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FINAL

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

for the
Norseland Mobile Estates
Kitsap County, Washington

Prepared for:

The Port of Bremerton and
Kitsap County

Submitted by:

Golder Associates Inc.

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EXECUTIVE SUMMARY

INTRODUCTION

This document presents the results of the Norseland Mobile Estates Remedial Investigation and Feasibility Study (RI/FS). The Norseland Mobile Estates site (Norseland) is a State of Washington Priority Listed Site under the auspices of the Model Toxics Control Act (MTCA), Chapter 70.105D RCW. Kitsap County, Port of Bremerton and the U.S. Navy have formed a working group called the Kitsap Public Authorities Team (KPAT) to oversee the preparation of this RI/FS and to address the environmental issues posed by the site.

The scope of work for the RI/FS was outlined in the Draft Phase I Remedial Investigation/ Feasibility Study Work Plan (Work Plan) for the Norseland Mobile Estates (Golder 1993a). The Work Plan and support project plans (Quality Assurance Project Plan, Health and Safety Plan, and Data Management Plan) together with the Conceptual Model (Golder 1993b) provide the necessary rationale and details for implementation of the RI/FS.

This RI/FS report is informational and will be used by the Washington Department of Ecology (Ecology) to make a decision on appropriate remedial measures.

BACKGROUND

The Norseland site consists of an adult mobile home park, the Norseland Mobile Estates, which has been in operation since the early 1960s. The site is in Kitsap County, Washington and is located near the Bremerton National Airport (0.25 miles east), the Olympic View Sanitary landfill (0.75 miles northwest) and the Olympic View Industrial Park (0.5 miles north). Olympic View Sanitary Landfill (OVSL) is the only operating landfill in Kitsap County. The site was previously used by the Federal government (U.S. Navy) in the 1940's as a military airfield and camp. The property was transferred to Kitsap County in 1948. During the 1950's and early 1960's, the site was permitted and used for landfilling municipal garbage from the City of Bremerton under contract to the Puget Service Company. In 1962 the County leased part of the property to a developer who commenced development of Norseland. In 1963 the County gave the property to the Port.

In 1991 Ecology received reports that transitory odors at the mobile home park were detected by residents and various health effects were attributed to the odors. In 1992, the Washington Department of Ecology ranked the site as a level 2 hazardous waste site under MTCA and determined that a MTCA RI/FS should be conducted. To accomplish this RI/FS, the Port and County have entered into a Consent Decree with Ecology. The Navy and Ecology have entered into a parallel Agreed Order.

The County and the Port decided that it would be consistent with the MTCA regulations WAC 173-340-430 to close Norseland and to relocate the residents as an interim remedial action.

REMEDIAL INVESTIGATION

A primary focus of the RI is to identify chemicals in the ambient air that may pose health risks to residents, identify potential on-site as well as off-site sources that could contribute to the inhalation exposure pathway, and evaluate the mechanism(s) by which these compounds might be mobilized. A second objective is to investigate other media, principally groundwater, to determine if it has been affected by landfilling activities at the site.

Data Collection Activities

The major data collection activities conducted during the RI include:

- Delineation of the landfill boundaries
- Investigation of subsurface soils
- Investigation of groundwater
- Resident Questionnaire and Odor Survey
- Characterization of soil gas
- Investigation of skirt air (air space under homes but above ground surface)
- Investigation of ambient air

Most often a remedial investigation includes a human risk assessment. Since the Port and County decided to close Norseland Mobile Estates and to relocate the residents, potential future risks would be eliminated. Ecology and KPAT determined that a risk assessment would be unnecessary for this document.

Landfill Boundary: The landfill was delineated using primarily geophysical techniques (electromagnetics and ground penetrating radar). It was discovered that a number of occupied residences were either over or partially over portions of the buried Puget Disposal Services landfill (see Figure 2-5 in the report for delineation of the landfill).

Investigation of Subsurface Soils: Subsurface soils were investigated by inspection and screening of test pits using a backhoe. Ten test pits were completed which confirmed the location and boundaries of the landfill. Only one test pit location contained odorous materials (TP-7) on vacant lot 62. Air monitoring during excavation of TP-7 test pits detected volatile organic compounds exceeding 100 ppm levels. Test pits were screened for volatile organic compounds (VOCs) and radioactivity using field screening monitors. None of the test pits indicated levels of VOCs (except TP-7 location) or radiation above ambient background. Waste materials were exposed especially in areas of high topographic relief and appear erosionally unstable.

Soils within two different depths within TP-7 were analyzed for a full range of priority pollutant metals, VOCs, semi-VOCs, and PCBs/pesticides. Many analytes were detected in the soil samples but none were at a concentration above regulatory criteria or natural background levels expected in Washington State. Many of the organic compounds detected are commonly associated with petroleum hydrocarbons. Total petroleum hydrocarbon (TPH) analyses on these soil samples indicated concentrations below regulatory limits (<100 ppm). It should also be noted, the vicinity of TP-7 is the only location where methane was detected in soil gas samples (see Soil Gas).

Investigation of Groundwater: Three monitoring wells were installed and sampled at least twice during the RI. One well (MW-1) was located hydraulically up-gradient to the landfill, while the other two wells (MW-2 and MW-3) were located downgradient. Groundwater samples were analyzed for priority pollutant metals, VOCs, semi-VOCs and PCBs/pesticides. The highest concentrations of compounds were detected in groundwater from MW-1 which was representing background conditions.

Resident Questionnaire and Odor Survey: Written questionnaires were submitted to residents to solicit opinions about odor events, ground stability and sanitary waste issues at the site. In addition, Golder Associates conducted an extensive survey of odors at the site and surrounding areas.

Primary findings regarding the odor questionnaire include:

- Most residents smell odors at the site
- Odors occur infrequently and the most frequently described odor is "garbage"
- "Foggy" and "still" were the most frequent weather conditions typical of odor events
- Early morning was by far the most frequent time of day associated with odors

Odor surveys conducted by Golder professionals over a three month period were in general agreement with resident questionnaires. Odors were infrequent and typically of short duration and represented an overall low percentage of time. Most odors occurred in the morning hours. The dominant odor was described as sulfur/mercaptan type which is common to landfilled "garbage." Weather conditions during odor events were most frequently during calm wind conditions or when the wind is coming from the direction of Olympic View Sanitary Landfill (OVSL). It was the opinion of Golder personnel that the primary source of odors at Norseland appears to be the OVSL. The former Puget Service Company landfill on site may also contribute to localized odor events at Norseland.

Characterization of Soil Gas: Soil gas is the gas below the surface of the ground which fills the space between particles of soil. Soil gas was sampled and analyzed during several tasks during the RI. Overall, soil gas was sampled and analyzed from about 50 different locations primarily within a 5 to 6 acre area. Several locations were sampled and analyzed repeatedly during this RI. Analytes included VOCs in all samples but in about half the locations atmospheric gases, sulfide gases, methane, amines and aldehydes were also analyzed.

A number of VOCs were detected within samples of soil gas above screening levels in many locations. This suggests there is subsurface waste at the site which contains compounds that are now defined as hazardous under MTCA. Methane was only detected at one location (lot 62) within landfill soil gas. Since methane was found only once, data indicate that this old landfill, for the most part, is no longer biologically degrading.

Investigation of Skirt Air: The skirt air is the above-ground air confined by the skirts of the mobile homes. Samples of skirt air was obtained from every mobile home that was over or partially over the former Puget Service Company landfill. Several skirt air samples which had the highest VOCs were obtained and analyzed repeatedly during the RI. The VOCs detected above screening levels were: benzene, chloromethane, carbon tetrachloride and methylene chloride. A number of tentatively identified compounds (TICs) were detected but do not have associated screening values. It must be noted that many VOCs had detection limits above screening values. Methane was not detected in any skirt air.

Investigation of Ambient Air: Two major tasks involved sampling and analyzing ambient air. The first task (Odor Investigation) involved sampling two odor events with a network of monitoring stations around OVSL and the Norseland site. The odor sampling events occurred on March 9 and March 17, 1995 which were the strongest odor events witnessed by Golder personnel. Numerous compounds were detected at trace concentrations. The only VOCs detected above screening levels include: benzene, chloromethane, formaldehyde and tetrachloroethene. Maximum concentrations of tetrachloroethene (except one time on March 17 at Norseland), benzene and formaldehyde occurred in the off-site samples around OVSL, while the maximum concentrations of chloromethane occurred at the Norseland site. Tetrachloroethene was only detected off-site during the March 9, 1995 odor sampling event, but was only detected on-site during the March 17, 1995 odor sampling event. Methane which is associated with active or decomposing landfills was only detectable in ambient air in off-site samples around OVSL during odor events. It must be noted that most of the odorous sulfur compounds have human odor thresholds 2 to 3 orders of magnitude below analytical detection limits.

The other task (Comparative Ambient Air Study) included sampling air off-site, air on-site, air within selected skirts and selected soil vapors at six different times representing different periods of the day with different wind directions. The repeated events provided data to statistically evaluate whether VOCs detected on site were at different concentrations than ambient air entering the site. The only compounds detected during these six events that were above screening levels in the ambient air were benzene and chloromethane.

Remedial Investigation Conclusions

Soil

No chemical constituent compounds above MTCA cleanup standards were detected in the soil samples collected at the site. However, landfilled materials are typically heterogeneous and very difficult to characterize. Based on the soil gas analyses, landfilled waste at the Norseland site probably contains compounds which are considered hazardous substances under current law. Subsurface sources of VOCs are present on a patchy basis at the site. In addition, some landfilled materials are exposed at the site, particularly on steep slopes and densely vegetated areas. These materials are subject to erosion and dispersal in the surface environment.

Groundwater

While some compounds were detected at levels above potential regulatory criteria in groundwater, the source of the compounds does not appear to be associated with the site.

Some organic compounds were detected, but the highest values were generally associated with the upgradient well. None of the organics detected at the site exceeded any regulatory criteria. Therefore, the former landfill does not appear to be impacting groundwater beneath the site, and no Chemicals of Potential Concern (COPC) are identified for groundwater in this RI.

Air

- Subsurface sources of VOCs exist at Norseland and are emitting to the ambient atmosphere. The incremental increase in VOC concentrations to the local atmosphere is estimated to be insignificant. A simple but very conservative model predicts on the average that incremental ambient air impacts from subsurface sources at Norseland would be 10,000 times less than the concentration of VOCs in the subsurface environment, and on the average would be less than regulatory screening levels.

- Benzene and chloromethane were the only compounds consistently observed above screening levels in skirt air and ambient air at the site. Statistical analyses of the skirt and ambient air data showed that skirt air benzene levels were indeed elevated over offsite air benzene at one location - lot 63. For chloromethane and the TICs, skirt air was not elevated over onsite air, onsite air was not elevated over offsite air, and skirt air was not elevated over offsite air.

- Carbon tetrachloride and methylene chloride were observed in several skirt air samples above regulatory screening values. The source of these compounds within these skirts are uncertain.

- Apart from the skirt air at lot 63, an important source of detected chemicals in air at Norseland appears to be off-site sources, presumably regional air pollution. Benzene (in most air samples), methylene chloride (within several skirt air samples) and carbon tetrachloride (within several skirt air samples) levels occur above screening values at the site, but the levels of these constituents in site skirt air and site ambient air appear to be typical of most rural and suburban settings in the United States, and therefore may be representative of general air quality in the area.

- Odorous compounds (sulfides, amines and acetaldehydes) were not detected to any significant extent in the soil gas or ambient air at the former landfill. Even though the detection limits of these compounds are 2 to 3 orders of magnitude higher than human odor thresholds, these compounds should have been detected in the soil gas beneath the site if they were present and causing odors that were observed in the ambient air. The fact that these compounds were not detected in the former landfill, combined with the results of onsite odor monitoring by Golder staff, results in the conclusion that the primary source of odors in the area is the OVSL. The former landfill beneath Norseland may contribute to odors in localized areas under certain meteorologic conditions and subsurface emissions. Subsurface odors were observed from test pit TP-7 in lot 62 when exposed by excavation.

- Methane concentrations above 25% of the lower explosive limit (LEL) and total hydrocarbon TICs in excess of 100 ppm-v were detected in soil gas in the vicinity of lots 62 and 63. This indicates that a potential concern regarding explosive hazard may be present in this area if methane were to accumulate in an enclosed space. Methane was not detected in any skirt air from lots located above the landfill or in any other on site sampling location. Detection limits for methane was 10 to 20 ppm. These results indicate that active methane production at the site is highly localized.

FEASIBILITY STUDY

The purpose of the Feasibility Study (FS) is to develop remedial action objectives, screen remedial technologies, assemble appropriate remedial alternatives and evaluate the relative merits of each alternative with respect to criteria under MTCA. Since the site contains a landfill, the Minimum Functional Standards (MFS) are considered an applicable or relevant and appropriate requirement for MTCA sites. The MFS are state laws and regulations which govern the closure of landfills.

Remedial Action Objectives

The RI did not identify unacceptable impacts to soils, ambient air, groundwater, or surface water from the Puget Service Company landfill at the Norseland site, based upon regulatory or screening levels. Accordingly, the remedial action objectives for this site are:

- Reduce the potential for migration of landfill waste or waste constituents in surface water run-off or airborne dust.

- Reduce the potential for future direct exposure of human or ecological receptors to landfill waste and waste constituents at the site via direct contact or exposure to potentially hazardous constituents in stormwater run-off or airborne dust. Special attention should be given to areas with elevated concentrations of detected compounds as observed beneath Lot 62 and 63.

- Remedial actions should be consistent with potential future land uses.

Remedial Technology Screening

Potential remedial technologies were identified and screened in the FS to eliminate technologies that are not appropriate for site conditions. The remedial technologies were screened using the following criteria:

- Effectiveness
- Implementability
- Cost

The technology screening criteria are listed in the priority presented above. Based on the site conditions, remedial technologies that were eliminated from further evaluation were: (1) reuse and recycling; (2) treatment; and (3) removal and off-site disposal.

Remedial technologies retained for detailed analysis include: (1) institutional controls and monitoring; and (2) containment.

Development of Alternatives

Considering MTCA regulations and other ARARs, remedial action objectives and the technology screening, the following alternatives have been assembled. All alternatives presented below assume the Norseland residents will be relocated because the remedial alternatives evaluated below would not be possible with people still residing at Norseland.

Alternative 1: No Action
Alternative 2: Institutional Controls and Monitoring
Alternative 3: Permeable Soil Cap
Alternative 4: Low-Permeability Cap

Alternative 1: No Action

A "no action" alternative is included only as a baseline for comparison to the other alternatives. This alternative would leave the site in its current state after Norseland residents are relocated, assuming no restrictions on future site use and no site maintenance or monitoring.

Alternative 2: Institutional Controls and Monitoring

This alternative would decrease potential site risks by preventing exposure to constituents of concern resulting from waste disposal activities at the site. Exposure would be prevented by a physical barrier in the form of fencing with warning signs, and by preventing site use via deed restrictions.

Long-term maintenance and monitoring would be included to ensure the continued effectiveness of the remedy. Because this alternative relies on institutional controls more than physical covering of the waste for its effectiveness, the site would be dedicated as a waste site and not available for beneficial use.

Alternative 3: Permeable Soil Cap

This alternative provides a cap consisting essentially of clean soil cover. Because it does not include a low-permeability liner or layer, this cap would not meet all of the landfill closure specifications of WAC 173-304-460. However, this cap would meet the cap thickness requirement of WAC 173-304-460 and would exceed the closure specifications of WAC 173-304-461 for inert waste landfills. In addition, as discussed in the evaluation of this alternative in Section 8.1.3, this cap meets the requirements for a variance under WAC 173-304-700. Any gases still produced by the old landfill could escape to the atmosphere through the cap. Such diffusion is preferable to concentrating any gases to point sources as would occur with a low-permeability cap.

The major steps in this alternative are:

1. Fill and grade the site for even slope and good stormwater drainage.
2. Place a soil cap over the landfill area (18 inches of clean fill plus 6 inches of vegetated topsoil).
3. Maintain the cap for at least 20 years.
4. Implement and maintain institutional controls and long-term monitoring.

Alternative 4: Low-Permeability Cap

This alternative provides a low-permeability cap over the landfill area. The cap would be designed to meet all of the landfill closure requirements of WAC 173-304-460. For the purposes of this FS, a cap design using synthetic flexible membrane liner (FML) has been assumed. A local (i.e., inexpensive) source of clay or other low-permeability soil is not known to be available for this site. Therefore, the FML cap has been assumed. However, the specific cap design would be selected during final design, should this alternative be selected. This low-permeability cap would reduce water percolating through refuse to the groundwater, thus reducing the risk to groundwater. However, sampling has indicated that the old landfill does not adversely impact the groundwater.

The major steps in this alternative are:

1. Fill and grade the site for even slope and good stormwater drainage.
2. Place a low-permeability cap over the landfill area (6 inches of pea gravel, geotextile, 50-mil FML, 18 inches clean fill plus 6 inches of vegetated topsoil).
3. Maintain the cap for 20 years.
4. Implement and maintain institutional controls and long-term monitoring.

Evaluation of Remedial Alternatives

Under MTCA, evaluation of remedial alternatives is a two-step process. In the first step, remediation alternatives must meet threshold requirements (WAC 173-340-360(2)). The second step requires that remediation alternatives must use permanent solutions to the maximum extent practicable with respect to specific criteria (WAC 173-340-360(5)).

Summary of Threshold Evaluation

Based on the foregoing evaluation, the following alternatives do not meet threshold criteria:

Alternative 1 (No Action)
Alternative 2 (Institutional Controls and Monitoring).

Alternative 3 (Permeable Soil Cap) meets all threshold criteria. Alternative 3 meets the substantive requirements of WAC 173-304-700, although a variance from Ecology to WAC 173-304-460(3)(3) would be required. Alternative 4 (Low-Permeability Cap) meets the threshold criteria, including meeting WAC 173-304-460(3)(e) without the need for a variance.

Summary of Permanence Evaluation

For completeness and perspective, all of the retained alternatives were included in the evaluation, even if they do not meet the threshold criteria. Alternative 3 provides the optimum combination of permanence and provides the best cost:benefit. Alternative 3 is, therefore, the recommended remedial measure for the Norseland site.

