Landfill Gas Management Plan

Hidden Valley Landfill
Pierce County, Washington

Prepared for

Pierce County Recycling, Composting and Disposal, LLC
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TABLE OF CONTENTS

FIGURES **Page Following Section**

TABLES

APPENDICES

1.0 INTRODUCTION

This manual is the primary reference document for the operation, maintenance, and monitoring of the landfill gas system at Hidden Valley Landfill during the post-closure period. The landfill gas system consists of a gas extraction well field, two enclosed flares, a gas to energy facility, and a gas condensate recirculation system. This manual updates the *Landfill Gas Management Plan, Hidden Valley Landfill* (EMCON 1994) and the *Operation and Maintenance Manual, Landfill Gas Condensate Recirculation System, Hidden Valley Landfill* (EMCON 1997). Information regarding maintenance of the landfill cover system is included in the *Hidden Valley Landfill Post-Closure Care Manual,* (Kleinfelder, 2001). Information regarding groundwater monitoring requirements is included in the *Hidden Valley Landfill Groundwater Compliance Monitoring Plan* (Kleinfelder, 2001).

1.1 MANUAL ORGANIZATION

This document contains pertinent data about the landfill gas system, its safe and efficient operation, monitoring, record keeping, reporting, and proper maintenance. The manual is divided into the following sections.

Section 1: Provides general information about the site and the landfill gas collection system, an overview of landfill gas, and a summary of regulatory requirements

Section 2: Describes the landfill gas system components and provides procedures for operation and maintenance of the gas system

Section 4: Provides monitoring procedures

Section 5: Presents record keeping and notification requirements

1.2 SITE DESCRIPTION

Hidden Valley Landfill is located in central Pierce County at 17925 Meridian Street, in Puyallup, Washington (Figure 1-1). The site lies in the north half of the northwest quarter of Section 34, Township 19 north, Range 4 east, and partially in the south half of the southwest corner of Section 27, Township 19 north, Range 4 east, of the Willamette Meridian. The landfill property is approximately 92 acres in size. The landfill (now closed) includes approximately 56 acres of unlined fill and a 30-acre lined cell (East Lined Area), as well as a leachate pre-treatment facility, a gas to energy facility, a transfer station, and a recycling center (see Figure 1-2).

Hidden Valley Landfill began operation in the mid-1960s and accepted municipal solid waste until December 31, 1998. Originally the site was operated by the Pierce County Department of Public Works. Land Recovery, Inc. (LRI), a privately owned solid waste disposal company, purchased the landfill in 1977 and operated it until closure in 1998. Waste disposed at the landfill included municipal solid waste, demolition wastes, and commercial waste. Prior to 1985 when applicable regulations changed, small quantities of bulk liquids, sludges, and larger volumes of industrial wastes were reportedly accepted at the landfill.

1.3 SITE CLOSURE AND GAS SYSTEM DEVELOPMENT

Closure of the landfill occurred in phases. The unlined portion of the landfill was capped during the summer seasons of 1989 (North Closure – 13 acres), 1992 (Southwest Closure – 26 acres) and 1993 (remaining closure of unlined area – 17 acres). The East Lined Area was capped during the summer seasons of 1998 (approximately 13 acres), 1999 (approximately 22 acres), and 2000 (approximately 1.5 acres). Closure activities included the installation of an engineered geomembrane cap (unlined area consistent with WAC 173-304) or a composite geomembrane cap (lined area consistent with WAC 173-351), the landfill gas recovery system (described below), and storm water controls.

The landfill gas system at Hidden Valley Landfill consists of a gas extraction well field that includes 120 vertical extraction wells, two horizontal extraction wells and associated valves and piping, a gas condensate collection/recirculation system, a flare station with two enclosed ground flares, a gas to energy facility, and 22 subsurface gas monitoring probes. Currently a portion of the collected landfill gas is routed to one of the flares, and the remainder is routed to the gas to energy facility. System components are shown on Figure 1-3. The following provides a brief chronology of the development of the landfill gas system at Hidden Valley Landfill.

- In August 1985, initial gas control measures began with the installation of open-flame candle flares stemming from vertical borings installed in the refuse.

- In early 1986, six horizontal gas collectors and an electric blower were installed to actively extract the gas and feed it into a single candle flare.

- Beginning in 1987, gas probes were installed to evaluate potential subsurface gas migration and the need for additional gas control measures.

- In 1988, 20 vertical gas extraction wells (N3 through N22) were installed within the northern portion of the landfill.

- In January 1989, the first enclosed gas flare was installed near the entrance road and scales area. The flare station included two centrifugal blowers and a 2,100 cubic-foot-per-minute (cfm) enclosed ground flare.

- Between October 1989 and December 1992, 36 additional vertical gas wells (N23 through N46 and N54 through N65) were installed sequentially and connected to the flare facility in conjunction with closure activities.

- In 1993, as part of the East Lined Area expansion, a bottom liner was constructed over refuse along the east sideslope of the landfill. This work included the installation of 15 extraction wells (N47 through N53 and N66 through N73). In addition, two horizontal collectors (N HORIZ 1 and N HORIZ 2) were constructed beneath the sideslope liner to provide pressure relief and increase gas collection from the underlying refuse.

- Between 1994 and 1999, 47 vertical extraction wells (E1 through E43) were installed in the East Lined Area.

- In 1995, the second enclosed flare was installed and the blowers were replaced.

- In 1997 the landfill gas condensate recirculation system was installed.

- In 1998, construction began on the gas to energy facility.

- In March 1999, the gas to energy facility began operation.

1.4 LANDFILL GAS CHARACTERISTICS

1.4.1 Landfill Gas Production

Landfill gas is primarily a mixture of methane and carbon dioxide gasses in approximately equal amounts. Landfill gas is produced when refuse decomposes anaerobically (in the absence of oxygen). Methane gas is combustible in concentrations between 5 and 15 percent by volume in air. Anaerobic decomposition in the landfill produces methane between 50 to 70 percent, by volume. The generation of landfill gas is continuous, provided sufficient quantities of organic matter remain for methanogenic decomposition. The duration and rate of gas generation varies

from site to site. Variations are due to site-specific factors including age, composition, moisture content, and rate of placement of incoming refuse, size of the refuse (shredded or bulk), degree of refuse compaction, and internal landfill moisture content, temperature, pH, and nutrients within the refuse. The gas generation life may range from a few years to several decades, depending on site factors. Various site studies have shown that gas production tends to peak within 1 to 7 years after termination of refuse placement, then declines exponentially for 20 to 60 (or more) years, as biodegradable materials are depleted within the landfill.

Once the landfill storage capacity for gas is exceeded, positive pressure can force the gas out of the landfill and into the surrounding environment. Landfill gas generally tries to escape vertically through the landfill surface where it disperses into the atmosphere. However, the composite layer used to cap the landfill is designed to prevent vertical migration. In the unlined portion of the landfill and along the east side of the East Lined Area, positive pressures within the landfill can cause landfill gas migration through the subsurface.

1.4.2 Air Intrusion

If landfill gas is extracted from the landfill at a rate that exceeds the rate of gas production, air intrusion into the landfill may occur and potentially result in adverse effects on the gas system. Air intrusion can dilute the methane content in the gas stream, making the gas too lean for efficient flare performance. In addition, oxygen is toxic to the methane-producing anaerobic bacteria. Prolonged air intrusion could temporarily stop or limit methane production, requiring lengthy time periods of little or no gas extraction to allow anaerobic bacteria to redevelop. Prolonged periods of air intrusion can also result in spontaneous internal refuse fires. Once started, internal landfill fires can be difficult to extinguish. However, through effective system operation and monitoring, air intrusion can be minimized, thus reducing the likelihood of adverse impacts.

1.4.3 Landfill Gas Hazards

The landfill gas collection system is designed protect human health, property, and the environment. However, to safely operate and maintain the gas control facilities, it is important to understand potential hazards attributable to landfill gas; fires, explosions, asphyxiation, and toxicity. These potential hazards can lead to property damage, injury, and death.

Fires and Explosions. As noted above, landfill gas is composed primarily of methane and carbon dioxide. Pure methane is odorless, colorless, and combustible when mixed with air in concentrations between 5 and 15 percent by volume. Combustible mixtures of landfill gas and air can develop within confined spaces or unventilated areas on or adjacent to landfills. Structures

are susceptible to gas intrusion through underground utilities, construction joints, or structural cracks in building foundations. In addition, underground fires can be caused by excess air intrusion into the landfill.

Asphyxiation. Methane and carbon dioxide can displace air in confined spaces, resulting in an oxygen-deficient atmosphere. Confined spaces not only include manholes, vaults, and excavations, but also the inside of other poorly vented areas where landfill gas can accumulate. Whenever entrance into a confined space near the landfill is necessary, it is imperative that the space be properly tested for oxygen levels before entrance. Entry must follow all current federal, state, or local regulatory safety requirements for confined space entry.

Not all incidents of landfill gas asphyxiation result in life-threatening situations. Gas intrusion can also be limited to small quantities. Shortness of breath, dizziness, nausea, and chest pains can be symptoms of an oxygen-deficient atmosphere. Any of these conditions reported by individuals working within or around a confined or unventilated area could indicate landfill gas infiltration into the workspace.

Toxicity. Landfill gas can contain a variety of trace gasses at low part-per-million (ppm) concentrations. Although toxic effects of methane and carbon dioxide on humans are minimal, trace gasses can include known human carcinogens. The presence and concentration of these compounds vary from site to site and are directly related to the landfill's waste stream composition. Direct exposure to any point sources of gas should be avoided. If exposure is necessary only trained personnel using proper safety equipment and procedures should be involved.

1.5 REGULATORY REQUIREMENTS

1.5.1 Solid Waste Regulations

The Hidden Valley Landfill is regulated under WAC 173-351, *Criteria for Municipal Solid Waste Landfills*. Local enforcement of solid waste issues under WAC 173-351 is the responsibility of the Tacoma-Pierce County Health Department (TPCHD).

Performance criteria for landfill gas control measures are outlined in WAC 173-351-200(4), *Operating Criteria-Explosive Gasses Control,* and contain the regulations presented below.

(a) Owners and operators of all Municipal Solid Waste Landfill (MSWLF) units must ensure that:

(i) The concentration of methane gas generated by the facility does not exceed twenty-five percent of the lower explosive limit for methane in facility structures (excluding gas control or recovery system components);

(ii) The concentration of methane gas does not exceed the lower explosive limit for methane at the property boundary or beyond; and

(iii) The concentration of methane gas does not exceed one hundred parts per million by volume of methane in off-site structures.

(b) Owners or operators of all MSWLF units must implement a routine methane-monitoring program to ensure that the standards of (a)(i) and (ii) of this subsection are met.

(i) The type and frequency of monitoring must be determined based on the following factors:

(A) Soil conditions;

(B) The hydrogeologic conditions surrounding the facility;

(C) The hydraulic conditions surrounding the facility; and

(D) The location of facility structures and property boundaries.

(ii) The minimum frequency of monitoring shall be quarterly.

(c) If methane gas levels exceeding the limits specified in subsection (4) (a)(i) or (ii) of this section are detected, the owner or operator must:

(i) Immediately take all necessary steps to ensure protection of human health including;

(A) Notify the jurisdictional health department;

(B) Where subsection (4)(a)(ii) of this section is exceeded, monitoring of the off-site structures for compliance with subsection (4)(a)(iii) of this section;

(C) Daily monitoring of methane gas levels unless otherwise authorized by the jurisdictional health department; and

(D) The jurisdictional health department and/or fire department shall determine the need for evacuation of buildings affected by landfill gas.

(ii) Within seven days of detection, place in the operating record, the methane gas levels detected and a description of the steps taken to protect human health; and

(iii) Within sixty days of detection, implement a remediation plan for the methane gas releases, place a copy of the plan in the operating record, and notify the jurisdictional health department that the plan has been implemented. The plan shall describe the nature and extent of the problem and the remedy.

(iv) The jurisdictional health department may establish alternative schedules for demonstrating compliance with (c) (ii) and (iii) of this subsection.

(d) For purposes of this subsection, "lower explosive limit" means lowest percent by volume of a mixture of explosive gasses in air that will propagate a flame at twenty-five degrees centigrade and atmospheric pressure.

1.5.2 Air Quality Regulations

The Puget Sound Clean Air Agency (PSCAA) is the lead agency for permitting air emission sources within King, Pierce, Snohomish, and Kitsap counties. PSCAA regulations are titled Regulations I, II, and III. The agency also enforces many federal regulations, e.g. New Source Performance Standards (NSPS), and New Source Review (NSR).

PSCAA Regulations. Regulation I contains general requirements for air emission sources such as opacity and ambient emission standards, but also requirements such as NSR, pre-construction permitting that does not require NSR Title V operating permit requirements, and continuous emission monitoring rules.

Section 5.05(d) of PSCAA Regulation I requires annual emission reporting if air contaminants are at or above designated levels. At the Hidden Valley Landfill, NO_X is the only pollutant potentially close to the designated threshold levels from the landfill gas flares. NO_X emissions were calculated for 1996, 1997, and 1998 and found to be 15, 20, and 20 tons, respectively, well below the 25-ton annual limit. Since the landfill stopped accepting waste in 1998 and emissions did not increase, it appears that the generation of landfill gas for Hidden Valley Landfill reached a maximum and future emissions above Regulation I levels are not anticipated.

Regulation II consists of control requirements for VOCs from specific types of emission sources. However, municipal landfills are not included by this regulation.

Regulation III specifies control standards and requirements for several hundred toxic air pollutants (TAPs). This regulation requires a new source or modification to a source to assess its emissions of TAPs with respect to air quality modeling and health related standards. The Hidden Valley Landfill is subject to this regulation and TAP impacts were assessed in the Notice of Construction for the flares and gas to energy facility.

NSPS. The New Source Protection Standards (NSPS) limit ambient emissions of non-methane volatile organic compounds (VOCs) and are titled *Standards of Performance for Stationary Sources and Guidelines for Control of Existing Sources: Municipal Solid Waste Landfills* (effective March 1996). This rule requires new and existing landfills to satisfy specific requirements for estimating annual landfill-derived, non-methane VOC emissions. The NSPS, found in 40 CFR 60 Subpart WWW, establish standards for landfills that commenced

construction, reconstruction or modification on or after May 30, 1991 and before March 12, 1996, and have a design capacity equal to or greater than 2.5 million megagrams (Mg), or 2.5 million cubic meters. In June 1996, initial design capacity and emission reports for Hidden Valley Landfill were submitted to the USEPA. The design capacity report estimated the landfill would contain approximately 5.8 million Mg (approximately 6.5 million tons) of refuse at final closure. However, construction of the East Lined Area commenced prior to May 30, 1991 and therefore the 40 CFR 60 Subpart WWW NSPS standards are not considered applicable. However, 40 CFR Subpart GGG may apply to Hidden Valley Landfill. LRI is currently discussing the applicability of these standards to Hidden Valley Landfill with PSCAA. If PSCAA requires emissions monitoring, the results should be included in the quarterly and annual monitoring reports.

For reference, the major points of the NSPS are as follows:

- NSPS requires that a gas collection and control system be installed at the landfill within 30 months after a non-methane organic compound (NMOC) emission rate greater than or equal to 50 megagrams (mg) per year is calculated.
- NSPS applies to landfills with a maximum design capacity of greater than or equal to 2.5 Mg.
- NSPS applies to disposal areas with:
  - Active areas where in-place refuse has reached an age of at least 5 years.
  - Areas closed or at final grade, where in-place refuse has reached an age of at least 2 -years.
- NSPS requires quarterly monitoring for methane concentrations at the surface of the landfill. The concentration of methane must not exceed 500 parts per million (ppm).
- NSPS stipulates emission control requirements that include installing a gas collection system and gas utilization or disposal system that achieves a 98 percent reduction of collected NMOC emissions.

1.5.3 Consent Decree Requirements

Ecology proposed a Consent Decree for Hidden Valley Landfill in August 2000 to implement a Cleanup Action Plan for the site. The Cleanup Action Plan describes cleanup activities that are based on information in the *Remedial Investigation Report, Hidden Valley Landfill Site* (February 1991) and the *Feasibility Study Report, Hidden Valley Landfill Site* (May 1992). The proposed Cleanup Action Plan includes (in part) operation of the landfill gas control and destruction system, monitoring for landfill gas, and maintenance of the final cover system.

1.6 SITE PERMITS

Hidden Valley Landfill stopped accepting waste on December 31, 1998 and is now in post-closure. In February 2001, the TPCHD issued a transition post-closure permit for the site.

The first landfill gas flare is permitted under Order of Approval/Notice of Construction (NOC) No. 3229. This NOC requires a minimum flare temperature of 1,400 degrees Fahrenheit (°F), and two emission source tests. Source testing was conducted in 1989 and 1990 by Amtest, Inc., Air Quality Division, Preston, Washington. The testing provided a comprehensive analysis of the constituents in the collected landfill gas and in the flare emissions. Based on the test findings, the flare emissions were within PSCAA's performance standards for combustion sources.

The second landfill gas flare is permitted under NOC No. 5645.

The gas to energy facility is permitted under NOC No. 7578.

Copies of the transition post-closure permit and the facilities air permits are included in Appendix D.

1.7 ROLES AND RESPONSIBILITIES

LRI shall be responsible for the implementation of this *Gas Management Plan.* LRI will provide personnel or will subcontract the duties of monitoring and maintaining the gas extraction well field, gas condensate collection/recirculation system, flare station, and gas to energy facility. A third party will be contracted to perform monitoring of the perimeter gas probes and data evaluation and reporting. Qualified personnel trained in the proper use and calibration of the equipment and monitoring instruments will perform all monitoring and maintenance activities. Compiled data and monitoring results will be reported to the TPCHD. If gas concentrations are noted to be above regulatory standards at the property boundary or within any structure, the consultant contracted to perform the monitoring will notify the TPCHD within 24 hours.

A list of identified individuals and their phone numbers follows:

LRI

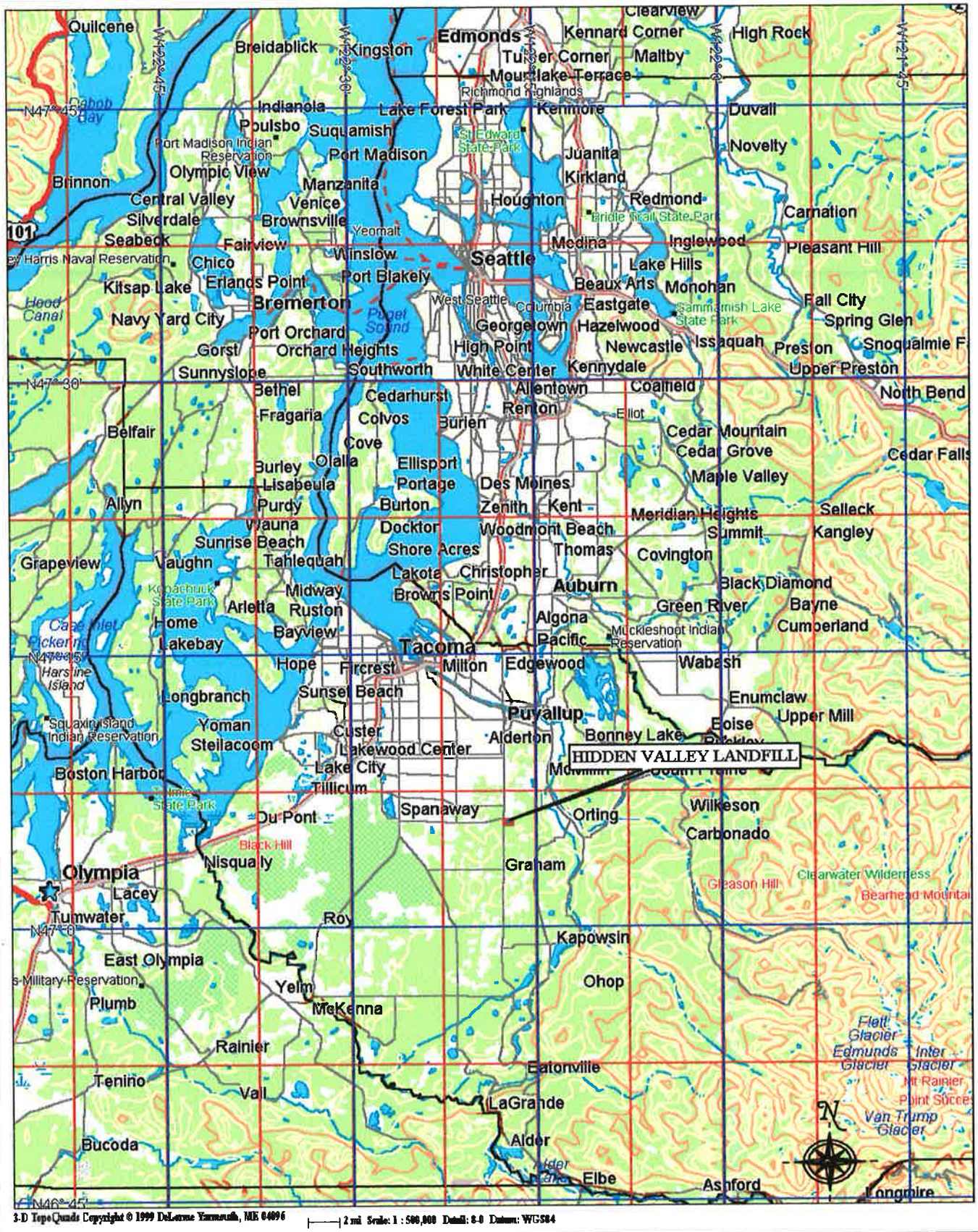
Greg Burrington Operations Manager	Office: (253) 847-7555 Mobil: (253) 377-2957
Paul Thomas Plant Manager, Gas to Energy Facility	Office: (253) 846-1421
John Pick Environmental Technician	Office: (253) 847-7555

Kleinfelder, Inc.

Kevin Lakey Project Manager	Office: (425) 562-4200 Mobil: (425) 766-9724

TPCHD

David Bosch Environmental Health Specialist	Office: (253) 798-6574



KLEINFELDER

PROJECT# 60-3051-05 AUGUST 2001

SITE LOCATION MAP
HIDDEN VALLEY LANDFILL
PIERCE COUNTY, WASHINGTON

FIGURE
1-1

E 51,500 E 52,000 E 52,500 E 53,000 E 53,500 E 54,000 E 54,500

N

MW-25D
MW-25S GP-21

BC-4S/D

FMMW-2

MW-27S MW-27D

FMMW-1

MW-22U/L
MW-18D MW-18S
GP-20

176th Street

Pierce County
Property Boundary

MW-11S/D MW-11D(R)

MW-26R

MAINTENANCE BUILDING

GP-3

GP-2

MW-15U
MW-15L GP-4

GP-5

GP-8

MW-14S/D MW-14R

GP-7

MW-17S

GP-1

OFFICE BUILDING

MW-12S/D
GP-19

Unlined Area

Meridian Avenue

GP-18

MW-28S

LIMIT OF REFUSE

MW-13S/D GP-17

Sideslope Liner Area

East Development Area

LRI Property Boundary

GP-8

MW-10S/D

GP-9

MW-23S MW-23D
GP-22

GP-10

GAS TO ENERGY FACILITY

GP-11

TRANSFER STATION

LEACHATE PRETREATMENT FACILITY

RECYCLING CENTER

GP-16

Site Access

MW-19S
MW-19D GP-15

GP-14

GP-13

GP-12
MW-20R

0 300 600

SCALE: 1"= 300'

LEGEND

- MW-27S — Moinitoring Well
- GP-21 — Gas Prope
- Landfill Cap
- Property Boundary

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REV	DATE	ISSUE	DWG	DES	CHK	APP

DWN. JS CHK. JH
DES. WLB APPR. JMS
ISSUE DATE: 8/21/01
PROJECT NO. 60-3051-05

HIDDEN VALLEY LANDFILL
PIERCE COUNTY, WASHINGTON
SITE MAP

FIGURE
1-2

U:\DRAFTING\60-3051-05\SITEMAP

GP-20

GP-21 LOCATED APPROXIMATELY 900' NORTH OF PROPERTY LINE

E 52,500 | E 53,000 | E 53,500 | E 54,000 | E 54,500

N 26,000

N 25,500

SR-161 (MEDIDIAN STREET)

GP-22 LOCATED IN RIFLE RANGE

N 25,000

GP-0 GP-1 GP-2 GP-4 GP-5 GP-6 GP-7 GP-8 GP-9 GP-10 GP-11 GP-12 GP-13 GP-14 GP-15 GP-16 GP-17 GP-18 GP-19

MAINTENANCE BUILDING

OFFICE BUILDING

FLARE STATION

FLARE NO.1

FLARE NO.2

CS-1 CS-2 CS-3 CS-4 CS-5 CS-6 CS-7 CS-8 CS-9 CS-10

LIMIT OF REFUSE

RECYCLING CENTER

12"x10" REDUCER

12"ø TEE

10"x8" REDUCER

8"x6" REDUCER

12"ø SCH 40 PVC

3"ø SCH 40 PVC LATERAL (TYP.)

10"ø SCH 40 PVC

10"x6" REDUCER

VERTICAL EXTRACTION WELLS AND HORIZONTAL COLLECTORS UNDER EAST LINED AREA SIDESLOPE LINER

CONDENSATE DISPOSAL TRENCH

LEACHATE COLLECTION PIPE CLEANOUT

LEACHATE PRETREATMENT FACILITY

GAS TO ENERGY FACILITY

TRANSFER STATION

PROPERTY LINE

UNDERGROUND AIR SUPPLY & CONDENSATE DISCHARGE PIPE

0 100 200
APPROXIMATE SCALE

1"=100'

LEGEND:

GP-1 Gas Probe
Vertical Extraction Well Buried Under Liner
Vertical Extraction Well
CO Leachate Cleanout Riser
Condensate Sump
Control Valve
Reducer

Condensate Recirculation Lines
Header Pipes
12"ø Header Pipe
10"ø PVC
8"ø PVC
6"ø PVC
4"ø PVC
Underground Header Pipe

NOTE: GAS PIPING SHOWN IN RED IS ROUTED TO THE GAS ENERGY FACILITY

U:\DRAFTING\60-3051-05\GASSYSTEM

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DES. WLB APPR. JMS
ISSUE DATE: 8/21/01
PROJECT NO. 60-3051-05

HIDDEN VALLEY LANDFILL
PIERCE COUNTY, WASHINGTON
GAS SYSTEM

FIGURE
1-3

2.0 GAS SYSTEM OPERATION AND MAINTENANCE

Landfill gas is constantly produced as buried refuse decomposes. Failure to remove landfill gas results in a buildup of pressure within the landfill that, in turn, drives the gas outward either through the surface or through surrounding soils. The landfill gas collection field is a system of wells and piping through which the gas is extracted from the refuse and delivered to either the flare station or the gas to energy facility for combusting. When a vacuum is placed on the field using vacuum blowers, the gas moves from the refuse into the extraction wells, through the valve assemblies and header piping, and to the flare station or gas to energy facility.

The Hidden Valley Landfill gas system is fully automated. Unless mechanical problems develop, or the collection system is physically damaged, the system should operate continuously. After a power failure, the system will automatically restart upon power restoration. Continual operation of the gas system is essential to provide the required negative pressure to extract gas from the landfill. Equipment outages must be addressed as soon as they are identified because system interruptions can quickly result in gas build-ups and a noncompliance condition. Qualified personnel trained in the proper use and calibration of the equipment will perform all maintenance activities.

2.1 GAS EXTRACTION WELL FIELD

The gas extraction system consists of 120 vertical and two horizontal gas extraction wells and valve assemblies, as well as the gas header piping (discussed in Section 2.2), and gas condensate collection/recirculation system (discussed in Section 2.3).

A total of 120 vertical gas extraction wells are present at the landfill (Figure 1-3). The well casings are installed into 24-inch–diameter borings drilled from 30 to 100 feet deep in refuse. The well casings are fabricated from a combination of 3- and 4-inch, Schedule 40 or Schedule 80, polyvinyl chloride (PVC) pipe. The 4-inch well casing is slotted along the lower 60 percent of the boring depth. Coarse washed drain rock is backfilled around the well screen to approximately 2 feet above the top of the slotted interval. A bentonite well seal is installed above the gravel backfill to minimize air intrusion. The 4-inch, slotted, PVC pipe is joined by a telescoping slip joint to a 3-inch solid PVC riser protruding above the landfill surface. The slip joint accommodates long-term refuse settlement and reduces stress points that could cause casing failure. Native soil is backfilled around the well casing to the surface. A geomembrane boot is installed to eliminate surface water infiltration and gas venting between the outside of the well riser and the geomembrane liner. To prevent potential settlement stress between the liner and the

well casing, the geomembrane boot is not attached to the exterior wall of the riser pipe. A bentonite surface seal is placed just beneath the geomembrane liner to provide an additional surface seal. A typical detail for a vertical gas extraction well is shown on Figure 2-1.

Efficient operation and maintenance of the gas extraction field is required to maintain minimum methane quantity and quality conditions for operation of the gas flare and the gas to energy facility and to control the escapement of gas from the landfill. This is accomplished by balancing the well field such that landfill gas is extracted at approximately the same rate as it is generated. If the collection rate is less than the gas production rate, the excess generated gas could escape from the landfill, resulting in noncompliance and potentially hazardous conditions. If the collection rate greatly exceeds the gas generation rate, air could be drawn into the landfill along the landfill perimeter and result in a subsurface fire or have other adverse impacts (see Section 1.5.2). Gas generation rates within the landfill vary over time (see Section 1.3), therefore, well field balancing will be an ongoing process.

The gas extraction rate from each well is controlled by an adjustment valve (PVC gate valve) located on lateral piping that connects the wellhead to the gas collection header. In addition to the adjustment valve, each well lateral is equipped with a sampling point to permit field measurement of gas composition, static pressure, and extraction rates (velocity pressure). As the valve is opened, the velocity pressure increases, corresponding to a greater flow of gas through the pipe. If the velocity pressure is zero, there is no flow and the valve is likely closed.

Warning signs of an underground fire include unusual settlement of the landfill surface, the presence of carbon monoxide (CO) in the landfill gas, or steam or smoke rising from a portion of the landfill cover. If a fire is suspected, notify the operations manager and secure the safety of any persons immediately endangered by the fire. Gas wells in the vicinity of a suspected fire should be monitored, and any wells with a CO content greater than 50 percent should be closed. Once gas extraction is discontinued, the CO content should gradually diminish as landfill gas displaces the oxygen and asphyxiates the fire. It is the refuse, not the landfill gas that is burning. After the fire is extinguished, the landfill cover may require repair as described in the Post-Closure Manual.

