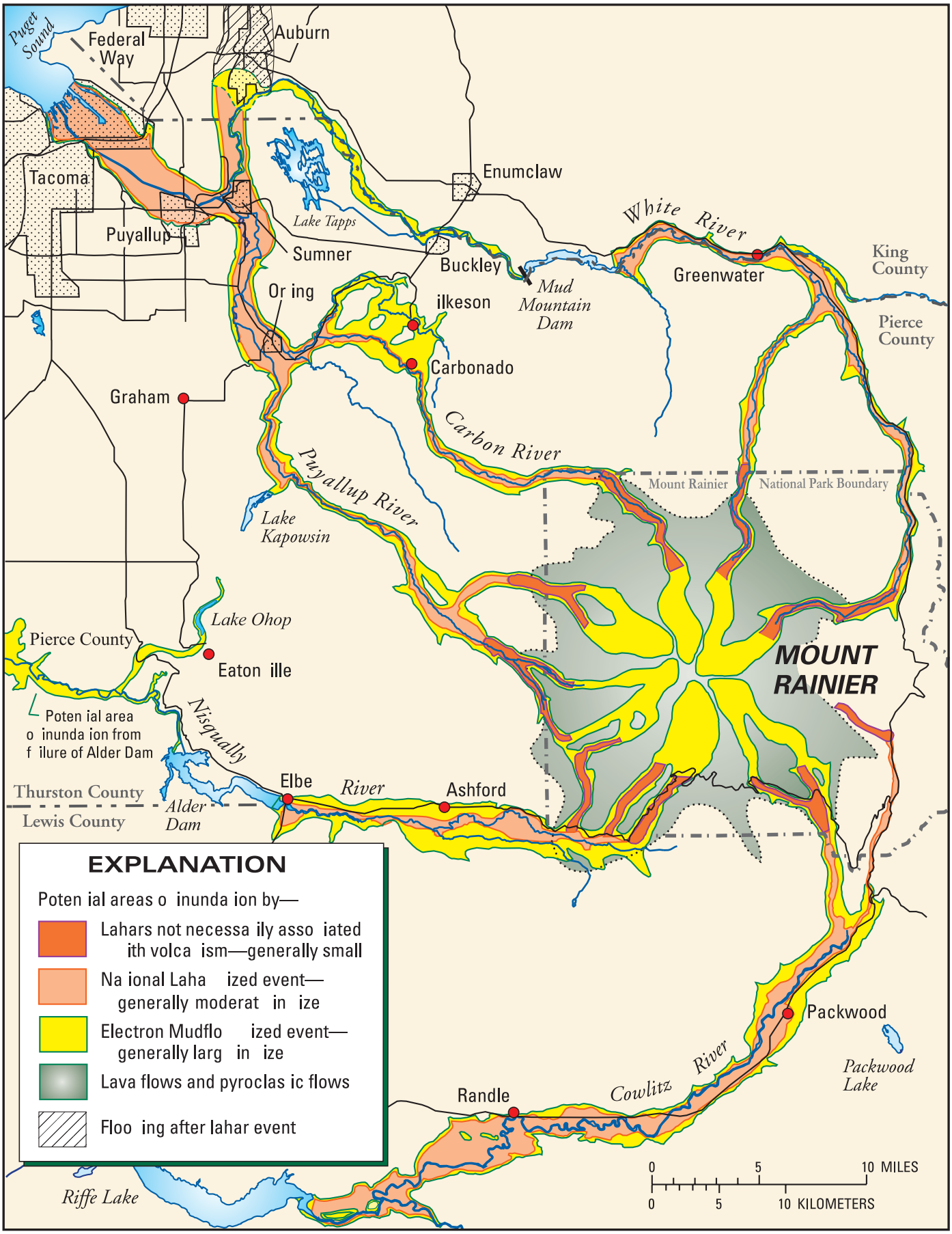


Figure 3.—*Hazard zones for lahars, lava flows, and pyroclastic flows from Mount Rainier (Hoblitt and others, 1998; US Geological Survey Open-File Report 98-428). The map shows areas that could be inundated if events similar in size to those of the past occurred today. Lahar hazard is not equal in all valleys. Puyallup Valley is the valley most susceptible to lahars caused by flank collapse. Risk to individual drainages will be refined as scientists learn more about the volcano.*

Flanks of volcano can unleash flank collapses and rockfalls

The west flank at the head of the Puyallup River valley has the greatest potential for collapse because it has the largest area of weakened clay-rich rock remaining at high altitude. The east and northeast sides of the volcano can let loose large rockslides, such as that of December 1963, because of fractures in the ridges.