Cost Estimates

The estimated costs for implementation of each alternative is summarized in Table ES-1. The estimates were prepared to allow comparative evaluation of alternatives, not for budgeting purposes. The design basis is subject to change during final, detailed design of the selected alternative, and these changes would affect the cost of the remedy. The uncertainties in the FS designs and associated cost estimates are such that actual costs could vary significantly from these estimates. Because restrictions on land use affect the sale value and earning potential of the land, these factors were reflected in the cost estimates.

TABLE ES-1

SUMMARY OF ESTIMATED COSTS FOR REMEDIATION ALTERNATIVES

	Alternative	Estimated Costs (millions) [a]			
		Capital [b]	Land Use Cost [c]	O&M [d]	Total
1	No Action	$0	$0	$0	$0
2	Institutional Controls and Monitoring	$0.11	$0.76	$0.14	$1.00
3	Permeable Soil Cap	$0.78	$0.25	$0.28	$1.30
4	Low-Permeability Cap (FML)	$1.48	$0.62	$0.56	$2.66

[a] Costs are for early 1996. See Appendix G for cost breakdowns.

[b] Includes operating costs during remedial action.

[c] Cost attributable to lost land value and earning potential (Alt. 2), or incremental development cost to provide equivalent land value and earning potential (Alts. 3 and 4).

[d] Long-term maintenance and monitoring for 20 years; net present value at 5% interest (net of inflation).

LIST OF ACRONYMS

AMSL	Above Mean Sea Level
ARAR	Applicable or Relevant and Appropriate Requirements
ASIL	Acceptable Source Impact Level
ATSDR	Agency for Toxic Substances and Disease Registry
AWOS	Automated Weather Observation Service
BACT	Best Available Control Technologies
BKCHD	Bremerton-Kitsap County Health District
BP	Barometric Pressure
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CAA	Clean Air Act
CAP	Cleanup Action Plan
CFR	Code of Federal Regulation
COPC	Chemical of Potential Concern
County	Kitsap County
CQA	Construction Quality Assurance
DMP	Data Management Plan
DNS	Determination of Nonsignificance
DOH	Washington Department of Health
DOW	Washington Department of Wildlife
Ecology	Washington Department of Ecology
EIS	Environmental Impact Statement
EM	Electro-Magnetics
EPA	U.S. Environmental Protection Agency
°F	Degrees Fahrenheit
FML	Flexible Membrane Liner
FS	Feasibility Study
GC	Gas Chromatography
GPR	Ground Penetrating Radar
HSP	Health and Safety Plan
KPAT	Kitsap Public Authorities Team
LEL	Lower Explosive Limit
LPM	Liters per minute
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goals
MFS	Minimum Functional Standards
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
MS	Mass Spectrometry
MTCA	Model Toxics Control Act
MW	Monitoring Well
Navy	U.S. Navy
NGVD	National Geodetic Vertical Datum
NIOSH	National Institute of Occupational Safety and Health

LIST OF ACRONYMS (Cont.)

NTU	Nephelometric Turbidity Units
1,1-DCE	1,1-Dichloroethene
OVA	Organic Vapor Analyzer
OVM	Organic Vapor Monitor
OVSL	Olympic View Sanitary Landfill
PCE	Tetrachloroethene
PLP	Potentially Liable Parties
Port	Port of Bremerton
ppb	parts per billion
ppb-v	parts per billion by volume
ppm	parts per million
ppm-v	parts per million by volume
PSAPCA	Puget Sound Air Pollution Control Agency
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
RI	Remedial Investigation
SDWA	Safe Drinking Water Act
SEPA	State Environmental Policy Act
SHA	Site Hazard Assessment
SIR	Surveillance Inspection Report
SMCL	Secondary Maximum Contaminant Level
SOP	Standard Operating Procedure
SV	Soil Vapor
SVP	Soil Vapor Probe
TAC	Toxic Air Contaminant
TAL	Target Analyte List
TCE	Trichloroethene
TCL	Target Compound List
TIC	Tentatively Identified Compound
TP	Test Pit
TPH	Total Petroleum Hydrocarbons
UCL	Upper Confidence Limit
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
U.S.	United States
UTL	Upper Tolerance Limit
VOC	Volatile Organic Compound

LIST OF ACRONYMS (Cont.)

WAC	Washington Administrative Code
WARM	Washington Ranking Method
WRS	Wilcoxon Rank Sum

GLOSSARY OF ANALYTICAL DATA REPORTING QUALIFIERS

Organic Data Reporting Qualifiers

B - Indicates the constituent was analyzed for and detected in the associated laboratory blank. This qualifier is applied by the laboratory. During the process of data validation this qualifier may be replaced by other appropriate qualifiers as defined by the validation procedures. The associated data should be considered usable for decision making purposes.

U - Indicates the constituent was analyzed for and not detected. The concentration reported is the sample quantitation limit corrected for aliquot size, dilution and percent solids (in the case of solid matrices) by the laboratory. The associated data should be considered usable for decision making purposes.

UJ - Indicates the constituent was analyzed for and not detected. Due to a minor quality control deficiency identified during data validation the concentration reported may not accurately reflect the sample quantitation limit. The associated data should be considered usable for decision making purposes.

J - Indicates the constituent was analyzed for and detected. This qualifier may be applied by the laboratory to indicate a concentration which is less than the contract required quantitation limit (CRQL) but greater than the instrument detection limit (IDL). During data validation this qualifier may be applied to indicate a minor quality control deficiency. However in either case, the associated data should be considered usable for decision making purposes.

NJ - Indicates presumptive evidence of a constituent at an estimated value. This qualifier is normally applied to GC analysis data (such as organochlorine pesticide and PCB data). The associated data should be considered usable for decision making purposes.

N - Indicates presumptive evidence of a constituent. This qualifier is normally applied to GC analysis data (such as organochlorine pesticide and PCB data). The associated data should be considered usable for decision making purposes.

JN - Indicates a tentatively identified compound (TIC) whose concentration and identification have been determined to be valid as a result of data validation. The associated data should be considered usable for decision making purposes.

UJN - Indicates a tentatively identified compound (TIC) that has been determined to be presumptive and valid (JN) in terms of identification and quantitation and has been qualified as undetected (U) due to associated blank contamination.

UR - Indicates the constituent was analyzed for and not detected. The concentration reported has been qualified as unusable due to a major quality control deficiency identified during data validation. The associated data should be considered unusable for decision making purposes.

R - Indicates the constituent was analyzed for and detected. The concentration reported has been qualified as unusable due to a major quality control deficiency identified during data validation. The associated data should be considered unusable for decision making purposes.

Inorganic Data Reporting Qualifiers

B - Indicates the analyte concentration is less than the Contract Required Detection Limit but greater than the instrument detection limit.

U - Indicates the constituent was analyzed for and not detected. The concentration reported is the sample quantitation limit corrected for aliquot size, dilution and percent solids (in the case of solid matrices) by the laboratory. The associated data should be considered usable for decision making purposes.

UJ - Indicates the constituent was analyzed for and not detected. Due to a minor quality control deficiency identified during data validation the concentration reported may not accurately reflect the sample quantitation limit. The associated data should be considered usable for decision making purposes.

J - Indicates the constituent was analyzed for and detected. During data validation this qualifier may be applied to indicate a minor quality control deficiency. The associated data should be considered usable for decision making purposes.

UR - Indicates the constituent was analyzed for and not detected. The concentration reported has been qualified as unusable due to a major quality control deficiency identified during data validation. The associated data should be considered unusable for decision making purposes.

R - Indicates the constituent was analyzed for and detected. The concentration reported has been qualified as unusable due to a major quality control deficiency identified during data validation. The associated data should be considered unusable for decision making purposes.

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1. INTRODUCTION

This document, prepared by Golder Associates Inc. (Golder) for the Port of Bremerton (the Port) and Kitsap County Department of Public Works (the County) presents the results of the Norseland Mobile Estates Remedial Investigation and Feasibility Study (RI/FS). The Norseland Mobile Estates site (Norseland) has been listed as a State of Washington Priority Listed Site under the auspices of the Model Toxics Control Act (MTCA), Chapter 70.105D RCW. The Port, the County, the U.S. Navy, the City of Bremerton, and Messers John Banchero and Josie Razore (d/b/a Puget Service Company) have been named by Ecology as Potentially Liable Parties (PLPs) at this site. While all these named PLPs at this site may be jointly and severally liable to perform response actions at this site, the County, Port, and the Navy have formed a working group called the Kitsap Public Authorities Team (KPAT) to oversee the preparation of this RI/FS and to address the environmental issues posed by the Norseland site. Pursuant to Ecology's authority under MTCA, Ecology issued a Consent Decree on March 28, 1994 (Ecology 1994a) which directed the Port and the County to conduct this RI/FS. Under Agreed Order 94TC-N-197 (Ecology 1994b), a separate document entered into between the Navy and Ecology on March 28, 1994, the Navy also agreed to participate in the completion of this RI/FS. An Enforcement Order was issued by Ecology requiring the City of Bremerton, another PLP, to participate in the RI/FS and other actions necessary at the site. The City of Bremerton elected not to participate in the RI/FS despite issuance of the enforcement order. This RI/FS document has been prepared in accordance with the Consent Decree and Agreed Order and the requirements of WAC 173-340-350 State Remedial Investigation and Feasibility Study.

Under the terms of the Consent Decree (Ecology 1994a) and Agreed Order (Ecology 1994b), the Norseland RI/FS was to be conducted using a phased approach, if necessary. The scope of work for the first phase was outlined in the *Draft Phase I Remedial Investigation/Feasibility Study (RI/FS) Work Plan for the Norseland Mobile Estates* (Golder 1993a) which was prepared by the Port and the County, approved by Ecology, and incorporated by reference into the Consent Decree/Agreed Order. The scope of work for a Phase II RI/FS, if one was required, was to be negotiated by Ecology and the PLPs upon completion of the Phase I RI/FS. However, during the performance of the Phase I RI and as discussed further in the subsequent chapters of this report, it was determined that sufficient data have been collected to support the selection of a final remedy for this site, and that no additional RI phases are necessary. This document, therefore, is considered to represent a complete and final RI and FS set of documents that will be sufficient to enable Ecology to make a decision regarding the final Cleanup Action Plan (CAP) for the Norseland site.

Ecology has indicated consideration of "presumptive remedies" is appropriate at Norseland. Presumptive remedies are remedies which have been demonstrated to work at large numbers of similar sites, such as landfills. This approach is well laid out in policy set by the United States Environmental Protection Agency (EPA), and basically involves ensuring that the public is protected at a minimum from direct contact with landfill debris and potential inhalation hazards. Use of presumptive remedies is a recognition that it is more appropriate to simply design and implement conservative remedial measures than to perform additional, time-consuming and expensive investigations and studies. Ultimately, implementation of a presumptive remedy at Norseland would involve relocating homes either temporarily while remedial work is being conducted or permanently.

The County and the Port decided that it would be consistent with the MTCA regulations WAC 173-340-430 to close Norseland and to relocate the residents as an interim remedial action [See WAC 173-340-430(1)[1]. The County and the Port believe that the relocation of the Norseland residents meets all of the criteria relating to interim actions. Closure of Norseland necessarily required finding a suitable place to relocate the Norseland residents. The County and the Port decided there was no existing, suitable site and, therefore, decided to build a new mobile home park. Construction on the new park for the relocated residents is presently underway. Following completion of the RI/FS, Ecology will select the final remedial alternative and will publish a clean up action plan for public comment.

1.1 Purpose and Rationale

The objective of the RI/FS process is to gather sufficient information to support an informed decision regarding disposition of the site consistent with the requirements of WAC 173-340-360. Data are required to select the most appropriate remedial alternative. The key concept in the RI/FS process is to gather sufficient information to meet the data needs while recognizing that removing all uncertainty is not necessary or achievable.

The Work Plan (Golder 1993a) and support project plans together with the Conceptual Model (Golder 1993b) provide the necessary rationale and details for implementation of the RI/FS. The Conceptual Model (GAI 1993b) presented data available at the time of Work Plan preparation for project scoping and summarized the understanding of site conditions available at that time. The support project plans include: Health and Safety Plan (HSP), Quality Assurance Project Plan (QAPP), and Data Management Plan (DMP).

1.2 Background

The Norseland site consists of an adult mobile home park, the Norseland Mobile Estates, located at 8651 State Highway 3, Port Orchard, Washington (Figure 1-1). The site contains 127 mobile home lots, 21 recreational vehicle spaces, a warehouse, and an office building. These improvements are now owned by the Port of Bremerton, but were previously the property of Sunshine Properties, Inc. who operated the Norseland Mobile Estates. The land is also owned by the Port of Bremerton. Norseland Mobile Estates is located near the Bremerton National Airport, the Olympic View Sanitary Landfill, and the Olympic View Industrial Park. The Norseland Mobile Estates site, the boundaries of the former Puget

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[1] WAC 173-340-430(1) states: "An interim action is: (a) An action that is technically necessary to reduce a threat to human health or the environment by eliminating or substantially reducing one or more pathways for exposure to a hazardous substance at a facility; or (b) An action that corrects a problem that may become substantially worse or cost substantially more to address if the action is delayed; or (c) An action needed to provide for completion of a site hazard assessment, state remedial investigation/feasibility study or design of cleanup action."

Service Company Landfill permit area, and the locations of the nearby facilities are shown in Figure 1-2.

Originally, the site was owned by Kitsap County. In the period from 1942 to 1948, the U.S. Navy acquired the site and operated Camp Christie on a portion of the property that was later to become Norseland Mobile Estates. In 1948, the US Government transferred this property by deed back to Kitsap County until 1963 when the County gave the property to the Port of Bremerton. During the early 1950s to early 1960s, the site was permitted and used for landfilling municipal garbage from the City of Bremerton. The disposal contractor was the Puget Service Company. In 1962, the site was leased for the development and use as a mobile home park adjacent to the former Puget Service Company landfill. Included in Figure 1-2 are the boundaries of the Norseland Mobile Estates lease and of the former Puget Service Company landfill permit area.

In September 1991 Ecology received reports that transitory odors at the mobile home park were detected by residents and that various health effects were attributed to the odors by some mobile home park residents. At that time it was believed that a portion of the Norseland Mobile Estates may have been developed over the former Puget Service Company Landfill.

In December 1991, Ecology conducted a Site Hazard Assessment (SHA) of the site. The SHA included air monitoring and soil and water sampling and analyses. Ecology concluded in the SHA that the primary concern at the site is the odor problem and potential health impacts. The site was given a ranking of 2 by Ecology using the Washington Ranking Method (WARM) on a scale of 1 to 5, with 1 being the highest priority.

In February and March 1992 the Washington State Department of Health (DOH) conducted a health survey of residents at Norseland Mobile Estates. DOH recommended continued investigation and characterization of the site to attempt to identify compounds which could be causing the reported odors and health effects (DOH 1992a).

The Port of Bremerton conducted an independent study to investigate complaints of odors and environmental concerns at Norseland Mobile Estates. Hazardous substances were detected in soil vapors in the subsurface and in ambient air at Norseland. The investigation concluded that ample evidence exists which indicates portions of Norseland Mobile Estates has been used for waste management and disposal activities and that it is likely that both offsite and onsite odor sources exist (SAIC 1992).

Based on the presence of the hazardous substances discovered at the landfill facility, Ecology determined there is a release or threatened release of hazardous substances from the landfill facility. Ecology has determined that a MTCA RI/FS should be conducted and is in the public interest.

1.3 Overview of the RI/FS Process

In accordance with EPA guidance (EPA 1988), an RI/FS is generally conducted in the following steps:

RI Process

1. Develop and implement an RI program.
2. Present and evaluate the RI data.
3. Evaluate the physical, ecological and social setting of the site. This evaluation uses data obtained during the RI as well as other available information.
4. Determine the nature and extent of chemicals in environmental media.
5. Evaluate the risks for human health and ecological exposure to these chemicals through an evaluation of their future fate and transport in the environment and the performance of a baseline risk assessment.

FS Process

6. Establish remedial action objectives (RAOs) (cleanup goals) for chemicals and media of interest. These objectives are developed based on the findings of the baseline risk assessment, and the applicable or relevant and appropriate requirements (ARARs).
7. Identify the applicable general response actions (e.g., containment, removal, and treatment).
8. Estimate the areas and volumes of impacted media that exceed the remedial action objectives based on information developed in the RI.
9. Identify and screen the potentially applicable remediation technologies for each impacted media to obtain a set of feasible technologies for use in achieving RAOs.
10. Assemble the retained technologies into remediation alternatives that cover the full range of possible response actions. The alternatives are then screened based on effectiveness, implementability, and cost to eliminate alternatives that are impractical, infeasible or too costly relative to the other alternatives.
11. Develop and evaluate the retained alternatives in sufficient detail to support selection of a site remedy.

This report consists of the Final RI and FS for the Norseland site. The RI portions of this report, together with the Work Plan (Golder 1993a) contain steps 1 through 5 with the exception of a formal baseline risk assessment. Data collected during the RI include two quarterly rounds of groundwater sampling, soil sampling of landfill soils and debris, and several episodes of soil vapor, mobile home skirt air (crawlspace air), and ambient air (both on- and off-site) sampling. With respect to step 5 (Baseline Risk Assessment), a formal baseline risk assessment has not been conducted as part of this RI due to the decision to relocate the existing mobile home residences off of the Norseland site. KPAT received approval from Ecology to remove the formal risk assessment from this RI in Ecology's letter of June 15, 1995. Even though a formal risk assessment is not included, site data are compared to risk-based regulatory criteria (MTCA cleanup levels).

The FS portions of this report consist of steps 6 through 11 (outlined above) which includes all the steps necessary in a final FS to support selection of a site remedy.

1.4 Report Organization

This RI/FS report is organized into the following sections:

- **Chapter 1, Introduction** - This section.

- **Chapter 2, Data Collection Activities** - This section presents the RI data collection activities by the tasks presented in the Work Plan (Golder 1993a).

- **Chapter 3, Physical Characteristics of the Site** - This section describes the physical characteristics of the site on the basis of previous studies, referenced information, and the data collected as part of the RI. Physical characteristics discussed include the regional and site geology, hydrogeology, hydrology, and meteorology as well as local ecological and social characteristics.

- **Chapter 4, Applicable or Relevant and Appropriate Requirements (ARARs)** - This section presents the ARARs for the site which are considered in development and evaluation of remedial alternatives.