2.2 GAS COLLECTION PIPING SYSTEM

Above-ground collection headers constructed of PVC piping convey the extracted landfill gas to either the flare facility or the gas-to-energy plant (see Figure 1-3). The headers are installed

directly on the landfill surface and are valved such that all or a portion of the extracted gas can be routed to either the flare station or the gas to energy facility. When both the flare and gas to energy facility are operating, it is important to ensure that the valves separating the header systems are kept closed so the blowers do not "pull" against each other. Typically, gas from the East Lined Area and the interior portion of the unlined area is routed to the gas to energy facility, and gas from the perimeter portion of the unlined area is routed to the flare station. The header piping can be rerouted at any time as long as gas migration is controlled.

The collection pipe sizes are based on the system's projected flow rates during peak production conditions. Using these maximum flow conditions, pressure loss calculations were performed to determine the system's total flow rate and pressure requirements for sizing the centrifugal blowers. Short lengths of flexible piping are installed at strategic points along the headers and laterals to accommodate differential settlement and thermal expansion and contraction of the piping system. The piping system is sloped to allow gas condensate to gravity drain into the gas extraction wells and to discharge points located at intervals along the header system (see Section 2.3).

During system operation, the collection piping should be inspected regularly. This inspection is typically performed during well monitoring. Components requiring occasional maintenance, adjustments, or replacement include throttle valves, labcock valves (sample ports), expansion joints, well laterals, and condensate sump connections. Differential settlement may alter the slope of the pipe and affect condensate drainage. Realignment may be required as surface features change over time. Thermal expansion and contraction, as well as settlement may cause leaks around the flexible couplings or pipe joints. Prompt repair of collection field problems is required to maintain an effective collection system.

Sampling ports and system control valves also require regular inspection. All sampling ports must remain closed or sealed unless they are being tested. This will help limit the amount of oxygen that is mixing with the methane gas, in turn improving the quality of gas. Valves in the collection field must be in working order to regulate the amount of negative pressure that is exerted on the collection field.

2.3 GAS CONDENSATE COLLECTION / RECIRCULATION SYSTEM

Landfill gas production is an exothermic process that results in the generation of a warm saturated gas. When extracted to the landfill surface, the gas cools inside of the collection piping, causing water vapor to condense and form gas condensate. Over time, uncontrolled condensate

accumulating within low elevation points along the collection piping could restrict or block gas flow, rendering the system inoperable. To alleviate this condition the gas collection pipes are sloped such that gas condensate gravity drains back into the gas extraction wells and to discharge points (condensate drains and sumps).

Six condensate drains are located over the East Lined Area. The drains are designed to discharge gas condensate into the refuse. The drains consist of an atmospheric water trap within a larger-diameter screen. The water trap permits the condensate to gravity drain from the header system (which is under negative pressure). As the condensate builds up, it overflows the water trap and discharges into the refuse through the screen. A typical detail for a gas condensate drain is shown on Figure 2-2.

Ten condensate sumps are present over the unlined portion of the landfill. The sumps collect condensate and pump it to a leach line located over the East Lined Area (see Figure 1-3). The sumps (for the most part) are former condensate drains. The drains were constructed with a drain pipe outlet rather than a screen. The pipe outlet was plugged when the drains were converted to sumps.

Each condensate sump includes an air-operated positive displacement SOLO Model SP 4000 pump manufactured by QED Environmental Systems, Inc. The operations and installation manual for the SOLO pumps is provided in Appendix C. The SOLO SP 4000 pumps can pump at a maximum rate of 4.5 gallons per minute (gpm), provide a maximum lift of 200 feet, and will handle the maximum expected condensate volumes. The pumps measure 3-inches in diameter and are 48-inches in length, easily fitting inside the 16-inch diameter sumps. The pumps automatically cycle based on the depth of condensate in the sump. Each pump has been set to cycle when the condensate reaches a depth of approximately 2 to 3 feet. As a precaution, the pumps are set to pump before the condensate level reaches the capped drainage outlet.

Check valves are installed on each pump discharge line to prevent condensate backflow into the sump. The pumps can be easily removed for maintenance by disconnecting the brass quick-disconnect coupling located on the air supply line and lifting the pump from the sump. The condensate discharge line is connected to the pump through a pitless adapter. As the pump is being lifted out, the pitless adapter disengages and, with the check valve, the condensate discharge line is prevented from backflowing into the sump.

Compressed air to operate the pneumatic pumps is delivered via a 1-½-inch diameter SDR 11 high-density polyethylene (HDPE) line from an air compressor located in the leachate pretreatment facility. The compressor is a Gardner-Denver, Model EJBRFB, which provides compressed air for the leachate facility. It is rated for 100 standard cubic feet per minute (scfm) at 125 psi. When operating, the pneumatic condensate pumps require an operating pressure of 40 to 100 pounds per square inch (psi), and approximately 1.75 scfm of air per pump. If all ten pumps operate simultaneously, approximately 18 scfm of air would be required. However, the actual demand will be closer to 2 to 4 scfm, since the pumps will be cycling periodically.

Condensate is pumped from the condensate sumps through a 1-½-inch diameter SDR11 HDPE discharge line to a perforated 1-½-inch diameter SDR11 HDPE leachline that allows condensate to percolate into the refuse over the East Lined Area. The 206-foot long leachline was constructed in a 2-foot deep, 3-foot wide gravel-filled trench. The leachline is perforated with 3/16-inch-diameter holes at 3-foot spacings. The design will minimize clogging and force the condensate to be distributed over the entire length of the drainfield.

Automated monitoring of condensate flow volumes and/or pump cycling is not considered a necessary component of the condensate recirculation system. As such, flow meters or pump cycle counters are not included. Proper operation of the condensate pumps will be confirmed during monthly observations (see Section 3.2).

The condensate collection/recirculation system requires minor periodic maintenance as parts become worn and need replacement. A parts list is included in Appendix C. Personnel performing maintenance and/or monitoring work at the sumps, should be aware that although the sumps are connected to the gas extraction system by negative pressure, there remains a potential that landfill gas could build up within the sump.

Turning the main air supply valve off can shut down the entire condensate recirculation system. This valve is located inside the southwest corner of the leachate pretreatment facility. After turning this valve off, it may take 20 to 30 minutes to bleed off air pressure in the condensate recirculation system through one quick-connect coupling vented to the atmosphere. Each individual condensate sump can be taken offline for maintenance by disconnecting the quick-connect air supply line and lifting the pump assembly out of the sump. If the condensate collection system must be down for more than 48 hours, provisions must be made to pump the sumps manually to avoid condensate blockage or sump overflow.

Air supply for the condensate recirculation system is provided by an air compressor located in a small outbuilding located in the northeast corner of the leachate pretreatment facility. This air compressor is also used for minor air requirements in the leachate pretreatment facility. As such, the compressor should always be running. However, the following procedure is provided for condensate recirculation startup assuming the compressor has been shut down:

1. With power to the leachate pretreatment facility, close the air supply valve at the end of the air compressor storage tank (Valve 1) and turn the air compressor breaker switch to the "ON" position.

2. Using the control box on the front of the air compressor, regulate the outlet pressure to maintain between 80 and 100 psi.

3. Slowly open the valve at the end of the air compressor storage tank (Valve 1) to a fully "OPEN" position. This will pressurize the air supply line to the leachate pretreatment facility. Slowly open all valves up to Valve Number 13 within the leachate pretreatment facility. (See Figure in Appendix C).

4. Slowly open the main supply valve to the condensate recirculation system (Valve 13).

5. Check the air pressure at each sump location using a hand held air pressure meter and the quick-connect riser at the top of the sump. The air pressure must be between 40 and 100 psi for the pneumatic pump to function.

6. Connect the flexible 3/8-inch diameter hose with quick-connect coupling to the pump. The pump is now on line. Once the condensate reaches the pre-set level above the bottom of the pump (below the sump-capped outlet pipe), the pump will automatically turn on and discharge condensate into the main collection line.

System maintenance for the air compressor should include the following:

- Oil change and parts/belt inspection (replacement as necessary) on the air compressor every 1,000 hours, and check pressure relief valve every 2,200 hours, replacing as necessary.
- The pressure regulator filter on the air-drying unit should be checked to verify that it is automatically draining every 1,000 hours, and be replaced as necessary.

2.4 FLARE STATION

The flare station includes the mechanical and electrical equipment and the controls necessary to actively extract landfill gas and discharge it into the flare for disposal. The primary components consist of a scrubber, two blowers, two enclosed ground flares, and a motor control center.

Continual operation of the flare facility is essential to provide the required negative pressure to extract gas from the landfill. Equipment outages must be kept at a minimum as system interruptions can quickly result in gas build-ups and potentially a noncompliance condition. If a prolonged failure occurs, adjustments must be made to the collection field to route the gas to the gas to energy facility and maintain a negative pressure on the landfill (see Section 2.6). Trained personnel consistent with the manufacturer's recommendations for the various components must perform operation and maintenance of the gas to energy facility.

Scrubber. A scrubber, or knockout vessel, is used before the gas enters the blower(s) to remove excess moisture and particulate matter. Without the scrubber, the moisture and particulate matter in the gas stream could be both corrosive and abrasive to the interior of the blower housing and impeller. The scrubber is an enlargement in the piping diameter that reduces gas velocity as it passes through. The gas enters the vessel tangentially, causing the gas to flow spirally. Centrifugal forces cause the moisture droplets and any particulates to impinge on the inside wall of the scrubber and settle on the bottom. Condensate accumulations drain from the scrubber into a condensate drain located near the blower pad. The scrubber is equipped with a removable bolt-on cover to permit inspection and cleaning.

Blowers. The flare station includes two Hoffman Multistage Centrifugal Blowers, with 75-horsepower (hp), 3,600 RPM motors. The blowers provide the negative pressure and flow capacity to extract gas from the landfill. One blower operates continuously and the other provides 100 percent backup capability. Blower usage should be alternated monthly.

Landfill Gas Flares. After exiting the blower, the gas is fed into one of two enclosed-flame landfill gas flares, discharged and incinerated through a burner head assembly. The flare purchased in 1989 is a refractory-lined, cylindrical vessel measuring 9 feet in diameter by 40 feet in height manufactured by I.T. McGill Pollution Control Systems, Tulsa, Oklahoma. The flare purchased in 1994 is a refractory-lined cylindrical vessel measuring 8 feet in diameter by 40 feet in height, manufactured by John Zink Company (which acquired the former I.T. McGill Pollution Control Systems), Tulsa, Oklahoma. Flare dimensions are based on the projected

maximum flow rates determined for the gas collection system. At maximum flow conditions, the height of the flame within the flare is limited to approximately 85 percent of the flare height to provide a completely hidden flame. The main flame is ignited by a propane-fueled pilot flame activated by the system's automated controls. The flare is equipped with a flame arrestor installed at the inlet to prevent flame propagation and possible damage to the blowers and gas piping.

In accordance with PSCAA permit requirements, the flare operating temperature must be maintained above 1,400 °F. Flare operating temperature is maintained by controlling the ratio of landfill gas to combustion air by two louver panels located 180 degrees apart at the base of the flare. A thermocouple, installed near the top of the flare, monitors the flare's interior stack temperature, which is displayed on a digital Honeywell UDC-2000 mounted within an electrical enclosure at the flare base. At each flare, one of the two louvers includes an automated adjustment system to maintain a constant operating flare temperature of approximately 1,500 °F. The combustion temperature should never exceed 2,000 °F as damage to the flare's refractory and thermocouple can occur. If major adjustments to the gas extraction well field increase or decrease the gas flow rate, the louver system may require readjustment. In addition, the louvers may require adjustment to avoid creating excessive noise and vibration.

System Controls. Gas system operation is controlled by a flame safeguard system and an ultraviolet (UV) flame scanner mounted on the flare stack. The scanner senses UV emissions by the interior flame and sends a continuous milli-amp signal to the flame safeguard circuit mounted within the motor control center (MCC). A sudden loss of UV emissions triggers an interruption in the multi-amp signal, and the system controls shut down the system and activate an alarm.

System Startup. Gas collection system startup is initiated by a switch located adjacent to the MCC. When initiated, an automatic ignition sequence begins with the opening of a solenoid valve installed on a propane line leading to a pilot burner within the flare. An electronic igniter then lights the pilot flame. Within a few seconds, the blower(s) start up and begin feeding landfill gas to the main burners. Once main flame ignition occurs, the flame scanner immediately senses the UV emissions and shuts off the pilot system. During typical operation, if the UV scanner loses proof of main flame, the system initially activates the pilot system one time in an attempt to relight the main flame. If unsuccessful, the blower(s) shut off, and the automated controls lock out. To relight the system, the controls must be manually reset before the system can be restarted. This is a safeguard feature to prevent the ignition system from continuously recycling

in an attempt to reignite the flare. After a lockout, the operator should investigate and identify the source of the problem before restarting the system. The flare is also equipped with a high temperature alarm feature that shuts down the system if the flare temperature reaches 1,800 °F. Temperatures in excess of this could damage the flare components.

System Maintenance. The mechanical equipment within the flare station requires regular servicing in accordance with manufacturer's recommendations. Typical maintenance activities for the flare station include the following:

- Lubrication of the bearings installed on the blowers and motors.
- Periodic inspection and replacement of any belt drives used for equipment operation
- Removal and cleaning of the flame arrester internal bank (if not periodically cleaned, it could become obstructed by particulates or other suspended debris in the gas stream, resulting in a loss of system pressure).
- Replenishing the contents of the propane tanks used for the pilot flame.
- As needed, cleaning or repainting of the various mechanical and electrical components.
- Periodic cleaning of UV scanners.

2.5 GAS TO ENERGY FACILITY

The landfill gas to energy plant is a highly sophisticated facility that includes the mechanical and electrical equipment and the controls to actively extract landfill gas and convert it into electrical energy. Operation of the gas to energy facility requires a full-time staff person. Detailed descriptions of the facility components and operation parameters are beyond the scope of this document. However, a brief description is included here to provide a basic understanding of system operation.

The primary components of the gas to energy facility consist of filters, a scrubber, a centrifugal blower, a chiller, three generators with radiators and mufflers, and a motor control center, as well as a transformer and utility relay. Presented below is a brief summary of system components.

As with the flare station, continual operation of the gas to energy facility is essential to provide the required negative pressure to extract gas from the landfill. Equipment outages must be kept at a minimum as system interruptions can quickly result in gas build-ups and potentially a noncompliance condition. If a prolonged failure occurs, adjustments must be made to the collection field to route the gas to the flare facility and maintain a negative pressure on the landfill (see Section 2.6). Trained personnel consistent with the manufacturer's

recommendations for the various components must perform operation and maintenance of the gas to energy facility.

Filters. A horizontal filter, manufactured by Highland Power Corporation, is used to initially filter the landfill gas. A coalescing filter, manufactured by Perry Equipment Company, is used as a final step to remove moisture and particulate matter.

Scrubber. After passing through the horizontal filter, the landfill gas next encounters a stainless steel scrubber that is used to remove moisture and particulate matter.

Blower. The blower consists of a Hoffman 1500 standard cubic feet per minute (csfm) centrifugal blower with a 100 horsepower (hp) variable speed motor. Two positive displacement blowers are available as a back up.

Chiller. Landfill gas enters the blower at a temperature of approximately 80°F to 120° F and exits at approximately 120 to 140°F. After exiting the blower, a refrigeration chiller, manufactured by the Thermotech Corporation, is used to reduce the temperature of the gas to approximately 90°F.

Generators. After passing through the chiller and the coalescing filter, the gas enters a manifold that is connected to three CAT 3516 generators capable of producing 950 kilowatts (kW) each. The generators are equipped with radiators and mufflers.

Transformer and Utility Relay. Generated electricity is transmitted to Puget Sound Energy (PSE) via a transformer located outside the gas to energy building. A utility relay is included to shut down power transmission when there are interruptions in the power service.

System Controls. A programmable logic controller (PLC) controls facility operation.

2.6 GAS SYSTEM BACKUP

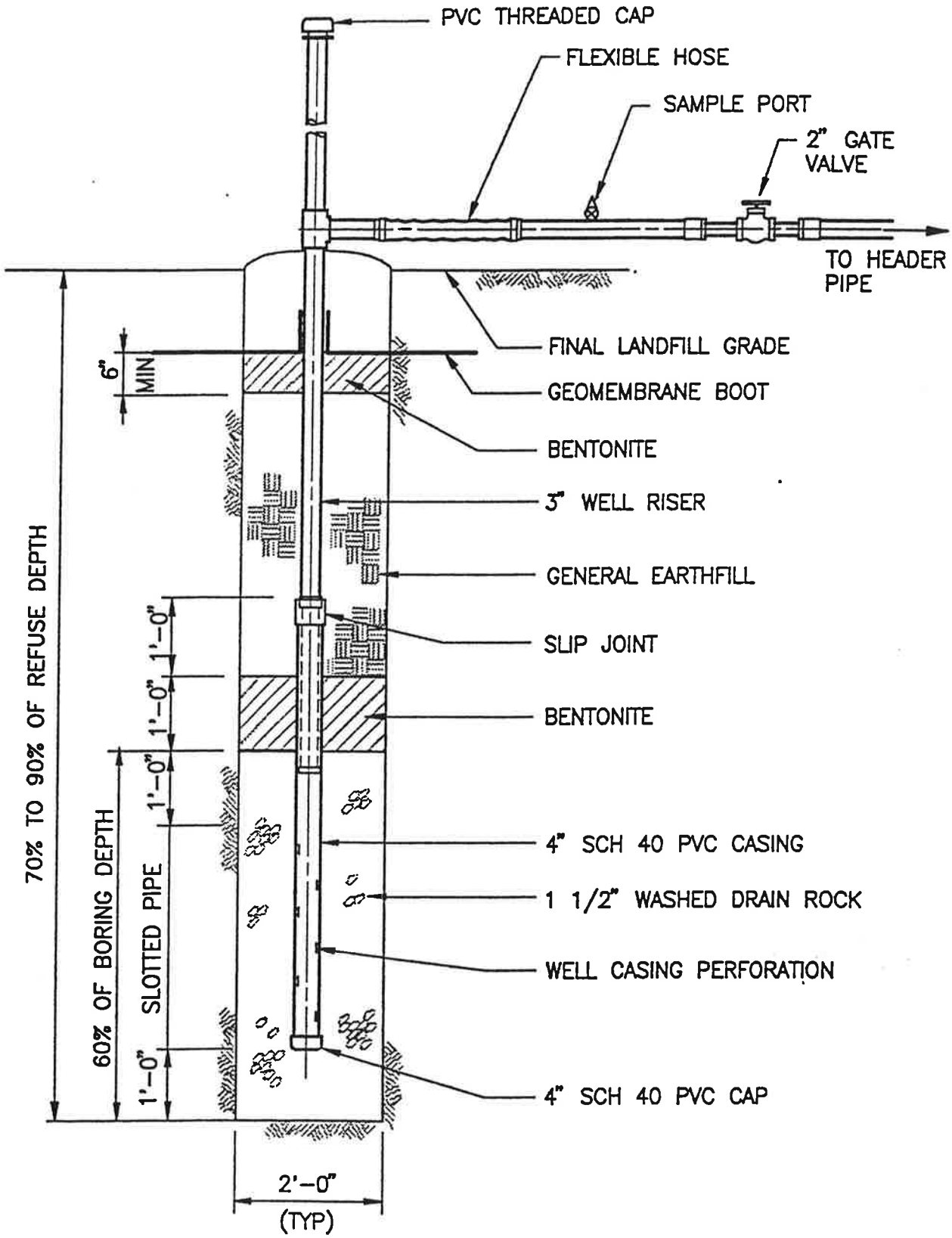
Currently only one of the two ground flares is required to combust the volume of gas routed to the flare station. If one flare malfunctions, the second flare can be utilized. The flare station also includes backup blower capacity. If a system failure at the flare station is such that neither flare can operate, adjustments must be made to the collection field to route the gas to the gas to energy facility and maintain a negative pressure on the landfill. If the primary blower at the gas to energy facility fails, two back-up blowers are available. If for any reason the gas to energy facility should be shut down, adjustments must be made to the collection field to route the gas to

the flare station until the gas to energy facility is returned to operation. These procedures will prevent gas build-ups and possible hazardous conditions or noncompliance.

2.7 GAS MONITORING PROBES

Gas monitoring probes are installed in the subsurface to evaluate the performance of the gas collection system (to check for gas migration in the subsurface) and to assess the site for compliance with gas control requirements at the property line (see Section 3.5).

The Hidden Valley Landfill has 22 gas probes installed around the landfill (see Figure 1-3). The probes consist of a 6-inch-diameter boring drilled to depths ranging from 37 to 160 feet, with a bottom elevation approximately equal to the bottom of the refuse. Each boring contains either one, two, or three solid, ½-inch PVC pipes connected to an 18-inch length of ½-inch, slotted PVC pipe which serves as the sensing tip. The installed elevations of the sensing tips vary to permit combustible gas monitoring within the native soils at differing elevations or geologic formations. Gravel is placed around the sensing tip of each probe, and the boring is backfilled with low permeability bentonite seals to isolate gravel cells from the atmosphere. The probes are labeled with stamped brass tags and secured within lockable security casings. Figure 2-3 presents a typical multi-completion gas probe detail. Boring logs and construction details for the gas probes are included in Appendix A.



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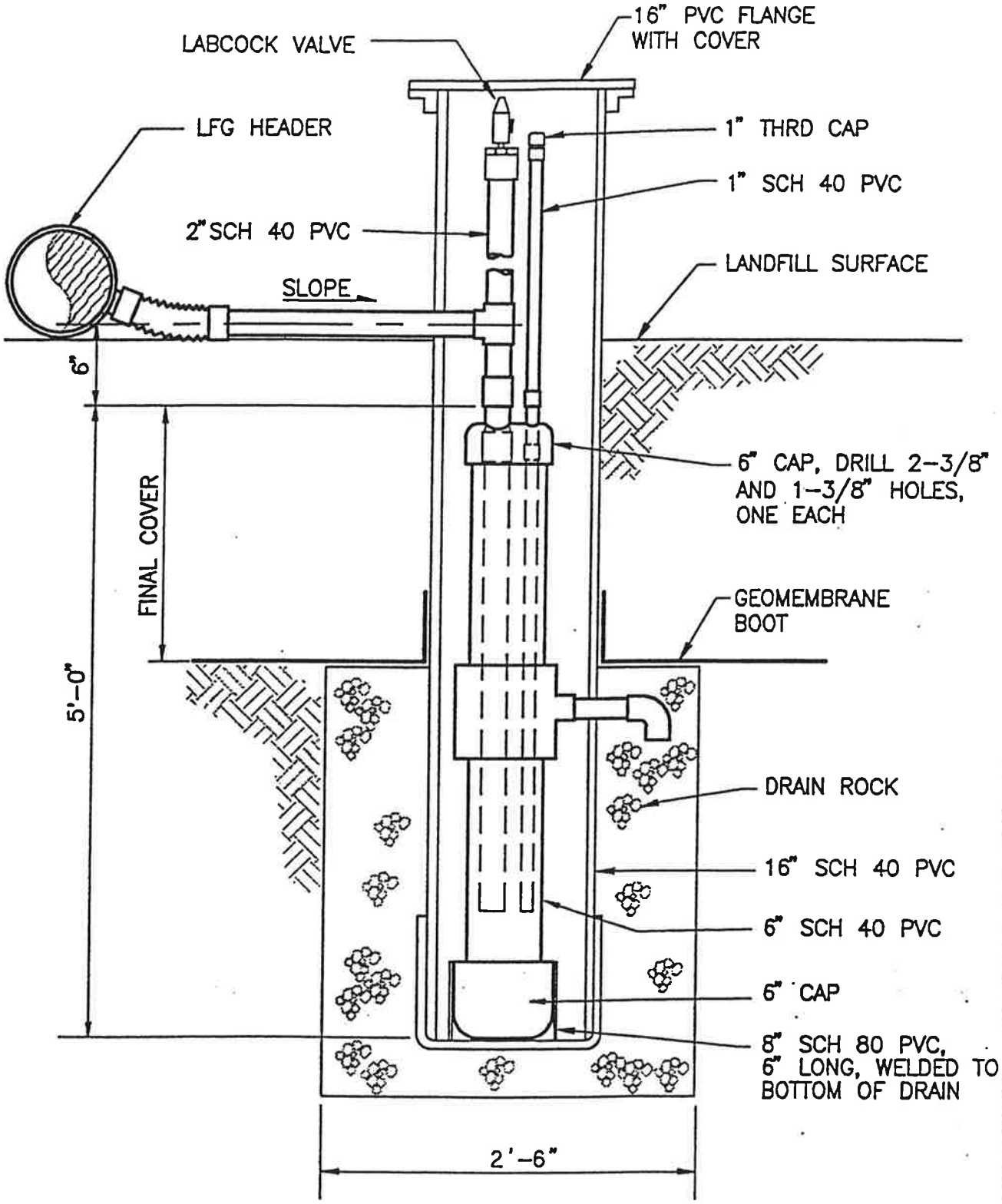
REV.
APPR.
PROJECT NO. 0202-001.81

Figure 2-1
HIDDEN VALLEY LANDFILL
LANDFILL GAS MANAGEMENT PLAN
TYPICAL VERTICAL GAS EXTRACTION WELL

1= 2 2-17-94 G:\DWG\0202\001\81C13



NOTE: BACKFILL AROUND CONDENSATE TRAP W/ PEA GRAVEL.

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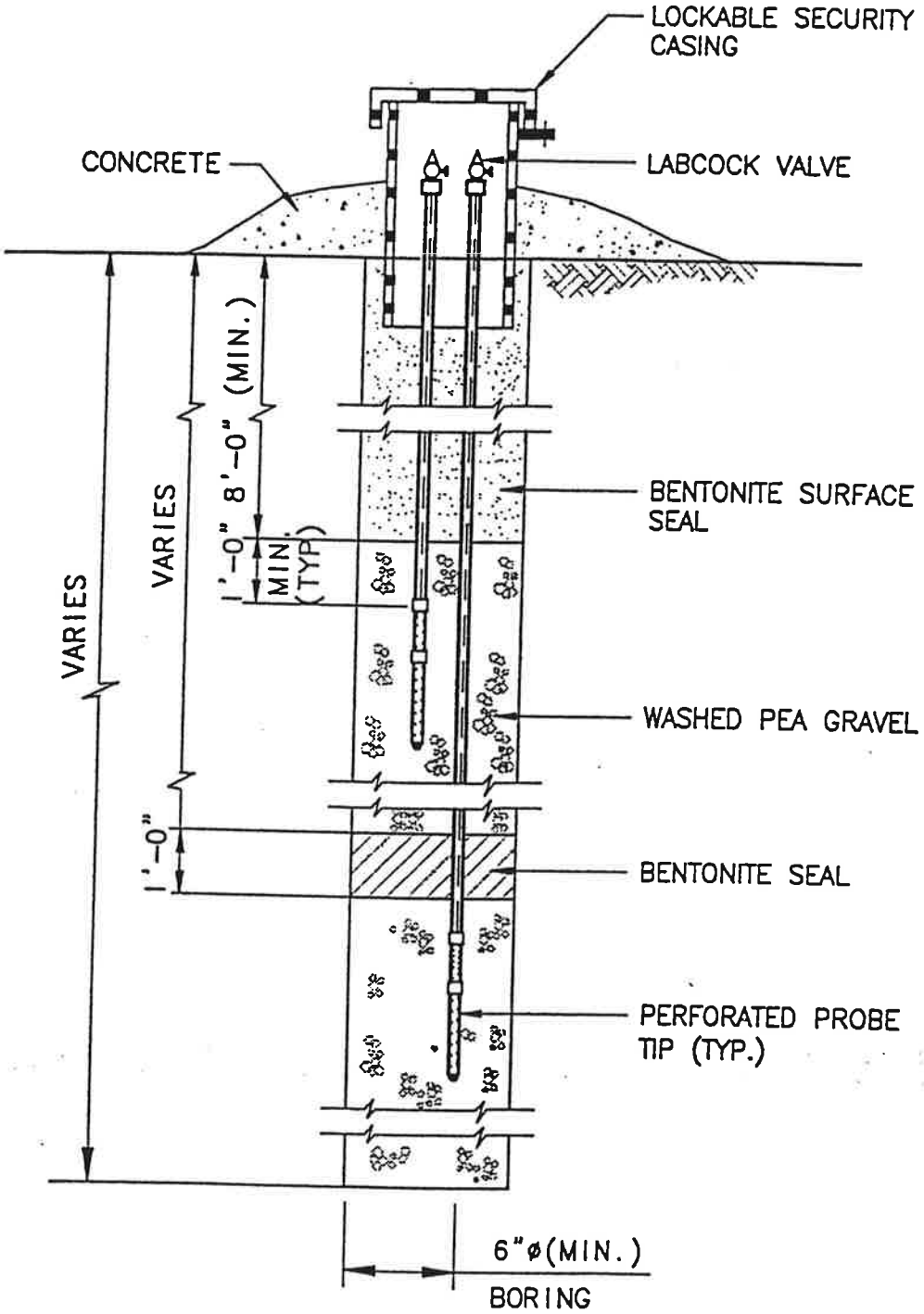
Figure 2-2
HIDDEN VALLEY LANDFILL
LANDFILL GAS MANAGEMENT PLAN
EXISTING CONDENSATE DRAIN DETAIL

1= 1 02-22-94 G:\DWG\0202\001\81C12



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PROJECT NO.	0202-001.81

Figure 2-3
HIDDEN VALLEY LANDFILL
LANDFILL GAS MANAGEMENT PLAN
TYPICAL GAS PROBE DETAIL

1= 1 02-22-94 G:\DWG\0202\001\81C14

3.0 SYSTEM MONITORING REQUIREMENTS

System performance monitoring and compliance monitoring are necessary to ensure a properly functioning landfill gas control program. System performance is evaluated by periodic monitoring at the gas wells, gas probes, flare station, and gas to energy plant. Compliance monitoring consists of periodic checks of gas probes and on-site structures to determine site compliance with regulatory standards for gas control. In addition, emission testing may be required by PSCAA to assess compliance with air quality standards. Qualified personnel trained in the proper use and calibration of the monitoring instruments should perform all monitoring and maintenance activities. Example field forms for use when monitoring the gas system are included in Appendix B. All field forms will include the date, time and a description of weather conditions at the time of monitoring, the name of the person conducting the monitoring, and the monitoring results.