One collapse can yield lahars in multiple valleys

Future lahars will follow river valleys that drain Mount Rainier. Four of the five major river systems flow westward into suburban areas of Pierce County. These flow pathways are mapped by the USGS (fig. 3), just as flood-inundation maps show the areas at risk of flooding. Lahars occurring during an eruption may affect valley areas miles from the volcano, but a precursory warning should allow ample time for evacuation.

A catastrophic flow will likely spread into multiple valleys. The largest known flow entered all five drainages, and most of the known large flows have entered two or more.

Monitoring and emergency planning are ongoing

The USGS, in cooperation with the University of Washington, monitors the state of the volcano and assesses hazards from volcanic activity. The lahar pathways mapped by the USGS guide the hazard-area regulations of the comprehensive land-use plan for local counties. The plan's urban growth boundary and its proposed land uses in unincorporated areas are designed to minimize population growth, where possible, within hazard zones.

Local, county, state, and federal agencies including the USGS have joined to develop a Mount Rainier volcanic hazards response plan that addresses such issues as emergency-response operations and strategies for expanded public awareness and mitigation of volcanic hazard.

Lahar-warning system reduces risk

Because of the higher level of risk from lahars in the Carbon and Puyallup River valleys, the USGS and Pierce County Department of Emergency Management have installed a lahar-detection and warning system. The system consists of arrays of five acoustic flow monitors (AFM's) that detect the ground vibrations of a lahar. Computerized evaluation of data confirms the presence of a flowing lahar and issues an automatic alert to emergency management agencies. Emergency managers then can initiate response measures such as evacuations. This system for automatic detection and notification of a lahar reduces, but does not eliminate, risk in the lahar pathways.

Lahar travel times are short

The estimated time between detection of a lahar and its arrival in Orting is about 40 minutes. Dispersed populations closer to Mount Rainier would be affected sooner. Time is short, and successful evacuation will depend on detection of the approaching lahar, effective notification of people at risk, public understanding of the hazard, and prompt response by citizens.

Volcanoes often show signs that they are getting ready to erupt days to weeks or months in advance. Scientists of the U.S. Geological Survey and University of Washington evaluate signs of unrest and look for increased seismic activity, increased emission of volcanic gases and swelling of the volcano. When unrest is detected, scientists will increase monitoring efforts and notify emergency management officials.

What can you do?

Learn: Determine whether you live, work, or go to school in a lahar hazard zone. Learn about all volcanic processes that could affect your community.

Inquire: Ask public officials to advise you about how to respond during any emergency.

Plan: Develop an emergency plan with your family so that you are prepared for natural hazards and emergencies.

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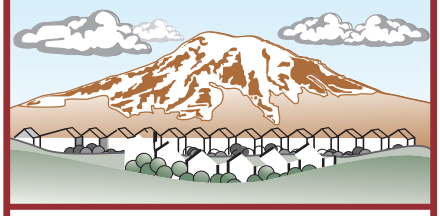
Mount Rainier is an active volcano...



Reducing population growth in the paths of lahars, implementing a warning system, and planning and practicing evacuations can lower the potential loss of life and property during future eruptions and lahars. These actions can reduce the risk from lahars and provide a measure of safety for those who enjoy living, working, and playing in valleys surrounding Mount Rainier.

For up-to-date information contact:

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Vancouver, WA 98683

Telephone: 360-993-8900

World Wide Web:
http://vulcan.wr.usgs.gov

or

USGS Volcano Hazards Program
http://volcanoes.usgs.gov

This fact sheet supersedes *Mount Rainier–Living with Perilous Beauty* (Fact Sheet 065-97).

See also *Volcano Hazards from Mount Rainier, Washington* (U.S. Geological Survey Open-File Report 98–428).

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