- **Chapter 5, Nature and Extent of Chemical Constituents Exceeding ARARs** - This section presents the results of the sampling and chemical analysis conducted for the RI and compares the data to ARARs to determine whether past waste disposal at the site has resulted in significant impacts.

- **Chapter 6, Phase I Feasibility Study** - This chapter develops remedial action objectives (RAOs) for the site and assembles and screens remediation technologies. The retained technologies are assembled into remediation alternatives, and the alternatives are screened to obtain the alternatives for detailed evaluation.

- **Chapter 7, Development of Alternatives** - This chapter consists of detailed development and description of the retained remediation alternatives.

- **Chapter 8, Evaluation of Alternatives** - This chapter consists of detailed evaluation of the remediation alternatives to support selection of a site remedy.

- **Chapter 9, References** - This section cites the documentation referenced in the body of this report.

- **Appendices** - Supporting RI and FS data are included in the Appendices.

Chapters 1 through 9 of the report, along with tables and figures, are included as Volume I. Volumes II and III consist of the appendices.

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2. RI/FS DATA COLLECTION ACTIVITIES

This chapter describes the data collection tasks and activities completed during the course of the RI/FS. Tasks, which were specified in the Work Plan, were conducted in accordance with procedures detailed in the Norseland Mobile Estates RI/FS Work Plan (Golder 1993a). Some additional tasks conducted under this RI were not included or described in the Work Plan (Golder 1993a). For these tasks (the Soil Gas and Skirt Sampling Study; and the Comparative Ambient Air Investigation) procedural details are included herein as well as appropriate background information providing the rationale for including the tasks in the RI. Interpretations of the data collected as part of the RI tasks are provided in subsequent chapters of this report.

The approach taken during the RI was to focus environmental sampling efforts on the primary pathways of potential chemical exposure which were identified in the Conceptual Model (Golder 1993b). These pathways include the following:

- Inhalation of volatile compounds that have been mobilized to the ambient air from subsurface sources;
- Inhalation of volatile compounds that have mobilized to the interior of homes from subsurface sources;
- Migration of waste constituents to the groundwater and subsequent migration of potentially affected groundwater to either the accessible environment (surface water) or to local drinking water supply wells; and
- Direct exposure and/or ingestion of landfill materials exposed at or near the surface during excavation, gardening activities, erosion, etc..

A primary focus of the RI is to identify chemicals in the ambient air that may pose health risks to residents, identify potential on-site as well as off-site sources that could contribute to the inhalation exposure pathway, and evaluate the mechanism(s) by which these compounds might be mobilized. A second objective is to investigate other media, principally groundwater, to determine if it has been affected by landfilling activities at the site.

As such, data collection activities conducted under the RI included the following primary tasks (Task 1 is Project Management):

- Task 2 - Data Compilation. A compilation of current information about the site; its history; and comments and surveys of residents.
- Task 3 -Geodetic Control and Base Map Preparation. A geodetic survey of the site to define site geography and to create an accurate site base map.

- Task 4 -Geophysical Site Survey. The use of geophysical surveying methods to establish the boundaries of the former landfill and to identify buried objects or debris outside the historical landfill boundaries.

- Task 5 -Soil Vapor Survey. The installation of soil vapor probes and collection of soil vapor samples to determine the nature and extent of chemicals in soil vapor.

- Task 6 -Soil Investigation. The excavation of test pits to examine buried waste and allow for soil sample collection and analysis.

- Task 7 -Ambient Air Monitoring. The collection of ambient air samples to assess the nature, concentrations and possible sources of chemicals in on-site and off-site air.

- Task 8 -Surface Water Investigation. The identification of site surface water bodies, if any, and sampling if deemed appropriate.

- Task 9 -Groundwater Investigation. The installation of groundwater monitoring wells to assess impacts of buried waste on site groundwater quality.

All environmental sampling activities were conducted under an approved Quality Assurance Project Plan (QAPP), which was included as part of the Work Plan (Golder 1993a). Detailed information on field procedures needed to carry out most of the investigation tasks are provided in the QAPP. Additional information is provided herein for tasks not addressed in the QAPP. Environmental monitoring requirements for ensuring the health and safety of on-site investigators are described in the HASP (Attachment B to the Work Plan). The procedures for handling, transfer, and filing of data are presented in the DMP (Attachment C to the Work Plan). Most field and data collection activities, described in this chapter, were completed during the period of March 1994 to June 1995.

2.1 Task 2 – Site Reconnaissance, Preliminary Data Compilation and Evaluation, and Preliminary Risk Assessment

2.1.1 On-Site Reconnaissance

On January 27, 1994, a site walk through was conducted to visually assess the current condition of the site. Personnel from Golder, the Port of Bremerton, KPAT, Ecology as well as a representative of the site residents performed a site walk-through in order to gain familiarity with the site and its features. Observations were made of site topography, suspected debris piles, the suspected drainfield area, areas of anomalous cracking in street paving, areas of distressed vegetation, and other site features. The reconnaissance team noted intermittent odors while exploring the western half of the site. The odors could be described as faint, intermittent, and "landfill-like."

2.1.2 Data Compilation, Interviews, and Questionnaires

Compilation of existing data, interviews and questionnaires provide a means to obtain valuable site information regarding previous disposal activities as well as current perceptions of odors. These tools were used to supplement the current information known about the site.

2.1.2.1 Data Compilation

Golder personnel visited the Bremerton-Kitsap County Health District (BKCHD) offices to review its data files on Norseland and the vicinity. Several files were selected for duplication and transfer to the Norseland project file.

Golder personnel visited the Puget Sound Air Pollution Control Agency to review files related to odor complaints, air monitoring, or other investigations or records pertaining to the Norseland site. Several files were selected for duplication and transfer to the Norseland project file.

An additional activity within this task was compiling the currently available results from previous investigations, and contacting the State of Washington Department of Wildlife (DOW) to determine if endangered or threatened species or critical habitats have been identified on or near the Norseland site. The DOW conducted a database search of three databases – Nongame Heritage, Priority Habitats and Species, and Washington Rivers Information System. General information regarding the background of the site including climate and topography, history and previous studies is included in Section 3.1. The results of the database search are presented in Section 3.5.

2.1.2.2 Questionnaires and Interviews

A focused questionnaire was prepared to solicit opinion about odor events. The questionnaire was prepared by Golder and reviewed and approved by KPAT and Ecology prior to distribution. These were circulated at the Norseland site itself, as well as to nearby residents and employees at the Olympic View office park. The questionnaire was designed to obtain information about the perception of odor events as well as potential problems with settlement of mobile homes and potential problems related to the sewer system at the Norseland site and within the surrounding community.

A limited number of interviews were conducted with persons who have knowledge of previous site activities or site conditions relevant to the RI/FS. The focus of these discussions was topics including the nature of waste disposal activities at the site, and the location of possible on-site wells. The interviews were recorded on standard telecon forms for inclusion in the project files.

The results of the data compilation activities conducted under this task are summarized in Section 5.3.1. A summary of the Norseland site questionnaire responses is included in Appendix A.

2.1.3 Preliminary Risk Assessment

The approved Work Plan for the Norseland RI/FS specifies that a preliminary risk assessment would be completed during the early stages of the Remedial Investigation, using information collected and compiled from existing sources as a basis for evaluation. Compilation of existing information indicated the data regarding airborne chemical compounds developed during preliminary studies (SAIC 1992, AGI 1993b) were insufficient to derive preliminary risk data. In addition, data review of existing information did not discover on-site groundwater quality data. The only existing soils data at the time the preliminary risk assessment was to be conducted consisted of chemical analysis of the "blue clay" and petroleum-impacted soils. The blue clay was originally believed to potentially contain lead at unacceptable concentrations, but additional analysis revealed acceptable lead levels. The petroleum-impacted soils were localized to a small area outside the Norseland Estates residential area. Insufficient analytical data for all media were available to evaluate risks. Hence, the preliminary risk assessment effort was not warranted and was not performed.

2.2 Task 3 – Geodetic Control and Base Map

Performance of the Norseland RI/FS requires detailed maps for reporting and presentation purposes. A system of horizontal and vertical control was established for the site through a combination of horizontal and vertical surveys and aerial photogrammetry. Horizontal surveys reference Washington State Plane Coordinates, and elevations are National Geodetic Vertical Datum (NGVD 1929), in accordance with WAC 173-340-840(4)(e-f).

The site surveying work was performed by personnel from the Kitsap County Department of Public Works who provided coordinates for a series of temporary benchmarks (TBMs) established by Golder at the site. Twenty (20) TBMs were located at the site, primarily at the center of local street intersections. The coordinates, when possible, were obtained by direct differential Global Positioning System (GPS). Points unable to receive satellite transmissions were calculated by distance-distance intersection calculations from two GPS observed points nearby.

The horizontal coordinates determined for each of the TBMs were entered into an electronic format for import into AutoCad®. The resulting AutoCad® plot of the TBM locations was then overlain onto a digitized aerial photo of the site resulting in the creation of a plan view site map with horizontal grid based on the TBM coordinates. Figure 2-1 depicts the locations of the TBMs and resulting base map for the site.

In addition to coordinates for the TBMs, coordinates were also determined for the soil vapor probes, monitoring wells and geophysics data collection points. A listing of all coordinates determined in the site surveying work is included as Appendix B.

2.3 Task 4 – Geophysical Site Survey

Two geophysical methods, electro-magnetic (EM) and ground penetrating radar (GPR), were employed at the Norseland site to delineate the extent of the former landfill area, and identify any other miscellaneous subsurface objects. A description of the equipment used and tasks performed is included below. The locations of the EM and GPR surveys are shown in Figure 2-2.

2.3.1 Electromagnetic Induction

A Geonics EM-31 Terrain Conductivity Meter was used to measure subsurface electrical properties at the site. The EM-31 is a portable instrument with transmitter and receiver coils located at opposite ends of a fixed 12-ft boom. The instrumentation and an analog meter are located at the midpoints of the coils, and are usually worn on the hip of the operator.

The EM-31 measures subsurface electrical properties using the principals of electromagnetic induction. A primary electromagnetic field is produced by the transmitter coil, which induces eddy currents in the subsurface. These induced ground currents generate a secondary magnetic field. The total (a combination of the primary and secondary fields) is detected by the receiver coil.

Both the quadrature and in-phase components of the total field are measured. The quadrature component is a ratio of the total field to the primary field and is directly proportional to the apparent subsurface conductivity. The EM-31 converts this ratio to a conductivity value in millisiemens per meter (mS/m). The in-phase component is a measurement of the degree to which the total field is in phase with the primary field and is expressed in parts per thousand (ppt). The in-phase component is useful in identifying metallic objects.

Factors which may affect subsurface conductivities include changes in soil type, variations in moisture content of the soils, and the presence of chemicals in soil and/or groundwater. The presence of buried metal, voids, and underground utilities also affect the conductivity data. The EM-31 measures the apparent subsurface conductivity, which is a contribution of these variables within the effective range of the instrument. The EM-31 has an effective depth of penetration of about 18 ft.

Because EM can be significantly affected by the presence of nearby metal objects, such as buildings and utilities, the use of the technique at Norseland was restricted to the non-inhabited portions of the site suspected of containing landfill debris. This region is generally located to the northwest of the occupied lots. The locations of the EM-31 surveys are shown in Figure 2-2.

2.3.2 Ground Penetrating Radar (GPR)

The GPR survey was conducted with a GSSI SIR system 4 radar. This system consists of a 500 Mhz and 300 Mhz antennae, a control unit, and a 200-ft cable connecting the antennae to the control unit. The data are displayed on an EPC 8700 thermal graphic recorder. The system is powered by a 12-volt car battery.

GPR is a continuous reflection profiling technique that transmits radar pulses into the subsurface and records the subsequent reflections. A radar antennae is pulled along the ground surface at a slow walking pace, and radar pulses are transmitted into the ground for every few inches of forward motion. The transmitted pulses are reflected from subsurface discontinuities that have contrasting electrical properties. Reflections can be produced by layering or other discontinuities in the soils, the water table, discrete objects such as pipes, drums, storage tanks, pits and trenches, and miscellaneous debris. The graphic record that is produced depicts a cross-sectional view of the subsurface along the survey line. A location mark, indicated by a vertical dashed line on the GPR records, is recorded as the antenna crosses known reference points on the ground.

Identification and classification of a target or subsurface reflector is based on the interpretation of the reflection patterns displayed on the GPR record. The characteristic reflection pattern, or "signature", of subsurface targets and soils depends on the depth, size, orientation, and electrical properties of the feature. Discrete targets, such as drums, tanks, and utilities appear as hyperbolic or inverted crescent-shaped reflection patterns. Large concentrations of debris appear as an anomalous zone of high amplitude reflections on the GPR record. Trench or pit boundaries appear as a continuous reflection that dips in the direction of the trench.

Maximum depth of penetration of the GPR signal is dependent on the frequency of the antenna used and the electrical properties of the soils. The presence of water or fine-grained sediments, such as silts or clays, reduces the depth of subsurface penetration.

The GPR surveys were conducted within inhabited areas of the Norseland site to support the EM surveys in the definition of the previously-active landfill limits. The method is well-suited to this application, because the equipment is not generally affected by proximity to metallic objects, which tend to affect the accuracy of other geophysical methods, such as EM. The locations of the GPR tracklines are shown in Figure 2-2.

2.3.3 Field Procedures

On February 22, 1994 Golder mobilized a geophysical survey team to complete electromagnetic and ground penetrating radar surveys at the Norseland site. The work was completed on March 3, 1994. This activity was somewhat hampered by heavy rain, which extended the field time beyond the amount estimated.

Prior to data collection with the EM-31, Golder personnel laid out a reference grid on the field to the west of the Norseland site. The grid was established by using a measuring tape, Brunton compass, wooden lathe, and fluorescent flagging. The grid extended from 00+0 N to 12+00 N and from 2+00 W to 4+00 E. The grid points 00+0 N, 00+0E and 12+00 N, 00+0E were surveyed during the site geodetic survey and were identified as TBM-19 and -12, respectively (Appendix B). The grid was laid out to facilitate the use of the EM-31, which assigns and records the measured value to a grid point. This allows for the relocation of anomalous areas interpreted from the collected data. These data were collected to delineate the western, northern and southern boundaries of the former landfill. A more detailed EM-31 survey was conducted near the center of the mobile home park. The locations of the EM-31 surveys are shown in Figure 2-2.

A ground penetrating radar survey was completed along the site streets and at several other selected locations in order to define the eastern boundary of landfill debris. Figure 2-2 shows all GPR tracklines. A GPR trackline was also situated parallel to Highway 3, between the highway and the eastern-most mobile homes, along the long axis of a topographical low area. On the basis of physical appearance noted during the site reconnaissance, this area appeared to have been excavated, probably for borrow for use elsewhere on the site.

Additional activities undertaken during the geophysical survey were the installation of rebar markers in the undeveloped area and the placement of P-K nails at prominent street intersections for subsequent survey and use as benchmarks.

The results of the geophysical surveys, consisting of a map of the interpreted former landfill boundaries, are presented below in Section 3.2.

2.4 Task 5 - Soil Vapor Sampling

This task consists of soil vapor sampling to quantify the significance of the landfill as a potential source of hazardous vapors at the site.

There were two separate phases of soil vapor sampling conducted during the RI. The first phase, designated herein as the Initial Soil Vapor Study, was specified in the Work Plan (Golder 1993a). The second phase, designated herein as the Soil Vapor and Skirt Sampling Study, was not included in the Work Plan but was conducted in response to results obtained in the initial study. Each of these is described below. Table 2-1 summarizes analyses performed during each of the air sampling tasks conducted under this RI.

2.4.1 Initial Soil Vapor Study

2.4.1.1 Soil Vapor Probe Installation

Golder equipment and personnel were mobilized to the Norseland site on March 21, 1994 to install soil vapor probes, perform field screening, and collect soil vapor samples. Soil probe installation and sampling continued through March 25, 1994. Equipment and personnel were again mobilized to the site on March 29, 1994 to complete the assigned tasks.

Sampling locations were selected on the basis of several factors:

- The distribution of landfill debris, suspect fill material, and native soil, as determined in the geophysical study;

- The results of soil vapor sampling programs carried out by SAIC and AGI;

- Suggestions by local site residents, made on the basis of current or historical knowledge of site conditions.

The soil vapor sampling program described in the work plan was modified slightly to provide for additional screening points. The plan specified that a total of 20 to 25 samples probes would be installed and sampled. During the probe installation phase, a total of 52 probes were installed for preliminary screening, with the sampling points to be selected after the screening was completed. Probe locations are shown in Figure 2-3.

The 52 probes were screened with an Organic Vapor Analyzer, Organic Vapor Monitor, and H_2S meter. The results of the screening were used to select 24 of the 52 probes for further analytical testing. Subsequent to the first analytical sampling round, two of the selected probes were dropped from the list, and one probe was switched for a total of 22 probes selected for further analysis. Probes were typically selected if the difference between the ambient air screen value and the soil vapor screen value appeared elevated with respect to other probes. Several probes with low screening responses were also selected for analytical testing. These were selected due to their proximity to suspect areas observed in prior investigations. The locations of the soil vapor probes installed at Norseland and those selected for sampling are shown on Figure 2-3.

Probes were constructed of approximately 5/8-inch diameter, Schedule 80, mild steel tubing, 5 feet in length. Installation was based on Golder technical procedure TP-2.2-4, "Sampling and Analysis of Soil Gases". The probes were decontaminated prior to transport to the site to remove all oil or other contaminants. Probes were installed by hand, using a fence-post driver to install each probe to a nominal depth of 3 feet. Prior to driving, a decontaminated carriage bolt was inserted into the down-hole end of each probe, to prevent soil from entering the pipe while it was being driven. Following installation and prior to sampling, each probe was pulled back approximately 2 inches to allow the carriage bolt to drop free of the probe bore. The upper end of the probe was closed with a single-hole rubber stopper, equipped with a three way valve, that was inserted into the probe bore. The valve and rubber stopper were sealed with "parafilm", a wax material. Each probe was also sealed where it penetrated the soil with a bentonite slurry. A label with the probe identification number was secured to the probe with transparent tape. A schematic diagram of the probe installations is shown in Figure 2-4.