3.1 GAS EXTRACTION WELL FIELD MONITORING

Gas extraction wells are monitored to ensure that gas collection rates are maintained (balanced) as needed for gas control. The Hidden Valley Landfill well system is currently monitored monthly. However, the monitoring frequency may be reduced as areas of the landfill become stable and gas generation rates decline, or increased if the system becomes unbalanced.

During each well-monitoring session the gas composition and pressure (both static and velocity) will be measured. Gas composition is measured using a portable, combustible gas/oxygen detector as described in Appendix D. Under normal gas control system operations, the methane and carbon dioxide content of the extracted gas should each range from 30 to 50 percent by volume, with an oxygen content of less than 2 percent.

Pressure measurements are used to determine the amount of gas flowing inside a pipe. Two types of pressure measurements are collected: static pressure and velocity pressure. Static pressure is related to gas transmissibility and moisture content of the refuse around the well and the amount of negative pressure (vacuum) applied by the blowers. When gas is actively withdrawn from the system, typical negative pressures should range from less than -1.0 to -40.0 inches of water column. The only time there should be a positive static pressure in a header is when the blowers are not operating or when the associated valves are closed. In this case the static pressure reading indicates pressures within the landfill. If zero static pressure is measured, it may indicate that a pipe is broken and open to the atmosphere (the atmosphere is considered zero static pressure). Velocity pressure is measured on lateral well connectors, header pipes and at the flare station and gas to energy facility to determine the amount of gas flow at a particular

location. The velocity pressure is always zero if there is no flow. As the flow increases, the velocity pressure will correspondingly increase.

Pressure is measured using either a digital manometer or a gauge (See Appendix D). Each instrument indicates pressure in inches of water column. Before taking pressure readings, be sure to zero the instruments. Open the labcock before connecting the instrument tubing to allow any gas condensate to evacuate. Digital manometers have positive and negative ports. Connecting a tube from the positive port to the sampling point will indicate the true static pressure on the display.

If velocity pressure is taken using a pitot tube, the top leg of the pitot tube should be connected to the positive port on the digital manometer. The horizontal leg of the pitot tube should be connected to the negative port. The pitot tube is then inserted into the center of the gas pipe in the upstream direction, so that gas flow rushes into the hole on the lower horizontal leg of the pitot tube.

When the pitot tube is inserted into the gas pipe, gas condensate may enter the tube. This may require that the pitot tube be shaken or blown out and the reading double-checked. Pitot tube readings are taken where the gas stream is straight and smooth rather than immediately downstream from valves and elbow fittings. The flow rate is calculated by taking the square root of the velocity pressure and multiplying the result by a factor based on the pipe diameter as shown on Table 4-1.

An example well field monitoring form to be completed monthly is included in Appendix B. This form is for performance monitoring purposes only and does not require inclusion in quarterly monitoring reports.

Table 3-1
Gas Flow Rate Conversion Chart
Hidden Valley Landfill, Pierce County, Washington

Pipe Diameter in Inches	Flow Factor
2	79
3	178
4	317
6	719
8	1248
10	1969
12	2792

Notes:
1. To determine gas flow rate, multiply the square root of the velocity pressure by the flow factor.
2. Velocity pressure is in units of inches of water column.
3. Pipe area based on Schedule 40 PVC pipe.

3.2 GAS CONDENSATE COLLECTION / RECIRCULATION SYSTEM MONITORING

The condensate collection/recirculation system should be inspected on a monthly basis. The inspection will include confirmation that the pump is running at each sump location, and visual observation for leaks. If a pump is not working, it should be repaired or replaced as soon as possible and the accumulated condensate should be removed using a vactor truck and transported to the leachate treatment system for disposal. If the leach line fails (clogs), the discharge line pressure will be such that the sump pumps will cease operating. If the discharge line breaks, condensate will be noticeable through staining of cover soils and/or odors. An example inspection form to be completed monthly is included in Appendix B. This form should be included in the quarterly monitoring reports (see Section 4). On an annual basis, the system will be pressure tested and the results reported to the TPCHD.

3.3 FLARE FACILITY MONITORING

The flare facility will be monitored at least monthly for combustion temperature, gas composition, and flow rate. In accordance with PSCAA permit requirements, the flare operating temperature must be maintained above 1,400 °F. The temperature is monitored by a thermocouple, installed near the top of the flare, and read using a digital Honeywell UDC-2000 mounted within an electrical enclosure at the flare base. Gas composition and flow rate are measured in the same manner as for the extraction wells (see Appendix D). The flow rate is measured using either a thermal anemometer or a pitot tube and manometer. A lean mixture of

methane can cause improper combustion within the flare, resulting in poor flare performance. An example form for recording flare operation data is included in Appendix B. This form is for performance monitoring purposes only and does not require inclusion in quarterly monitoring reports. In addition, the volume of gas consumed at the flare will be recorded monthly.

3.4 GAS TO ENERGY FACILITY MONITORING

As noted in Section 2.5, operation of the gas to energy facility requires a full-time staff person. Detailed descriptions of the facility components and operation parameters are beyond the scope of this document. However, the landfill gas technician should ensure that the volume of gas consumed at the gas to energy facility is recorded each month.

3.5 GAS PROBE MONITORING

The Hidden Valley Landfill gas probes are currently monitored monthly. Gas probes GP-1, GP-10 and GP-11 are located within the interior portion of the landfill property and are used to monitor performance of the gas system. The remaining gas probes are located along or near the property line and are considered compliance probes. Gas probes GP-20, GP-21, and GP-22 are located off-site and will not be monitored unless off-site subsurface gas migration is suspected.

The gas probes are monitored for the percentage of methane, carbon dioxide, and oxygen, as well as static pressure. The concentration of methane is not allowed to exceed the lower explosive limit (LEL) of 5 percent methane by volume, at the property line or beyond (WAC 173-351-200[4][a][ii]). Ideally, the probes should show no trace of landfill gas, while the oxygen should be approximately 21 percent as air. The presence of any methane concentrations, even if below the regulatory standards, should be a concern. If methane is detected in any gas probe above 5 percent methane by volume, the TPCHD must be notified as outlined in Section 4 and the negative pressure applied to the adjacent extraction wells should be increased to recapture the gas. Static pressure readings should be zero or slightly negative. An example gas probe monitoring form is included in Appendix B. This form is to be included in the quarterly monitoring reports (see Section 5). Detailed procedures for gas probe monitoring are included in Appendix D.

3.6 BUILDING MONITORING

The interiors of on-site structures will be monitored quarterly to assess compliance with regulatory standards. The concentration of landfill gas is not allowed to exceed 25 percent of the LEL in the interior space of any on-site structure (WAC 173-351-200[4][a][i]). The monitoring will be performed in the early morning and will include the inhabited space, as well as any crawl space areas. If monthly probe monitoring detects methane concentrations in probes located near on-site structures, the building interior will be checked. The following on-site structures, shown of Figure 2, will be monitored:

Main Office
Maintenance Building
Guard Post
Pay/Scale Booth
Recycle Building
Leachate Treatment Building
Gas to Energy Building
Transfer Station Building

An example building monitoring form is included in Appendix B. This form is to be included in the quarterly monitoring reports (see Section 5).

Monitoring of off-site structures is required if odors are reported in the structures or if methane is detected at the property boundary and adjacent structures are present. Landfill gas concentrations of no more than 100 parts per million (ppm) by volume are allowed in off-site structures (WAC 173-351-200[4][a][iii]). If off-site monitoring is necessary, appropriate instrument calibration will be performed to ensure the 100 ppm standard can be measured.

4.0 RECORD KEEPING AND NOTIFICATION REQUIREMENTS

Copies of all landfill gas system monitoring data must be kept and filed in the site's Operating Record. Gas probe and building monitoring results will be faxed to the TPCHD on a monthly basis. Copies of monitoring data for the gas probes, condensate sumps, and buildings will be submitted to the TPCHD on a quarterly basis as part of the quarterly monitoring report. The volume of gas consumed at both the flare station and the gas to energy facility will be recorded on a monthly basis.

If methane is detected in any gas probe above five percent by volume, LRI will immediately take all steps necessary to ensure protection of human health, including the following.

- Notify the TPCHD within 24 hours (by Consultant)
- Adjust the adjacent extraction well field to recapture the gas
- Monitor the probe(s) daily until gas concentrations decrease to below five percent by volume
- Monitor nearby buildings (if present)

If methane is detected in any structure above the performance standard of 25 percent of the LEL, LRI will immediately take all steps necessary to ensure protection of human health, including the following.

- Notify the TPCHD within 24 hours (by Consultant)
- Evacuate the affected structure(s) as determined appropriate by the TPCHD and the Fire Department
- Adjust the adjacent extraction well field to recapture the gas
- Monitor the affected structure(s) daily until gas concentrations decrease to compliance levels
- Monitor adjacent off-site structures (if present)

Within 7 calendar days of a detection exceeding regulatory limits, the methane levels detected and a description of the steps taken to protect human health and correct the situation will be placed in the site's Operating Record.

Within 60 days of detection exceeding regulatory limits, a remediation plan must be completed and implemented. The TPCHD will be notified that the plan has been implemented and a copy of the remediation plan will be placed in the site's Operating Record.

DOCUMENT REVIEW ACKNOWLEDGEMENT

By signing below I acknowledge that I have read and understand the requirements of the *Hidden Valley Landfill, Landfill Gas Management Plan*, revision date January 2, 2002.

Name	Signature	Title	Date

APPENDIX A

GAS PROBE COMPLETION LOGS

Sweet-Edwards/EMCON, Inc.

BORING LOG

PROJECT Thun Field Landfill Site

Location Northern Property Line

Boring No. MW-17S (GP-1 a, b, c)

Surface Elevation 548 ft. (MSL)

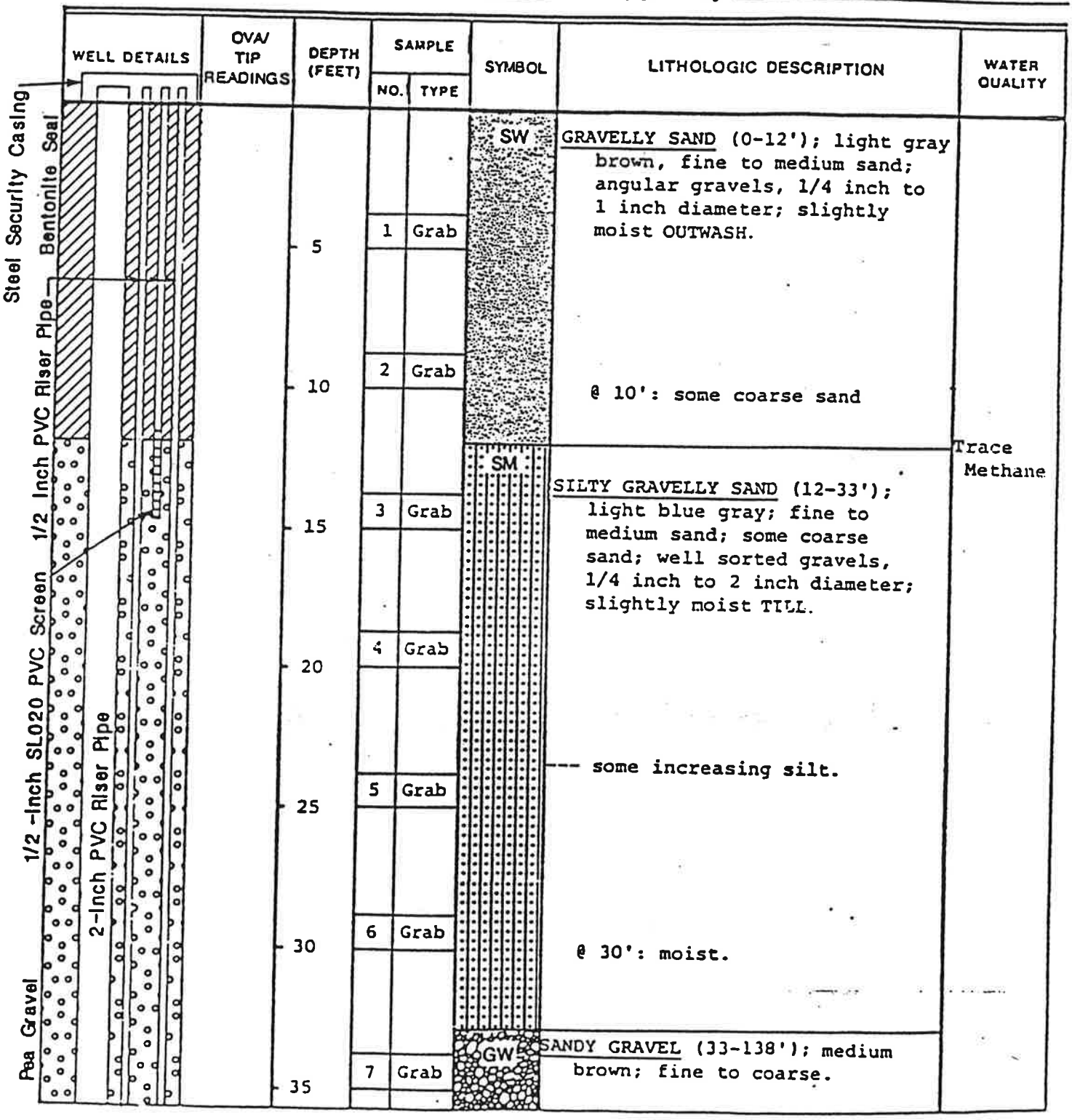
Drilling Method Air Rotary - 6"

Total Depth 154 feet.

Drilled By Hayes Well Drilling Co.

Date Completed 6/30/87

Logged By Kevin G. Rattue



SEA-300-02a

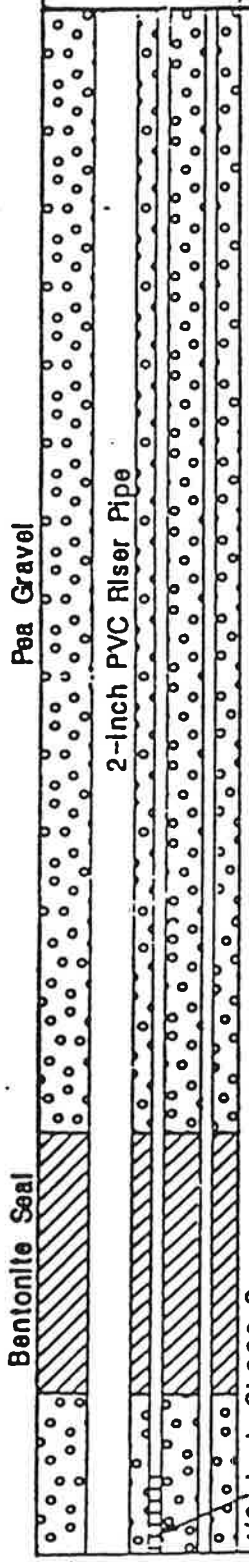
GP-1 ; 1 of 4

Sweet-Edwards/EMCON, Inc.

BORING LOG

PROJECT Thun Field Landfill Site

Boring No. MW-17S



WELL DETAILS	OVA/ TIP READINGS	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		35			GW	Sand, poorly graded subangular gravel; 1/4 inch to 1 inch diameter; some silt; moist (OUTWASH.)	
			8	Grab			
		40					
			9	Grab			
		45					Trace Metha
			10	Grab			
		50					
			11	Grab		@52': increasing gravels; subangular to angular; 1/8 inch to 2 inch diameter; wet.	
		55					
			12	Grab			
		60					
			13	Grab		@ 65': wet.	
		65					
			14	Grab		@ 70': some scattered boulders.	0.3% Methan
		70					

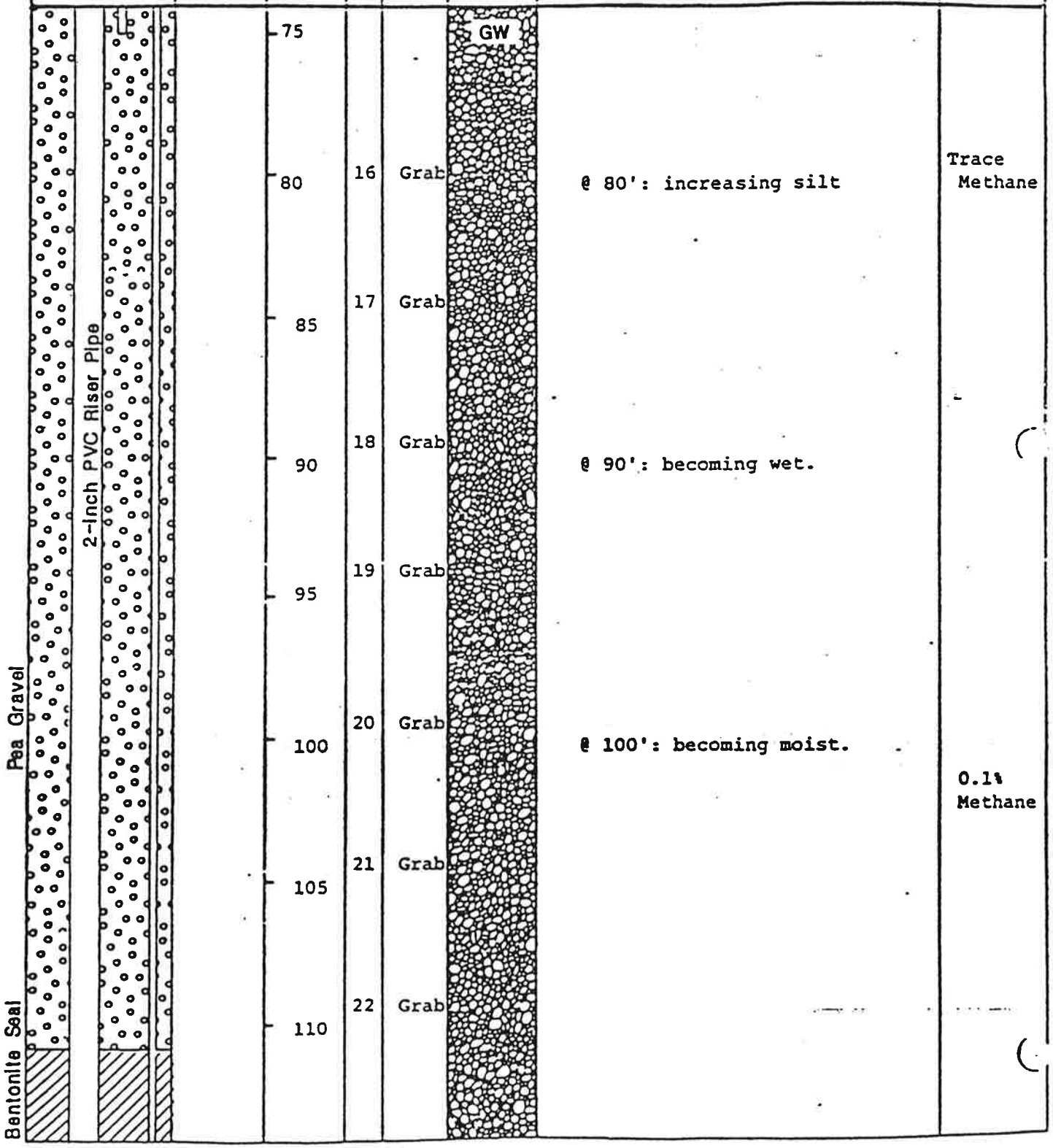
SEA-300-025

Sweet-Edwards/EMCON, Inc.

BORING LOG

PROJECT Thun Field Landfill Site

Boring No. MW-17S



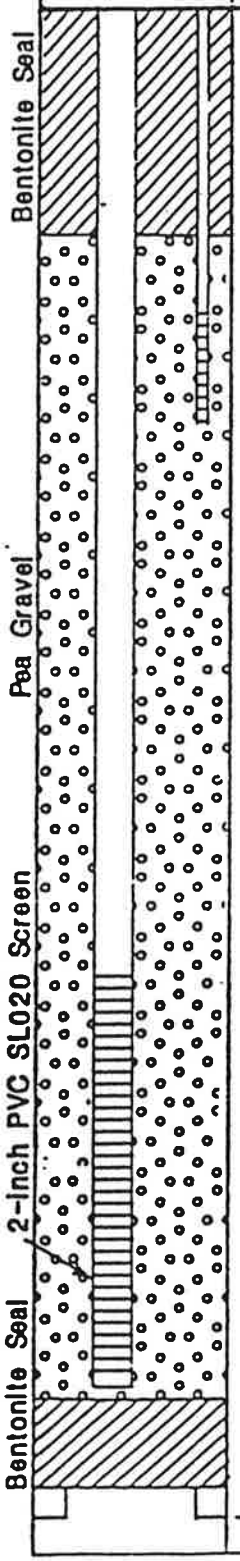
SEA-300-025

Sweet-Edwards/EMCON, Inc.

BORING LOG

PROJECT Thun Field Landfill Site

Boring No. MW-17S



WELL DETAILS	OVA/ TIP READINGS	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		115	23	Grab	GW	SANDY GRAVEL; medium brown; fine to coarse sand; subrounded gravels; less than 1 inch; some silt; slightly moist. (33 -138')	0.5% Methane
		120	24	Grab			
		125	25	Grab			
		130	26	Grab		--- becoming very wet; grading to gray brown; gravels well sorted, 1/2 inch to 3 inch diameter; saturated.	S.W.L.
		135	27	Grab			Conducti =2150 T= 23°C pH=7.6
		140	28	Grab	GP	Sandy Gravel: (138'-B.O.B.) --- increasing coarse sand; becoming increasingly poorly sorted gravels; 1/2 inch to 1 inch diameter; saturated.	
		145	29	Grab			
		150	30	Grab			Conducti =1530 T=21 pH-7.
						Boring terminated at 154 feet.	

SEA-300-02

Sweet-Edwards/EMCON, Inc.

BORING LOG

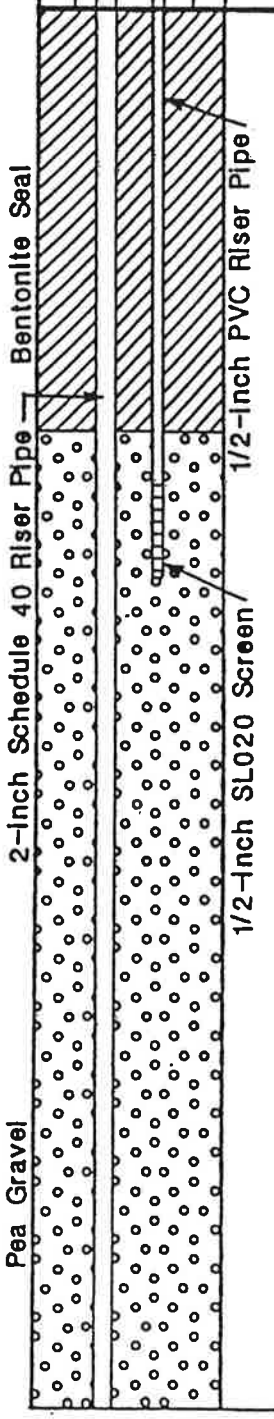
PROJECT Thun Field Landfill Site — **Page** 1 of 4

Location (SEE Figure) — **Boring No.** GP-2

Surface Elevation Approx. 545.5 ft. (MSL) — **Drilling Method** Air Rotary

Total Depth 120 feet. — **Drilled By** Hayes Well Drilling Co.

Date Completed 07/01/87 — **Logged By** Kevin G. Rattue



DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
5			SW	GRAVELLY SAND (0-15'); light brown; fine to coarse sand; poorly sorted angular gravels, 1/8 inch to 1 1/2 inch diameter; moist. (Outwash)	
10					
15				SILTY GRAVELLY SAND (15-29'); light blueish gray; fine to medium sand; silty; subangular gravels; well sorted, 1/8 inch to 1 inch diameter; moist TILL	0.4% Methane
20			SW		
25			SP	@ 25': becoming moderately poorly sorted with gravels 1/4 inch to 3/4 inches diameter; fine to medium sand; moist.	
30			GW	SANDY GRAVELS (29-BOB); gray brown; medium to coarse sand with some fine sand and trace silt; gravels well sorted, 1/8 inch to 2 inches diameter; wet OUTWASH	
35					

SEA-300-02a

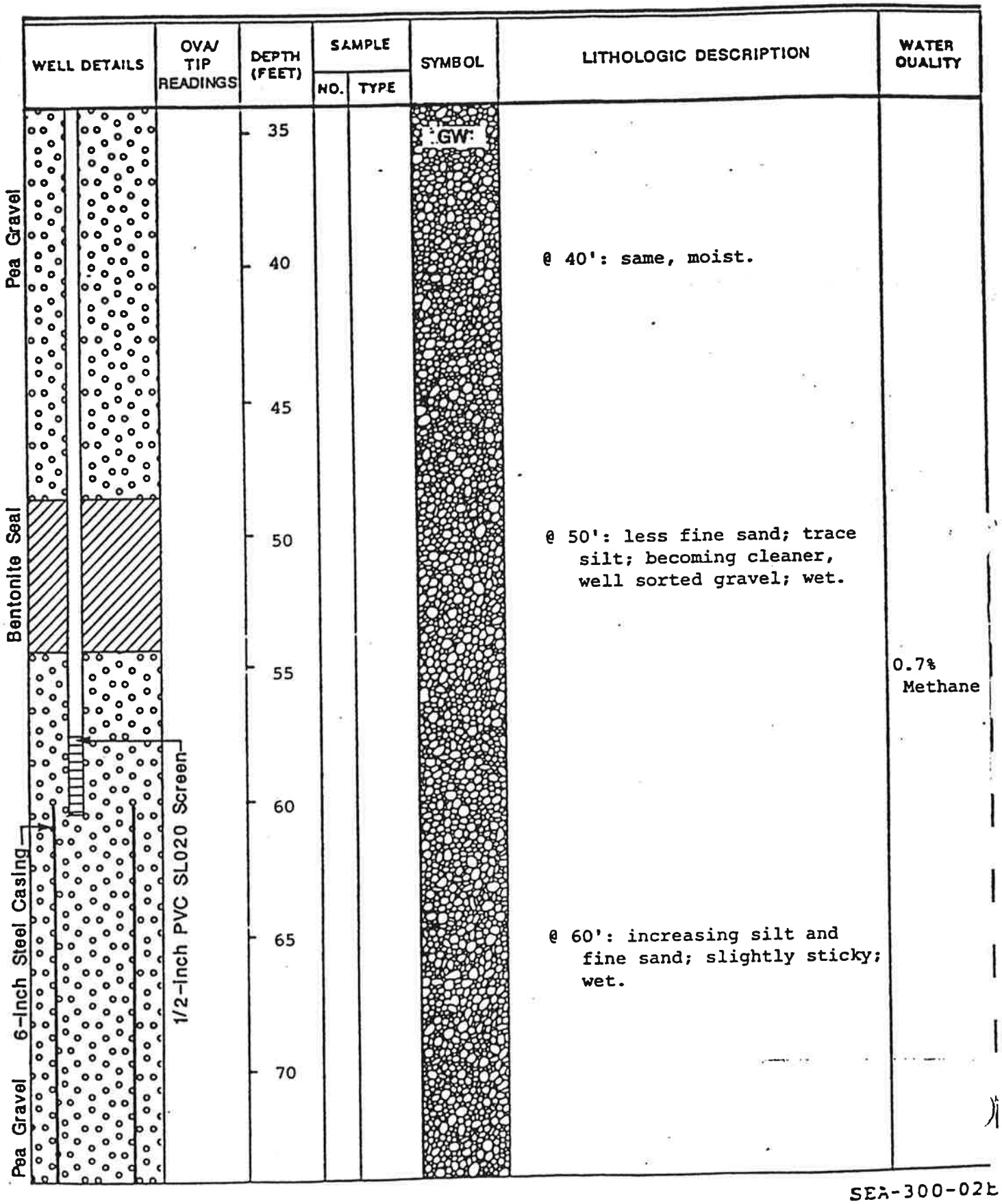
GP-2: 1 of 2

Sweet-Edwards/EMCON, Inc.

BORING LOG

PROJECT Thun Field Landfill Site

Boring No. GP-2



SEA-300-02b

LOG OF EXPLORATORY BORING

PROJECT NAME	Hidden Valley Landfill	BORING NO.	GP-23 (GP-3)
LOCATION	North Property Line	PAGE	1 OF 7
DRILLED BY	Layne Environmental	REFERENCE ELEV.	
DRILL METHOD	Revrs Air	TOTAL DEPTH	123.00'
LOGGED BY	G. S. Mack	DATE COMPLETED	6/27/91

SAMPLING METHOD AND NUMBER	PID (in ppm)	BLOWS PER FOOT	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
1				5				0 - 18.0 feet: SILTY SAND (SM) with cobbles; moderate yellowish-brown, grayish-brown; mostly fine SAND (50%) with few coarse to medium; some non-plastic fines (40%); few gravel (10%); cobbles subrounded and up to 5 inch in size; dry; well graded.
2				10				@ 12.0 feet: increase in cobbles to 5-inch. @ 13.0 feet: change to grayish-brown
3				15				@ 16.0 feet: change to yellowish-brown.
				20				18.0 - 22.0 feet: GRAVELLY SAND (SW); medium grayish -brown, mostly fine to coarse sand (55%); some gravel (40%), subangular to subrounded; trace of fines; moist, well

REMARKS
All samples are grab samples. C.G. = combustible gas.

SWEET-EDWARDS/EMCON

T02-01.35.GP23.28/sd:2.7/12/91

LOG OF EXPLORATORY BORING

PROJECT NAME	Hidden Valley Landfill	BORING NO.	GP-23 (GP-3)
LOCATION	North Property Line	PAGE	2 OF 7
DRILLED BY	Layne Environmental	REFERENCE ELEV.	
DRILL METHOD	Revrs Air	TOTAL DEPTH	123.00'
LOGGED BY	G. S. Mack	DATE COMPLETED	6/27/91

SAMPLING METHOD AND NUMBER	PID (in ppm)	BLOWS PER FOOT	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
		NO C.G.						graded.
4								22.0 - 41.0 feet: SANDY GRAVEL (GW) with boulders; yellowish-brown; fine to coarse gravel (55%) subangular to subrounded, hard; some sand (40%), fine to coarse; boulders up to one foot; few fines (<5%); dry.
5				25				@ 26.0 feet: increasing moisture.
								@ 28.0 feet: faster drilling
		NO C.G.						
6				30				
7				35				
		NO C.G.						@ 39.0 feet: increase in moisture, sand is mostly coarse with a trace of lines.
				40				

REMARKS
All samples are grab samples. C.G. = combustible gas.