2.4.1.2 Soil Vapor Sampling

All 52 of the installed temporary soil vapor probes were screened with an OVM. Sulfide samples were collected from 24 of the probes. Aldehydes, VOCs, aliphatic amines and atmospheric gases were sampled from 22 of the probes. Table 2-1 summarizes the analyses performed.

In an effort to determine the effects of various volume withdrawals from a probe on the concentrations measured in a sample, a "step test" was performed at three of the soil vapor probes. Volatile organic compound (VOC) analyses were performed on the samples collected from the step tests. The procedures used are described below.

2.4.1.2.1 Screening

Screening of all the probes was performed by Golder field personnel with an OVM to help ascertain which probes would be tested further, and prior to sulfide, aldehyde, and aliphatic amines, and VOC volume consideration sampling.

In general, probes were screened using the following procedure:

- The desired instrument was operated in ambient air to obtain a background value;
- The instrument was connected to the probe via tubing attached to the 3-way valve, and was operated to purge the probe of atmospheric air (given the volume of the probe bore and the pumping rate, this calculated to 54 seconds);
- At the conclusion of the purging the instrument was read and the result recorded;
- A second background reading of ambient air was then made and recorded;
- The probe was sealed with a tamper-proof seal prior to moving on to the next probe.

2.4.1.2.2 Sulfide Sampling

Sulfide sampling was conducted on March 23, 1994 by Golder field personnel. A total of 24 soil vapor probes were sampled for sulfides. Upon arrival at a probe, the parafilm seal was examined for evidence of tampering, then removed. The ambient air in the vicinity of the probe was tested with an OVM and recorded, then the probe was tested with the OVM for 54 seconds (one probe volume) and the highest reading was recorded. Another ambient air background reading was then taken and recorded.

The sulfide samples were taken using a new Tedlar bag and a lung sampler. The Tedlar bag was placed in the lung sampler and connected to the probe via a new section of Teflon tubing, and the three-way valve was opened to allow air to travel to the Tedlar bag. A low-pressure pump was then connected to the pumping port of the lung sampler, and the sampler lid was closed. The pumping action of the pump produces a relative negative pressure, allowing the Tedlar bag to fill with sample from the soil vapor probe. Once the sample was obtained, the valve to the probe was closed.

After each sample was obtained, it was labeled as to the date, time, location the sample was taken, as well as the sampler's name. Once a sample was labeled, it was immediately placed in a rigid, insulated cooler. No ice was added to the cooler. All sampling events were recorded in the field notebook. Finally, the three-way valve and rubber stopper were sealed with parafilm.

2.4.1.2.3 Aldehyde Sampling

Aldehyde sampling was conducted on March 24 and 25, 1994. A total of 22 soil vapor probes were sampled for aldehydes. A blank and two duplicate samples were also collected. Upon arrival at a probe, the parafilm seal was examined for evidence of tampering, and removed. The ambient air in the vicinity of the probe was tested with an OVM and recorded, then the probe was tested with the OVM for 54 seconds (one probe volume) and the highest reading was recorded. Another ambient air background reading was then taken and recorded.

Sampling was accomplished by pumping at least 20 liters but less than 50 liters of soil vapor through a sep-pac cartridge. An SKC programmable air pump was used to pull the gas though the cartridge. The air pump used for the sampling was connected with a "dummy" cartridge, and calibrated to a flow rate of 1 liter per minute (LPM) or less. The calibration information was recorded in the field notebook, and the time requirement needed to pump at least 20 liters was calculated, recorded and the pump was programmed to operate the calculated amount of time. The sample cartridge was labeled with its identification and put in line with the calibrated sampling pump and the probe. The valve to the probe was opened, and the pump started. Once the sampling had begun, the operation was set up at the next well to be sampled.

Once the sampling period had expired, the field crew returned to the probe. The sampling cartridge was taken out of the line, sealed, bagged, and placed on ice in a rigid, insulated cooler. The pump rate of the pump was then checked with the dummy cartridge, and the flow rate recorded.

2.4.1.2.4 Volatile Organic Compound and Atmospheric Gases Sampling

Volatile organic compound (VOC) sampling was conducted by Golder field personnel on March 24 and 25, 1994. A total of 22 probes were sampled. Additionally, an equipment blank sample and two duplicate samples were taken. Immediately following the aldehyde sampling, the VOCs sample was taken. An evacuated 6-liter SUMMA canister (constructed of stainless steel) was attached to the three-way valve on the probe, and the probe valve and SUMMA canister valve were both opened to allow sample to fill the empty canister. Both valves were held open for approximately 30 seconds, or until it appeared that the canister had been filled. The date, time, sample identification, and sampler identification were all recorded on the attached tag on the SUMMA canister, and in the field notebook. The SUMMA canisters were then placed in the cardboard boxes they were shipped in, labeled, and taped shut. Before departing a probe, the three-way valve and rubber stopper were sealed with parafilm. Aliquots for the atmospheric gases analyses were taken from the SUMMA canister.

2.4.1.2.5 Aliphatic Amines Sampling

The sampling for aliphatic amines was conducted on March 29, 1994. A total of 22 probes were sampled. The sampling technique used was very similar to that for the aldehyde sampling.

Upon arrival at a probe, the parafilm seal was examined for evidence of tampering, and removed. The ambient air in the vicinity of the probe was tested with an OVM and recorded, then the probe was tested with the OVM for 54 seconds (one probe volume) and the highest reading was recorded. Another ambient air background reading was then taken and recorded.

Sampling was accomplished by pumping at least 20 liters but less than 50 liters of soil vapor through a silica gel cartridge. An SKC programmable air pump was used to pull the gas through. The air pump used for the sampling was connected with a "dummy" cartridge, and calibrated to a flow rate of 1 liter per minute (LPM). The calibration information was recorded in the field notebook, and the time requirement needed to pump at least 20 liters was calculated, recorded and the pump was programmed to operate for the calculated amount of time. The sample cartridge was labeled with its identification and put in line with the calibrated sampling pump and the probe. The valve to the probe was opened, and the pump started. Once the sampling had begun, the operation was set up at the next well to be sampled.

Once the sampling period had expired, the field crew returned to the probe. The sampling cartridge was taken out of the line, sealed, bagged, and placed on ice in a rigid, insulated cooler. The pump rate of the air pump was then checked with the dummy cartridge, and the flow rate recorded. Finally, the three-way valve and rubber stopper were sealed with parafilm.

2.4.1.2.6 Soil Vapor Volume Consideration Testing

In an effort to determine the effects of various volume withdrawals from a probe on the concentrations measured in a sample, a "step test" was performed on three of the soil vapor probes. A test consisted of an initial sample collected after one probe volume had been purged with the OVM (0 liters purged), then at various "steps". Steps were selected to vary geometrically. Probe SV-26 was sampled after 0, 20, 40, 80, and 160 liters purged. Probe SV-10 was sampled after 0, 28, 56 and 112 liters purged. Probe SV-42 was sampled at 0, 32, 64, and 128 liters purged.

Three pumps were calibrated to 1 liter/minute for use on each of the three selected soil vapor probes. Time required for each pump was calculated between sampling stops. The flow rate on each pump was checked after all the samples had been collected.

Samples were collected to evacuated glass vials fitted with an air-tight rubber stopper in the neck of the vial. Samples were collected by piercing the rubber stopper with a sampling needle attached to the three-way valve on the probe. The valve on the probe was then opened to allow sample to be collected to the glass vial. The other outlet of the three-way valve was fit with another three-way valve to prevent gas from flowing into the vial immediately preceding sample acquisition.

The vials were labeled with the date, time, location, volume purged, and sampler's names. The vial then was immediately placed in a rigid, insulated cooler with ice. These samples were delivered in person to the Redmond laboratory of Golder for VOC analysis on a gas chromatogram.

The results of this sampling activity indicated that there were no significant changes in the levels of the parameters tested after approximately three probe volumes had been purged. This indicates that removal of three probe volumes during sampling is adequate to insure collection of a representative sample.

2.4.1.3 Laboratory Analysis

As indicated above, samples were collected for sulfide, aldehyde, VOCs, and aliphatic amine laboratory analyses (Table 2-1). These target analytes were selected on the basis of their potential toxic or carcinogenic effects, their potential for causing characteristic odors, and/or their association with landfills or sewage treatment processes. Analysis for fixed gases (atmospheric gases - CO_2, methane, nitrogen, oxygen, and total non-methane hydrocarbons) was also performed. The suite of analytes includes all compounds on the EPA Priority Pollutant List, as well as other families of compounds that meet the other criteria listed for selection. Chemical analyses was performed by Air Toxics, Ltd. Folsom, CA. Pace Inc., Golden, CO performed the aliphatic amines analysis.

Volatile organic compounds (VOCs) were analyzed using EPA method TO-14, a gas chromatograph/mass spectrometer (GC/MS) method. This method permits identification and quantification of VOCs at detection limits into the low part per billion range for most compounds. Chromatographs were examined for Tentatively Identified Compounds (TICs).

Atmospheric gases (fixed gases) were analyzed using ASTM Method D-3416. Aliquots for this analysis were taken from the SUMMA canister. Detection limits for the various gases vary, and are described in the ASTM method.

Sulfur gases and other sulfide compounds (such as mercaptans) were analyzed using EPA Method 15/16 using sep-pac adsorbent tubes for sample collection. This method provides detection limits of 0.05 ppm-v.

Aliphatic amines were analyzed using a Gas Chromatograph, Flame Ionization Detection method described in NIOSH Volume IV, which utilizes an adsorbent tube for collection. This method provides detection limits at concentrations of 0.1 ppm-v or above.

USEPA Method TO-11 was used to analyze for formaldehyde and other aldehydes. This method provides detection limits down to approximately 5 $\mu g/m^3$.

The results of the soil vapor sampling are described in Section 5.3.2. Complete laboratory reports from the analytical laboratory are included in Appendix C.

2.4.2 Soil Vapor and Skirt Sampling Study

2.4.2.1 Rationale

The Soil Vapor and Skirt Sampling Study was conducted in response to the results obtained from the initial soil gas study. As discussed further in Chapter 3, hazardous chemicals were detected in the soil vapor samples collected during the initial soil vapor study. The results raised concerns about exposure to these chemicals within the interior of the site's mobile homes. In order to assess potential risks posed by such exposures, this additional soil vapor sampling study was initiated. The study's approach involved characterization of the undisturbed air in the crawlspaces of 28 homes at the site and simultaneous sampling of soil vapor directly beneath the crawlspaces. In addition, one ambient air sample was collected. The homes selected consisted of those located on portions of the site underlain by landfill debris, as determined in the geophysical survey. Figure 2-5 depicts the study area for the soil vapor and skirt sampling study.

The crawlspaces were sampled because they represent the next step in the pathway of possible soil vapor migration into the mobile home park homes. The crawlspaces do not represent the breathable zone. Concentrations of vapors in the crawlspaces, if originating from the landfill, could be diluted and at lower concentrations within the overlying home. Sampling of the crawlspace vapors (rather than the actual home interiors) was felt to be less subject to possible interferences from ambient chemicals which may be present in the home, such as those derived from cigarette smoke or household chemical products. Sampling was conducted at a time when soil gas emission would be high (i.e., dry soil conditions and barometric pressure either falling or steady).

The study consisted of soil gas and skirt sampling at the locations shown in Figure 2-5. Concurrent with the soil vapor and skirt sampling, one ambient sample was also collected. The ambient sample was collected near the entrance to the mobile home park, which was upwind of the site at the time of sampling. All sampling activities were conducted on the morning of September 23, 1994.

2.4.2.2 Field Sampling and Laboratory Analysis

Angled soil gas probes 1.5 m in length were installed beneath 28 of the site's homes. The probes were installed to a depth of approximately 1 m below the ground surface using the procedures described above in Section 2.4.1.1 for the initial soil vapor study and based on Golder technical procedure TP-2.2-4, "Sampling and Analysis of Soil Gases".

All samples were collected in 6 L SUMMA canisters. Soil vapor samples were collected using the procedures described above in Section 2.4.1.2 for the initial soil vapor sampling study. For the skirt samples, a dedicated Teflon tube was attached to a SUMMA canister and inserted through a crack or crevice in the skirts surrounding the mobile home crawlspaces.

Samples were sent to Air Toxics Ltd., Folsom, CA and analyzed for VOCs. Table 2-1 summarizes the analyses performed on the soil gas and skirt samples. Analysis of samples for VOAs was per TO-14 GC/MS. Fixed gases were analyzed for the skirt samples using ASTM Method D-3416. Aliquots for this analysis were taken from the SUMMA canister. Discussion of results is in Section 5.3.3. Lab reports are included in Appendix C.

2.5 Task 6 – Soil Investigation

Test pit excavations were completed at the Norseland site in order to verify geophysical delineation of landfill waste, estimate waste thickness (if possible), determine depth of cover, characterize waste type (domestic, industrial, etc.), and provide the opportunity to acquire soil samples, if desired.

2.5.1 Selection of Test Pit Locations

Sampling sites were located after the completion of the initial soil vapor sampling study and geophysical surveys. The test pits were chosen to correspond, to the extent possible, with areas of elevated chemical concentrations in soil vapor and/or to confirm the results of the geophysical surveys regarding the limits of the former landfill. The locations of the test-pits are indicated in Figure 2-6.

2.5.2 Test Pit Inspection and Sampling

On July 13, 1994 Golder personnel excavated a total of 11 test pits at the Norseland site. A rubber-tired backhoe was used to complete the test pits. They were excavated to a maximum depth of about 12 feet, the typical extension of a medium-sized industrial backhoe. Representatives from KPAT agencies and Ecology were present for part of this work.

Soil removed from the excavation was frequently scanned with an Organic Vapor Analyzer (which utilizes a flame ionization detector) which provided a field screening capability for methane, as well as other volatile organic compounds. A hydrogen sulfide detector and explosimeter were also monitored regularly to observe for elevated concentrations of methane and or hydrogen sulfide during excavation. The samples were also routinely screened for radionuclides, using an Eberline radiation meter, performing alpha and beta/gamma scans. The beta and gamma radiation values represent the total beta and gamma radiation. The instrument does not report separate values for beta and gamma radiation.

Organic vapor measurements were collected from all test pits except TP-10 and TP-11. Excavation of TP-10 uncovered a buried nest of aggressive hornets, which prevented attempts to obtain organic vapor or radioactivity readings from the test pit or backhoe bucket. Excavation of TP-11 broke an active sewage drain line. A field judgment was made that the organic content of the sewage would interfere with accurate measurements of the VOC content of the soil, so the OVA measurement was not taken.

A sewer contractor was hired to repair the damaged section of pipe and restore the system to service. This work was accomplished the week of August 29, 1994, and Golder verified that the repairs had been completed. In addition, a telephone service wire was accidentally severed during the excavation of one of the test pits. Temporary repairs were made immediately by the investigation team, and the telephone company was notified by the end of the day to make a permanent repair.

H_2S readings were taken in all test pits except TP-8, TP-9, TP-10, and TP-11. TP-10 and 11 were not surveyed due to the aforementioned difficulties with insects and sewage. TP-8 and TP-9 were not surveyed for H_2S because the debris excavated from the pits consisted almost entirely of broken glass and metal fragments, with insufficient matrix to reasonably scan with the field instrument. However, soil vapor probes in the vicinity of all of these test pits indicated that H_2S concentrations were below the detection limits of the specified laboratory analytical procedures.

The Norseland Work Plan specified that if visual observation and/or screening with field instruments indicated the presence of volatile organic compounds (other than methane) or other compounds identified in the soil vapor, two soil samples would be collected from each test pit for subsequent laboratory analysis. One test pit (TP-7), excavated adjacent to soil vapor probe SV-10, exhibited relatively elevated concentrations of volatile organic compounds (VOCs). Golder personnel returned to the site on July 25, 1994 to obtain soil samples from the area of the test pit. As the test pit had been filled in on July 13, a second test pit was excavated immediately adjacent to the first within fresh, undisturbed soil. Two samples were collected from different depths (7 ft and 11 ft) within the test pit. These samples were collected, transported, and stored under chain-of-custody as described in the QAPP. Ecology also obtained soil samples from the same depth and soil horizon for comparison. The samples were submitted to Analytical Resources Inc. for analysis. No odors were detected by Golder personnel in any test pit except TP-7, which had a petroleum odor which was consistent with the elevated OVA measurements observed at the site.

Topsoil was initially removed and segregated from the fill debris. Fill debris was placed on a plastic liner. All excavated materials were returned to the test pit immediately following examination of the pit. The topsoil was returned to the top of the pit area.

All test pits were logged and photographed, as described in the QAPP. Because the two test pits at TP-7 were located immediately adjacent to one another, a single log was prepared for the location. Test pit logs and photographs are included in Appendix D. Results of the test pit investigation are discussed in Section 3.2.

2.5.3 Laboratory Analysis

Two soil samples were analyzed from test pit TP-7 (designated TP-7A and TP-7B) and represent soils at different depths. Analysis was conducted for volatile organic compounds by USEPA method 8240 (with examination of chromatographs for Tentatively Identified Compounds (TICs)), semi-volatile organic compounds by USEPA method 8270, Pesticides and PCB compounds by USEPA method 8080, and USEPA Priority Pollutant Metals. Chemical analysis was performed by ARI of Renton, WA. The results of the chemical analyses of the test pit samples are discussed in Section 5.1. Appendix C contains the ARI laboratory reports.

2.5.4 Radioactivity Surveys

As a part of well drilling and test pit excavation activities, Golder personnel scanned for radioactivity at the Norseland site on several occasions. A Geiger counter (Eberline radiation meter) equipped with alpha and beta/gamma detectors was used during the installation of monitoring wells at the site to check for radioactivity in drill cuttings. The results of the radioactivity surveys are discussed in Section 5.1.1.

2.6 Task 7 – Ambient Air Sampling

2.6.1 Introduction

The Norseland RI/FS was initiated primarily because of complaints of noxious odors detected by residents at the site and concern for potential health effects to residents resulting from exposure to airborne chemicals. Air quality surveys at the site have, at times, detected very low concentrations of organic compounds in the ambient air. This task was conducted to provide data by which ambient air quality at the site can be characterized and to evaluate the compounds that may be creating the odors typically perceived at the site.

The Work Plan (Golder 1993a) included a single ambient air sampling task. The ambient air sampling task described in the Work Plan was aimed at capturing and identifying potential contaminants that may be present in the ambient air during "odor events". Work conducted pursuant to this task is described below as the Ambient Air (Odor) Investigation. In addition to this work, a second ambient air study was conducted during this RI. The Comparative Ambient Air Study was performed to characterize local off-site ambient air versus on-site air. The addition of this study to the RI was prompted because of the persistent detection of primarily two compounds, benzene and chloromethane, during the Ambient Air (Odor) Investigation. The two compounds were being detected at levels representative of typical background concentrations for rural and suburban/urban areas. The Comparative Ambient Air Study was intended to determine whether the source of the compounds was on-site or off-site.

The two ambient air investigations are described below.

2.6.2 Ambient Air (Odor) Investigation

2.6.2.1 <u>Background</u>

Air sampling under the ambient air (odor) investigation was initiated at the site to capture and identify potential contaminants that may be present in the ambient air during odor events. Samples were acquired at various locations on the site to evaluate the variability of compound concentrations across the site, and at several off-site locations, to develop a preliminary characterization of the air quality in the vicinity.

The Work Plan (Golder 1993a) provided for two ambient air (odor) sampling rounds during strong odor events at Norseland. Each sampling round was to include sampling at six stations: three located within the Norseland community (on-site), and three located around the Norseland site perimeter (off-site). The locations of the sampling stations were to be selected on the basis of the soil vapor survey results, responses to site questionnaires, and information gained during an on-site familiarization period for the resident engineer (described below). Additional sampling was also approved to permit the capture of three ambient air samples at fixed locations near the Olympic View Sanitary Landfill (OVSL) located to the west of the Norseland site. These fixed stations were intended to provide data regarding the concentration and variability of captured organic and inorganic compounds across an extended transact of the Norseland site and the OVSL site during significant odor events. The timing of sampling was to be based on the site engineer's evaluation that a given sampling event was sufficiently strong to provide useful results, i.e. at the engineer's discretion.

An Ambient Air Standard Operating Procedure (SOP) was prepared by Golder which defined criteria for initiating a sampling event. The initial SOP was dated 12/16/94. This SOP was not a part of or required under the Work Plan, but was written to provide guidance to field personnel in ambient air monitoring activities and to define the criteria necessary to trigger an odor sampling event. The SOP was originally written to require a "site-wide" odor event for the performance of the odor sampling round. It became apparent during the odor investigation that the site-wide events either happen very infrequently or not at all, and the SOP was modified, as discussed below, to include an option to sample a localized odor event. The evolution of the SOPs are reflected in Appendix I which includes copies of all SOP and Technical Procedures prepared for this task.

In accordance with the Work Plan (Golder, 1993a), QA audits were conducted for the odor sampling events. The QA audits, termed Surveillance Inspection Reports (SIR), are included in Appendix I.

2.6.2.2 <u>Single-Location Sampling Event</u>

The following subsections describe the method for observing localized odors, selecting a suitable odor event for sampling, acquiring a sample, and performing required Quality Assurance, pursuant to the Quality Assurance Plan, Attachment A of the Work Plan.

2.6.2.2.1 Golder-Initiated Observations

Golder field personnel were present at the site from December 5 through December 23, 1994 for approximately six hours per day. Beginning in January 1995, a resident Golder engineer or environmental scientist was present at the site on a five-day per week, 24-hour per day basis from early January 1995 through March 22, 1995. The resident individual took up residence in an apartment located in the mobile home park community center. In total therefore, Golder field personnel were present at the site on a daily basis for over three months. The primary function of the field personnel during this residence period was to document the nature and occurrence of odor events and to conduct sampling during strong odors. Also, he or she was available for consultation with residents and document his or her perception of air quality at selected locations during odor events, as well as distribute, collect, and tabulate questionnaires or surveys. It is important to note that all Golder field odor surveyors were tested in Golder's lab for their odor detection threshold and discrimination for common landfill gases. A summary of the observations made by the Golder residents at the site is included in Section 5.3.1 and Appendix E.

A protocol was established in the Ambient Air SOP for performing regular site excursions to investigate for odors at the Norseland site and in the vicinity of OVSL. The required activities and documentation responsibilities included:

- Site excursions were conducted by the Golder representative on an hourly basis between 0600 and 1100. Site excursions could be conducted either on foot or in a vehicle. For any odor detected, the investigator spent a minimum of two to three minutes observing and documenting the local atmospheric conditions;

- All odor events were logged in the field book, with notations including time of day, wind velocity, general meteorological conditions (e.g., rain, fog, clear), odor description, and odor intensity;

- If an odor was detected by the field investigator at an intensity of "3," or more, as defined in the Ambient Air SOP, the investigator prepared to collect an ambient air sample as described in TP-1.2-25, "Ambient Air/Soil Vapor Sampling for Chemical Analyses". An intensity of "3," was defined in the Work Plan as being readily noticeable and continuously observable for a period of at least 3 minutes. All types of odors, without restriction, (e.g., sweet, sour, "landfill") were recorded.

- Meteorological data was obtained from the Bremerton National Airport and from OVSL for quantitation of meteorological conditions during this task.

2.6.2.2.2 Resident-Initiated Observations

In addition to odors identified by Golder personnel for potential sample acquisition, field investigators also responded to communications from Norseland residents that an odor event was underway. These communications included telephone calls, telephone messages, or direct communication.

Upon notification that an odor event was occurring, the investigator was to respond as quickly as practicable to the location of the event to meet with the resident. The investigator logged the following resident observations:

- Time odor was noticed;
- Location where odor was first noticed;
- Description of odor;
- Intensity of odor when first noticed;
- Current intensity of odor.

If the current intensity of the odor was "3," or above, the investigator prepared to collect a sample of outdoor ambient air. Prior to beginning sample collection, the investigator was to query the resident if the odor was still present. If the intensity is still at "3" or above, the sample collection was to be initiated as described in TP-1.2-25.

All observations recorded by Golder personnel during the nearly four month period of site observational monitoring were recorded in a series of three log books maintained in the project's files. The results of these qualitative observations are summarized in Section 5.3.1.

2.6.2.2.3 Odor-Event Sampling

A "false start" to sample an odor event occurred on the morning of December 23. Golder's field technician determined that an event of approximately 6 on a 1 to 10 scale was underway, and initiated sampling at the three stations situated within the Norseland residence area. The intensity of the odors quickly diminished before all air sampling stations could be activated. The approved work plan made provisions for false starts, so the depleted sampling media (gel tubes, Summa canisters, Tedlar bags) were replaced in preparation for the next sampling attempt.

On the basis of observations made through December and January, KPAT modified the ambient air sampling protocol, as discussed above. Observations made during these months of presumed peak odor frequency indicated that odors did not occur over a sufficiently wide area to permit the initiation of sampling under the current protocol. The modifications to the protocol would permit sampling at a single outdoor location at Norseland, wherever an odor was perceived by either a Golder field investigator or a Norseland resident, subject to minimum qualifications (i.e., the event must register at least a "3" on a 1 to 10 scale: it must be clearly and constantly noticeable to the observer).

As a result, two ambient air sampling rounds were accomplished during strong odor events; the first on March 9, 1995 and the second March 17, 1995. Each sampling round consisted of a localized odor event. The sampling locations for the two events are shown in Figures 2-7 and 2-8.

The procedures for acquiring, managing, shipping and analyzing ambient air samples are provided in the Ambient Air SOP and in the Technical Procedure TP-1.2-25. These are included in Appendix I. Chemical analyses conducted on the odor samples are summarized in Table 2-1. Results of the chemical analyses conducted in the odor investigation are presented in Appendix C and evaluated in Section 5.3.4.

2.6.3 Comparative Ambient Air Study

2.6.3.1 Field Sampling Plan

This study was conducted in order to characterize local off-site ambient air versus air in Norseland mobile home skirts and the soil vapor. Sampling was performed during six sampling events (May 30, June 1, June 6, June 7, June 14, and June 16, 1995) under the following conditions:

1) When the wind direction is steady from a single direction (i.e., within a 90° range), and

2) When there is a steady or falling barometric pressure (BP) measured at the Bremerton National Airport.

The following describes the field sampling task for each of the six sampling events:

- 3 upwind, off-site ambient air samples were collected using SUMMA canisters with pre-calibrated flow controllers. Sample analysis was according to the US EPA Method TO-14, described in the Compendium of Methods for the Determination of Toxic Organic Compounds. Samples were collected over a 1 hour period. The sampling results are to be used to characterize off-site ambient air in the immediate vicinity of, but not impacted by (i.e., upwind) the Norseland site.

- 1 on-site ambient air sample was collected using a SUMMA canister with calibrated flow controller. The sample was collected concurrently with the 3 upwind samples over a 1 hour period. The objective is to characterize on-site ambient air and compare on-site and off-site ambient air. Sample analysis was according to the TO-14 Method.

- 4 skirt air samples were collected from 4 separate on-site lots using SUMMA canisters with calibrated flow controllers. Sample analysis was according to the TO-14 Method. Samples were collected concurrently with the ambient air samples over a 1 hour period. The sample analyses are to be used to characterize the air in the skirts below the 4 subject mobile homes.

- 4 soil gas samples were collected from probes located on the same lots as the skirt samples using SUMMA canisters with calibrated flow controllers. The samples were collected concurrently with the ambient air samples over a 1 hour period. Sample analysis was according to the TO-14 Method. The sample analyses are to be used to characterize the soil vapor underlying the subject mobile homes.

Thirteen samples were collected for each sampling event (as outlined above) during 6 separate events. The events occurred on May 30, June 1, June 6, June 7, June 14, and June 16, 1995 Two duplicates were collected with off-site ambient air samples, two with skirt samples, one with a soil vapor sample and one with an ambient air sample. Table 2-1 summarizes the analyses conducted.

2.6.3.2 Specific Tasks

Prior to a sampling event, Golder staff monitored AWOS meteorological data from the Bremerton National Airport the day before a planned sampling event. Sampling was conducted when barometric pressure was stable or falling and wind direction was detectable and steady from one direction. Golder field personnel met at the site the following morning, set up the sampling equipment, and collected ambient air, skirt air, and soil vapor after establishing that a consistent prevailing wind direction was maintained in the site area. The following sections provide the details of these procedures.

All samples were collected in 6 L SUMMA canisters for a one hour period in order to collect a four liter sample for analysis. In order to do this, a precalibrated flow controller was provided by the analytical laboratory, Air Toxics Ltd. (ATL), which was calibrated in the laboratory to allow a near constant flow into the canister for one hour and guarantee that a final pressure of approximately -10 " to -12 " Hg or 3.5 - 4 liters of air was collected..

After arriving on-site, Golder staff recorded AWOS wind direction/speed data at intervals of one call every 5 to 10 minutes, or as often as possible. Consistent prevailing wind was interpreted as being from a direction within a 90° range for a period of 60 minutes. After this was established, three off-site ambient stations were established as follows:

- Sample 1 was located off-site, adjacent to the Norseland property line, and was oriented to the prevailing wind direction from the approximate center of the site, which for purposes of this investigation is the center of the old landfill area, near Ambient Air Station - 2 (AA-2), on Lot 66. So, if the wind was from 180° (True North), Sample 1 was at an off-site location oriented 180° from the Lot 66. The AWOS reports in Magnetic North, 21° east of True North, so compass settings were set to account for this declination in order to coordinate readings to site maps.

- Samples 2 and 3 were located approximately 20° in either direction from Sample 1, i.e., Sample 1 at 160° and Sample 2 at 200°. In this way sampling occurred within a 40° wedge of the site center, based on the prevailing wind.

After the stations were established, Golder staff called the AWOS station to confirm and document wind direction/speed and barometric pressure, and to ensure that conditions were consistent with previous measurements. If they changed, Golder staff were to document the changes and continue sampling for one hour. That is, if Sample 1 was at 180° from the middle of the old landfill area (i.e., Lot 66), the prevailing winds should not have changed direction outside of a 135° to 225° orientation, i.e., outside of the 90° sampling wedge. Figure 2-9 provides a conceptual model for establishing off-site ambient air sample locations. Figures 2-10 through 2-15 show the location of the ambient air samples collected during the six sampling events.

Golder staff continued documenting AWOS wind direction/speed and barometric pressure measurements every 5 - 10 minutes or as often as possible during the sampling event.

The on-site ambient air sample was placed at the center of the old landfill area on the RV road, adjacent to Lot 66.

All samples were collected according to the following guidelines:

- The sample identification was affixed to the SUMMA canister and recorded in the canister sample ID in the field logbook.

- The off-site ambient air sampling canisters were set up at the predetermined sample locations, as described above. Ambient air and soil vapor samples were taken by opening the valve of the canister. All SUMMA canisters were placed out of direct sunlight during sampling to minimize flow rate drift.

- The soil vapor and skirt samples (4 of each) were set up at the following mobile home units:

    - Lot 39
    - Lot 54
    - Lot 60
    - Lot 63

- For soil vapor collection, the SUMMA canisters were connected to the sample probe via Teflon tubing. For skirt air collection, the Teflon tubing was attached to the SUMMA sampling port and inserted into the skirt. The soil vapor and skirt air samples were collected concurrently for each of 4 mobile homes sampled.

    The times when sampling commences was documented for each sampling site and each SUMMA canister's internal pressure was recorded on the attached regulator in inches mercury (" Hg). The initial reading was to be approximately -29 " to -30 "Hg.

- The samplers were shut off after one hour. The time and SUMMA pressure reading were recorded. The regulator was to read approximately -10 " to -12 "Hg in order to ensure that approximately 3.5 to 4 liters had been collected.

- The samples were prepared for shipment to the lab. Each SUMMA canister's internal pressure was documented on the chain of custody form, so that the lab could verify sample integrity. Also the flow controller number for each SUMMA canister sample was documented.

Two Golder field scientists conducted the sampling for each event. As indicated earlier, sampling occurred on May 30, June 1, June 6, June 7, June 14, and June 16, 1995. Table 2-1 summarizes the analyses conducted. Results of the chemical analyses conducted in the comparative ambient air investigation are presented in Appendix C and evaluated in Section 5.3.5.

2.7 Task 8 – Surface Water Investigation

The RI surface water investigation consisted of characterizing the site to determine the surface drainage patterns, to determine whether surface streams are potentially exposed to contaminated materials, evaluating any erosional features to evaluate whether contaminated materials or landfill wastes are likely to be exposed, and determining if any sampling and analysis is required.

Current stereoscopic aerial photographs were examined using a Bausch and Lomb Zoom Transfer Stereoscope to identify and define surface streams at the site. The site was then field checked to verify the aerial photos interpretations. The site was inspected to identify and locate any springs or seeps, sinkholes (which may indicate subsidence of landfill debris), dry wells or cisterns, or other geologic or cultural features of interest.

The results of the surface water evaluation are discussed in Section 3.4.

2.8 Task 9 – Groundwater Investigation

The purpose of the groundwater investigation is to obtain hydrogeologic, chemical, and hydraulic data to evaluate the groundwater quality at the site, characterize the hydrogeological setting, and evaluate the extent and potential migration of any groundwater contaminants. Initially, there were no monitoring wells associated with the Norseland site. The primary activities associated with this task centered on the installation and development of monitoring wells to accomplish the objectives listed above. The groundwater conditions at the site are discussed in Section 3.3.2.

2.8.1 Site-Adjacent Well Identification

In order to identify wells that potentially could be impacted by the former landfill, a survey of local water wells was conducted. Water well records were obtained from Ecology's Northwest Regional office for wells within a one mile radius of the site. Information obtained included well location, year installed, owner, formation, depth to water, screened interval, and approximate yield. The domestic well study area is shown in Figure 2-16. Results of the well survey are presented in Section 3.3.2.1.

2.8.2 Monitoring Well Installation

To monitor groundwater levels and groundwater quality in the vicinity of the former landfill, three groundwater monitoring wells were installed at the Norseland site. Two wells were placed in such a way as to detect groundwater contamination emanating from the former landfill. One well was installed to the east, hydraulically upgradient of the former landfill, to provide background water quality data. The locations of the monitoring wells are depicted in Figure 2-6.

Golder retained Cascade Drilling (Cascade) of Woodinville, Washington to drill and install the monitoring wells. Equipment and personnel from Cascade and Golder were mobilized to the site on April 25, 1994. All three wells were installed on April 25. As discussed further below, it became apparent after the wells were installed that MW-1 and -3 had been installed in perched zones. Therefore, on May 25, 1995, Golder and Cascade remobilized to the site to deepen these two wells.

All monitoring well installations were supervised by a Golder hydrogeologist and constructed in accordance with Golder Technical Procedures TP-1.2-12 as provided in the QAPP. The well installations were in conformance with State well construction regulations (WAC 173-160). Figure 2-17 depicts a schematic diagram of the well construction.

Drilling was performed with 6" hollow-stem augers. Soil samples were obtained by a split-spoon sampler with a standard hammer at 5 foot intervals for classification by Golder personnel. All cuttings were placed in DOT approved 55 gallon barrels and stored near each well for later disposal.

As drilling progressed, the workspace and cuttings were monitored by Golder personnel for hazardous vapors. Potentially explosive or hazardous gases were monitored with a field-calibrated Foxboro organic vapor analyzer (OVA). At no time during the drilling or well installations did the OVA indicate elevated readings in the workspace or associated with the cuttings. The workspace and cuttings were also monitored for beta/gamma radiation with an Eberline scintillometer. No readings above background were recorded during the well installations.

Once the groundwater level was identified, drilling continued for approximately 7 additional feet for the installation of the well screen and sand pack. Any adjustments needed in the elevation of the bottom of the screen were made by the placement of sand. Once the bottom elevation of the hole was satisfactory, the screen and casing were placed in the well.

All three monitoring wells were installed according to WAC 173-160-500 requirements with schedule 40, 2-in diameter PVC casing and screens with 0.01-in slots. Ten foot screens were placed in each well to allow for substantial annual variations of the local groundwater levels. Since April usually represents one of the highest groundwater levels of the year, the screens were installed relatively deep into the water table (about 7 feet). Once the screen and casing had been set, sand was added into the hole until the sand pack was at least one foot above the top of the screen. A 10/20 CSSI sand was utilized for the sandpack. Bentonite chips were placed from the top of the sand pack to 1.5 feet below ground surface, and hydrated with potable water. The top was sealed with 1.5 feet of concrete, and the monument was installed. All the monuments were installed above ground, and with a concrete pad and metal posts.