SWEET-EDWARDS/EMCON

T02-01.35.GP23.28/sd:2.7/12/91

LOG OF EXPLORATORY BORING

PROJECT NAME	Hidden Valley Landfill	BORING NO.	GP-23 (GP-3)
LOCATION	North Property Line	PAGE	3 OF 7
DRILLED BY	Layne Environmental	REFERENCE ELEV.	
DRILL METHOD	Revrs Air	TOTAL DEPTH	123.00'
LOGGED BY	G. S. Mack	DATE COMPLETED	6/27/91

SAMPLING METHOD AND NUMBER	PID (in ppm)	BLOWS PER FOOT	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
8								41.0 - 42.5 feet: SAND (SP); yellowish-brown, mostly fine sand (95%) with some medium to coarse, moist, poorly graded.
9				45				42.5 - 123.0 feet: SANDY GRAVEL (GW) with cobbles and boulders; medium gray; mostly gravel (60-80%), subangular to subrounded, hard, some sand (20-40%), fine to coarse; trace of fines; boulder to several feet and hard, moderate to well graded, moist.
10		NO C.G.		50				@ 48 feet: easier drilling, moist. @ 50 feet: gravel is subangular to subrounded pea gravel.
11				55				@ 54 feet: color change to darker gray.
12		NO C.G.		60				

REMARKS
All samples are grab samples. C.G. = combustible gas.

SWEET-EDWARDS/EMCON

T02-01.35.GP23.28/sd:2.7/12/91

LOG OF EXPLORATORY BORING

PROJECT NAME	Hidden Valley Landfill	BORING NO.	GP-23 (GP-3)
LOCATION	North Property Line	PAGE	4 OF 7
DRILLED BY	Layne Environmental	REFERENCE ELEV.	
DRILL METHOD	Revrs Air	TOTAL DEPTH	123.00'
LOGGED BY	G. S. Mack	DATE COMPLETED	6/27/91

SAMPLING METHOD AND NUMBER	PID (in ppm)	BLOWS PER FOOT	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
13				65				
14		NO C.G.		70				@ 71.0 - 73.0 feet: boulder, white quartzite, slow drilling, dry. @ 73.0 feet: faster drilling, moist.
				75				
				80				

REMARKS
All samples are grab samples. C.G. = combustible gas.

SWEET-EDWARDS/EMCON

T02-01.35.GP23.28/sd:2.7/12/91

LOG OF EXPLORATORY BORING

PROJECT NAME	Hidden Valley Landfill	BORING NO.	GP-23 (GP-3)
LOCATION	North Property Line	PAGE	5 OF 7
DRILLED BY	Layne Environmental	REFERENCE ELEV.	
DRILL METHOD	Revrs Air	TOTAL DEPTH	123.00'
LOGGED BY	G. S. Mack	DATE COMPLETED	6/27/91

SAMPLING METHOD AND NUMBER	PID (in ppm)	BLOWS PER FOOT	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
15								@ 82.0 feet: boulder. @ 84.0 feet: easier drilling.
				85				@ 86.0 feet: slow drilling, boulder - basalt or andesite. @ 86.5 feet: faster drilling increasing silt in matrix. @ 88.0 feet: slower drilling, dense.
16		NO C.G.						@ 89.5 feet: boulder. @ 90.5 - 93.0 feet: boulder - metamorphic
				90				
				95				@ 96.0 feet: boulder, dusting.
17		NO C.G.		100				98.0 feet: faster drilling, increase in sand and silt.

REMARKS
All samples are grab samples. C.G. = combustible gas.

SWEET-EDWARDS/EMCON

T02-01.35.GP23.28/sd:2.7/12/91

LOG OF EXPLORATORY BORING

PROJECT NAME	Hidden Valley Landfill	BORING NO.	GP-23 (GP-3)
LOCATION	North Property Line	PAGE	6 OF 7
DRILLED BY	Layne Environmental	REFERENCE ELEV.	
DRILL METHOD	Revrs Air	TOTAL DEPTH	123.00'
LOGGED BY	G. S. Mack	DATE COMPLETED	6/27/91

SAMPLING METHOD AND NUMBER	PID (in ppm)	BLOWS PER FOOT	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
								@ 102.0 feet: slow drilling, dense, dry - dusting, increase in fine sand and silt.
								@ 103.0 feet: cobbles, dense.
				105				@ 105 feet: cobbles - mostly basalt to andusite.
								@ 107.0 feet: cobbles.
18				110				@ 109.0 feet: increase in moisture, very slow drilling (109.0-116.0 feet)
				115				@ 116.0 feet: faster drilling, increase in moisture.
				120				

REMARKS
All samples are grab samples. C.G. = combustible gas.

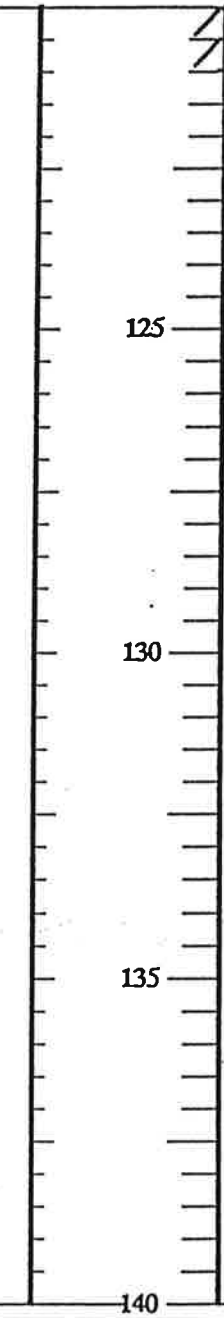
SWEET-EDWARDS/EMCON

T02-01.35.GP23.28/sd:2.7/12/91

LOG OF EXPLORATORY BORING

PROJECT NAME	Hidden Valley Landfill	BORING NO.	GP-23 (GP-3)
LOCATION	North Property Line	PAGE	7 OF 7
DRILLED BY	Layne Environmental	REFERENCE ELEV.	
DRILL METHOD	Revrs Air	TOTAL DEPTH	123.00'
LOGGED BY	G. S. Mack	DATE COMPLETED	6/27/91

SAMPLING METHOD AND NUMBER	PID (in ppm)	BLOWS PER FOOT	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
19				125				@ 122.0 feet: sand is mostly coarse with some fine to medium increasing moisture, wet at 123 feet. Total depth at 123.0 feet.



REMARKS

All samples are grab samples. C.G. = combustible gas.

SWEET-EDWARDS/EMCON

T02-01.35.GP23.28/sd:2.7/12/91

GP-3: 7 of 7

Sweet-Edwards/EMCON, Inc.

BORING LOG

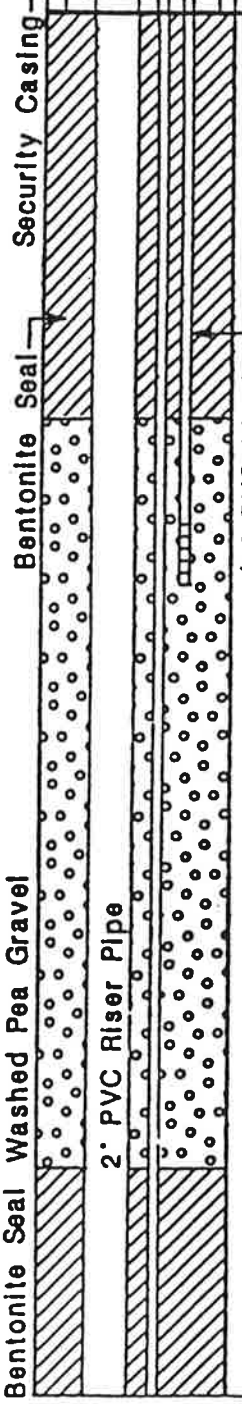
PROJECT Thun Field Landfill Site **Page** 1 of 3

Location Northern Property Line **Boring No.** MW-15 S (GP-4)

Surface Elevation 487 **Drilling Method** Air Rotary

Total Depth 80 feet **Drilled By** Hayes Well Drilling Co.

Date Completed June 24, 1987 **Logged By** Kevin G. Rattue



WELL DETAILS	OVA/ TIP READINGS	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
	Average 1 min/ft	5			GW	SANDY GRAVEL (0-80'); medium brown; medium to coarse sand; some fine sand; angular to subangular gravels; 1/4 inch to 3/4 inch diameter; damp OUTWASH	
		10					
		15				@ 15': increasing medium coarse sand.	
		20					
		25				@ 25': grading to olive brown with trace of fine sand; moist.	
		30					
		35				@ 35': becoming wet.	

SEA-300-02a

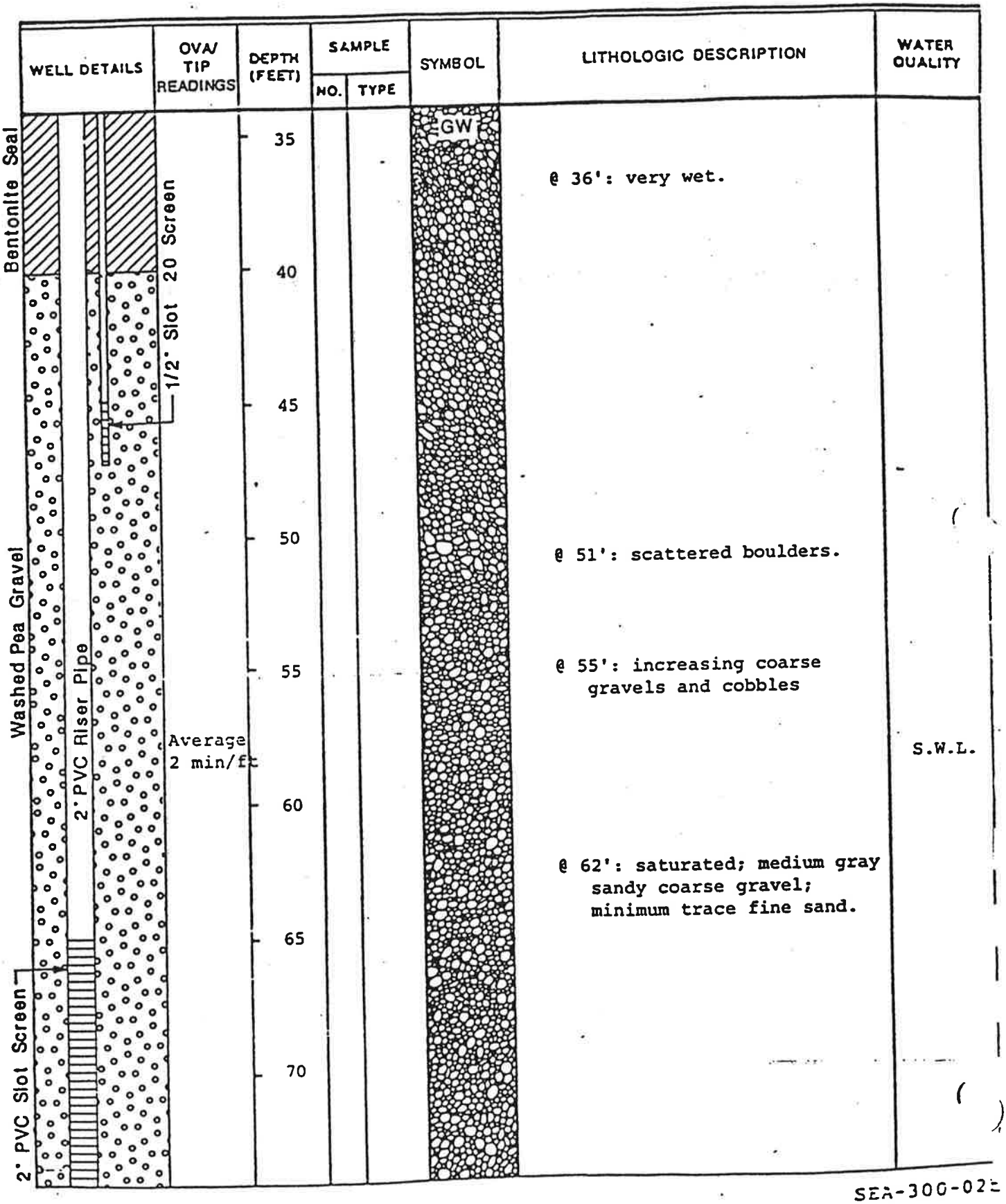
GP-4: 1 of 2

Sweet-Edwards/EMCON, Inc.

BORING LOG

PROJECT Thun Field Landfill Site

Boring No. MW-15



SEA-300-02

GP-4: 2 of 2

Sweet-Edwards/EMCON, Inc.

BORING LOG

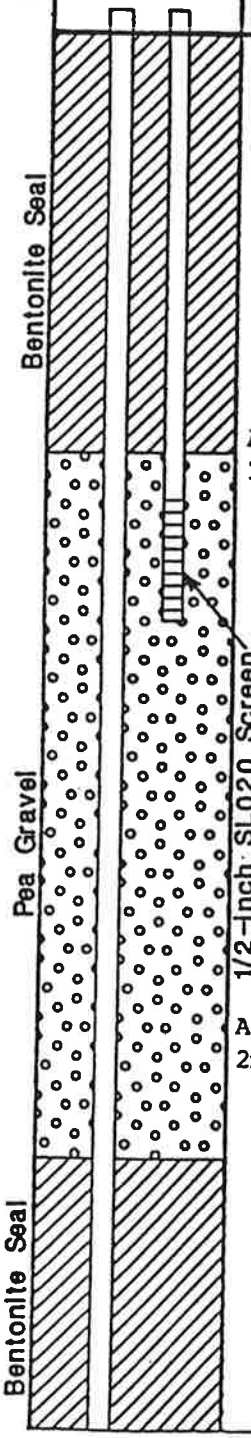
PROJECT Thun Field Landfill Site

Location (See Figure) **Boring No.** GP-5

Surface Elevation approx. 480 ft. (MSL) **Drilling Method** Air Rotary

Total Depth 58 feet. **Drilled By** Hayes Well Drilling co.

Date Completed 06/25/87 **Logged By** Kevin G. Rattue



PENETRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
				SW	SANDY GRAVELS (0-58'); light medium brown; fine to coarse sand; trace silt, well sorted angular gravels less than 1 inch diameter; moist.	
					@ 15': increasing silt and increasing gravels.	Trace Methane
					@ 24': becoming wet.	
					@ 34': gravels increasing; well sorted, subangular 1	

(continued on next page)

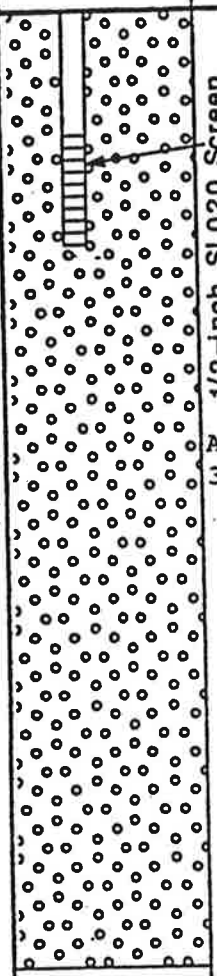
SEA-300-02a

BORING LOG

Sweet-Edwards/EMCON, Inc.

PROJECT Thun Field Landfill Site

Boring No. GP-5



WELL DETAILS	PENETRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		35			SW	(continued from previous page); inch to 2 inches in diameter; wet.	
							0.5% methane
		40				@42': becoming wet, slightly sticky/some silt, otherwise medium coarse sandy gravel.	
	Average 3min/ft	45					
		50				@ 50': becoming very wet.	
							S.W.L.
		55				@ 55': saturated; color change to medium - dark gray.	
							Conductiv =2272 pH=7.4 T=21°C
						Boring terminated at 58.0 feet.	
		60					
		65					
		70					

SEA-300-021

Sweet, Edwards & Associates, Inc.

-- BORING LOG

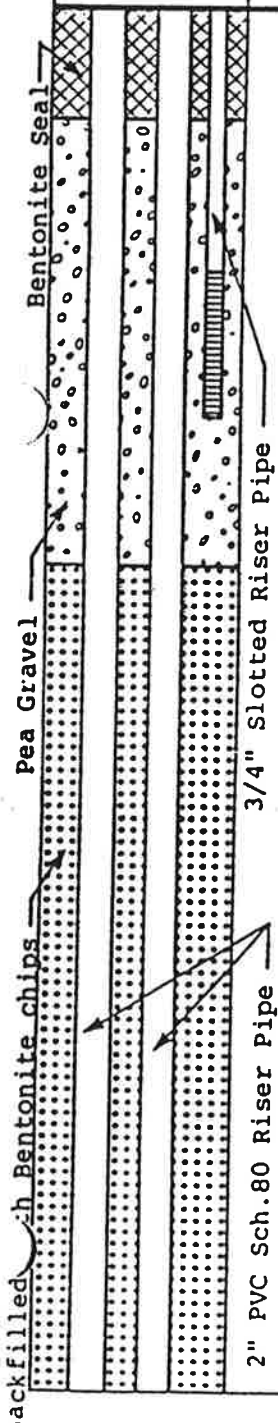
PROJECT Thun Field Landfill Site — Page 1 of ___

Location Northern Property Line — **Boring No.** TF-14 (GP-6)

Surface Elevation 475 ft. (msl) — **Drilling Method** Air Rotary

Total Depth 98 feet — **Drilled By** Haves Well Drilling Co.

Date Completed 6/6/86 — **Logged By** K.G. Rattue



WELL DETAILS	PENE-TRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		5	1	Grab		SP	GRAVELLY SAND, (Recessional outwash), light brown medium sand, scattered cobbles, angular gravels (1/2"), moist.	
		10	2	Grab				Gaseous odor at approx. 10 feet
		15	3	Grab			---increasing gravels (1"), sub-angular to sub-rounded, moist. ---trace silt.	
		20	4	Grab				
		25	5	Grab			---increasing medium and medium fine sand.	
		30	6	Grab			---grading to brownish gray, some fine sands, very moist.	
		35	7					

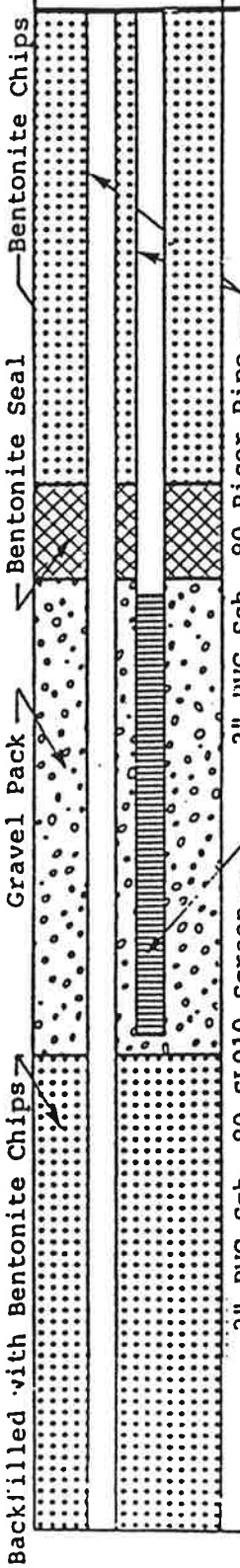
SEA-300-02a

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT Thun Field Landfill Site

Boring No. TF-14



WELL DETAILS	PENETRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
							SANDY GRAVELS, (Recessional outwash), medium to dark gray, medium coarse, moist.	
		40	8	Grab		GP		
		45	9	Grab			---increasing fine sand.	
		50	10	Grab			---less fine sand increasing medium sand, moist to wet.	
		55	11	Grab		GM	SILTY SAND GAVEL, (Recessional outwash), brownish gray, fine to coarse sand, "sticky", very wet.	SWL while drilling S.C.= 2700
		60	12	Grab		GM	SILTY SANDY GRAVEL, (till), light brownish gray, fine to coarse sand, "sticky", very wet.	No flaw
		65	13	Grab				
		70	14	Grab			---increasing silt.	

SEA-300-02a

GP-6: 2 of 2

Sweet-Edwards / EMCON, Inc.

BORING LOG

PROJECT Thun Field Landfill

Location Pierce County, Washington

Boring No. MW-16S (GP-7)

Surface Elevation 479.5ft. (MSL)

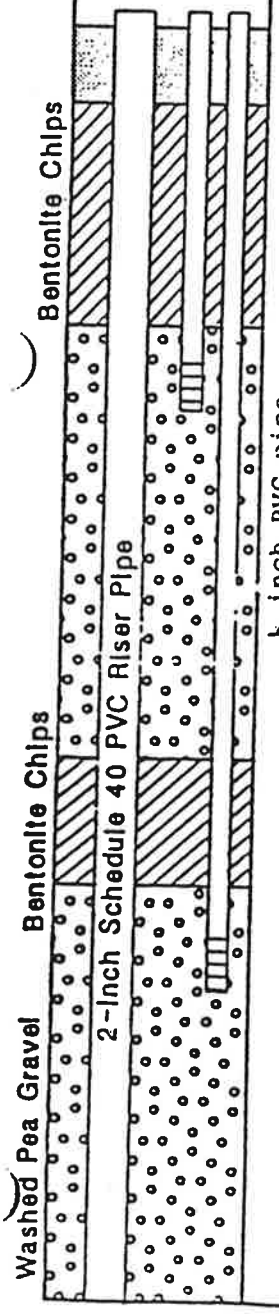
Drilling Method Air Rotary

Total Depth 72'

Drilled By Hayes Well Drilling

Date Completed 09/25/87

Logged By KGL



DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PENETRATION TIME/ RATE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
0					GM	Silty Sandy Gravel: (0-5') brown, sobrounded cobbles to 10" diameter, wood chips, medium dense, dry.	
5						Sandy Gravel: (5'-72') brownish gray, broken gravel to 0.5" diameter, fine sand, some brown silt, medium dense, very slightly moist.	
10						@ 10' dark brownish gray, fine to coarse sand, trace silt, medeium dense, moist.	
15					GW	loss of air circulation, coarse sand and gravel	
20							
25						increasing fine sand and silt	
30						boulder at 38'	

S-E/E

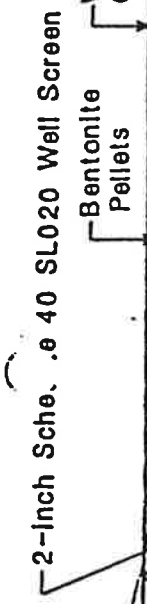
GP-7; 1 of 2

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT Thun Field Landfill

Boring No. MW-16s



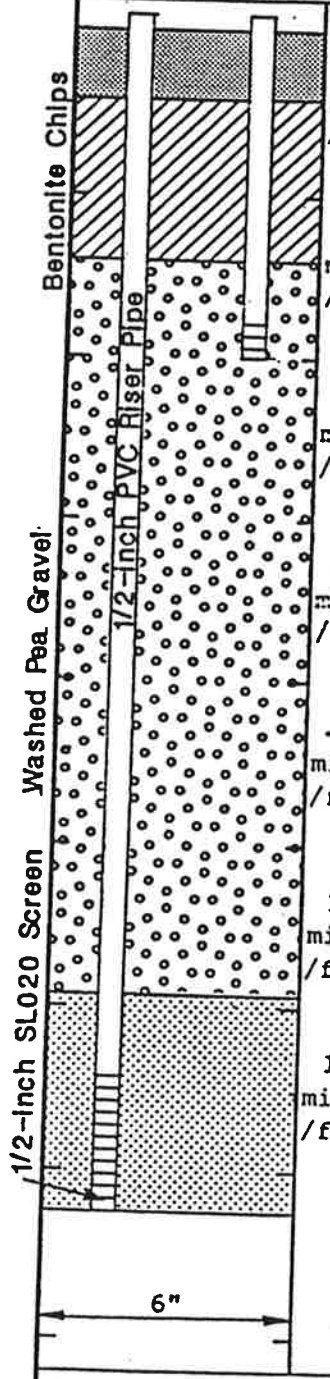
WELL DETAILS	PENETRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		40				GW	Sandy Gravel: (5-72') grayish brown, broken gravel to 0.5" diameter, fine to medium sand, trace to some silt, medium dense, moist.	
		45						
		50					increase in moisture at 53'	
		55						
		60				GW	at 60' brown, subrounded gravel to 0.5" diameter, fine to medium sand, loose, wet.	
		65						
		70					slightly sticky cuttings	
							9/25/87, 1445, terminate boring at 72' driller adds water to develop boring	
		75						

SEA-300-02b

BORING LOG

Project: Thun Field Landfill
Project No.: T0201.07
Location: Pierce County, Washington
Drilling Method: Air Rotary
Surface Elevation: approx.450 ft. (MSL)
Well Elevation:

Boring No.: GP-8
Logged by: KGR/KGL
Start: 9/9/87, 1345
Finish: 9/9/87, 1700
Page 1 of 1



Well Construction Details	Penetration Rate	Sample No	Sample Type	Depth	Soil Type USCS	Soil Type Sym.	Description
	1-2 min./ft.			0			Sandy Gravel: light gray, well sorted to 1.5" diameter, subangular and broken, medium to coarse sand, loose, dry.
		1	Grab	5			
	1 min./ft.				GW		increasing medium sand, dry
		2	Grab	10			grades to brownish gray, medium dense, moist
	1 min./ft.						wet cuttings
		3	Grab	15			increasing fine sand and some silt, brown, subangular and broken gravel to 2" diam., medium dense, moist.
	1 min./ft.						GasTech = 0% on top of casing
		4	Grab	20			
	.5 min./ft.						
		5	Grab	25			subrounded gravel to 1" diam. medium sand, some silt, medium dense, wet.
	1 min./ft.				GW		
		6	Grab	30			encounter H_2O at 28'
	1 min./ft.						
		7	Grab	35			
				40			Terminate boring at 36.0' 9/9/87, 1437

Remarks:
1) Installed GP-8(A) and PZ-85
2) PVC glue on all joints
3) Saw-cut slots for piezometer screen
4) 0.5" Schedule 40 PVC riser pipe
5) Hayes Well Drilling and Pump

Sweet, Edwards & Associates

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT THUN FIELD

Boring No. TF-10

WELL DETAILS	PENETRATION TIME/RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		40			Not Undretaken To Date		40-45' SAND, light gray, medium to coarse, occasional pebbles, saturated.	EC=177
	3m/ft.	45					45-50' SAND, as above medium, moderately well sorted, subrounded, saturated.	EC=152
	4m/ft.	50					50-55' SAND, light brown to gray, medium well sorted with numerous subrounded pebbles, saturated.	EC=95
	2m/ft.	55					55-60' SAND, as above, becoming less well sorted and fewer pebbles, saturated.	EC=130
	3m/ft.	60					60-65' SILTY SAND, light to medium brown to gray, illsorted, few pebbles, slightly silty, saturated.	EC=110
	2m/ft.	65					65-70' SILTY SAND, as above. Saturated.	EC=135
	4m/ft.	70					70-75' SILTY SAND, as above. Saturated.	EC=115
		75					75-80' GRAVELLY SILTY SAND (TILL/DRIFT), brownish, gray, medium to coarse sand, well sorted, increasing gravel content and silty, saturated.	EC=116
	3m/ft.	80					80-85' (TILL/DRIFT), brownish gray with a tinge of reddish brown, illsorted gravel, sand and silt, very wet with irregular flows.	EC=121
		85						

SEA-300-02b

GP-9; 2 of 2

Sweet, Edwards & Associates, Inc.

PROJECT THUN FIELD LANDFILL

Location Eastern Gate of Landfield

Boring No. TF-10 (GP-9)

Surface Elevation 454.56' a.m.s.l.

Drilling Method Air Rotary

Total Depth 98 feet

Drilled By Johnson Drilling Co.

Date Completed 6/26/85

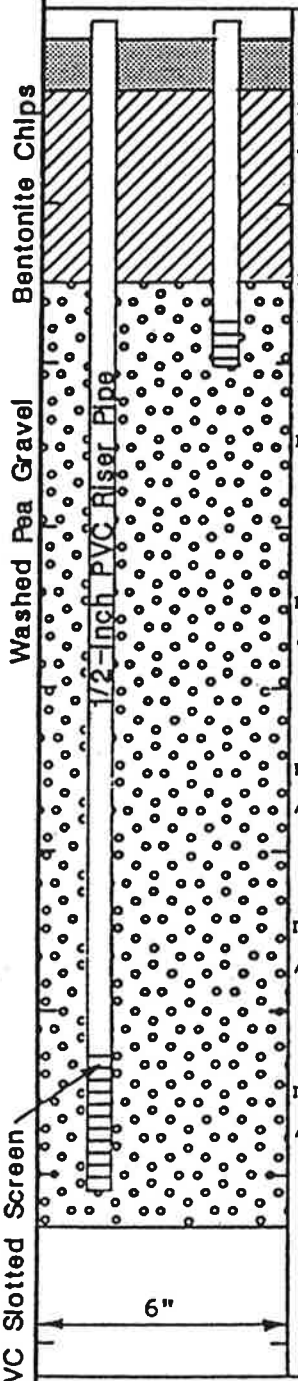
Logged By K.G.Rattue

WELL DETAILS	PENETRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
	3m/ft. Avr	0		Grab Sampling Throughout At 5 Feet Intervals	Not Undretaken To Date		0-5' SAND and GRAVEL, light brown, illsorted, loose, very dry with few boulders.	
1" PVC Hydrotip; 3/4" riser		5					5-10' SAND and GRAVEL, yellowish brown, medium to coarse, sand loose, very dry with occasional pebbles	
	2m/ft.	10					10-15' SAND and GRAVEL, as above becoming slightly moist.	
		15					15-20' SAND and GRAVEL, light brown, medium to coarse sand, weakly cohesive, few pebbles, slightly moist.	
		20					20-25' SAND and GRAVEL, as above becoming coarser and very moist.	
	3m/ft.	25					25-30' SAND and GRAVEL, light brown to gray, illsorted, very pebbly, saturated.	RWL 27'
		30					30-35' SAND and GRAVEL, as above.	EC=190
	2m/ft.	35					35-40' SAND and GRAVEL, as above with increasing medium sand content, saturated.	EC=125
		40						

BORING LOG

Project: Thun Field Landfill
Project No.: T0202.07
Location: Pierce County, Washington
Drilling Method: Air Rotary
Surface Elevation: approx 455 ft. (MSL)
Well Elevation:

Boring No.: GP-10
Logged by: KGL
Start: 9/10/87
Finish: 9/10/87
Page 1 of 1



Penetration Rate	Sample No	Sample Type	Depth	Soil Type USCS	Soil Type Sym.	Description
			0			Sandy Gravel: bluish gray, broken gravel to 1" diam., medium sand, medium dense, dry.
.5 min./ft.						
	1	Grab	5	GW		
.5 min./ft.						
						grades to brownish gray, moist
	2	Grab	10	GW / SW		Sandy Gravel to Gravelly Sand: brownish gray, fine to medium sand, subangular and broken gravel to 1", some silt, medium dense, moist
1 min./ft.						
	3	Grab	15			Sandy Gravel: brown, subrounded gravel to 1.5" diameter, fine to coarse sand, tra[ce] silt, medium dense, moist
1 min./ft.						
	4	Grab	20			Gas Tech = 0% on top of casing
.5 min./ft.				GW		
	5	Grab	25			slight increase in silt content
1 min./ft.						
	6	Grab	30			encounter H2O at 28'
.5 min./ft.						
	7	Grab	35			
			40			Terminate boring at 36.5' 9/10/87, 1100

Remarks:
1) Installed GP-10(A) and PZ-10(S)
2) PVC glue on all joints
3) Saw-cut slots for piezometer screen
4) 0.15" Schedule 40 PVC riser pipe
5) Hayes Well Drilling and Pump

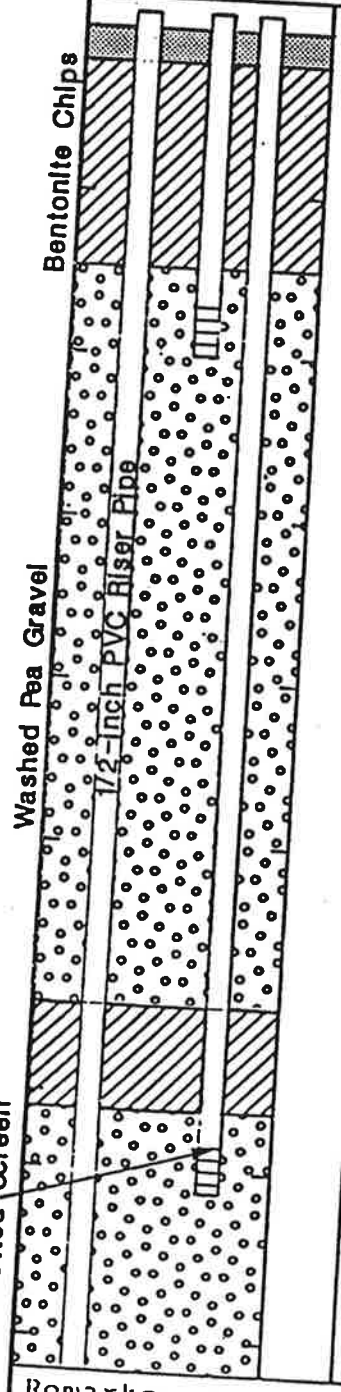
Sweet, Edwards & Associates

GP-10; 1 of 1

BORING LOG

Project Thun Field Landfill
Project No. T0201.07
Location Pierce County, Washington
Drilling Method Air Rotary
Surface Elevation approx. 485 ft.(MSL)
Well Elevation

Boring No. GP-11
Logged by KGL
Start 9/10/87, 1420
Finish
Page 1 of 2



Well Construction Details	Penetration Rate	Sample No	Sample Type	Depth	Soil Type USCS	Soil Type Sym.	Description
				0	GM		Silty Gravel (Top Soil): brown, cobbles to 6" diameter, loose, dry.
		1	Grab	5	GW		Sandy Gravel: bouish gray, broken gravel to 2" diam., fine to coarse sand, trace brown silt, medium dense, dry.
		2	Grab	10			increasing fines, brown, slightly moist
		3	Grab	15			
		4	Grab	20			Gas Tech = 0% on top of casing
		5	Grab	25			
		6	Grab	30	GW		boulder at 29', 10" diam., dark blue grey
		7	Grab	35			Metal flakes from bit notes in cuttings
		8	Grab	40			Gas Tech - 0% on top of casing
							Continued

Remarks: 1) Installed GP-11(A), GP-11(B) and PZ-11(S)
2) PVC glue on all joints
3) Saw-cut slots for piezometer screen
4) 0.5" Schedule 40 PVC riser pipe
5) Hayes Well Drilling and Pump

Sweet, Edwards & Associates

GP-11 1 of 4

BORING LOG

Project Thun Field Landfill
Project No. T0201.07
Location Pierce County, Washington
Drilling Method Air Rotary
Surface Elevation
Well Elevation

Boring No. GP-11
Logged by KGL
Start 9/10/87, 1420
Finish 9/11/87, 1230
Page 2 of 2

Well Construction Details	Penetration Rate	Sample No	Sample Type	Depth	Soil Type USCS	Soil Type Sym.	Description
Washed Pea Gravel; 1/2-Inch PVC Riser Pipe	.5 min./ft.	8	Grab	40			Sandy Gravel: brown, subrounded gravel to 1" diameter, coarse sand, trace silt, medium dense, moist
	.5 min./ft.	9	Grab	45	GW		increasing moisture content
	1 min./ft.	10	Grab	50			wet cuttings
	1 min./ft.	11	Grab	55			Gas Tech = 0% on top of casing
	.5 min./ft.	12	Grab	60			use approximately 60 gallons of water mixed with air to try and develop boring, 5-10 gallons of water returned, resume drilling
		13	Grab	65			Driller notes ground water
1/2-Inch PVC Slotted Screen; 6"				70			blow out ground water at 66'
							Terminate boring at 67', 9/10/87, 1632

Remarks: See Page 1

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Sweet-Edwards/EMCON, Inc.

BORING LOG

PROJECT Thun Field Landfill Site

Location (See Figure)

Boring No. MW-20 Regional (GP-12)
8"-30'

Surface Elevation 464.5 ft. (MSL)

Drilling Method Cable Tool 6"-265'

Total Depth 265 feet

Drilled By Tacoma Pump and Drill

Date Completed 3/3/88

Logged By Patrick Dunn

WELL DETAILS	OVA/ TIP READINGS	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
1/2" PVC Riser Pipe		5			GM	SANDY GRAVELS (0-7'); light olive brown; coarse gravel grained; 5-10% fines; 15-30% fine to medium sand; 15-20% coarse sand to fine gravel; gravels sub-rounded to maximum size of 8 inches; medium dense; dry. (OUTWASH)	
2" PVC Riser Pipe	Trace	10	1	Grab	SM	SILTY GRAVELLY SANDS (7-20'); Brown; 30-40 % silt fines; medium to coarse grained; 10-15% fine gravels; trace cobbles; medium density; dry.	
1/2-Inch Gas Probe Screen		15					
	Trace	20			GM	SILTY SANDY GRAVELS (20-50'); light brownish gray (2.5 Y, 6/2); 25-35% silt fines; 10-20% fine to medium sand; 20-30% coarse sand to fine gravel; 15-25% coarse gravel; trace to 5% cobbles; medium dense; some open hole; dry.	
	Trace	25	2	Grab		@ 25': in-situ sample of 1/2 inch rounded gravels with sand silt binder.	
		30					
		35					

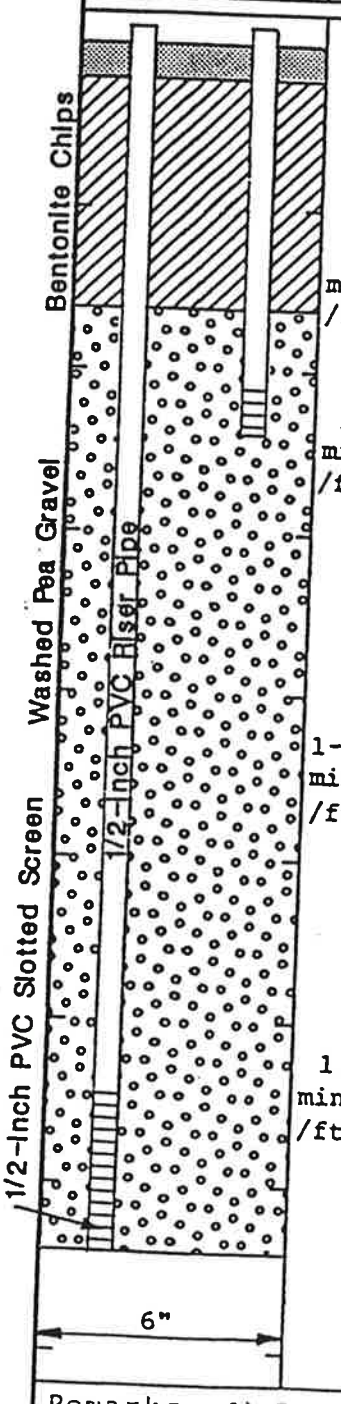
SEA-300-02

GP-12

BORING LOG

Project Thun Field Landfill
Project No. T0201.07
Location Pierce County, Washington
Drilling Method Air Rotary
Surface Elevation
Well Elevation

Boring No. GP-13
Logged by KGR
Start 9/14/87
Finish 9/14/87
Page 1 of 1



Well Construction Details	Penetration Rate	Sample No	Sample Type	Depth	Soil Type USCS	Soil Type Sym.	Description
	1 min./ft.	1	Grab	0 - 5	GM		Silty Sandy Gravel: tan to buff, well sorted subangular to subrounded gravels to 1.5" diam., fine to coarse sand, loose, wet
	2 min./ft.	2	Grab	10			very wet cuttings
		3	Grab	15			Gas Tech = 1.2% on top of casing
	1-2 min./ft.	4	Grab	20			grades to gray brown with increasing silt and fine to medium sand, angular gravels to 1" diameter, medium dense saturated
		5	Grab	25			
	1 min./ft.	6	Grab	30	GM		grades to less silt, gray brown, saturat
		7	Grab	35	GW		Gas Tech = trace level only
				40			

Remarks: 1) Installed GP-13A and PZ-13S
2) PVC glue on all joints
3) Saw-cut slots for piezometer screen
4) 0.5" Schedule 40 PVC riser pipe
5) Hayes Well Drilling and Pump

Sweet, Edwards & Assoc

GP-13 1 of 1

Sweet-Edwards/EMCON, Inc.

BORING LOG

PROJECT Thun Field Landfill Site

Location (See Figure)

Boring No. MW-19 Shallow, GP-15 (A) (B

Surface Elevation 490.5 (MSL)

Drilling Method Air Rotary - 6"

Total Depth 80 feet below surface

Drilled By Hayes Well Drilling Co.

Date Completed 2/6/88

Logged By Patrick Dunn

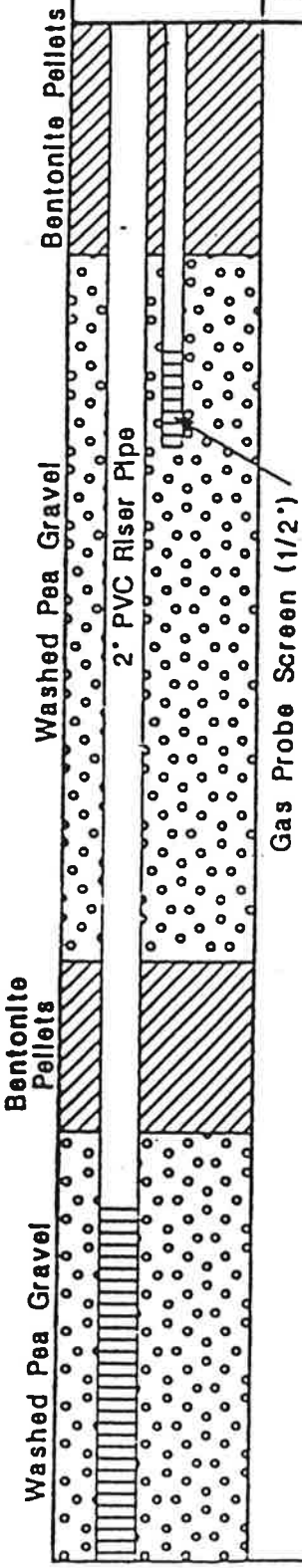
WELL DETAILS	OVA/ TIP READINGS	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		5	1	Grab	GM (FILL)	SAND GRAVELS (0-9'); light olive brown (2.5 Y, 5/4); coarse sand to fine gravel; wood fragments; loose; dry. (FILL) @ 7-13': color change to dark brown.	
		10	2	Grab	SW/ SP	GRAVELLY SAND to SAND (9-45'); light olive brown (2.5 Y, 5/4); fine to medium grained; 10% slightly plastic fines; 10-15% coarse sand; 10-20% fine to medium gravels; trace cobbles; dense. (OUTWASH)	
		15	3	Grab			
		20	4	Grab		@ 20-30': finer grained.	
		25					
		30	5	Grab		@ 30-43': coarser grained.	
		35					

Sweet-Edwards/EMCON, Inc.

BORING LOG

PROJECT Thun Field Landfill Site

Boring No. MW-19S



WELL DETAILS	OVA/ TIP READINGS	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		35			SW/ SP	GRAVELLY SAND to SAND (continued)	
		40	6	Grab			
		45			GP	SANDY GRAVELS with occasional Boulders (45-77'); olive brown (2.5 Y, 4/4); 1/4 to 1 inch gravel; trace 10% slightly plastic fines; 15-30% fine to medium sand; 10% coarse sand; medium dense; dry. (OUTWASH)	
		50	7	Grab			
		55					
		60	8	Grab		@ 61': wet.	2/26/88
		65					
		70	9	Grab			Conducti 470 u

GP-15; 2 of 2

Sweet-Edwards/EMCON, Inc.

BORING LOG

PROJECT Thun Field Landfill

Location (see figure)

Boring No. GP-16

Surface Elevation

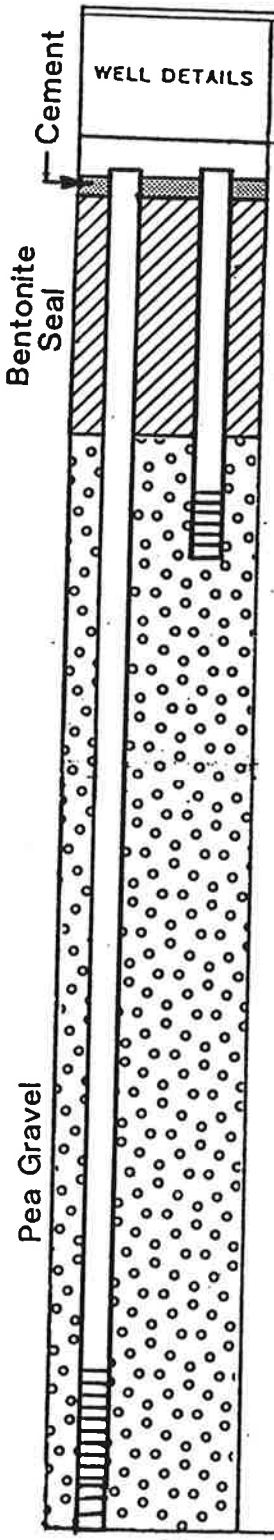
Drilling Method Air Rotary

Total Depth 60 feet

Drilled By

Date Completed 9/15/87

Logged By KGR



WELL DETAILS	PENETRATION TIME/RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		0				SANDY GRAVEL (Dirty Outwash)	
						Light brown gravels, well sorted 1/4 - 1 1/2" angular - to subangular, medium to course sand, some silt, occasional boulders, moist.	
		5					
		10					
		15				-- Dirty Outwash, medium to course sand, dry, grading to medium brown.	
		20					
		25				GRAVELY SAND - grayish brown, with tinge of red, medium to course sand, some silt, subrounded to rounded gravels 1/2 - 1" diam., dirty, wet.	
		30					
		35				-- Saturated.	
		40					

Sweet-Edwards/EMCON, Inc.

BORING LOG

PROJECT Thun Field Landfill

Location (see figure)

Boring No. GP-16

Surface Elevation

Drilling Method Air Rotary

Total Depth 60 feet

Drilled By

Date Completed 9/15/87

Logged By KGR

WELL DETAILS	PENETRATION TIME/RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
Pea Gravel		40				-- Gravels angular 1/8 to 1 1/2" diam., occasional subangular, saturated.	
		45				-- Gray brown, well sorted gravels, 1/2 - 3/4" diam.	
		50				-- Subrounded, 1/4 - 1 1/2" diam.	
		55				-- Medium to course sand, light brown, well sorted gravel, saturated, some silt.	
		60					

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT Thun Field Landfill Site — Page 1 of 4

Location See figure — **Boring No.** TF-13 (GP-17)

Surface Elevation 446 ft. (MSL) — **Drilling Method** Air Rotary

Total Depth 120 feet — **Drilled By** Hayes Well Drilling Co.

Date Completed 6/6/86 — **Logged By** K. G. Rattue

WELL DETAILS	PENETRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
Concrete seal; Bentonite; Bentonite Seal; Gravel Pack; Backfilled; 2" PVC Sch. 80 Riser Pipe; 1/2" PVC Sch. 80 SL010 Screen; 1/2" PVC Sch. 80 Riser Pipe		5	1	Grab		SP	GRAVELLY SAND, light brown, fine to medium, angular gravels (1/2") moist.	
		10	2	Grab		GP	SANDY GRAVELS, medium to dark gray, medium-coarse sand, sub-rounded to sub-angular gravels (1") moist.	
		15	3	Grab				
		20	4	Grab				
		25	5	Grab		SP	GRAVELLY SAND, medium to dark gray, medium with trace coarse sand, rounded gravels (1"), saturated.	SWL 26' Specific Conducting (S.C.) = 307 S.C.=342
		30	6	Grab				
		35	7	Grab				

SEA-300-02a

LOG OF EXPLORATORY BORING

PROJECT NAME Hidden Valley Landfill
LOCATION
DRILLED BY Tacoma Pump & Drilling
DRILL METHOD 6-inch Air Rotary
LOGGED BY G. Mack

BORING NO. GP-10
PAGE 1 OF 3
GROUND ELEV.
TOTAL DEPTH 34.50'
DATE COMPLETED 12/19/95

SAMPLING METHOD	SAMPLE NUMBER	C.G. PERCENT LEL	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
Bag	4'			5				0 to 34.5 feet: SANDY GRAVEL WITH COBBLES AND BOULDERS (GW), yellowish brown, fine to coarse gravel, few fine to coarse sand, trace of fines, cobbles, and boulder to several feet diameter, slightly damp at surface, moist to wet below 24 feet.
Bag	8'	0		10				@ 8.0 feet: decreases in gravel size, no cobbles.
Bag	12'			15				@ 10.0 feet: gravel was coated with silt.
Bag	17.5'	0		20				@ 14.0 feet: becoming finer grain size, increase in gravel.

REMARKS
Bag samples collected for lithologic characterization.

EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME Hidden Valley Landfill
LOCATION
DRILLED BY Tacoma Pump & Drilling
DRILL METHOD 6-inch Air Rotary
LOGGED BY G. Mack

BORING NO. GP-10
PAGE 2 OF 3
GROUND ELEV.
TOTAL DEPTH 34.50'
DATE COMPLETED 12/19/95

SAMPLING METHOD	SAMPLE NUMBER	C.G. PERCENT LEL	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
								0 to 34.5 feet: SANDY GRAVEL WITH COBBLES AND BOULDERS (GW), continued.
								@ 20.0 feet: boulder.
			▽					@ 23.0 feet: soil getting moist.
				25				
Bag	25'	0						
Bag	30'			30				@ 30.0 feet: soil is wetter.
Bag	35'	0						First water out of hole.
				35				Total depth drilled = 34.5 feet. Total depth sampled = 34.5 feet.
				40				See Page 3 for Well Completion Details.

REMARKS
Bag samples collected for lithologic characterization.

EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME Hidden Valley Landfill
LOCATION
DRILLED BY Tacoma Pump & Drilling
DRILL METHOD 6-inch Air Rotary
LOGGED BY G. Mack

BORING NO. GP-10
PAGE 3 OF 3
GROUND ELEV.
TOTAL DEPTH 34.50'
DATE COMPLETED 12/19/95

SAMPLING METHOD	SAMPLE NUMBER	C.G. PERCENT LEL	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION

45
50
55
60

WELL COMPLETION DETAILS:

0 to 6.0 feet: 1/2-inch-diameter, schedule 80 PVC with bottom 2.0 feet perforated with 20 holes using a 3/16-inch drill, and a glued PVC end cap. Total length of PVC was 7.9 feet.

0 to 3.0 feet: Baroid holeplug 3/4 bentonite chips hydrated with potable water.

3.0 to 35.0 feet: Lonestar Trumix washed pea gravel.

REMARKS

Bag samples collected for lithologic characterization.

EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME Hidden Valley Landfill
LOCATION
DRILLED BY Tacoma Pump & Drilling
DRILL METHOD 6-inch Air Rotary
LOGGED BY G. Mack

BORING NO. GP-11
PAGE 1 OF 3
GROUND ELEV.
TOTAL DEPTH 35.00'
DATE COMPLETED 12/19/95

SAMPLING METHOD	SAMPLE NUMBER	C.G. PERCENT LEL	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
								0 to 35.0 feet: SANDY GRAVEL WITH SILT, COBBLES AND BOULDERS (GW), yellowish brown, fine to coarse gravel, little fine to coarse sand, trace to few fines, cobbles and boulders to several feet, moist, no odors.
Bag	5'			5				
		0						@ 7.0 to 9.0 feet: boulder.
Bag	10'			10				@ 10.0 feet: gravel was coated with silt.
								@ 13.0 feet: increasing fines.
Bag	15'							@ 14.0 feet: boulder.
		0		15				
								@ 19.0 to 20.0 feet: SILTY zone.
				20				

REMARKS
Bag samples collected for lithologic characterization.

EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME Hidden Valley Landfill
LOCATION
DRILLED BY Tacoma Pump & Drilling
DRILL METHOD 6-inch Air Rotary
LOGGED BY G. Mack

BORING NO. GP-11
PAGE 2 OF 3
GROUND ELEV.
TOTAL DEPTH 35.00'
DATE COMPLETED 12/19/95

SAMPLING METHOD	SAMPLE NUMBER	C.G. PERCENT LEL	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
Bag	21'							0 to 35.0 feet: SANDY GRAVEL WITH SILT, COBBLES AND BOULDERS (GW), continued.
Bag	25'	0		25				@ 24.0 feet: increasing sand.
Bag	30'			30				@ 31.0 feet: increasing fines.
Bag	35'	0		35				Total depth drilled = 35.0 feet. Total depth sampled = 35.0 feet.
				40				See Page 3 for Well Completion Details.

REMARKS
Bag samples collected for lithologic characterization.

EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME Hidden Valley Landfill
LOCATION
DRILLED BY Tacoma Pump & Drilling
DRILL METHOD 6-inch Air Rotary
LOGGED BY G. Mack

BORING NO. GP-11
PAGE 3 OF 3
GROUND ELEV.
TOTAL DEPTH 35.00'
DATE COMPLETED 12/19/95

SAMPLING METHOD	SAMPLE NUMBER	C.G. PERCENT LEL	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION

45
50
55
60

WELL COMPLETION DETAILS:

0 to 6.0 feet: 1/2-inch-diameter schedule 80 PVC with perforated with 34 holes using 3/16-inch drill, and a glued end cap. Total length of PVC was 8.3 feet.

0 to 3.0 feet: Baroid holaplug 3/4 bentonite chips hydrated with potable water.

3.0 to 35.0 feet: Lonestar Trumix washed pea gravel.

REMARKS

Bag samples collected for lithologic characterization.

EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME	LRI	BORING NO.	GP-14
LOCATION	Hidden Valley Landfill	PAGE	1 OF 3
DRILLED BY	Tacoma Pump &Drilling	GROUND ELEV.	
DRILL METHOD	6-inch ODEX, 4-inch HSA	TOTAL DEPTH	35.00'
LOGGED BY	G. Mack	DATE COMPLETED	08/23/94

SAMPLING METHOD AND NUMBER	COMBUSTIBLE GAS %gas/%LEL	BLOWS PER 6 INCHES	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
G-5	0/0	–		5				0 to 16.5 feet: SANDY GRAVEL WITH COBBLES AND BOULDERS (GW), yellowish gray to yellowish brown, fine to coarse subangular to subrounded gravel, some fine to coarse sand, trace of silt, boulders to several feet, wood debris, moist. (FILL)
								@ 6.0 feet: wood chips.
G-10	0/0	–		10				@ 8.0 feet: moist, noticeable landfill-like odor.
								@ 9.0 to 12.0 feet: no returns.
G-15	0/4			15				
G-18								16.5 to 21.5 feet: GRAVEL WITH SAND (GW), medium gray to olive gray, fine to coarse subangular to subrounded, hard gravel up to several inches, few to little fine to coarse sand, trace of silt, moist.
				20				

REMARKS

G = Grab sample from ODEX air discharge. Combustible gas = 0% gas/0% LEL.

LOG OF EXPLORATORY BORING

PROJECT NAME LRI
LOCATION Hidden Valley Landfill
DRILLED BY Tacoma Pump &Drilling
DRILL METHOD 6-inch ODEX, 4-inch HSA
LOGGED BY G. Mack

BORING NO. GP-14
PAGE 2 OF 3
GROUND ELEV.
TOTAL DEPTH 35.00'
DATE COMPLETED 08/23/94

SAMPLING METHOD AND NUMBER	COMBUSTIBLE GAS %gas/%LEL	BLOWS PER 6 INCHES	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
								16.5 to 21.5 feet: GRAVEL WITH SAND (GW), continued.
G-24	0/0			25				21.5 to 35.0 feet: SANDY GRAVEL (GW), olive gray, fine to coarse subangular to subrounded hard gravel up to several inches, some fine to coarse sand, few to trace of silt, moist.
								No samples collected below 24.0 feet.
	0/0			30				@ 31.0 feet: surface cutting of silty gravel.
				35				Total depth drilled = 35.0 feet, refusal. Total depth sampled = 24.0 feet.
				40				See Page 3 for Well Completion Details.

REMARKS

G = Grab sample from ODEX air discharge. Combustible gas = 0% gas/0% LEL.

LOG OF EXPLORATORY BORING

PROJECT NAME	LRI	BORING NO.	GP-14
LOCATION	Hidden Valley Landfill	PAGE	3 OF 3
DRILLED BY	Tacoma Pump &Drilling	GROUND ELEV.	
DRILL METHOD	6-inch ODEX, 4-inch HSA	TOTAL DEPTH	35.00'
LOGGED BY	G. Mack	DATE COMPLETED	08/23/94

SAMPLING METHOD AND NUMBER	COMBUST. IBLE GAS %gas/%LEL	BLOWS PER 6 INCHES	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION

45

50

55

60

WELL COMPLETION DETAILS:

Deep Probe:

0 to 21.3 feet: Schedule 80 PVC blank riser pipe with 1/8-inch ID Tygon tubing.

21.3 to 23.2 feet: PVC gas probe tip.

Shallow Probe:

0 to 4.0 feet: Schedule 80 PVC blank riser pipe with 1/8-inch ID Tygon tubing.

4.0 to 5.5 feet: PVC gas probe tip.

Seals:

0 to 3.0 feet: Baroid 3/4-inch hole plug - hydrated bentonite chips.

3.0 to 18.5 feet: Lonestar washed pea gravel.

18.5 to 20.5 feet: Baroid 3/4-inch hole plug - hydrated bentonite chips.

20.5 to 35.0 feet: Lonestar washed pea gravel.

REMARKS

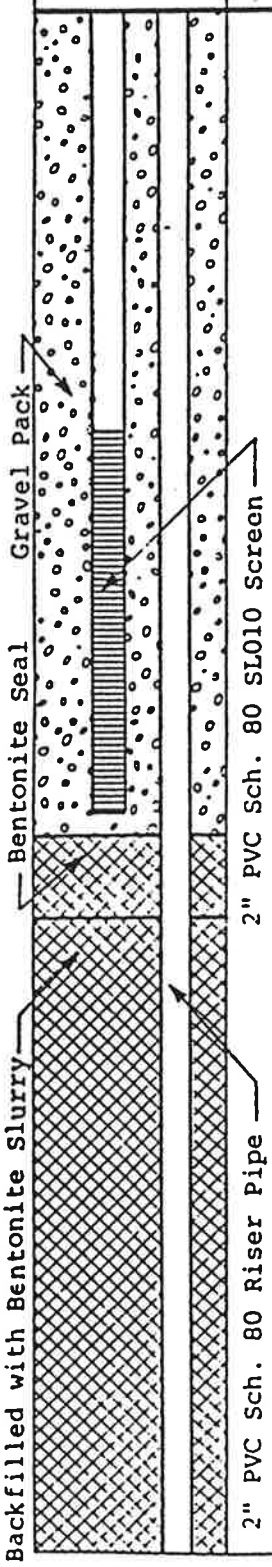
G = Grab sample from ODEX air discharge. Combustible gas = 0% gas/0% LEL.

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT Thun Field Landfill Site

Boring No. _____



WELL DETAILS	PENE-TRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		35	7	Grab				S.C.=518
		40	8	Grab			--increasing silt.	S.C.=597
		45	9	Grab		GM	SILTY SANDY GRAVEL, dark gray, fine sand with trace medium sand, slightly oxidized, saturated.	S.C.=894
		50	10	Grab				Flows 150+ gpm
		55	11	Grab				
		60	12	Grab				S.C.=859
		65	13	Grab			--increasing medium sand.	S.C.=840
		70	14	Grab		SP	GRAVELLY SAND, medium to dark gray, medium to coarse, trace of silt, angular gravels (3/4"), saturated.	Flows 210+ gpm

SEA-300-02b

GP-17; 2 of 2

Sweet-Edwards/EMCON, Inc.