Well MW-1 intercepted water at a depth of 15 feet below ground surface, and was completed to a depth of 27 feet. Well MW-2 encountered water at a depth of 20 feet and was completed at a depth of 27 feet. Well MW-3 was completed to a depth of 55 feet, with the water level stabilizing at 48.5 feet.

Upon returning to the site on May 2 to develop the wells, the two shallow ones (MW-1 and MW-2) were dry. This indicates that the water encountered was perched, probably limited in extent, and not be suitable for an ongoing monitoring program. Therefore, on May 25, Golder personnel re-mobilized to the Norseland site to deepen the two monitoring wells. The wells were drilled and installed by Cascade Drilling of Woodinville, Washington.

The original well MW-1 was installed to a depth of 27 feet, with perched water encountered at 15 feet below the ground surface. MW-1 was redrilled through the existing borehole and deepened. The redrill of MW-1 confirmed a very small quantity of water at 15 feet. This is believed to be a local perched aquifer. Water was encountered again at a depth of approximately 45 feet, and the well was completed to 50 feet.

The original MW-2 was completed at a depth of 27 feet after encountering water at 20 feet. The original MW-2 was abandoned in accordance with WAC 173-160 standards. The redrilled MW-2b confirmed the perched water table at 20 feet, and was continued to a depth of 60 feet. The well was completed to a depth of 59 feet, with the measured water table at a depth of 55 feet.

Boring logs and well construction diagrams for the final completed wells are included in Appendix F.

2.8.3 Well Development and Sampling

Following final installation of the groundwater monitoring wells, and after adequate time had elapsed for the grout to harden, the monitoring wells were developed with a Grundfos Redi-Flo portable electric submersible pump.

Groundwater was sampled from the three wells during two sampling events, August 1994 and December 1994. Each sampling event included the following general activities:

- measurement of static water level;
- purging of stagnant well water to ensure that samples are representative, using a bailer;
- measurement of field parameters, including pH, electrical conductance, and temperature, periodically during purging,
- collection of all purge water in appropriate containers for on-site temporary storage prior to disposal, and
- collection of representative groundwater samples in appropriate containers.

Each of these activities was subject to controls and strict QA protocols and procedures specified in the relevant technical procedures referenced in the QAPP. Water levels were taken according to the specifications of procedure TP-1.4-6 "Water Level Measurements". Sample collection and handling was performed as described in procedure TP-1.2-20 "Collection of Groundwater Quality Samples". All instruments used for field analysis were calibrated in accordance with procedure P-12.0-1, "Calibration and Maintenance of Measuring and Test Equipment". Chain of custody was maintained in accordance with the procedure TP-1.2-23, "Sample Handling and Chain of Custody". All field parameter measurements, purge water volumes and water level readings were recorded in field notebooks for project filing.

Well purging was performed using non-dedicated stainless steel bailers for all sampling rounds. All equipment was properly decontaminated prior to use. Non-dedicated equipment was cleaned prior to placement into each well. Cleaning was as described in procedure TP-1.2-20 "Collection of Groundwater Quality Samples".

Samples were collected in properly cleaned bottles of appropriate volume and type. After filling, the bottles were immediately sealed, labeled and placed in a cooler maintained at 4° C. Samples were transported to the analytical facility under formal chain of custody documentation in sufficient time to conduct the requested analyses within the specified holding times.

During the August sampling round, metals analysis was performed on both filtered and unfiltered samples. During the December 1994 sampling event, however, metals analysis on filtered samples was not conducted. Because some of the unfiltered values in December exceeded MTCA criteria, well MW-1 was re-sampled during March 1995 for metals analyses. Analysis was performed on filtered and unfiltered samples from the March sampling event at MW-1. MW-1 was selected for this re-sampling because groundwater from this well contained several regulatory exceedances for metals in the December unfiltered sample.

2.8.4 Laboratory Analysis

Analysis of groundwater samples was performed by Analytical Resources, Inc. (ARI), Renton, WA. Samples were analyzed for contaminants on EPA's Target Analyte List (TAL) and Target Compound List (TCL), standard water quality parameters, and Priority Pollutants. Analytical methods included using wet chemistry (anions), and gas chromatograph/mass spectrometry methods for volatile organic compounds (EPA Method 8260) and semi-volatile compounds (EPA Method 8270), and gas chromatography for pesticides/PCBs (EPA Method 8080). The analytes, referenced analytical methods, and practical quantification limits for water samples are provided in the Quality Assurance Project Plan.

The results of the groundwater analyses are presented in Section 5.2. Laboratory reports from ARI for all groundwater analyses are included in Appendix C.

2.8.5 Purge Water and Drill Cutting Disposal

All drill cuttings and groundwater produced during drilling, the development process and well sampling were collected in 55-gallon containers for storage on the site and characterization prior to disposal. The results of the groundwater sampling and analysis were used to determine appropriate means of disposal.

Ecology provided permission for disposal, via direct discharge to the ground surface, of all purge water and drill cuttings collected at the site. The water and cuttings were emptied directly from their drums to the ground surface some distance from the wells.

3. SITE PHYSICAL DESCRIPTION

This chapter provides a description of the relevant physical, ecological and social characteristics of the Norseland site. Descriptions are presented of the site background, waste characteristics, geology and hydrogeology, surface water hydrology, and ecology.

3.1 Site Background

3.1.1 History

Prior to the development of the mobile home park, the area now known as the Norseland site was utilized for several purposes. Development of the Bremerton National Airport (former Kitsap County Airport) on the parcel containing the Norseland site began in 1935, although this development is not known to have directly involved the site. The U.S. Navy acquired the airport property in 1942, and the U.S. Army acquired additional adjacent property in 1943. The Navy parcel included 485 acres and the Army acquired 1,224 acres, for a total of 1,709 acres. This property was occupied jointly by the two service branches between 1942 and 1944. Subsequently, the entire property was transferred to the Navy (1944), then to the General Services Administration, and finally back to Kitsap County in 1948 (U.S. Army 1987).

During the joint Army-Navy possession, the Army constructed barracks, officer's quarters, and several other outbuildings on a portion of the property that was later to become Norseland. The United States facility was named Camp Christie (U.S. Army 1987). Evidence of these activities is confirmed by aerial photographs taken at the time. According to the BKCHD, all buildings and debris were removed from the site or burned before the Army relinquished the land (SAIC 1992).

Until 1951, the City of Bremerton was disposing its garbage into the tidelands of Sinclair Inlet. However, in 1951 a court order required the city to stop such disposal. In 1951, the Department of Public Health for Bremerton-Kitsap County granted a permit to Puget Service Company to operate a landfill within the permit boundaries shown on Figure 1-2, a portion of what was later to become the site of Norseland Mobile Estates. The location of the landfill was initially approved by the local health district. Puget Service Company was the City of Bremerton's contractor for the collection and disposal of all waste produced within the city and controlled by the city. Neither the city nor Puget Service Company had a waste segregation plan in effect; therefore, the garbage collected by Puget Service Company is expected to contain a portion of what are now considered hazardous substances.

The Puget Service landfill was the disposal site for the City of Bremerton's wastes from 1952 to 1961, but the site may have been used for waste disposal prior to 1952 (SAIC 1992). The permit specifications included requirements for daily cover of the active landfill and set forth the conditions under which burning was allowed at the site (Benham 1951). For much of the time, the landfill was operated as a burning dump. A salvage operation was also located at the landfill. The local health district annually approved the operating permit based upon regular inspections. Available records do not reveal any permit violations by Puget Service

Company. Testimony during the Coleman litigation depositions (Coleman et al. vs. Port of Bremerton et al. 1994) indicates that wastes associated with the Puget Sound Naval Shipyard may have been discarded at the landfill, but no disposal records have been found at any time which substantiate this testimony (U.S. Navy 1992). In addition, the landfill was reportedly open to the public for self-hauled waste disposal. When Puget Service Company lost its contract with the city in 1961, it closed the Puget Service Landfill. Based upon available information, landfill closure was consistent with standards acceptable in 1961.

In 1962 Kitsap County leased property to Omar Nesham for use as a mobile home park on the southeast portion of the area formerly permitted for landfilling. In 1963 the County gave the property to the Port of Bremerton. Mr. Nesham called his mobile home park Norseland Mobile Estates. He developed the park in phases. While he operated the park, mobile homes were not reported to be closer than 500 feet to the closed landfill.

In order to control dust at the site, Mr. Nesham obtained barrels of cosmoline (aircraft preservative oil). Some of this leaked into the soil at the western perimeter of the site.

In 1982 Nesham assigned the leasehold to the Johnsons and Wilsons. The Johnson and Wilsons continued to operate the mobile home park and expanded it as well. They expanded the park to overlay the old landfill and excavated old garbage in order to install utility lines. Figure 2-5 illustrates the current locations (including expansions by the Johnsons and Wilsons) of the Norseland Mobile Estates Park and landfill materials.

In connection with one expansion the Johnsons and Wilsons imported "blue clay" onto the site which they used for fill. This blue clay was initially believed to be contaminated with lead, but was subsequently determined to contain acceptable concentrations of lead.

In 1991 the Johnsons and Wilsons assigned their leasehold interest to Sunshine Properties, Inc. In 1995, Sunshine Properties transferred its leasehold to the Port of Bremerton. Norseland Mobile Estates is now owned and operated by the Port of Bremerton.

3.1.2 Site Description and Resident Demographics

The Norseland Mobile Estates site (the site) is located at 8651 State Highway 3 South near Port Orchard, Washington in section 11, Township 23N, Range 1W (Figure 1-1). The site is located in Kitsap County, approximately six miles southwest of the City of Bremerton. Site development as a mobile home park began in 1962 while Kitsap County owned the land. The property was acquired by the Port of Bremerton in 1963. The Port currently owns the land and the Norseland Mobile Estates. Today, approximately 100 mobile homes are on the 30+ acre site (Figure 2-1).

Land surrounding the site has been used primarily for commercial and industrial purposes since development. The Port of Bremerton operates a wastewater treatment plant less than one-half mile northwest of the site (Figure 1-2). This plant services the Port's Olympic View Industrial Park, located north and northeast of the site, and airport. The Olympic View Sanitary Landfill (OVSL) is located within one mile to the northwest of the site. The landfill holds a permit from the Bremerton/Kitsap County Health District (BKCHD) to receive soil containing up to 3% by weight total petroleum hydrocarbons for use as daily and intermediate cover. The landfill also accepts sewage sludge under permit from the Health District (Ecology 1994a). The City of Bremerton sprays a forested area with wastewater treatment plant sludge within one mile west of the site. The Bremerton National Airport (former Kitsap County Airport) is located east and southeast of the site across Highway 3. Each of these activities represents a potential source of odors in the vicinity of the mobile home park, in addition to the former Puget Service Company Landfill.

DOH conducted a health survey in 1992 of the Norseland Mobile Estates residents. One hundred and forty one (141) residents responded to the survey from a total population of 170 residents within 108 households. At that time, the median age was 65 years and the average length of residence at Norseland was 7.2 years (Department of Health, 1992a).

The mobile home park is served by a septic drainfield located to the immediate west of the site. Residents of the park are served by drinking water supplied by the Port of Bremerton. The Port's water supply is purchased from the City of Bremerton Municipal Utilities. The City of Bremerton Municipal utilities is a Class A water supply and is consistently within Maximum Contaminant Levels (MCLs) as required by WAC 246-290. The water delivered to the Port's distribution system is currently supplied by wells 15, 18 and 19. Well 15 is chlorinated but wells 18 and 19 are not (City of Bremerton 1992). These wells are located on Old Belfair Highway to the northwest of the park more than one mile from the site (SAIC 1992).

3.1.3 Climate and Topography

The site is located on the Kitsap Peninsula which has a characteristically maritime climate typified by relatively short, cool, dry summers and prolonged, mild, wet winters (Garling et al. 1965). The site area receives approximately 55 inches of precipitation annually (Ecology 1991a). Prevailing winds are from the southwest and northeast. Fog occurs approximately 50 days per year (SAIC 1992).

The Norseland site is located in an area of low, rolling hills with a poorly-developed drainage system. A strong north northeast - south southwest lineation exists in the development of valleys and ridges, and the region is dotted with enclosed topographic depressions, typically containing wetlands. This topography is consistent with a glacial drift plain environment.

The site itself slopes to the northwest from an elevation of about 470 ft above mean sea level (AMSL) along the eastern and southeastern margin to about 410 ft AMSL on the western and northwestern margin. The topography of the site is depicted in Figure 2-1. Low-rolling hills surrounding the heavily wooded site are the remains of a glacial drift plain.

3.1.4 Previous Studies

Beginning in September 1991 Ecology received reports of odor problems from residents at the mobile home park. Some residents and nearby business tenants reported odors emanating from around the industrial park and mobile home park and various health effects attributed to the odors.

Initial Investigation (Ecology 1991b). As a result of the odor and health complaints, in October 1991 Ecology performed an initial investigation to attempt to determine the source of the odors (Ecology 1991b). No conclusions were reached with regard to the source of odors (whether on site from the former Puget Service Company Landfill or offsite); however, Ecology determined that a number of 55-gal drums have been stored at the site and some of them have reportedly been emptied onto the soil and used as burn barrels. An estimated 800 ft^2 area of oil stained soil was identified at the old drum storage area.

Site Hazard Assessment (Ecology 1992). Based upon information gathered during the Initial Investigation, the site was added to Ecology's list of Confirmed and Suspected Contaminated Sites as a suspected site. In November 1991, the site was selected for a Site Hazard Assessment and ranking using the Washington Ranking Method (WARM). The SHA (Ecology 1992) was conducted in December 1991 by Ecology.

Ecology conducted air monitoring and collected soil and water samples as part of the SHA. The highest readings for organic compounds in air were observed at the eastern boundary of the OVSL where concentrations of methane measured approximately 70 ppm. Ecology collected soil samples of the "blue clay" fill material and from oil-stained soils in the former drum storage area. Water samples were collected from storm sewer drains.

Ecology concluded in the SHA that the primary concern at the site is the odor problem and its potential health impacts. There was some concern regarding contamination at one exposed location of blue clay and the oily soil area. No firm source of the odor was identified. The site was given a ranking of 2 through the WARM scoring process. The scoring was based on the relative toxicity of the lead detected in the "blue clay," the proximity of the site to populated areas and fishery resources, and the lack of runoff control, cover or vapor recovery for the petroleum-impacted and "blue clay" areas.

Washington State Department of Health Survey (DOH 1992a). In February and March 1992 the Washington State Department of Health (DOH) conducted a health survey of residents at the mobile home park (DOH 1992a). The survey consisted of a questionnaire mailed to 108 residents of the mobile home park and was conducted to assess the health status of the residents as well as gather information about the odors. Over half of the residents responded that they had first detected the odor between April and November 1991. The residents most frequently indicated that they detected the odor on a daily basis. Sixty-six percent of the respondents indicated that they had experienced one or more health symptoms. The study concluded that there was no evidence of an acute health threat posed by the site. The residents may have an increased reporting of respiratory complaints; however, other symptoms appeared to be within the normal range. Additional investigation and characterization of the site was recommended to identify compounds which could be causing the reported odors (Ecology 1994a; DOH 1992a).

U.S. Navy Records Search. (Navy 1992). In 1992, the US Navy conducted an historical records search regarding past Navy ownership, operation and waste disposal activities at the

Norseland site, in particular whether the Navy disposed of the so-called "blue clay" at the site. The report concludes that the Navy was not the source of the "blue clay" used as fill at the site, and there was no evidence to support allegations that the Navy disposed of material at the site.

Site Investigation at Norseland Mobile Estates (SAIC 1992). Prompted by complaints of odors and environmental concerns, Science Applications International Corporation (SAIC) conducted a study for the Port of Bremerton in April/May 1992 involving an historical records search, soil gas survey, and ambient air sampling (SAIC 1992). The US Army and Navy, Kitsap County, City of Bremerton, past park owners and private garbage haulers were identified as potential contributors to the former landfill. However, no written records of disposal activities were found in the study. The exact source of the site odors was not identified in the study; however, it was stated that both an off-site (Olympic View Sanitary Landfill) and an on-site subsurface source (potentially the former Puget Service Company landfill) are likely present. Odor episodes were correlated with calm or low wind conditions. Soil gas, and on-site and off-site ambient air sampling suggested that a variety of organic compounds (including benzene, toluene, ethylbenzene, and xylene (BTEX)) are present in the subsurface at Norseland and in the ambient air at Norseland and OVSL. Low levels of methane and sulfide compounds were detected at OVSL but not at Norseland. Several compounds detected in ambient air samples at Norseland and OVSL exceeded MTCA air standards. The report recommended additional investigations to confirm the presence of soil contamination, additional ambient air sampling, and a geophysical survey to delineate the extent of disposal areas at the Norseland site. This information could be evaluated in the context of a human health risk assessment.

PETREX Soil Gas Survey (AGI 1993a). Applied Geotechnology Inc. (AGI) conducted a soil gas survey at the mobile home park during December 1992. PETREX soil gas samplers were placed at five locations associated with past landfill operations. The samplers were placed at specific locations of suspected contamination. AGI did not detect any volatile organic compounds or semi-volatile organic compounds which might indicate soil gas contamination in any of the samplers. The report concluded that the data suggest that soil gas does not substantially contribute to odor events.

Air Sampling Results (AGI 1993b) AGI personnel conducted ambient air sampling during an "odor event" on April 21, 1993. Samples were collected from three outside locations and one inside location (inside one of the site mobile homes). Sample analysis was performed for volatile organics compounds (VOCs), fixed gases, sulfur compounds, and aldehydes. No VOCs, sulfur compounds, or aldehysdes were detected in the outdoor samples collected at the site. Low concentrations of several compounds were detected in an air sample collected from inside a home.

Site Radiation Survey at Norseland (DOH 1993). A radiation survey of the Norseland neighborhood and open field adjacent to the site was made by DOH radiation personnel. No elevated readings were observed.

Drinking Water Study (DOH 1992b). The Washington State Department of Health tested the drinking water supplied to the mobile home park and found it to be of good quality and satisfactory for use. The results indicated that there was no evidence of contamination of the water system from leaching of organic or inorganic chemicals through the water distribution system at the site.

Additional Soil Sampling (Ecology 1993). Ecology conducted additional sampling of the petroleum-contaminated soils and so-called "blue clay" to determine whether additional action was warranted with regards to these materials. The results of the blue clay sampling, which included the collection of 20 samples for chemical testing and statistical analysis of results, indicated that lead and chromium are below MTCA cleanup levels for these soils and no further action is warranted. The petroleum-contaminated soils contained Total Petroleum Hydrocarbon (TPH) concentrations of 360 and 600 mg/kg. The TPH is most likely lube oil or heavy motor oil. The petroleum-contaminated soils at Norseland represent a small, isolated surface staining of soils (approximately 800 ft^2) identified and sampled by Ecology. These soils are specifically excluded from the RI/FS per the Consent Decree. Remediation of these soils is to be done independently by the potentially liable person.

Odor Monitoring Network Report (BKCHD 1995). The study consisted of a compilation of observations made at six locations in the area over the period April 1993 to March 1994. The observations were made utilizing a standardized system for recording odor observations. Odors occurred throughout the period of the study. The majority of the strong odors occurred during early morning or late evening when air mixing is lowest. Odors decreased during periods of increased wind. The OVSL was identified as the most likely source of the odors. The presence of the odors indicated the need for continued gas control improvements at OVSL and the use of best available technology to minimize odor impacts from the landfill.

3.2 Waste Characteristics

3.2.1 General

The Puget Service Company landfill was developed primarily as a municipal waste landfill to serve the disposal needs of the City of Bremerton. The body of historical evidence suggests that the greatest part of the waste stream disposed at Norseland was comprised of municipal garbage. However, some evidence suggests that other types of waste were also discarded at the site, including petroleum products. Anecdotal evidence, derived from depositions given during the Coleman litigation, interviews with long-time residents of the area, former truck drivers who delivered waste materials to the site, and others with potential site knowledge, also suggests that some industrial wastes, including pesticides, solvents, paints, and chemical reagents may have been dumped at the site. Mention is made in interviews of various coating materials discarded at the site, as well as debris and residue resulting from the burning of an airport crash truck at the airport (SAIC 1992). Some speculation also has been made regarding the possibility that radioactive materials may have been discarded at the site, but this is unsubstantiated by documentation (Navy 1992) or the evidence obtained during site investigations. A DOH radiation survey of site surficial materials detected no elevated radioactivity above normal background levels.

Landfilled materials are exposed at the surface, particularly on steep slopes and densely vegetated areas. During investigations, landfilled materials were not observed to be exposed within leased properties. The potential for direct exposure and ingestion of landfilled materials is low. The population is expected to conduct minimal activities in areas having exposed landfilled materials.

3.2.2 Landfill Boundaries (Geophysical Survey Results)

GPR and EM-31 surveys were performed at the site in the areas shown in Figure 2-2. The results of this work are discussed below.

EM-31 survey results are depicted in Figures 3-1 and 3-2. The electromagnetic survey was particularly successful in defining the western edge of the landfill. This generally corresponds to the toe of the slope of the prominent banks and berms that are apparent along the approximate east-west midpoint of the site. The topographic mounds that lie west of the irregular berm line were also identified as landfill debris. A survey of the parking lot area southeast of the warehouse did not detect any unusual objects in the subsurface, which tends to invalidate claims that debris, including discarded beverage vending machines, had been buried there. Discrete anomalies identified in the far western portion of the grid area are associated with surface metal debris and not subsurface debris.

A ground penetrating radar survey was completed along the site streets and at several other selected locations in order to define the eastern boundary of landfill debris. The results of the GPR survey are shown in Figure 3-3. The GPR survey indicated that several lots in the west-central portion of the site are partially or wholly underlain by landfill debris. The demarcation was readily apparent on several GPR profiles that clearly displayed the gradation from native soil to landfill material.

A GPR trackline was also situated parallel to Highway 3, between the highway and the eastern-most mobile homes, along the long axis of a topographical low area. On the basis of physical appearance noted during the site reconnaissance, this area appeared to have been excavated, probably for borrow for use elsewhere on the site. GPR indicated the occurrence of undisturbed native soil in this area.

The combined results of the EM-31 and GPR surveys are shown in Figure 3-4, and indicate the areas of the site interpreted to be underlain by the former landfill.

3.2.3 Test Pit Observations

The test pit excavation program was successful in verifying the results of the geophysical investigation that delineated the landfill debris. Results of test pitting indicated that the geophysical methods used in the investigation successfully discriminated landfill waste vs. native ground or non-waste earth fill.

Landfill debris was encountered at test pits TP-6, TP-7, TP-8, and TP-10 (Figure 2-6). The waste was encountered at these locations at a depth of from 1 to 3 ft below ground surface, and varied in thickness from about 3 to 5 ft. Materials identified in the debris included melted glass, a 55-gl drum lid, rubber, hoses, pipes, and auto parts. At the other locations, a dense sand and gravel till was typically observed. Test pit logs and photos are presented in Appendix D.

3.3 Geology and Hydrogeology

This section describes the geology and hydrogeology of the site area.

3.3.1 Geology

Kitsap County lies in the center of the Puget Sound Lowland, a broad and gently rolling plain whose surface is commonly about 400 to 600 ft AMSL. The Puget Sound Lowland lies between the Olympic Mountains to the west and the Cascade Range to the east and consists of a large glacial drift plain formed by multiple glaciations over the area. This history of glacial erosion and deposition events separated by long-periods of non-glacial deposition has created a very complex mixture of unconsolidated sediments beneath the area. This sediment blanket ranges in thickness from 0 to over 3,600 feet in the lowland. These sediments overlay an irregular bedrock surface which is exposed in the central and eastern portions of the county on south Bainbridge Island and the Green and Gold Mountain highlands, west of Bremerton.

In the Pleistocene epoch of the last 1.5 million years, the Puget Lowland was occupied by at least five successive continental ice sheets. The most recent of these, the Vashon stade, receded about 15,000 years ago. During this period, an ice sheet 1,000 to 1,400 feet thick covered Kitsap County.

The surficial geology of the Kitsap Peninsula within the area of the Norseland site consists of glacially-derived sediments, either till that was directly deposited by glaciers, or outwash gravels and sands deposited as the glaciers receded following the last continental glaciation. These deposits, which are veneered by topsoil throughout the peninsula, overlie non-marine conglomerate and siltstone of the Blakely Harbor Formation, and tuffaceous siltstone and sandy siltstone of the Blakely Formation. The oldest rocks exposed in the county are the volcanic and plutonic rocks of Green Mountain, which are Tertiary in age. These rocks, including rhyolite, gabbro and granite, andesite, tonalite, and basalt may also underlie the site, but are not exposed in the vicinity.

Geologic structure at the site vicinity is not precisely known. There is no strong indication of major controlling structures at the site, and although faulting does occur in the region, there is no evidence of any faults crossing on or near the Norseland site.

Monitoring wells MW-1, -2 and -3 were drilled to depths of 50, 55 and 60 ft, respectively. Materials encountered in these boreholes consisted of compact to dense silty, fine to medium sands, and gravelly sands typical of glacial drift deposits. Very few silt or clay zones were noted. The total thickness of the unconsolidated sediments at the site is not known but is at least 200 ft based on well logs of nearby wells, discussed below. Boring logs are included in Appendix F.

3.3.2 Groundwater

3.3.2.1 Survey of Nearby Wells

In order to provide local hydrogeologic information and to identify wells that have the possibility of being impacted by the former landfill, a survey of local water wells was conducted. Water well records were obtained from Ecology files to identify commercial or domestic water supply wells within a one-mile radius of the Norseland site. A total of nine wells were identified within this radius. The locations of the wells are shown in Figure 3-5. Table 3-1 lists the nearby wells, owner at time of construction, location, distance from the site, and other relevant well construction details.

The wells range in depth from 65 to 219 ft below ground surface. All are installed within the unconsolidated glacial drift materials which overlie bedrock, and none completely penetrate to the bedrock. Materials screened primarily include sand and gravel intervals with some clay layers and till. The surveyed wells have a relatively narrow range of yields, from about 6 to 20 gallons per minute. All of the wells identified in the records search were installed after 1978. There may be additional wells near the site, however, since it was not a requirement for well drillers to submit well records to Ecology until 1974.

Three wells were identified about 0.75 miles from the site, the remainder are approximately a mile away. None of the wells are believed to be downgradient from the site. Groundwater is not utilized as a resource at Norseland, which receives domestic water supplies from the Bremerton municipal system via pipeline from the City's well system.

The Department of Ecology, in an interview with Mr. Robert Farnham, learned of a well that had been installed at the site prior to its development as a mobile home park. To date, this well has not been observed in the field during geophysical investigations or other field activities.

3.3.2.2 Site Conditions

As described in Section 2.8, three monitoring wells were installed at the site. Wells MW-1 and MW-3 needed to be re-drilled to extend the wells to the local water table beneath the site. The original well MW-1 was installed to a depth of 27 feet, with perched water encountered at 15 feet below the ground surface. The redrill of MW-1 confirmed a very small quantity of water at 15 feet. This is believed to be a local perched aquifer. Water was encountered again at a depth of approximately 45 feet, and the well was completed to 50 feet. The original MW-2 was completed at a depth of 27 feet after encountering water at 20 feet. The redrill confirmed the perched water table at 20 feet, and continued to a depth of 60 feet. The well was completed to a depth of 59 feet, with the measured water table at a depth of 55 feet. Therefore, the local water table beneath the site occurs at a depth between about 40 to 60 ft, depending on location.

Depths to water and groundwater elevations measured at the three wells during the August and December 1994 sampling rounds are shown in Figure 3-6. Contours of the groundwater elevations, based on the August 1994 water levels, are also depicted in Figure 3-6. As seen in the figure, the direction of groundwater flow beneath the site is to the northwest, consistent with the ground surface topography. Groundwater flows to the northwest beneath the site at an average hydraulic gradient of approximately 0.06 ft/ft.

3.4 Surface Water Hydrology

Golder personnel reviewed stereo pairs of aerial photographs dating back to the 1950's, using a Bausch and Lomb Zoom Transfer Stereoscope. No evidence of any surface streams – permanent, seasonal, or ephemeral – was observed. This is consistent with field observations made during the geophysical investigation, soil vapor testing, and the site walk through, which also did not find any evidence of current streams or past fluvial activity on the site.

Interviews with some residents of the park indicated that two small surface streams may have traversed the southern half of Norseland. These could not be verified on the photos examined or in subsequent field examinations. It is likely that the streams, if they existed, were ephemeral, and were obliterated during site development.

There are two unnamed creeks near the site (Figure 1-2). One is north and one is south of the site. Both are approximately one-half mile from the site. Both creeks discharge to the Union River, located about two miles west of the site. Wetlands are located in the area, although none are directly on the site.

3.5 Ecology

At Golder's request, the Washington State Department of Wildlife (DOW) completed a review of DOW's databases containing locations of species and habitats of importance (Nongame Heritage, Priority Habitats and Species, and Washington Rivers Information System databases). The search was conducted within a one mile radius of the Norseland project area. No threatened, endangered or candidate species, or critical habitats were identified in the database searches (DOW 1994).

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4. POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

4.1 Introduction

This section identifies and evaluates federal and state requirements that are potentially applicable or relevant and appropriate (ARARs) for remedial actions at the Norseland site. ARAR identification is in accordance with WAC 173-340-710. Final ARARs will be determined by Ecology in accordance with the requirements of the Consent Decree for the Cleanup Action Plan (CAP).

WAC 173-340-360(2) and 173-340-710(1)(a) require cleanup actions conducted under the Model Toxics Control Act (RCW 70.105D) (MTCA) to comply with applicable federal and state laws. Applicable laws are defined as those requirements that are legally applicable, as well as those that are both relevant and appropriate.

In order to be defined as a "legally applicable" requirement, the requirement must be promulgated under state or federal law and must specifically address a hazardous substance, cleanup action, location or other circumstance at the site. "Relevant and appropriate" requirements are limited to those requirements promulgated under state and federal laws that, while not legally applicable, address circumstances sufficiently similar to those encountered at the site such that the use of the requirements is well suited to particular site conditions.

Identification of ARARs must be made on a site-specific basis and involves a two-part analysis: first, a determination is made whether a given promulgated requirement is applicable; then, if it is not applicable, a determination is made whether it is both relevant and appropriate. A requirement may be either "applicable" or "relevant and appropriate," but not both.

The following discussion focuses on the most significant potential ARARs. The full list of potential ARARs is presented and discussed in Tables 4-1 and 4-2. Several of the ARARs identified in these tables would be ARAR only under conditions which may or may not occur at the site. Therefore, identification of a potential ARAR in these tables indicates that the potential ARAR would be considered based on the selected remedy, but may not be an ARAR for some remedial actions.

Table 4-3 provides toxicity and references for airborne contaminants detected at the Norseland site. Potential specific regulatory limits (cleanup criteria) for air, groundwater, and soil are presented in Tables 4-4, 4-5, and 4-6, respectively. Surface water with aquatic life has not been observed on the site and, therefore, water quality standards for the protection of aquatic life are not presented.

4.2 Federal ARARs

National Primary Drinking Water Regulations - 40 CFR 141

Requirements of the National Primary Drinking Water Regulations (40 CFR 141) promulgated under the Safe Drinking Water Act (SDWA) address contamination in community water systems, which are generally defined as public water systems having at least 15 service connections or serving an average of at least 25 year-round residents. The primary drinking water regulations establish maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs). MCLs are enforceable standards for specific contaminants EPA has determined have an adverse effect on human health. MCLGs, in contrast, are non-enforceable, strictly health-based standards which do not take cost or feasibility into account. Where applicable, the regulations of the SDWA are applied at the tap. Secondary maximum contaminant levels (SMCLs) are also established pursuant to the SDWA and are set forth in 40 CFR 143.

MTCA requires cleanup levels to be at least as stringent as the MCLs, SMCLs and non-carcinogen MCLGs established under the SDWA where groundwater is a current or potential future source of drinking water. Since site groundwater is not currently used for drinking water purposes (water supply at the site is from the City of Bremerton system), these requirements are not applicable. However, they may be potentially relevant and appropriate as cleanup standards since site groundwater could be classified by Ecology as a potential source of drinking water. Table 4-5 gives the MCLs, SMCLs and non-carcinogen MCLGs for detected groundwater constituents.

Clean Air Act - Title 42 USC 7401 et seq., as amended

The Clean Air Act (CAA) regulates emission of pollutants to the air. In Washington, the majority of CAA authority has been delegated to the State of Washington (see Section 4.3) by the U.S. EPA.

4.3 State ARARs

Model Toxics Control Act (MTCA) - RCW 70.105D

The Norseland site is a listed site under MTCA; therefore, MTCA and its implementing regulations are the key state requirements governing the investigation and remediation of the Norseland site. MTCA describes the requirements for selecting cleanup actions, preferred technologies, policies for use of permanent solutions, the time frame for cleanup, and the decision-making process.

Recently, MTCA was amended to achieve the following purposes [see RCW 70.105D.010(4)]: 1) to promote the public's interest to efficiently use the finite land base; 2) to integrate land use planning policies; 3) to cleanup and reuse contaminated industrial properties in order to minimize industrial development pressures on undeveloped land; and 4) to make clean land available for future social use.

Recent amendments to MTCA (RCW 70.105D.090) exempt remedial actions conducted pursuant to a Consent Decree or an Agreed Order from the procedural requirements of certain state and all local laws and regulations, including permitting. The substantive requirements of applicable laws, regulations, and ordinances must still be met. However, permits and separate approvals within the exemption are not required for remedial actions at the site.

MTCA Regulations - WAC 173-340

Regulations under WAC Chapter 173-340, which implement the requirements of MTCA, are the primary regulatory vehicle under which Norseland site remediation is being conducted. MTCA regulations are therefore applicable. These regulations establish administrative processes and standards to identify, investigate and cleanup facilities where hazardous substances have been released.

WAC 173-340-700 establishes cleanup levels for air, groundwater, soil, and surface water. Three methods are presented for determining cleanup levels: Method A (routine, using tables), Method B (standard), and Method C (conditional, primarily for industrial sites). However, for all three methods, cleanup levels cannot be more stringent than an established area background for the site. Method A is generally used for routine cleanups with relatively few contaminants. Method A standards are presented in tables in MTCA regulations. Method B is the "standard" method for determining cleanup levels, using risk calculations specified in the regulations, based on limiting excess lifetime cancer risk to one in one million (1×10^{-6}) for individual constituents and one in one hundred thousand (1×10^{-5}) for combined constituents and pathways. For non-carcinogenic risk, the total hazard index limit is 1. Method C cleanup levels are used for industrial/commercial sites, or where Method A and B are not appropriate. Under ESSB 6123, which amended MTCA, industrial cleanup levels are appropriate for land zoned for industrial use.

For all three methods of establishing cleanup levels, a "point of compliance" is set for determining when and whether cleanup levels have been met. For cleanup alternatives where waste or hazardous substances remain on-site (i.e. containment remedies), a conditional point of compliance is established. Under WAC 173-340-750(6) and WAC 173-340-720(6)(c), the conditional point of compliance is set "as close as practicable to the source of hazardous substances, not to exceed the property boundary." With containment actions, institutional controls and long-term monitoring are required in accordance with WAC 173-340-360(8)(b). Potential cleanup levels for air, groundwater, and soil under MTCA are summarized in Tables 4-4, 4-5, and 4-6, respectively.

WAC 173-340-710(6)(c) specifies that for "solid waste landfills, the solid waste closure requirements in chapter 173-304 WAC shall be minimum requirements for cleanup actions".

State Environmental Policy Act (SEPA) - WAC 197-11, 173-802

SEPA is triggered when a governmental action is taken on a public or private proposal. Under WAC 197-11-784, a proposal includes both regulatory decisions of agencies and actions proposed by applicants. Under WAC 197-11-253, Ecology is the lead agency for site cleanup actions performed under MTCA. SEPA is applicable to remedial actions at the Norseland site.