BORING LOG

PROJECT Thun Field Landfill

Location (see figure)

Boring No. GP-18

Surface Elevation

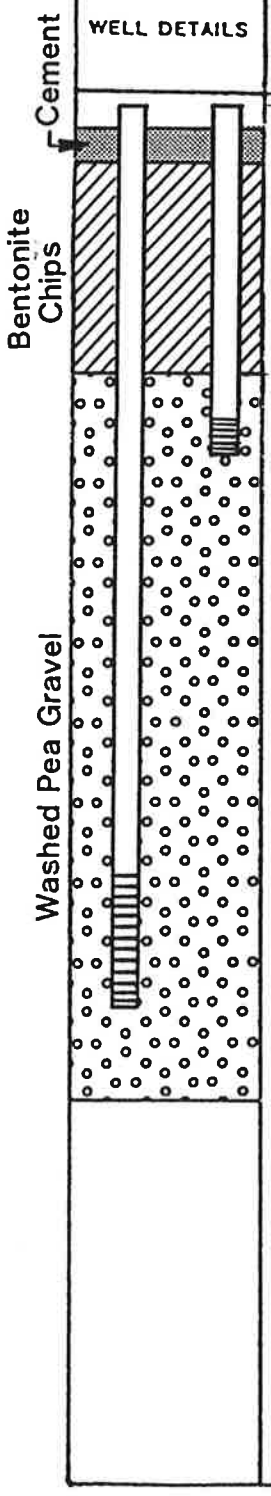
Drilling Method Air Rotary

Total Depth 30 feet

Drilled By

Date Completed 9/16/87

Logged By KGR



WELL DETAILS	PENETRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		0				Silty Sandy Gravels (Till).	
						Gray brown, fine to medium sand, well sorted gravels 1/8 - 1 1/4" diam., moist, sand f-crs, some silt.	
		5					
						-- Scattered boulders greater than 1 foot diam.	
		10					
						-- Gravels subangular, subrounded, poorly sorted 1/2 - 3/4", some silt, tan, light brown.	
		15					
		20				-- Outwash. Increasing medium to course sand, poorly sorted gravels approximately 1" diam. wet, some silt, wet.	
		25				-- Increasing subrounded gravels less than 2" diam., gray to light brown, sticky, medium to coarse sand, saturated.	
		30				Boring depth at 30' bgs.	
		35					
		40					

GP-18: 1 of 1

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT THUN FIELD LANDFILL SITE **Page** 1 of 4

Location West of Offices. **Boring No.** TF-12(S)(D)

Surface Elevation _____ **Drilling Method** Air Rotary

Total Depth 124 feet **Drilled By** Johnson Drilling

Date Completed 4/86 **Logged By** K.G. Rattue

WELL DETAILS	PENETRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
Bentonite Seal; Bentonite Slurry; 2" sch. 80 riser pipe; 1" PVC riser pipe; Natural Sand and Gravel Backfill; 2" sch. 80 riser pipe; 1" PVC screen	2m/ft.	5	1	Grab		SM	0-7' SILTY SAND, (Recessional Outwash), light brown, fine to medium sand, trace coarse sand, damp.	
	4m/ft.	10	2	Grab		SW	7-21' SILTY GRAVELLY SAND, (Till?), dark brown, fine to coarse, damp.	
	3m/ft.	15	3	Grab			-increasing sand, decreasing silt, damp.	
		20	4	Grab			-increasing fine sand, silt, damp.	
	4m/ft.	25	5	Grab		GW	21-37' SANDY GRAVELS, (Outwash), light gray, fine to coarse sand, angular gravels, dry.	
		30	6	Grab			-becoming medium to dark gray, damp.	
	5m/ft.	35	7	Grab				

GP-19; 1 of 2

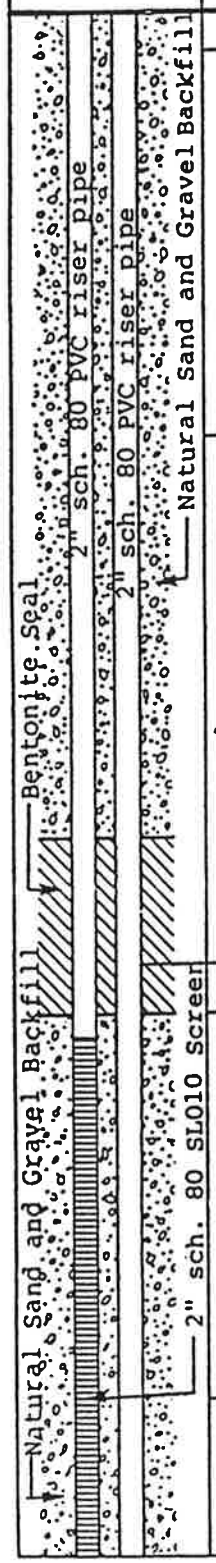
SEA-300-02a

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT THUN FIELD LANDFILL SITE

Boring No. TF-12(S)(D)



WELL DETAILS	PENETRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		35	7	Grab		GW	GRAVELLY SAND, medium brown, slightly silty, fine to coarse, dry.	
	4m/ft.	40	8	Grab		GM	31-53' SILTY GRAVELLY SAND, medium dark grayish brown, fine to coarse sand, moist.	
							-same.	
		45	9	Grab				
							-same.	
		50	10	Grab				
	4-5m/ft							
		55	11	Grab		GM	53-60' GRAVELLY SILTY SAND, (Till), dark brown, fine to medium sand, cohesive silt, very moist.	
		60	12	Grab		GM	60-74' SILTY GRAVELLY SAND, (Outwash), light gray, fine to coarse sand, angular gravel, saturated.	SWL 62' While drilling conductivity = 1100.
	3m/ft.	65	13	Grab			-same - saturated.	
		70	14	Grab			-same.	
	2m/ft.							

High - April 90

SEA-300-02b

GP-19; 2 of 2

Sweet-Edwards/EMCON, Inc.

BORING LOG

PROJECT Thun Field Landfill Site

Location (See Figure)

Boring No. MW-18 Shallow (GP-20A,B,C)

Surface Elevation 546 ft. (MSL)

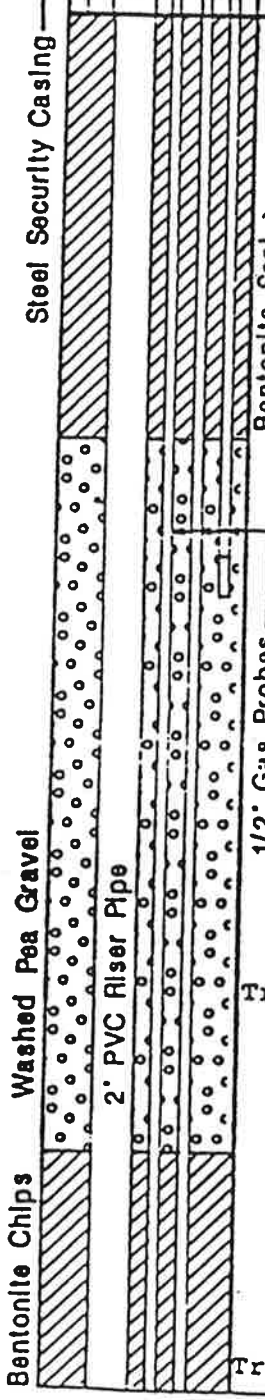
Drilling Method Air Rotary - 6"

Total Depth 160 feet below ground surface

Drilled By Hayes Well Drilling Co.

Date Completed 3/2/88

Logged By Patrick Dunn



OVA/ TIP READINGS	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
	5			SM	SILTY SAND (0-16'); light olive brown (2.5Y, 5/4); fine grained 20-30% low plasticity fines; 10-15% coarse gravel; loose; dry. (TILL)	
	10	1	Grab		@ 13-13.5': color change to gray.	
	15			GM/ SM	SILTY, SANDY GRAVEL to GRAVELLY SILTY SAND (16-42'); light olive brown to grayish brown; medium gravel grained; 1 inch rounded; 15-30% low plasticity fines; 15-30% fine to coarse grained sand; loose; dry. (TILL)	
	20	2	Grab			
	25					
	30	3	Grab		@ 30': lenticular quartz sands; harder.	
	35				@ 34-35.5': less fines coarser grained; damp.	

SEA-300-02

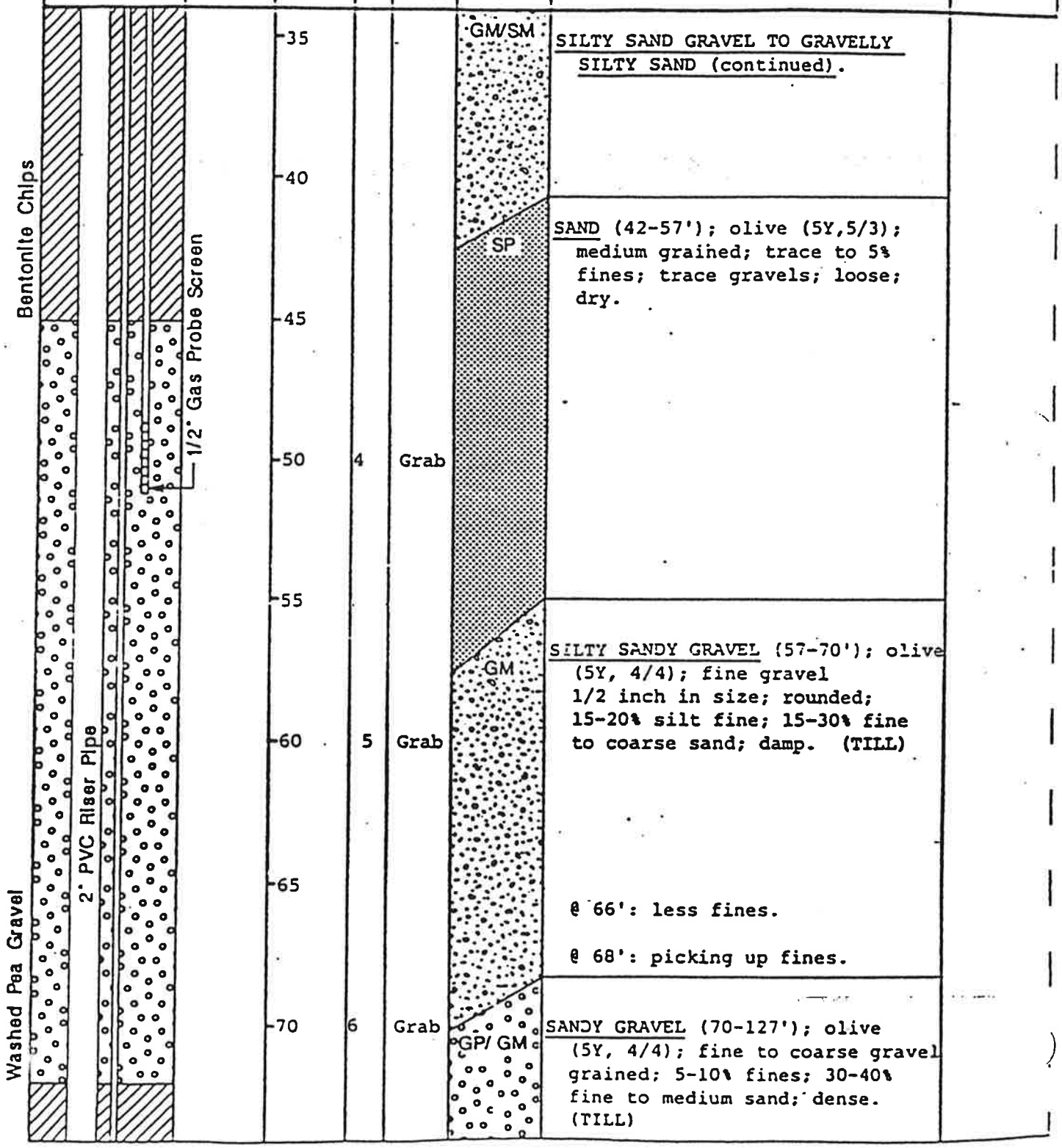
GP-20, 1 of 4

Sweet-Edwards/EMCON, Inc.

BORING LOG

PROJECT Thun Field Landfill Site

Boring No. MW-18S



SEA-300-02

GP-20; 2 of 4

Sweet-Edwards/EMCON, Inc.

BORING LOG

PROJECT Thun Field Landfill Site

Boring No. MW-18S

WELL DETAILS	OVA/ TIP READINGS	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
Bentonite Chips; 2" PVC Riser Pipe		75			GP/ GM	SANDY GRAVELS to SILTY SANDY GRAVELS (continued). @ 72': change in color to gray, due to basaltic composition of rock. (OUTWASH)	
		80	7	Grab			
		85					
		90	8	Grab			
		95					
		100	9	Grab		SANDY GRAVELS to SILTY SANDY GRAVELS (72-127'); olive gray (5Y, 4/2); fine to coarse gravels; 1/2 inch to 1 inch rounded; 10-20% fines; 15-30% fine to coarse sand; dense; damp. (OUTWASH)	
		105					
		110	10	Grab			

SEA-300-02

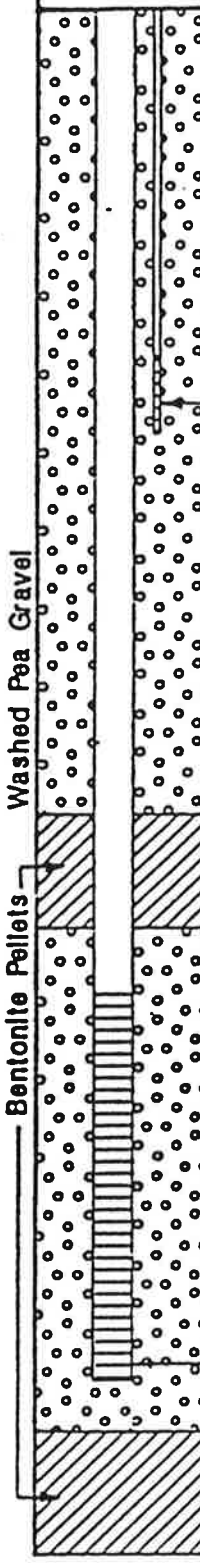
GP-20', 3 of 4

Sweet-Edwards/EMCON, Inc.

BORING LOG

PROJECT Thun Field Landfill Site

Boring No. MW-18S



WELL DETAILS	OVA/ TIP READINGS	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		115			GP/ GM	SANDY GRAVELS to SILTY SANDY GRAVES (continued).	
		120	11	Grab			
		125			SM	SILTY SAND (127-150'); olive gray (5Y, 4/2); fine to coarse grained; 20-25% low plasticity fines; 5-15% fine gravels; up to 1/2 inch, rounded; drill hole staying open; dense; damp. (TILL)	
		130	12	Grab		@ 133': Brighter olive color.	
		135					
		140	13	Grab		@ 139': dark andesitic boulders.	
						@ 142': damp.	
		145				@ 145': wet.	3/2/88 Conductiv 980 umhos/cm
		150	14	Grab	GM/ SW	SANDY SILTY GRAVELS to GRAVELLY SAND (150- BOB); olive brown (2.5Y, 5/4); coarse grained to fine gravel grained; 10-20% fine to medium sand; (continued-)	

SEA-300-02

GP-20', 4 of 4

LOG OF EXPLORATORY BORING

GP-21

PROJECT NAME	Phase II Remedial Investigation	BORING NO.	MW-25S
LOCATION	Hidden Valley Landfill	PAGE	1 OF 9
DRILLED BY	Hayes Drilling	REFERENCE ELEV.	
DRILL METHOD	Air-Rotary	TOTAL DEPTH	170.00'
LOGGED BY	John North	DATE COMPLETED	12/13/89

SAMPLE NUMBER	SAMPLE METHOD	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
S-1	GRAB		5, 10, 15, 20				0 - 20 feet: SANDY GRAVEL; browns; sand fine to coarse; gravel fine to coarse; scattered cobbles; 5-10% silt; moist.

REMARKS

Gas Probes GP-21S and GP-21D installed with MW-25S. Well construction materials: 2" sch 40 flush-threaded PVC blank, 2" sch 40 0.010" factory slotted PVC screen, FILTER PACK = washed pea gravel, SEAL MATERIAL = medium and coarse bentonite chips. Locking steel monument cemented in place at surface.

SWEET-EDWARDS/EMCON

T02-01.21.LRIG2.13a/cj:4.09/10/9

LOG OF EXPLORATORY BORING

PROJECT NAME	Phase II Remedial Investigation	BORING NO.	MW-25S
LOCATION	Hidden Valley Landfill	PAGE	2 OF 9
DRILLED BY	Hayes Drilling	REFERENCE ELEV.	
DRILL METHOD	Air-Rotary	TOTAL DEPTH	170.00'
LOGGED BY	John North	DATE COMPLETED	12/13/89

SAMPLE NUMBER	SAMPLE METHOD	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
S-2	GRAB						20 - 152 feet: GRAVELLY SAND; browns; sand fine to medium; gravel fine to 0.5", subrounded to subangular; trace silt; slightly moist.
			25				
S-3	GRAB		30				— @ 30 feet: moisture increasing.
			35				
			40				

REMARKS

Gas Probes GP-21S and GP-21D installed with MW-25S. Well construction materials: 2" sch 40 flush-threaded PVC blank, 2" sch 40 0.010" factory slotted PVC screen, FILTER PACK = washed pea gravel, SEAL MATERIAL = medium and coarse bentonite chips. Locking steel monument cemented in place at surface.

GP-22

LOG OF EXPLORATORY BORING

PROJECT NAME	Phase II Remedial Investigation	BORING NO.	MW-23S
LOCATION	Hidden Valley Landfill	PAGE	1 OF 2
DRILLED BY	Tacoma Pump & Drill	REFERENCE ELEV.	
DRILL METHOD	Air Rotary	TOTAL DEPTH	32.00'
LOGGED BY	John North	DATE COMPLETED	10/31/89

SAMPLE NUMBER	SAMPLE METHOD	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
S-1	GRAB		5, 10, 15, 20				0 - 8 feet: SANDY GRAVEL; greys; sands fine to coarse; gravels fine to 3"; with abundant cobbles to approximately 8"; trace silt. (RECESSIONAL) 8 - 32 feet: GRAVELLY SAND INTERBEDDED WITH SANDY GRAVEL; dark greys; sands fine to coarse, gravels subrounded, fine to 1 inch. (RECESSIONAL) Slight moisture.

REMARKS

Gas probe GP-22 installed with MW-23S. Well construction materials: 2" sch 40 flush-threaded PVC blank, 2" sch 40 .010" factory slotted PVC screen, FILTER PACK = pea gravel, SEAL MATERIAL = bentonite 3/8" pellets, medium bentonite chips. Locking steel monument cemented in place at surface.

SWEET-EDWARDS/EMCON

T02-01.02.LRI.14/cjf:4.09/10/90

GP-22; 1 of 2

LOG OF EXPLORATORY BORING

PROJECT NAME	Phase II Remedial Investigation	BORING NO.	MW-23S
LOCATION	Hidden Valley Landfill	PAGE	2 OF 2
DRILLED BY	Tacoma Pump & Drill	REFERENCE ELEV.	
DRILL METHOD	Air Rotary	TOTAL DEPTH	32.00'
LOGGED BY	John North	DATE COMPLETED	10/31/89

SAMPLE NUMBER	SAMPLE METHOD	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
S-2	GRAB		25				
			30				Bottom of hole at 32 feet.
			35				
			40				

REMARKS

Gas probe GP-22 installed with MW-23S. Well construction materials: 2" sch 40 flush-threaded PVC blank, 2" sch 40 .010" factory slotted PVC screen, FILTER PACK = pea gravel, SEAL MATERIAL = bentonite 3/8" pellets, medium bentonite chips. Locking steel monument cemented in place at surface.

SWEET-EDWARDS/EMCON

T02-01.02.LRI.14/cjf:4.09/10/90

GP-22; 2 of 2

APPENDIX B

FIELD MONITORING FORMS

Hidden Valley Landfil
Landfill Gas Probe Data

Date: _____
Weather Conditions: _____
Barometric Pressure: _____
Instrument: _____
Measured By: _____

Probe GP	CH_4 %	CH_4 %LEL	CO_2 %	O_2 %	Pressure In. W.C.
1A					
1B					
1C					
2A					
2B					
3S					
3M					
3D					
4A					
4B					
5A					
5B					
6					
7S					
7D					
8A					
8B					
9					
10					
11					
12					
13A					
13B					
14S					
14D					
15A					
15B					
16A					
16B					

Probe GP	CH_4 %	CH_4 %LEL	CO_2 %	O_2 %	Pressure In. W.C.
17					
18					
19					
20A					
20B					
20C					
21S					
21D					
22					

Field Notes: _____

Notes: On-site probes GP-1, GP-10 and GP-11 are for system performance monitoring
Off-site probes GP-20, -21, and -22 only to be monitored if off-site subsurface gas migration is suspected

Hidden Valley Landfill
Landfill Gas Monitoring of On-site Buildings

Date:
Weather Conditions:
Instrument:
Measured By:

The atmosphere inside buildings at the landfill were monitored for possible intrusion of methane gas. Per WAC 173-351, concentrations of methane in on-site structures must not exceed 25% of the lower explosive limit (LEL). If off-site gas migration is suspected, concentrations of methane in off-site structures must not exceed 100 ppm methane.

The areas monitored included:
- The general overall work area
- Floor drains
- Underground conduit protrusions
- Closed areas where landfill gas could collect, such as under cupboards and inside closets

The gas detection instrument must be calibrated using calibration gas containing methane equal to 50 % LEL. Calibration must be performed before and after the survey is completed.

Checked boxes indicate that the survey revealed **no detectable methane**.

- ☐ Main Office - individual office spaces, storage areas and within open crawl-space area.
- ☐ Repair Shop – survey atmosphere conditions throughout (lower height levels).
- ☐ Guard Post – main room and restroom area.
- ☐ Pay/Scale Booth – interior of building.
- ☐ Recycle Building – throughout facility and water drainage areas.
- ☐ Leachate Treatment Building – all lower level office spaces, restrooms, water drainage system and storage/equipment areas.
- ☐ Gas to Energy Building – central monitoring/control room, engine room and storage cabinets.
- ☐ Transfer Station Building – throughout entire building and lower levels.

_____
Signature

Hidden Valley Landfill
Landfill Gas Flare Station Data

Date:
Weather:
Measured By:

Well Number	Pipe Size	Flow Factor	Field Measurements						Calcutated Flow Rate[(a)] (scfm)	Monthly Total[(b)] (scf)
			$\%CH_4$	$\%CO_2$	$\%O_2$	Static Pressure	Velocity Pressure	Temp (^0F)		
COMP 1	12	2792								
COMP 2	12	2792								
									Flare Total:	
COGEN	10	1969								

Field Notes:

(scfm) = standard cubic feet per minute (at standard temperature and pressure)

(a) Flow rate equals the square root of the velocity pressure multiplied by the flow factor

(b) Monthly total equals the flow rate per minute (scfm) x 60 x 24 x days of operation in a given month

Hidden Valley Landfill
Condensate System Inspection

Date:
Measured By:

Condensate Sump	Pump Operating Correctly?	Comments
CS-1		
CS-2		
CS-3		
CS-4		
CS-5		
CS-6		
CS-		
CS-8		
CS-9		
CS-10		

Field Notes:

Hidden Valley Landfill
Landfill Gas Well Field Data

Date:
Weather:
Measured By:

VSC: Valve Stuck Closed
OTS: Open Tested Shut
VCO: Valve Cracked Open
VSO: Valve Stuck Open

Well Number	Pipe Size	Flow Factor	Field Measurements						Calcutated Flow Rate	Comments
			$\%CH_4$	$\%CO_2$	$\%O_2$	Static Pressure	Velocity Pressure	Temp (^0F)		
N65	2	79								
N64	2	79								
N64B/C	2	79								
N63	2	79								
N62	2	79								
N61	2	79								
N60A	2	79								
N59	2	79								
N58	2	79								
N57	2	79								
N56	2	79								
N55A	2	79								
N31	3	178								
N30	3	178								
N29	3	178								
N39	3	178								
N27	3	178								
N28	3	178								
N26	3	178								
N25	3	178								
N23	3	178								
N24	3	178								
W COM	12	2792								
N46	3	178								
N66	2	79								
N53	2	79								
N52	2	79								

Hidden Valley Landfill
Landfill Gas Well Field Data

Date:
Weather:
Measured By:

VSC: Valve Stuck Closed
OTS: Open Tested Shut
VCO: Valve Cracked Open
VSO: Valve Stuck Open

Well Number	Pipe Size	Flow Factor	Field Measurements						Calcutated Flow Rate	Comments
			$\%CH_4$	$\%CO_2$	$\%O_2$	Static Pressure	Velocity Pressure	Temp (^0F)		
N67	3	178								
N68	2	79								
N44	2	79								
N45	3	178								
N43	3	178								
N42	3	178								
N37	2	79								
N38	3	178								
N54	3	178								
N41	3	178								
N40	3	178								
N36	3	178								
N35	3	178								
N33	3	178								
N34	3	178								
N70	3	178								
N69	3	178								
N51	3	178								
N HORIZ 1	3	178								
N HORIZ 2	3	178								
N50	3	178								
N71	3	178								
N72	3	178								
N32	3	178								
SE COMP	10	1969								
S COMP	10	1969								
N16	3	178								

Hidden Valley Landfill
Landfill Gas Well Field Data

Date:
Weather:
Measured By:

VSC: Valve Stuck Closed
OTS: Open Tested Shut
VCO: Valve Cracked Open
VSO: Valve Stuck Open

Well Number	Pipe Size	Flow Factor	Field Measurements						Calcutated Flow Rate	Comments
			$\%CH_4$	$\%CO_2$	$\%O_2$	Static Pressure	Velocity Pressure	Temp (^0F)		
N15	3	178								
N17	3	178								
N14	3	178								
N4	3	178								
N3	3	178								
N21	3	178								
N20	3	178								
N19	2	79								
N19A	3	178								
N18	3	178								
N5	3	178								
N6	3	178								
N7	3	178								
N12	3	178								
N11	3	178								
E38	3	178								
E27	3	178								
E26	2	79								
E25A	2	79								
E25	2	79								
E24	2	79								
E23	2	79								
E22	2	79								
E20	2	79								
E18	2	79								
E16	2	79								

Hidden Valley Landfill
Landfill Gas Well Field Data

Date:
Weather:
Measured By:

VSC: Valve Stuck Closed
OTS: Open Tested Shut
VCO: Valve Cracked Open
VSO: Valve Stuck Open

Well Number	Pipe Size	Flow Factor	Field Measurements						Calcutated Flow Rate	Comments
			$\%CH_4$	$\%CO_2$	$\%O_2$	Static Pressure	Velocity Pressure	Temp (^0F)		
E15	2	79								
E14	2	79								
E13	3	178								
E12	2	79								
E11A	2	79								
E10	2	79								
E2	2	79								
E1	2	79								
E2A	2	79								
E3A	2	79								
E4A	3	178								
E6B	3	178								
E43	2	79								
E42	2	79								
E41	2	79								
E37	3	178								
E40	4	317								
E11A	3	178								
E6B	3	178								
E8	2	79								
E9A	2	79								
E8A	3	178								
E17A	2	79								
E19A	2	79								
E21	3	178								
E28	2	79								
E29	3	178								

Hidden Valley Landfill
Landfill Gas Well Field Data

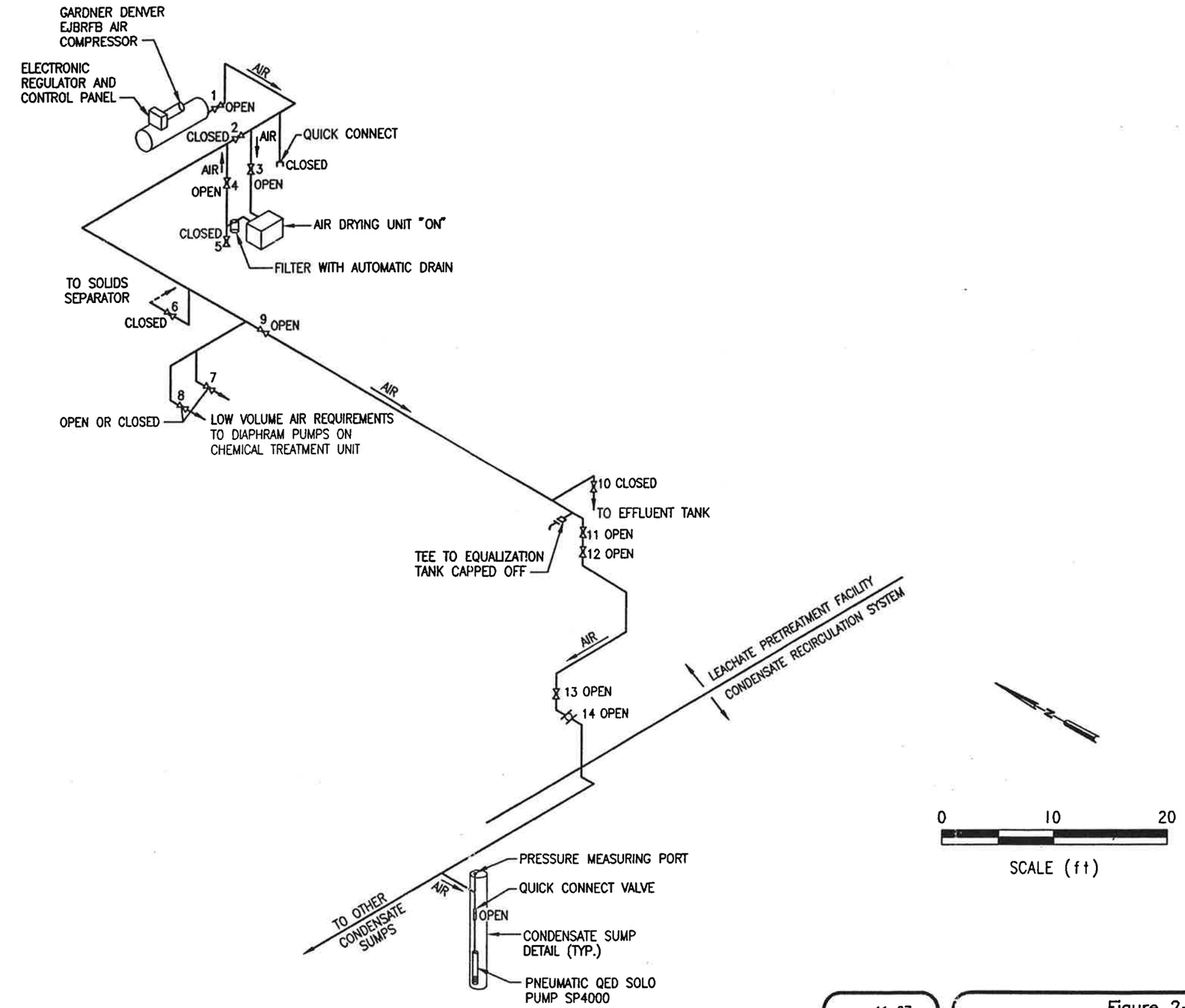
Date:
Weather:
Measured By:

VSC: Valve Stuck Closed
OTS: Open Tested Shut
VCO: Valve Cracked Open
VSO: Valve Stuck Open

Well Number	Pipe Size	Flow Factor	Field Measurements						Calcutated Flow Rate	Comments
			$\%CH_4$	$\%CO_2$	$\%O_2$	Static Pressure	Velocity Pressure	Temp (^0F)		
E31A	3	178								
E34A	3	178								
E34	3	178								
E7	2	79								
E33	2	79								
E32	3	178								
E39	2	79								
E36	2	79								
E5	2	79								
N10	3	178								
N9	3	178								
N48	2	79								
N49	2	79								
N47	2	79								
N8	3	178								
N73	2	79								
N75	2	79								
N13	3	178								
COMP 1	12	2792								
COMP 2	12	2792								
COGEN	10	1969								

APPENDIX C

GAS CONDENSATE SYSTEM REFERENCE MATERIAL



EMCON

DATE	11-97
DWN	MLP
APP	KWW
REV	KWW
PROJECT NO.	40202-005.052

Figure 2-1
LAND RECOVERY, INC.
HIDDEN VALLEY LANDFILL
PIERCE COUNTY, WASHINGTON
CONDENSATE RECIRCULATION SYSTEM
AIR SUPPLY ISOMETRIC

ENW-BOTHELL2/DATA: G:\DWG\40202005\BD052C04.dwg Xrefs: <NONE>
Scale: 1 = 10.00 DimScale: 1 = 10.00 Date: 11/26/97 Time: 9:26 AM Operator: MLP

Suppliers for the Gas Condensate Recirculation System

Equipment/Material	Supplier
Pneumatic Condensate Pumps	QED Groundwater Specialists P.O. Box 3726 Ann Arbor, MI 48106 (800) 624-2026
Main HDPE Condensate Discharge and Air Supply Lines	Maskell-Robbins Incorporated P.O. Box 12590 Seattle, Washington 98111-4590 (206) 775-8600
Stainless Steel Piping	Floyd Equipment Company, Inc. 2208 Pacific Hwy East Tacoma, WA 98424-1013 (800) 828-3322
Pipe Fittings	Familian Northwest 3517 Pacific Hwy East Tacoma, WA 98424-1120
	Pacific Water Works 602 Valley Ave. N.E. Puyallup, WA 98372 (206) 840-8558
	Tacoma Screw Products, Inc. 2001 Center Street Tacoma WA 98409-7895 (800) 562-8192
	TIMCO, Inc. 1926 Port of Tacoma Road Tacoma, WA 98421 (253) 272-0397
	Western Fluid Components, Inc. 11440 120th Avenue N.E. Kirkland, WA 98033 (800) 343-5843
	Campbell Manufacturing, Inc. Spring & Railroad Streets Bechtelsville, PA 19505 (800) 523-0224

QED
GroundWater Specialists
6095 Jackson Rd.
P.O. Box 3726
Ann Arbor, Michigan 48106
800-624-2026 / In Michigan 313-995-2547

SOLO™

CONTROLLERLESS PNEUMATIC PUMP

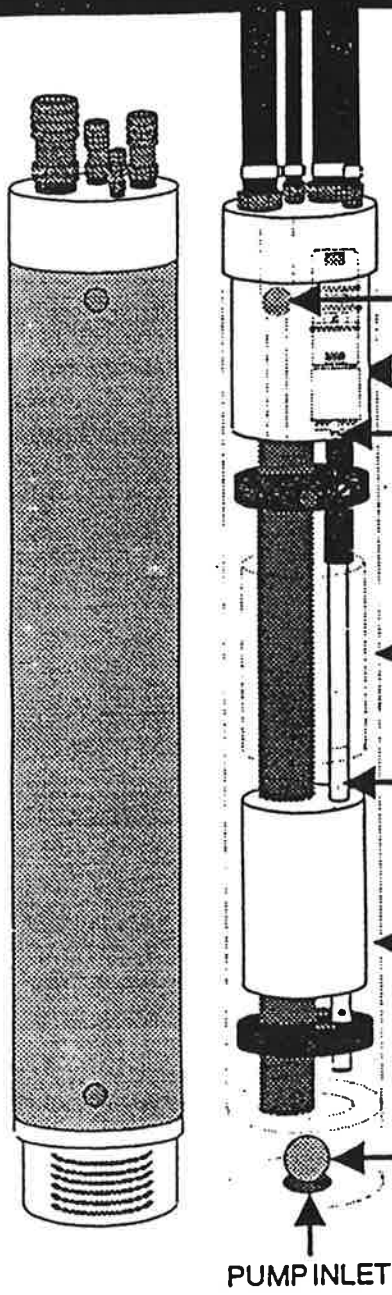
MANUAL P/N 36226 REV. 2-22-94

SOLO

SOLO is an intelligent, high-rate pneumatic pump for total fluids applications. It runs itself, with an internal float system and a magnetic "brain" cartridge. The brain senses liquid level in the pump, turning the air supply on when the pump is full, and turning it off as soon as the pump empties. With its built- in brain, SOLO doesn't require air cycle or on-off level control at the well head, simplifying system design. All you need above the well cap is a compact air filter/speed control. SOLO is easy to install-just run air to each well. Continued operation is truly hands-off. SOLO constantly reacts to changes in well recovery rate, so it's always pumping at the highest rate possible. It also shuts down automatically if water in the well drops below pumping level. (NOTE: SP4000 requires a minimum of 3.5 feet of liquid in order to pump and the SP2000 requires a minimum of 1 foot of liquid in order to pump) Because cycling is controlled at the pump, SOLO is either refilling or discharging 100% of the time. There's no waiting between active phases of the cycle for the entire length of air supply tubing to re-pressurize. This operating efficiency enables SOLO to deliver pumping rates of up to 4.5 gallons per minute while also saving on air supply requirements. The mechanism in SOLO uses the same high-clearance design that has made PULSE PUMP the standard for field performance without clogging or breakdowns.

TABLE OF CONTENTS

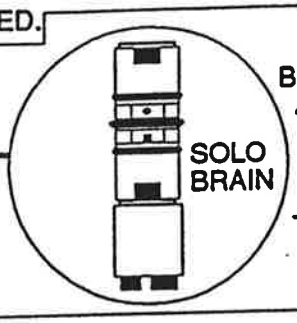
HOW THE SOLO PUMP WORKS



THE SP4000 REQUIRES A MINIMUM OF 3.5' OF LIQUID TO PUMP.
THE SP2000 REQUIRES A MINIMUM OF 1' OF LIQUID TO PUMP.
THE SOLO PUMP AUTOMATICALLY SHUTS OFF WHEN THE LIQUID LEVEL IS PUMPED DOWN.
THE SOLO PUMP WILL AUTOMATICALLY BEGIN PUMPING AGAIN ONCE WELL LEVEL HAS RECOVERED.

TOP CHECK BALL

AIR PORTAL



BRAIN CONTROLS AIR INTO AND OUT OF THE PUMP WHEN SIGNALED BY THE ACTION OF THE FLOAT

-FLOAT WITH PUMP FULL

FLOAT IN THIS POSITION SLIDES THE ACTUATOR ROD UPWARD CAUSING AIR TO ENTER THE PUMP. THE AIR PRESSURE FORCES THE INLET CHECK BALL TO SEAT, PREVENTING WATER FROM ESCAPING OUT THE INLET. THE LIQUID IN THE PUMP'S BODY IS THEN FORCED INTO THE PUMP'S FILL TUBE AND UP THE DISCHARGE LINE TO THE SURFACE. THE TOP CHECK BALL IS UNSEATED BY THE UPWARD FORCE OF THE DISCHARGED LIQUID.

ACTUATOR ROD

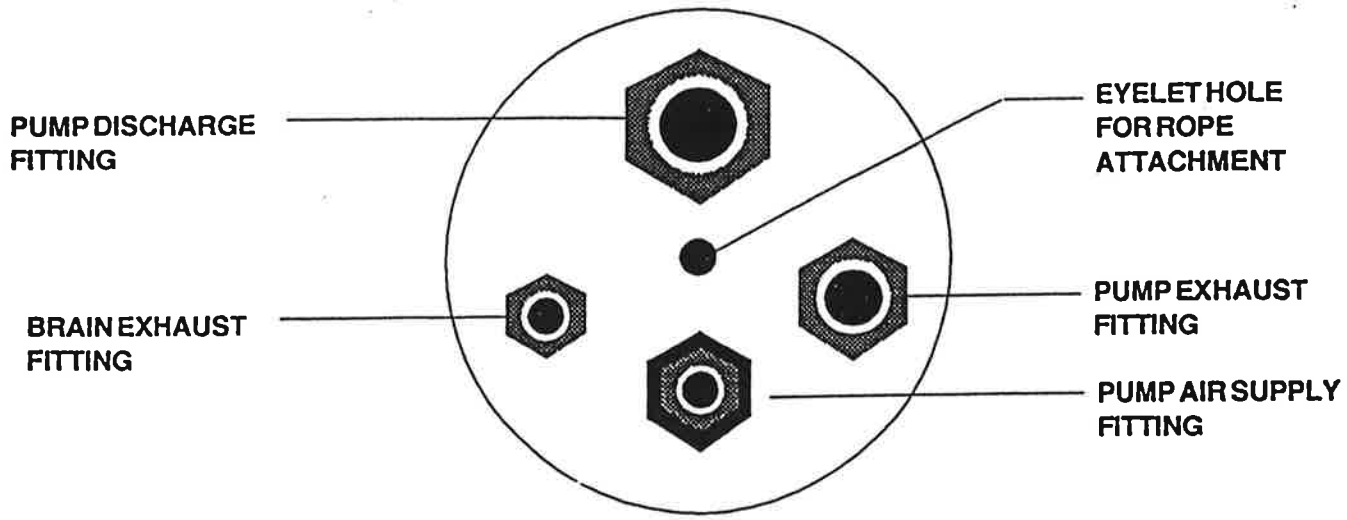
FLOAT WITH PUMP EMPTY

FLOAT IN THIS POSITION SLIDES ACTUATOR ROD DOWNWARD ALLOWING THE COMPRESSED AIR IN THE PUMP TO VENT. THE INLET CHECK BALL UNSEATS (NO LONGER HAVING ANY AIR AIR PRESSURE HOLDING IT DOWN) WHICH ALLOWS THE NEXT VOLUME OF LIQUID FROM THE WELL INTO THE PUMP. AS THE LIQUID REFILLS THE PUMP, THE FLOAT RISES BACK UP INTO THE POSITION MENTIONED ABOVE AND THE PUMPING PROCESS IS REPEATED. THE TOP CHECK BALL IS SEATED BY THE WEIGHT OF ANY LIQUID IN THE DISCHARGE LINE ABOVE IT PREVENTING THAT LIQUID FROM RE-ENTERING THE PUMP BODY.

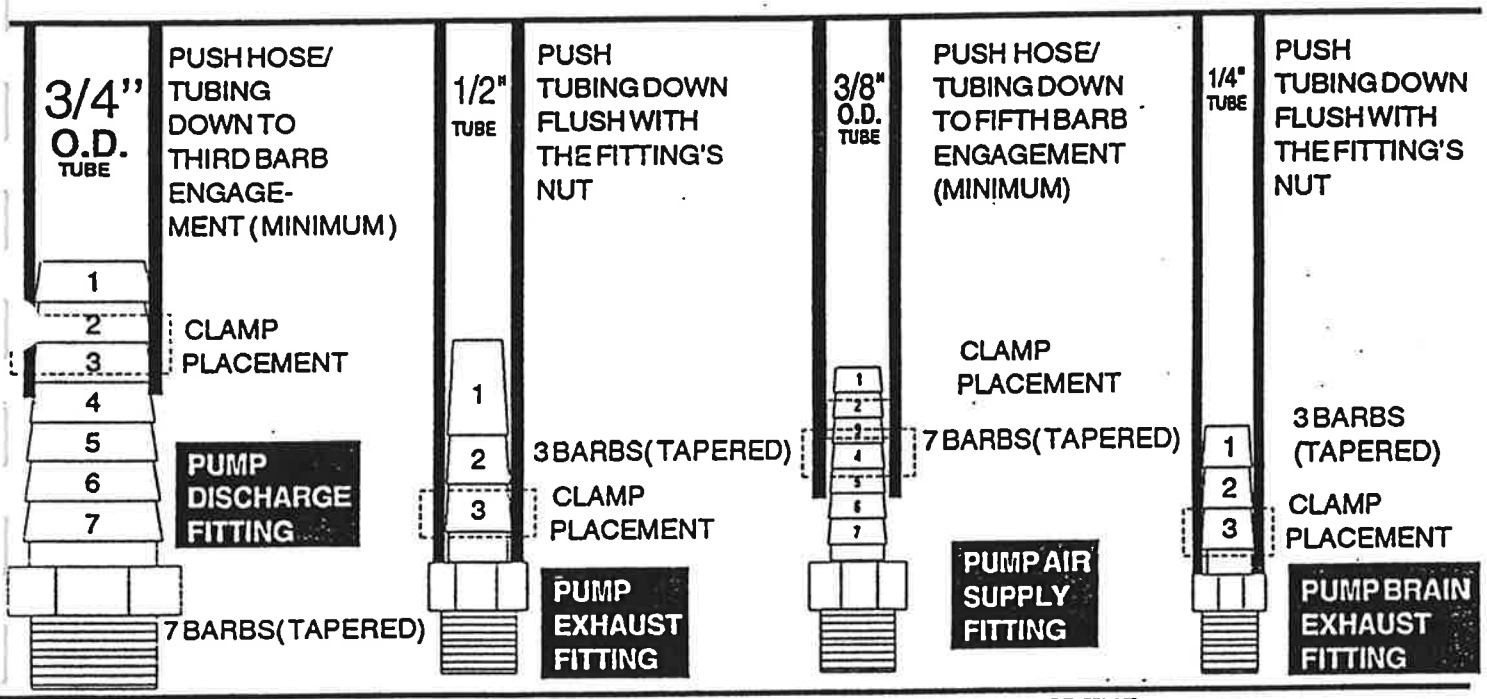
INLET CHECK BALL

PUMP INLET

HOSE/TUBING ATTACHMENTS TO TOP OF SOLO PUMP



TOP VIEW OF SOLO PUMP

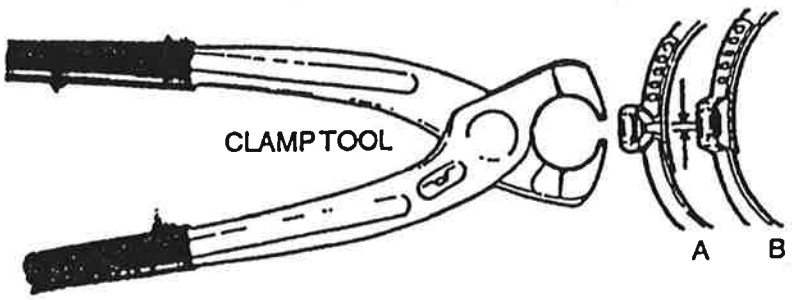


TIGHTENING THE CLAMPS

DIMPLED EAR

EAR CLAMP

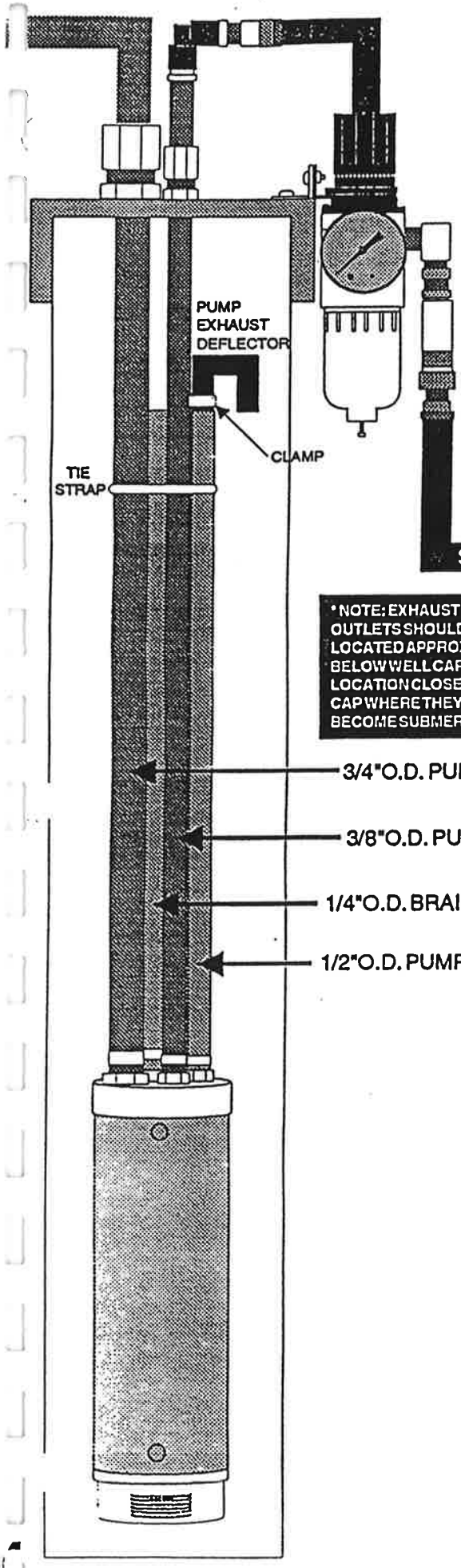
PLACE CLAMP TOOL OVER THE DIMPLED EAR PORTION OF THE CLAMP AND SQUEEZE EAR TOGETHER (AS SHOWN BELOW).



A. CLAMP IN CLOSED POSITION

B. CLAMP IN OPEN POSITION

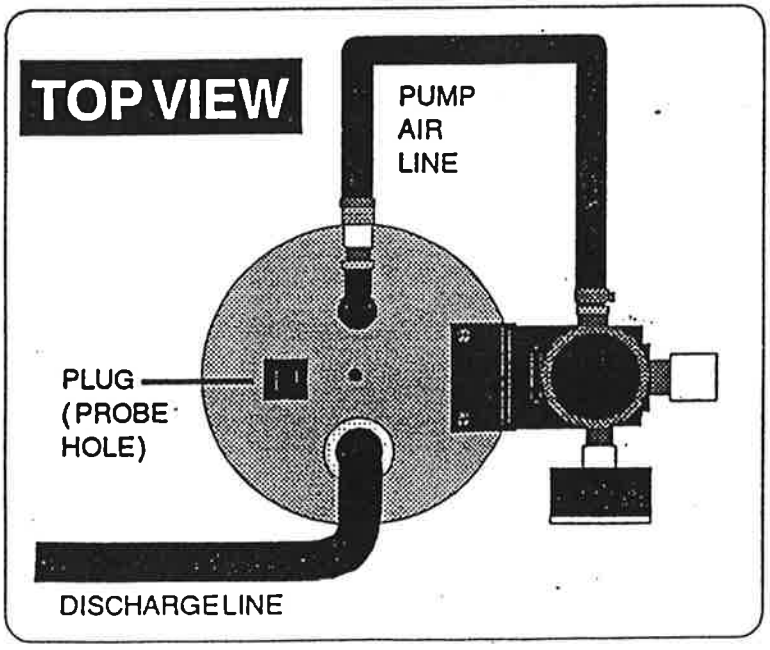
ALL NYLON TUBING 4, 6, 8" CAPS



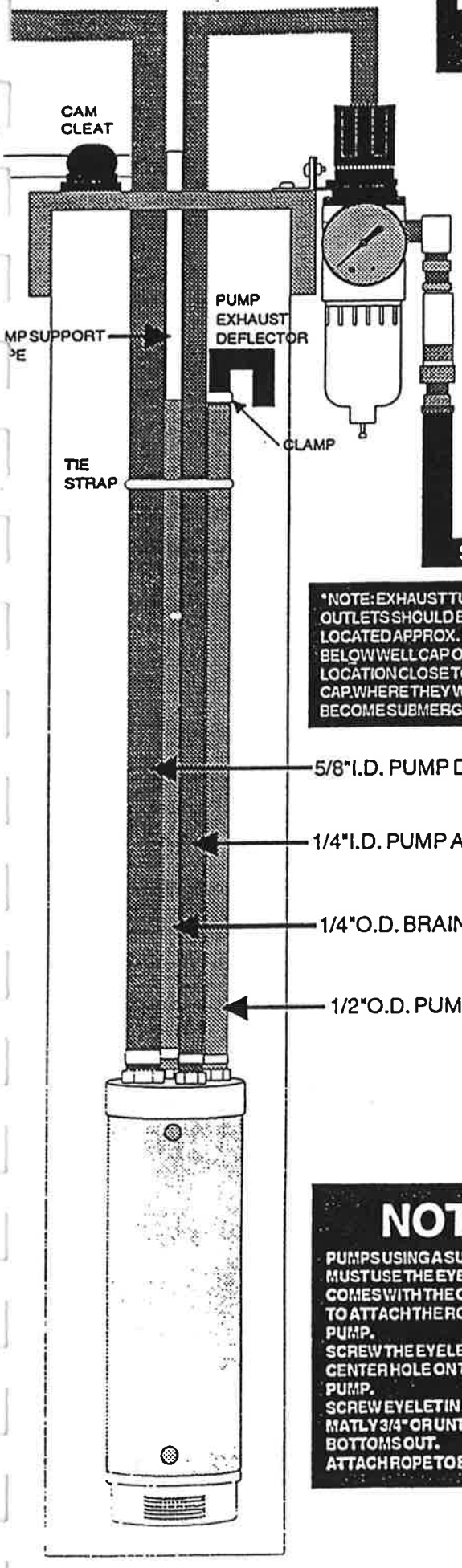
1. LOWER PUMP TO DESIRED DEPTH.
2. ONCE PUMP DEPTH HAS BEEN DETERMINED, MEASURE OFF APPROXIMATELY 1 FT. OF TUBING LENGTH (MEASURED FROM THE TOP OF WELL CASING) FROM BOTH THE PUMP EXHAUST LINE AND THE BRAIN EXHAUST LINE.*
3. CUT BOTH EXHAUST LINES.
4. ATTACH THE PUMP EXHAUST DEFLECTOR TO THE PUMP EXHAUST LINE. (SEE PAGE 3 FOR CLAMP INSTRUCTIONS)

*NOTE: EXHAUST TUBING OUTLETS SHOULD BE LOCATED APPROX. 1' BELOW WELL CAP OR IN A LOCATION CLOSE TO THE CAP WHERE THEY WILL NOT BECOME SUBMERGED.

5. TIE STRAP ALL TUBING INTO ONE BUNDLE APPROXIMATELY 4-6" BELOW WHERE YOU CUT OFF YOUR EXHAUST LINES.
6. PASS PUMP DISCHARGE AND AIR SUPPLY LINES THROUGH THE WELL CAP.
7. RE-ADJUST PUMP TO DESIRED DEPTH.
8. TIGHTEN WELL CAP FITTINGS DOWN ONTO AIR/DISCHARGE LINES.



HOSE AND TUBING COMBINATION
4, 6, 8" CAPS



1. ATTACH EYELET FOR SUPPORT ROPE TO THE TOP OF THE SOLO PUMP. ATTACH ROPE.
2. LOWER PUMP TO DESIRED DEPTH.
3. ONCE PUMP DEPTH HAS BEEN DETERMINED, MEASURE OFF APPROXIMATELY 1 FT. OF TUBING LENGTH (MEASURED FROM THE TOP OF WELL CASING) FROM BOTH THE PUMP EXHAUST LINE AND THE BRAIN EXHAUST LINE.*
4. CUT BOTH EXHAUST LINES.
5. ATTACH THE PUMP EXHAUST DEFLECTOR TO THE PUMP EXHAUST LINE. (SEE PAGE 3 FOR CLAMP INSTRUCTIONS)

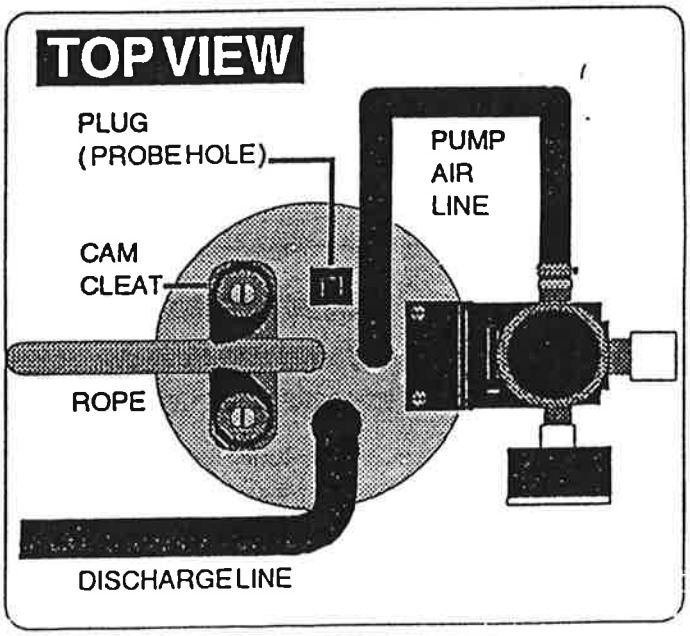
SUPPLY AIR IN FROM COMPRESSOR

*NOTE: EXHAUST TUBING OUTLETS SHOULD BE LOCATED APPROX. 1' BELOW WELL CAP OR IN A LOCATION CLOSE TO THE CAP WHERE THEY WILL NOT BECOME SUBMERGED.

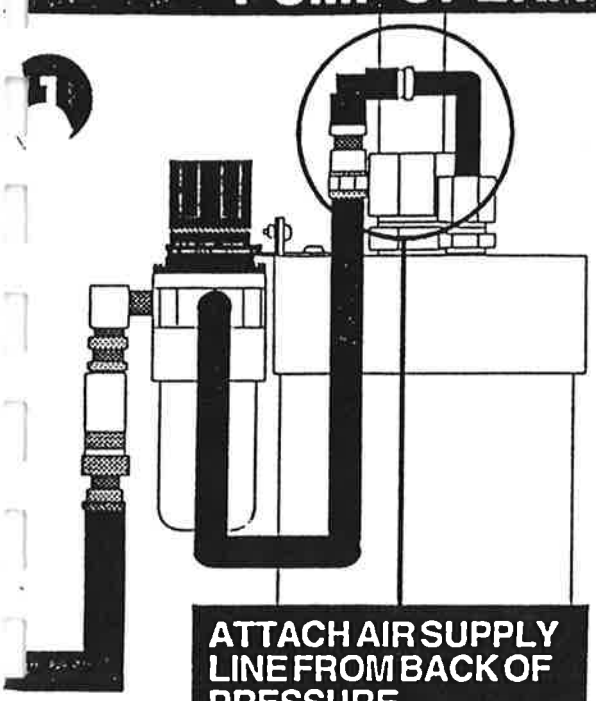
6. TIE STRAP ALL TUBING INTO ONE BUNDLE APPROXIMATELY 4-6" BELOW WHERE YOU CUT OFF YOUR EXHAUST LINES.
7. PASS PUMP DISCHARGE AND AIR SUPPLY LINES THROUGH THE WELL CAP.
8. RE-ADJUST PUMP TO DESIRED DEPTH.
9. PASS PUMP SUPPORT ROPE THROUGH CAM CLEAT TO HOLD PUMP INTO POSITION.

NOTE

PUMPS USING A SUPPORT ROPE MUST USE THE EYELET, (WHICH COMES WITH THE CAP), IN ORDER TO ATTACH THE ROPE TO THE PUMP.
SCREW THE EYELET INTO THE CENTER HOLE ON TOP OF THE PUMP.
SCREW EYELET IN APPROXIMATLY 3/4" OR UNTIL IT BOTTOMS OUT.
ATTACH ROPE TO EYELET



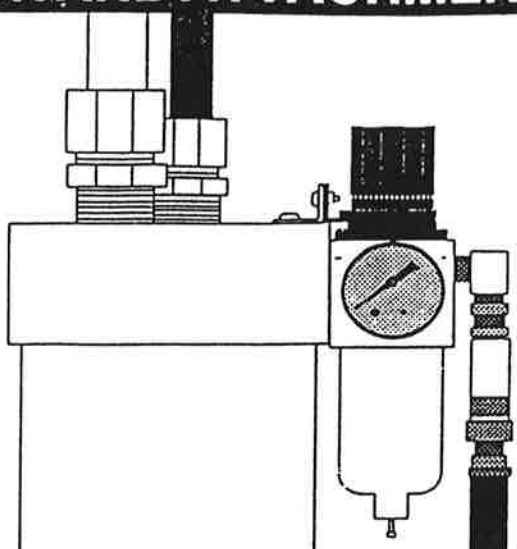
PUMP OPERATION AND ATTACHMENTS



ATTACH AIR SUPPLY LINE FROM BACK OF PRESSURE CONTROLLER TO THE PUMP'S AIR SUPPLY LINE

P, PRESSURE
NTROLLER
FILTER
CK VIEW)

2



CAP, PRESSURE CONTROLLER AND FILTER (FRONT VIEW)

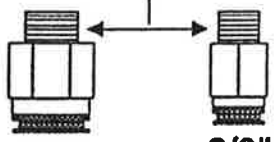
5" AIR SUPPLY HOSE (SUPPLIED)

ATTACH AIR SOURCE HERE

1/4" MALE

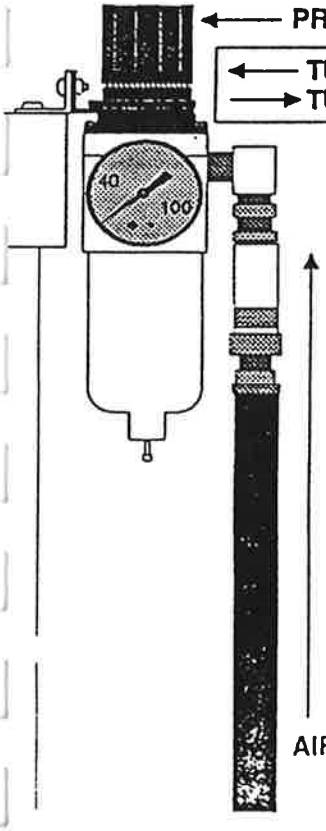
COUPLER
1/4" FEMALE

AIR SUPPLY HOSE FITTINGS OPTIONS:



1/2" 3/8"

PRESSURE CONTROL ADJUSTMENTS



PRESSURE CONTROL KNOB

TURNING CLOCKWISE INCREASES PRESSURE
TURNING COUNTER-CLOCKWISE DECREASES PRESSURE

AIR SOURCE

3

MINIMUM 40 P.S.I.
MAXIMUM 100 P.S.I.

NOTE: FLOW RATE IS DEPENDENT ON THE AMOUNT OF AIR PRESSURE THAT IS RECEIVED BY THE PUMP. FLOW RATES CAN BE INCREASED BY INCREASING AIR PRESSURE TO THE PUMP AND FLOW RATES CAN BE DECREASED BY DECREASING AIR PRESSURE TO THE PUMP.

ADJUST AIR PRESSURE TO DESIRED PRESSURE

P4000 SPECIFICATIONS

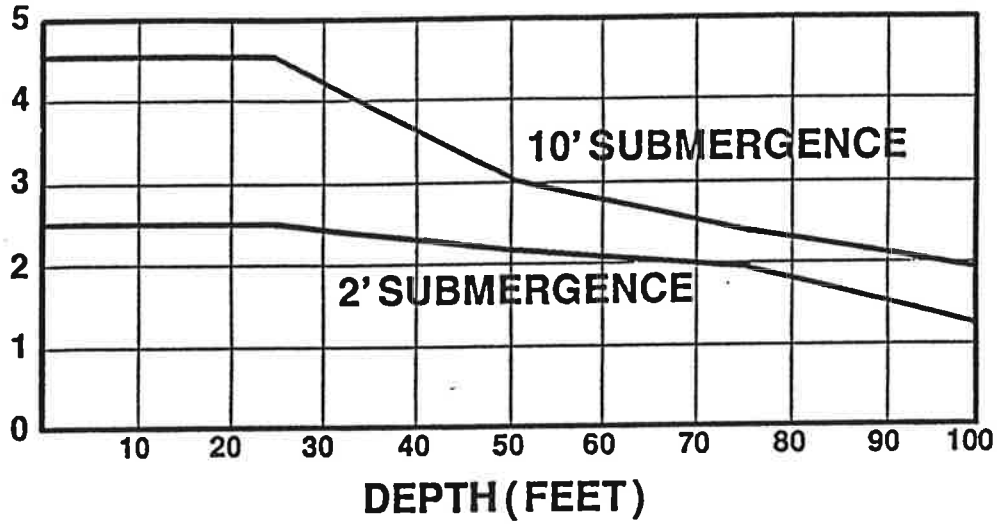
DIAMETER: 3.0"
LENGTH: 48"
WEIGHT: 11.5 LBS
FITTINGS: TYPE-BARB
ZES-DISCHARGE 5/8" ID (3/4" OD)
AIR 1/4" ID (3/8" OD)
EXHAUST 3/8" ID (1/2" OD)
VENT, (BRAIN) 3/16" ID (1/4" OD)

PRESSURE REGULATOR/FILTER DIMENSIONS:
WIDTH-3" (OUT FROM CAP)
WIDTH-5" (PARALLEL TO CAP)
HEIGTH-2-1/2" (ABOVE CAP)
OVERALL LENGTH-6-1/2"

PUMP TYPE: POSITIVE GAS DISPLACEMENT
PUMP VOLUME: 1.9 LITERS (.5 GALLONS) Nominal
MAXIMUM FLOW RATE-4.5 G.P.M.
MATERIALS OF CONSTRUCTION: BODY-STAINLESS STEEL
HOUSINGS-Q-TAL
CHECKBALLS-TEFLON
FITTINGS-BRASS
AIR REQUIREMENTS: MINIMUM-40 P.S.I.
MAXIMUM-100P.S.I.

SP4000 FLOW RATES

FLOW (GPM)
AT 100 P.S.I.



P2000 SPECIFICATIONS

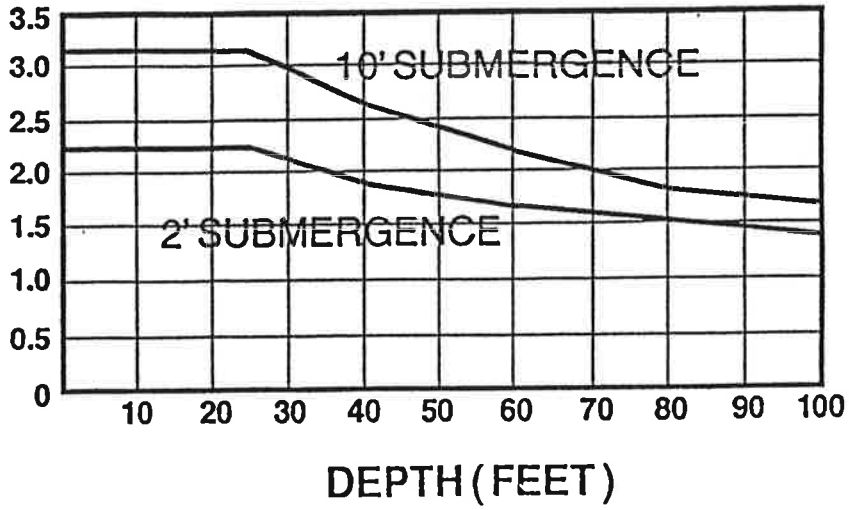
DIAMETER: 3.0"
LENGTH: 24"
WEIGHT: 8.5 LBS
FITTINGS: TYPE-BARB
VENT, (BRAIN) 3/16" ID (1/4" OD)
SIZES-DISCHARGE 5/8" ID (3/4" OD)
AIR 1/4" ID (3/8" OD)
EXHAUST 3/8" ID (1/2" OD)

PRESSURE REGULATOR/FILTER DIMENSIONS:
WIDTH-3" (OUT FROM CAP)
WIDTH-5" (PARALLEL TO CAP)
HEIGTH-2-1/2" (ABOVE CAP)
OVERALL LENGTH-6-1/2"

PUMP TYPE: POSITIVE GAS DISPLACEMENT
PUMP VOLUME: .36 LITERS (0.095 GALLONS) Nominal
MATERIALS OF CONSTRUCTION: BODY-STAINLESS STEEL
HOUSINGS-Q-TAL
CHECKBALLS-TEFLON
FITTINGS-BRASS
AIR REQUIREMENTS: MINIMUM-40 P.S.I.
MAXIMUM-100P.S.I.

P2000 FLOW RATES

FLOW (GPM)
AT 100 P.S.I.



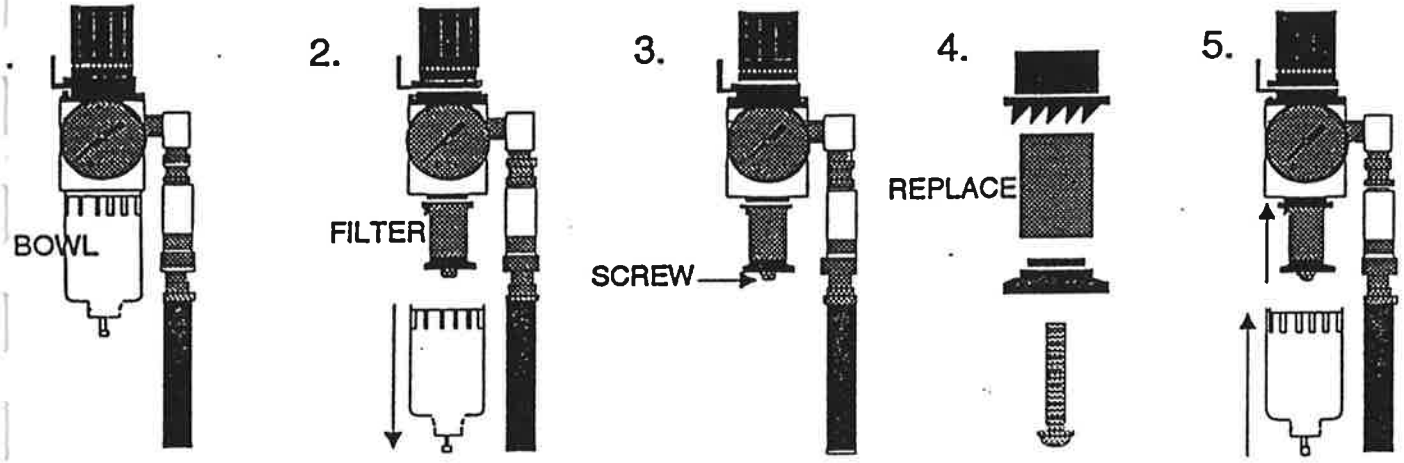
TO ACCESS FILTER ELEMENT SIMPLY UNSCREW FILTER BOWL COUNTERCLOCKWISE.

1PLETELY REMOVE FILTER BOWL.

TO REMOVE FILTER UNSCREW HOLDING SCREW LOCATED AT BOTTOM OF FILTER ASSEMBLY.

ONCE SCREW IS REMOVED THE FILTER ASSEMBLY SHOULD COME APART AS SHOWN (4.) DISCARD OLD LTER AND REPLACE WITH NEW ONE. REASSEMBLE FILTER ASSEMBLY AS IT WAS ORIGINALLY.

REATTACH FILTER AND THEN FILTER BOWL IN THE SAME MANNER AS THEY WERE REMOVED.



NOTE: REPLACEMENT FILTER ELEMENTS MAY BE PURCHASED THROUGH Q.E.D. PART NUMBER 36861

SP4000 PACKAGES

SOLO PUMP, WELL CAP AND REGULATOR FILTER SOLO PUMP PACKAGES INCLUDE:

SOLO PUMP PACKAGES:

WELL DIAMETER	HOSE OR TUBE	PART NUMBER
4 INCH	HOSE	SP4000A
	TUBE	SP4000B
6 INCH	HOSE	SP4000C
	TUBE	SP4000D
8 INCH	HOSE	SP4000E
	TUBE	SP4000F

SP2000 PACKAGES

SOLO PUMP, WELL CAP AND REGULATOR FILTER SOLO PUMP PACKAGES INCLUDE:

SOLO PUMP PACKAGES:

WELL DIAMETER	HOSE OR TUBE	PART NUMBER
4 INCH	HOSE	SP2000A
	TUBE	SP2000B
6 INCH	HOSE	SP2000C
	TUBE	SP2000D
8 INCH	HOSE	SP2000E
	TUBE	SP2000F

APPENDIX D

LANDFILL GAS MONITORING PROCEDURES

LANDFILL GAS MONITORING PROCEDURES

The following are step-by-step procedures for landfill gas monitoring. Always refer to the instrument manufacturer's manual for operational instructions.

Obstructions/Water Vapor. During instrument operation at any location (gas well, probe or gas header), the operator must be alert for the presence of moisture. Small droplets of moisture should not cause concern, but excess moisture will damage detector elements, making the instrument inoperable. Before connecting a combustible gas/oxygen detector to a gas probe, the operator should check for possible probe obstructions and/or the presence of water.

A recommended method to test for obstructions is to attach a squeeze-type aspirator bulb to the probe top with clear vinyl tubing and to evacuate an air sample from the probe with the aspirator bulb. If the deflated bulb fails to expand, the probe tip or the tubing within the probe may be obstructed by foreign matter or water. Dirt or other obstructing particles can block perforations of the probe tip, decreasing the rate at which the sample volume is extracted by the probe and causing slow expansion of the bulb. If the bulb expands slowly, watch the clear tubing for water being extracted from the probe. If a steady stream or a large amount of moisture is observed, do not use the combustible gas detector.

Pressure Measurement Procedures Using a Landtec Gem 500.

1. Press the "on" switch and allow the instrument to warm up for at least 30 seconds.

2. Press "CONTINUE" and No. 2, "READ GAS LEVELS".

3. Press either No. 1 for "PREPROGRAMMED IDENTIFICATION", or No. 2 for "NO PREPROGRAMMED IDENTIFICATION".

4. Press No. 2 "CONTINUE" and No. 3 to "ZERO PRESSURE". Wait approximately 30 seconds and Press No. 1.

5. Return to the original screen and connect the Landtec to the probe or well.

6. Allow 45 seconds for the instrument to stabilize and record data and exit.

Static Pressure Measurement Procedures Using a Magnehelic Pressure Gauge.

1. Set a 0 to 0.25 inches water column (" w.c.) Magnehelic pressure gauge on a flat surface near the probe to be measured. Use a small flat screwdriver and adjust the needle to zero using the set screw located at the bottom of the face of the gauge.

2. Hold the open end of the flexible vinyl tubing connected to the "HIGH PRESSURE" port near your mouth and blow lightly into the tubing while observing the gauge. An upscale movement of the needle should be observed. If it is not, check all tubing connections, possible obstructions within tubing, or gauge operation.
3. Attach "HIGH PRESSURE" tubing to the top of the probe. Connect the gas detector to the probe top using a 4-foot length of 1/8-inch inside-diameter clear vinyl tubing. Using the tubing, the operator can see whether water originating within the probe is pumped into the

instrument. The tubing should be connected to the instrument and probe with an air-tight seal to prevent leakage which could affect the monitoring results.

4. Observe the needle on the gauge.

   - If the needle moves upscale, the pressure is positive. If it stabilizes within the range of the 0 to 0.25 "w.c. gauge, record the positive static pressure value on the data monitoring form.
   - If the needle moves upscale and pegs the 0 to 0.25 "w.c. pressure gauge, disconnect the gauge and repeat the procedure, using a gauge of a higher range.
   - If the needle moves downscale and indicates a sub-zero reading, the pressure at the probe tip is negative. Disconnect the vinyl tubing from the "HIGH PRESSURE" port of the gauge and reconnect it to the "LOW PRESSURE" port. The needle should now indicate an upscale movement. Record the indicated value on the monitoring data form, and note that it is a negative pressure. If the indicated pressure is greater than the range of the gauge, repeat step 4(b), using the "LOW PRESSURE" port of a higher-range gauge.

Gas Composition Measurement Procedures Using a Landtec Gem 500.

7. Press the "on" switch and allow the instrument to warm up for at least 30 seconds.

8. Press "CONTINUE" and No. 2, "READ GAS LEVELS".

9. Press either No. 1 for "PREPROGRAMMED IDENTIFICATION", or No. 2 for "NO PREPROGRAMMED IDENTIFICATION".

10. Connect the Landtec to the probe or well.

11. Press No. 5 "PUMP ON", and allow the pump to run for at least 45 seconds for gas wells and at least 90 seconds for gas probes (until readings stabilize).

12. Record data and press No. 5 again to stop the pump.

Gas Composition Measurement Procedures Using a GasTech® Model 1939-OX portable combustible gas/oxygen detector.

1. Place the "LEL-GAS" switch in the "GAS" (in) position. Place the "OXYGEN-GAS/LEL" switch in the "OXYGEN" (in) position.

2. Turn on instrument by depressing the "POWER" switch. The meter will rise upscale and should steady out at approximately 21 percent on the "percent OXY" scale (the top scale of the meter). Allow the instrument to warm up approximately 1 minute.

3. Depress the "BATTERY CHECK" switch and note the meter reading. The meter should show a reading above the "BATT CK" mark on the "percent OXY" scale. If the reading is at or below the "BATT CK" mark, recharge it by plugging in the battery charger for a minimum of 8 hours before monitoring.

4. If necessary, adjust the black potentiometer labeled "OXY CAL" to bring the meter to the "OXY CAL" mark (21 percent) on the "percent OXY" scale. Place the "OXYGEN-GAS/LEL" switch in the "GAS/LEL" (out) position and the "LEL-GAS" switch in the "LEL" (out) position. With the sampling inlet hose in a gas-free environment, adjust the other black potentiometer labeled "GAS/LEL ZERO" to bring the meter to 0 percent on the "percent LEL" scale (middle scale of meter). Return the "LEL-GAS" switch to the "GAS" position and the "OXYGEN-GAS/LEL" switch to the "OXYGEN" position.

5. Connect the GasTech to the probe or well.

6. When the needle stabilizes, observe the reading on the "percent OXY" scale, and record the percent oxygen value on the monitoring data form. Return the "OXYGEN-GAS/LEL" switch to the "GAS/LEL" position.

7. Observe the "PERCENT GAS" scale (bottom scale of meter).

   - If the needle stabilizes at more than 5 percent, record the percent combustible gas value on the monitoring data form. Proceed to Step 9.
   - If the needle indicates less than or equal to 5 percent, and the oxygen concentration measured in Step 6 is less than or equal to 9 percent, record the percent combustible gas value from the "PERCENT GAS" scale on the monitoring data form. Proceed to Step 9.
   - If the needle indicates less than or equal to 5 percent, and the oxygen concentration is greater than 9 percent, proceed to step 8.

8. Return the "LEL-GAS" switch to the "LEL" position. As soon as the needle stabilizes, observe the "percent LEL" scale and record the percent of the lower explosive limit value on the monitoring data form.

9. Disconnect the GasTech from the probe. Replace the probe top and allow the GasTech to continue to run approximately 1 minute to purge any residual combustible gas. Shut off the "POWER" switch.

10. Proceed to the next probe and repeat the procedure.

If detectable concentrations of combustible gas are suddenly recorded at a probe, the combustible gas detector should be recalibrated immediately and the probe again monitored for verification of results.

APPENDIX E

LANDFILL PERMITS

Municipal Solid Waste Landfill
Transition Permit

Issued Pursuant to
WAC 173-351-700

Transition Permit Number 27-016

Date of Issuance June 29, 1994
Date of Expiration February 27, 2002

Date of Renewal June 6, 1995
Date of Renewal April 30, 1996
Date of Renewal April 18, 1997 (Amended June 12, 1997)
Date of Renewal April 15, 1998
Date of Renewal February 27, 2001

Facility Name:	Hidden Valley Landfill
Facility Location:	17925 Meridian Street East, Puyallup, WA
Facility Owner/Operator:	Land Recovery, Inc.
("the permittee")	Harvey Doman, General Manager (253)847-7555
c/o Address:	P.O. Box 73057
	Puyallup, WA 98373

Transition Permit Issuance:

The permittee, noted above, is hereby authorized to continue operation of the existing municipal solid waste landfill unit(s) under the terms and conditions of this transition permit and in accordance with local ordinances, and Chapter 173-351 WAC.

Federico Cruz Uribe MD

Signed (Health Officer or Designee)

HIDDEN VALLEY LANDFILL
TRANSITION POST-CLOSURE PERMIT

DESCRIPTION

The permittee, Land Recovery, Inc. (LRI), is allowed to perform post-closure activities at the Hidden Valley Landfill located at 17925 Meridian South. The landfill consists of approximately 56-acres of unlined landfill and about 31-acres of lined area. The lined area is comprised of 18-acres on a side slope abutting refuse and 13-acres on native or engineered soil. The landfill was capped in five major phases. The North Closure occurred in 1989 and consisted of approximately 13-acres. The Southwest Closure occurred in 1992 and comprised of approximately 26-acres. In 1993, the side slope area of the landfill was capped with a small area in the northwest corner than consisted of about 17-acres. The Partial Closure was conducted in 1998 and consisted of 11.43-acres. The Final Closure was conducted in 1999 and 2000 and consisted of approximately 22-acres. The landfill closures completed in 1989, 1992, and 1993 were constructed in accordance with WAC 173-304 (synthetic 60–mil geomembrane). The landfill closures conducted in 1998, 1999, and 2000 were constructed in accordance with WAC 173-351 (i.e., a composite cap).

GENERAL CONDITIONS

1. LRI is authorized to perform post-closure activities and must abide by the conditions set forth in the Specific Conditions of this transition permit until this transition permit expires, is revoked, or the full permit is issued in accordance with Section 700 of Chapter 173-351 WAC, Criteria for Municipal Solid Waste Landfills (WAC 173-351).

2. This transition post-closure permit must be renewed annually, in accordance with WAC 173-351-720(1)(a)(i) until either expiration or a full permit is issued.

3. This transition post-closure permit may be modified (amended) by the TPCHD in accordance with WAC 173-351-720(5). More stringent restrictions may be imposed on the facility during the time period this transition permit is valid. Modifications will be made in writing and become specific conditions of the permit.

4. This permit is subject to suspension or revocation if the TPCHD finds:
   A. That the transition permit was obtained by misrepresentation or failure to disclose any relevant information that could potentially have affected the issuance of this transition permit;
   B. That the site is in violation of Chapter 70.95 RCW, WAC 173-351 or local statutes, ordinances, or regulations; or
   C. That there has been a violation of any of the conditions contained in this permit.

   LRI may appeal any such suspension or revocation in accordance with WAC 173-351-760.

5. All conditions of this transition post-closure permit shall be followed or accomplished for LRI to remain in compliance. Compliance schedules shall be met by the specified time period. LRI is responsible for all acts and omissions of contractors and agents of LRI.

6. Any duly authorized officer, employee, or representative of the Tacoma-Pierce County Health Department (TPCHD) may enter and inspect the facility at any reasonable time to determine compliance with WAC 173-351, WAC 173-304 and local solid waste ordinances.

7. LRI must comply with WAC 173-351, Criteria for Municipal Solid Waste Landfills.

8. The permit (with conditions) shall be displayed or stored in a manner that allows easy access by site personnel.

9. Nothing in this permit shall be construed as excusing LRI from compliance with any applicable federal, state, or local statutes, ordinances or regulations.

SPECIFIC CONDITIONS

1. By the end of August 2001, LRI must perform the remaining quality assurance construction activities outlined in the *Final Construction Report for the East Development Area* dated December 11, 2000. The report describing these activities must be submitted to the TPCHD by October 15, 2001.

2. LRI must submit a "complete permit application" in order to obtain a Full Post-Closure Permit for this facility. The complete permit application must contain the information outlined in Kleinfelder's letter dated February 2, 2000, and the following revised and updated reports: Post-Closure Care and Maintenance Plan; the Landfill Gas Management Plan; and the Groundwater Compliance Monitoring Plan. The Post-Closure Care Plan shall include a description of maintaining the integrity and effectiveness of the final cover, a description of maintaining the operation of the leachate collection system, a description of future uses of the property and an updated post closure cost plan. The complete permit application must be submitted to the TPCHD by either **June 1, 2001,** or in accordance with the Hidden Valley Landfill Consent Decree, whichever is earlier.

3. Any repairs to the final cover cap of the landfill must be approved by the TPCHD prior to constructing. LRI shall submit appropriate documentation to assure that all repairs are conducted with current engineering and quality assurance standards.

4. This permit expires on **February 27, 2002**, or when a Full Post-Closure Permit is issued.

TACOMA-PIERCE COUNTY HEALTH DEPARTMENT

CONDITIONAL

SOLID WASTE HANDLING PERMIT

PERMIT #: 27-016 **EXPIRATION DATE:** February 27, 2002

TYPE OF FACILITY: LANDFILL [X] TRANSFER STATION [ ] RECYCLING [ ]

BIOSOLIDS UTILIZATION [ ] COMPOSTING [ ] INCINERATOR [ ] OTHER [ ]

THIS CERTIFIES THAT Land Recovery, Inc.

ENGAGED IN THE BUSINESS OF Post-Closure Activities at the Hidden Valley Landfill

IS PERMITTED IN ACCORDANCE WITH RCW 70.95, WAC 173-304 and WAC 173-351

BY Federico Cruz Ulrich MD

DIRECTOR OF HEALTH

THIS CERTIFICATE IS REVOCABLE FOR CAUSE AND IS NOT TRANSFERABLE

Puget Sound Air Pollution Control Agency

HEREBY ISSUES AN ORDER OF APPROVAL TO CONSTRUCT, INSTALL, OR ESTABLISH

Notice of Construction No. 3229

Date MAY [illegible] 1998

One landfill gas collection system with 16 wells and a McGill Landfill Gas Flare, 9'dia. by 40' high, with propane pilot

APPLICANT
HARVEY DORMAN, LAND RECOVERY INC
PO BOX 73057
PUYALLUP WA 98373

OWNER
HARVEY DORMAN, LAND RECOVERY INC
PO BOX 73057
PUYALLUP WA 98373

INSTALLATION ADDRESS

Hidden Valley Landfill (Thun Field), 17925 MERIDIAN E, PUYALLUP, WA, 98373

THIS ORDER IS ISSUED SUBJECT TO THE FOLLOWING RESTRICTIONS AND CONDITIONS

1. Approval is hereby granted as provided in Article 6 of Regulation I of the Puget Sound Air Pollution Control Agency to the applicant to install, alter or establish the equipment, device or process described hereon at the INSTALLATION ADDRESS in accordance with the plans and specifications on file in the Engineering Division of PSAPCA.
2. Compliance with this ORDER and its conditions does not relieve the owner or operator from the responsibility of compliance with Regulations I or II, RCW 70.94 or any other emission control requirements, nor from the resulting liabilities and/or legal remedies for failure to comply.
3. This approval does not relieve the applicant or owner of any requirement of any other governmental agency.
4. The combustion zone will provide for a minimum combustion temperature of 1400 degrees F.
5. The combustor will be provided with an ultraviolet flame scanner which senses flame-outs and shuts down the system operation and automatically prevents venting of malodorous landfill gas into the atmosphere.
6. Following initial system startup and balancing, the flare shall be tested within 60 days in accordance with PSAPCA approved testing procedures.
7. The owner shall collect and analyze landfill gas emissions from up stream and downstream of the combustor flame. Analysis shall include methane, CO2, O2, HCl, and trace organic and inorganic gases. Initial data shall be reported to PSAPCA.
8. The owner shall retest the flare one year from the date of the initial test in accordance with PSAPCA approved testing procedures.
9. The owner shall submit an operation and maintenance plan including a proposed flare testing plan for approval by PSAPCA.

Fredrick L. Austin
FREDRICK L. AUSTIN
Reviewing Engineer

hw

Anita J. Frankel
Anita J. Frankel
Air Pollution Control Officer

Puget Sound Air Pollution Control Agency

HEREBY ISSUES AN ORDER OF APPROVAL
TO CONSTRUCT, INSTALL, OR ESTABLISH

Registration No. 21331

Notice of Construction No. 5645

Date OCT 10 1994

One Landfill Gas Flare at 1,500 cfm.

DAVID VONASEK, MGR LANDFILL GAS SVCS

APPLICANT
EMCON NORTHWEST, INC
18912 N CREEK PARKWAY, STE 100
BOTHELL WA 98011-8016

OWNER
LAND RECOVERY, INC (J CRANDALL)
PO BOX 73057
PUYALLUP WA 98373

INSTALLATION ADDRESS

PIERCE CO PUBLIC WRKS LND RECOVERY (HIDDEN VALLEY LNDFILL), 17925 MERIDIAN E, PUYALLUP, WA, 98373

THIS ORDER IS ISSUED SUBJECT TO THE FOLLOWING RESTRICTIONS AND CONDITIONS

1. Approval is hereby granted as provided in Article 6 of Regulation I of the Puget Sound Air Pollution Control Agency to the applicant to install or establish the equipment, device or process described hereon at the INSTALLATION ADDRESS in accordance with the plans and specifications on file in the Engineering Division of PSAPCA.
2. Compliance with this ORDER and its conditions does not relieve the owner or operator from the responsibility of compliance with Regulations I, II or III, RCW 70.94 or any other emission control requirements, nor from the resulting liabilities and/or legal remedies for failure to comply. Section 5.05(e) of Regulation I requires that the owner or operator must develop and implement an operation and maintenance (O&M) plan to assure continuous compliance with Regulations I, II, and III.
3. This approval does not relieve the applicant or owner of any requirement of any other governmental agency.
4. The federal New Source Performance Standards (NSPS) found in 40 CFR Part 60, Subpart WWW, for Municipal Solid Waste (MSW) Landfills apply to this permit.

CLAUDE M. WILLIAMS
Reviewing Engineer

JAY M. WILLENBERG
Reviewing Engineer

for DENNIS J. McLERRAN
Air Pollution Control Officer

MEJ

Form 50-118, (1/91)

Puget Sound Clean Air Agency

Notice of Construction No. 7578

Registration No. 21331

Date OCT 24 2000

HEREBY ISSUES AN ORDER OF APPROVAL TO CONSTRUCT, INSTALL, OR ESTABLISH

Three Caterpillar G3516 Internal Combustion Engine Generator Sets producing 950 KW each from Landfill Gas.

APPLICANT
Jody Snyder
Land Recovery Incorporated
PO Box 73057
Puyallup, WA 98373

OWNER
Harvey Doman
Land Recovery Incorporated
PO Box 73057
Puyallup, WA 98373

INSTALLATION ADDRESS

Land Recovery Incorporated, 17925 Meridian St E, Puyallup, WA, 98373

THIS ORDER IS ISSUED SUBJECT TO THE FOLLOWING RESTRICTIONS AND CONDITIONS

1. Approval is hereby granted as provided in Article 6 of Regulation I of the Puget Sound Clean Air Agency to the applicant to install or establish the equipment, device or process described hereon at the INSTALLATION ADDRESS in accordance with the plans and specifications on file in the Engineering Division of the Puget Sound Clean Air Agency.

2. This approval does not relieve the applicant or owner of any requirement of any other governmental agency.

3. Land Recovery Inc shall not exceed the following one hour average limits from the three Caterpillar G3516 internal combustion engines as measured by a compliance source test that follows the requirements of Regulation I, Section 3.07:

(a) 0.60 g/BHP-hr of NOx (EPA Method 7E), and

(b) 2.5 g/BHP-hr of CO (EPA Method 10).

4. Land Recovery Inc shall reduce the Non-Methane Organic Compounds (NMOC) in the landfill gas, using these engine/generator sets, by 98 weight percent, or reduce the outlet NMOC concentration to less than 20 parts per million by volume, dry basis as hexane at 3 percent oxygen.

5. Land Recovery Inc shall develop an emission testing plan following Regulation I, Section 3.07, and conduct a source test of each of the three Caterpillar G3516 internal combustion engines within 60 days of approval, to demonstrate compliance with Condition Nos. 3(a), 3(b) and 4 above, and submit all source test reports to the Puget Sound Clean Air Agency within 60 days of the date of the test unless otherwise approved by the Control Officer.

6. To monitor compliance with Condition Nos. 3(a) and 3(b) above, Land Recovery Inc shall either conduct annual source tests as in Condition No. 5, or shall perform quarterly monitoring using an exhaust gas analyzer meeting the specifications contained in: (I) Steady-State Exhaust Analysis System of Appendix D-Steady-State Short Test Equipment of Subpart S-Inspection/Maintenance Program Requirements of Part 51 of Chapter 1, Title 40 of the Code of Federal Regulations in effect as of July 1, 2000. Any monitoring result that indicates noncompliance with the conditions in this Order shall be reported to the Agency within 30 days. Otherwise, a report of the combined quarterly results shall be submitted with the annual emission reports of Regulation I, Section 5.05(d).

7. Land Recovery Inc shall maintain logs of the three Caterpillar G3516 internal combustion engine operating hours and shall use these logs with emissions factors based on the most recent source test results to report annual emissions required by Regulation I, Article 5.

8. Land Recovery Inc shall not exceed 5% opacity from the three Caterpillar G3516 internal combustion engines stacks aggregated for 3 minutes in any 1-hour as measured by WDOE Method 9A.

APPEAL RIGHTS

Pursuant to Puget Sound Clean Air Agency's Regulation I, Section 3.17 and RCW 43.21B.310, this Order may be appealed to the Pollution Control Hearings Board (PCHB). To appeal to the PCHB, a written notice of appeal must be filed with the PCHB and a copy served upon Puget Sound Clean Air Agency within 30 days of the date the applicant receives this Order.

Claude Williams
Reviewing Engineer
mej

Jay M. Willenberg
Reviewing Engineer

for Dennis J. McLerran
Air Pollution Control Officer