If the proposal is not "exempt", Ecology will require the submission of a SEPA checklist giving information regarding how the proposal will affect elements of the environment, such as air and water. If the proposal is determined by Ecology to have a "probable significant adverse environmental impact", an environmental impact statement (EIS) is required. The EIS examines the potential environmental problems that would be result from the proposed action, and options for mitigation of adverse affects. If there will be no significant adverse environmental impact, Ecology issues Determination of Nonsignificance (DNS) and no EIS is required.

Any public comment period required under SEPA must be combined with any comment period under MTCA in order to expedite and streamline public input. According to WAC 197-11-259, if Ecology makes a determination that the proposal will not have a probable significant adverse environmental impact, a DNS can be issued with the draft CAP.

Washington Clean Air Act - Ch. 79.94 RCW and Ch. 43.21A RCW

The Washington State Clean Air Act is the state equivalent of the federal Clean Air Act. Substantive standards (WAC 173-400) established for the control and prevention of air pollution under this regulation may be applicable to some remediation alternatives. The regulation requires that all sources of air contaminants meet emission standards for visible, particulate, fugitive, odors, and hazardous air emissions. Under WAC 173-340-710(6)(b), air emissions are required to use best available control technologies (BACT) consistent with 70.94 RCW and its implementing regulations.

Table 4-4 presents air quality standards for compounds of concern at the Norseland site. The Puget Sound Air Pollution Control Agency (PSAPCA), activated under RCW 70.94, has jurisdiction over regulation and control of the emission of air contaminants and the requirements of state and federal Clean Air Acts from all sources in King, Pierce, Snohomish and Kitsap county areas. PSAPCA has established three regulations: Regulations 1, 2 and 3. The aim of Regulation 1 is to control the emission of air contaminants from all sources, to provide for administration and enforcement of air pollution controls and to carry out the requirements and purposes of the Washington Clean Air Act. Ambient air quality standards are provided for suspended particulate, PM_{10}, lead, carbon monoxide, ozone, nitrogen dioxide, and sulfur dioxide. Regulation 2 was adopted as a special regulation to reduce ozone concentrations as required by the Federal Clean Air Act. Regulation 2 provides for control of photochemically reactive VOCs which are precursors to ozone, in order to meet National Ambient Air Quality Standards for ozone. The requirements of Regulation 2 are aimed at specific industrial practices, including gasoline marketing, graphic arts systems, petroleum solvent dry cleaning systems, etc. The purpose of Regulation 3 is to reduce the ambient concentrations of toxic air contaminants (TACs). TACs are any air contaminant listed in Appendix A of this regulation or listed under 40 CFR Part 372, Subpart D. The ambient impact of emissions of TACs are evaluated by comparing modeled or measured concentrations with Acceptable Source Impact Levels (ASILs). ASILs are used by comparing a concentration of a TAC in the outdoor atmosphere in any area that does not have restricted or controlled public access in order to evaluate the air quality impacts of a single source. There are three types of ASILs: risk-based, threshold-based, and special. Concentrations of these three types of ASILs are listed in Appendix A of this regulation.

It is not entirely clear whether the landfill meets the definition of a source under Regulation 1. Due to this uncertainty, selected portions of these regulations are considered applicable to the Norseland site. Regulation 2, however, is not considered applicable or relevant and appropriate because the landfill does not fall into any of the specific industrial activities which are identified under the regulation. ASILs identified under Regulation 3 are applicable to the site, but only to outdoor air. Outdoor air is defined as that portion of the atmosphere, external to buildings, which the general public has access. Therefore, ASILs are not ARAR to soil gas, but are retained for screening comparison to skirt and ambient air.

Minimum Functional Standards (MFS) for Solid Waste Handling - WAC 173-304

WAC 173-304 ("Minimum Functional Standards for Solid Waste Handling") contains requirements for the management of solid waste. Because the Norseland site stopped receiving waste materials prior to the effective date of these regulations and does not meet the definition of a regulated facility, WAC 173-304 is not legally applicable to the Norseland site. However, MTCA regulations [WAC 173-340-710(6)(c)] specify that for "solid waste landfills, the solid waste closure requirements in chapter 173-304 WAC shall be minimum requirements for cleanup actions"; i.e., relevant and appropriate.

WAC 173-304-407 contains general closure and post-closure standards. There are three separate landfill closure standards: WAC 173-304-460 (for most solid waste landfills), WAC 173-304-461 (for inert waste and demolition waste landfills), and WAC 173-304-462 (for woodwaste landfills). The woodwaste landfill standards are neither relevant nor appropriate to the Norseland site. As discussed below, the -460 and -461 standards are relevant and appropriate for the Norseland landfill. WAC 173-304-700 provides for variances from the WAC 173-304 closure standards.

The -460 standards are intended for typical solid waste landfills. The -460 landfill closure standards include requirements that the closure cap 1) have a minimum of two feet of soil having a permeability of 1×10^{-6} or lower, 2) have surface slopes of at least 2% and side slopes less than 33%, and 3) have a vegetated top cover of six inches of topsoil. An artificial (synthetic) liner with a thickness of at least 50 mils may be used instead of a low-permeability soil liner.

Based on the types of waste received, the -460 standards are relevant and appropriate. However, the -460 standards were developed assuming landfill closure soon after completion of operations and a post-closure period of 20 years. In contrast, the Norseland landfill has not operated in over 30 years.

The -461 landfill closure standards include requirements that the wastes be leveled to the extent practicable, that voids be filled, and that the closure cap include a minimum of one foot of soil cover.

The Norseland landfill received a variety of solid wastes. Much of the waste received at the landfill was reportedly burned, which would leave a relatively inert residual. Inert wastes are defined under WAC 173-304-100(40) as "noncombustible, nondangerous solid wastes that are likely to retain their physical and chemical structure under expected conditions of disposal, including resistance to biological attack and chemical attack from acidic rainwater." Typical municipal landfills generate significant quantities of methane as putrescible waste is degraded anaerobically by microorganisms. However, the Norseland site has low concentrations of methane in soil gas, meaning a low rate of methane generation. This lack of methane generation is more typical of an inert waste landfill. In addition, were waste constituents significantly mobile, given the limited existing soil cover, groundwater under or near the site would be expected to contain waste constituents. However, as would be expected for an inert waste landfill, waste constituents have not been found in site groundwater. Accordingly, based on site conditions, the closure standards of WAC 173-304-461 are also relevant and appropriate.

Because the Norseland landfill has characteristics of both a typical solid waste landfill and an inert waste landfill, the closure standards under both WAC 173-304-460 and -461 are relevant and appropriate. Thus, to meet ARARs, the remedial action should include closure that is appropriate considering the closure standards of both -460 and -461.

In addition, under 173-304-700, a variance to WAC 173-304 standards may be granted if:

> "(a) The solid waste handling practices or location do not endanger the public health, safety or the environment; and
>
> (b) Compliance with the regulation from which variance is sought would produce hardship without equal or greater benefits to the public."

This section provides an additional basis for selecting appropriate closure requirements to meet MFS (WAC 173-304). Because remedial action at the Norseland site is being conducted under a Consent Decree, no permitting or formal submission is required for a variance. Ecology, in consultation with the relevant permitting agencies, considers the appropriateness of any variances necessary for a selected remedial action when preparing the CAP. Approval of the variance is effectively done when, after public comment and revision if necessary, Ecology signs the decree or order implementing the CAP.

5. NATURE AND EXTENT OF CHEMICALS IN ENVIRONMENTAL MEDIA

This chapter presents the results of the chemical analyses performed on the soil, groundwater and air samples collected as part of this RI. The primary aims of this chapter are as follows:

Soil and Groundwater Media

- to identify the nature and extent of any chemical compounds present in soil and groundwater which have resulted from site waste disposal activities and which exceed potential regulatory criteria. These compounds, if any, are termed for the purposes of this RI as the contaminants of potential concern (COPC);

Air Media

- to identify the nature and extent of any chemical compounds present in soil gas, trailer skirt air and ambient air which may have resulted from site waste disposal activities which exceed potential regulatory or screening levels; and

- to determine if the former Puget Service Company landfill serves as a source of odors observed in ambient air at the site.

Potential regulatory criteria are defined for each compound detected as the minimum of various chemical-specific regulatory values presented in Tables 4-3, 4-4, and 4-5, for groundwater, air and soil, respectively. The reader is referred to Chapter 4 for a detailed presentation of the chemical-specific regulatory levels determined for the Norseland site. The minimum regulatory value for each compound is termed for the purposes of this RI as a "screening value".

As discussed in Section 1.3 of this report, a formal Baseline Risk Assessment is not included in this RI, due to the action taken by the County and the Port to relocate the trailer park residents, thereby eliminating any future risk of long-term exposure to potentially hazardous or odor-producing compounds.

5.1 Soil

This section describes the results of soil sampling and analysis. The conduct of the soils investigation is described in Section 2.5.

5.1.1 Results of Field Screening

As a part of well drilling and test pit excavation activities, Golder personnel scanned for radioactivity at the Norseland site on several occasions. A Geiger counter (Eberline radiation meter) equipped with alpha and beta/gamma detectors was used during the installation of monitoring wells at the site to check for radioactivity in drill cuttings. The same instrument was used to scan soil excavated during the excavation of 11 test pits. No activities above background were detected. Background activities were noted in air at the breathing zone for each scanning operation, then soil from drill cuttings or excavation was directly scanned with the alpha and beta/gamma detectors. No activities above background were detected during any scanning operation.

An Organic Vapor Analyzer (flame ionization detector) was used to monitor the breathing zone and the interior of test pits during excavation. In general, concentrations (less than detection to 8 ppm) of organic vapors were detected. One test pit (TP-7), excavated adjacent to soil vapor probe SV-10 (see Figure 2-6), exhibited elevated concentrations of volatile organic compounds (VOCs). Values in the 100 to 150 ppm range were measured by the OVA at TP-7 for soils obtained at a depth below 3 ft. As such, two samples were collected (at depths of 7 ft and 11 ft) within the test pit. No odors were detected by Golder personnel in any test pit except TP-7, which had a petroleum odor which was consistent with the elevated OVA measurements observed at the site. TP-7 was the only location where elevated readings were observed with the OVA.

As discussed earlier in Section 2.5, two test pits were actually excavated at the TP-7 location on different dates. These are designated TP 7-1 and TP 7-2. No soil samples were taken from test pit TP 7-1. The OVA measurements were conducted in TP 7-1, excavated on 7/13/94, and the sampling was conducted from TP 7-2, located approximately 10 ft from the first, on 7/25/94. OVA measurements were similar in TP-7-2 as in TP 7-1.

The results of the field screening analyses conducted at monitoring wells and test pits are summarized in Table 5-1.

5.1.2 Results of Chemical Analysis

Two soil samples were obtained from test pit TP-7-2. These soil samples were designated TP-7A (6-7 ft. depth) and TP-7B (10-11 ft. depth). The results of the chemical analyses conducted on the test pit TP-7-2 soils are summarized in Table 5-2. The detected compounds and their associated screening values are listed in the table. As seen in the table, in addition to the inorganic constituents detected, a number of volatile and semi-volatile organic compounds were detected in the two samples. The concentrations are very low, however, and no organic compounds exceeded any screening values.

Beryllium was the only compound detected in soil at a level above any regulatory criteria. The compound was detected at a concentration of 0.8 mg/kg versus a screening value of 0.233 mg/kg. The exceedance of the beryllium screening value occurred in only a single sample.

This value, however, is less than reported background values for beryllium listed in *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994c). In lieu of site-specific determinations of background values, information provided in the referenced report can be used to establish background for the site. The report defines a range of values that represent the natural concentrations of metals in surficial soils throughout Washington. State-wide and regional 90th percentile upper tolerance limit (UTL) values are presented. There are no restrictions on the use of the site-wide values. These can be used for comparison against data collected from any site in the State. The regional values can be compared against data collected from those regions only.

The statewide 90th percentile value for beryllium is 1.44 mg/kg, and the western Washington background value is 1.51 mg/kg. As seen in Table 5-2, all of the detected values for beryllium (0.8 and 0.2 mg/kg) are less than these UTL values. Beryllium can therefore be eliminated from further consideration in this RI.

5.2 Groundwater

5.2.1 Results of Chemical Analysis

The results for the August and December 1994 sampling events of groundwater from all site wells and the February 1995 re-sampling of groundwater from well MW-1 are shown in Tables 5-3, 5-4, and 5-5, respectively. This sub-section evaluates the groundwater analytical data obtained during the RI in order to determine if the data indicate that the former landfill is currently impacting the underlying groundwater at the site and if groundwater quality exceeds potential regulatory criteria. The conduct of the groundwater investigation is described in Section 2.8.

It is important to note that for metals data, only the results for the filtered samples are utilized in this evaluation. The monitored saturated zones in MW-1, MW-2 and MW-3 produce little water and purging with a bailer resulted in dewatering some wells. As a result, groundwater samples contain suspended particulates (turbidity much greater than 5 N.T.U.). These particulates are not mobile within the groundwater system and should not be considered part of the groundwater sample. Analysis of metals (also certain highly hydrophobic organic compounds) in turbid groundwater usually results in elevated concentrations for these compounds that are not representative of the groundwater conditions. Turbidity is important for the metals analyses because metals are contained naturally within or sorbed onto the suspended solids present in the sample. Suspended solids would not be expected to be present in the groundwater produced from a properly constructed production supply well. Samples for all other groundwater analytes (which are not sensitive to sample turbidity) were not filtered, and as such, all groundwater evaluations for non-metals are based on the use of unfiltered data.

Metal analyses were performed on both filtered and unfiltered samples during the August 1994 sampling event. Only unfiltered samples were analyzed for metals during the December 1994 event, because filtered samples were not obtained during the this event. In review of the unfiltered sample analytical results for the December 1994 event, it was decided that groundwater from well MW-1 should be resampled, filtered and analyzed, which occurred during March 1995. The decision to resample, filter and analyze groundwater from well MW-1 and not from wells MW-2 or MW-3 is based on the following reasons:

- Analytical results on unfiltered groundwater samples were comparable between the December 1994 and August 1994 monitoring events for MW-2 and MW-3. The results for unfiltered groundwater from MW-1 were quite different between these monitoring events.

- Analytical results for unfiltered groundwater from MW-1 in December 1994 were above regulatory screening values for many metals (aluminum, beryllium, chromium, iron, lead, manganese, nickel, thallium and vanadium). Several of these metals were above primary MCLs and lead was above the Federal Action Level for drinking water supplies. Analytical results for unfiltered groundwater from MW-2 and MW-3 were only above regulatory screening values for aluminum, iron, lead (MW-2 only) and manganese.

- Aluminum, iron and manganese, which were above secondary drinking water standards in unfiltered groundwater during December 1994 and August 1994 monitoring events from MW-2 and MW-3, are non-health-based standards. These metals were below the secondary drinking water standards in filtered samples obtained during the August 1994 sampling event. In addition, these metals were detected at higher concentrations in the upgradient well MW-1.

- Lead concentrations in unfiltered groundwater samples from well MW-2 (6.5 µg/L) were below the Federal Action Level for drinking water (15 µg/L) but were slightly above the MTCA Method A level (5 µg/L) during the monitoring period December 1994. The lead concentration was also higher in unfiltered groundwater in the upgradient (background) well MW-1 during the December 1994 event. The filtered groundwater sample from MW-2 obtained during the August 1994 event reported lead at only 2 µg/L, but was qualified because of lead detections in the associated blank sample. Therefore, representative lead concentrations in groundwater from well MW-2 are below Federal Action Levels, are acceptable for drinking water and are at lower concentrations in groundwater downgradient of the Norseland site landfill than in upgradient groundwater.

Review of the groundwater data results in the following observations:

- Some organic constituents, consisting of phthalates, were detected in groundwater at the site. These include bis(2-ethylhexyl)phthalate, butylbenzylphthalate, di-n-octyl phthalate and diethylphthalate. These compounds were observed in up- and down-gradient wells. All of the measured concentrations, however, were below any potential regulatory values. Bis(2-ethylhexyl)phthalate was detected at a maximum concentration of 2.8 µg/L at MW-1, butylbenzylphthalate at a maximum concentration of 54 µg/L at MW-1, di-n-octyl phthalate at a maximum concentration of 5 µg/L at MW-1, and diethylphthalate at a maximum concentration of 1.5 µg/L at MW-3. Except for diethylphthalate, which was detected only once during all the sampling rounds, all of the maximum levels observed for these compounds occurred at MW-1, the upgradient well. This indicates that the former landfill at the site is not the source of these compounds. The source of these constituents in groundwater is either off-site, or consists of laboratory contamination, since all of these compounds represent common laboratory contaminants. Since the levels are all well below regulatory criteria, and the source of the compounds is not associated with the site, none of these compounds represent contaminants of potential concern (COPC) for groundwater.

- Several inorganic parameters were observed at levels above the screening criteria. Except for one compound (thallium), the exceedances all occurred at well MW-1 only. MW-1 is the upgradient well at the site. These exceedances were for manganese, nitrate, nitrate + nitrite, aluminum and iron. None of these constituents exceeded the screening values at any other site wells. It is possible that the values observed for these inorganic compounds represent background, or that an upgradient source is present. Additional investigation would be required in order to determine the nature of the source of these compounds. Because the maximum values for all of these compounds occurred at the upgradient well, the former landfill does not appear to be the source of these compounds, and none are retained as COPC for groundwater.

- The only exceedance of a regulatory screening value in filtered groundwater at a downgradient well was for thallium, which was observed at a concentration of 1 μg/L at well MW-2 during the August 1994 sampling event. The regulatory limit for thallium is 0.5 μg/L; the detection limit is 1 μg/L. The compound was not detected in the associated unfiltered sample. The compound was not ever detected at any other downgradient well. It was detected, however, at well MW-1 (in an unfiltered sample) at a concentration of 3 μg/L. Because of the closeness of the one downgradient detected value to the detection limit and the inconsistency of detection between rounds, the compound is not retained as a COPC.

5.3 Air

This section describes the results of the various air monitoring activities conducted during the RI. The performance of these tasks was described earlier in Sections 2.4 and 2.6.

Sections 5.3.2, 5.3.3, 5.3.4 and 5.3.4 below include the results of chemical analyses performed on ambient, soil vapor, and skirt air samples collected under the various RI air tasks. As part of the evaluation of these data, the data are compared to screening values: (1) MTCA Method B values for all air samples (including soil gas); and (2) ASIL values for skirt air and ambient air samples. The Method B values are calculated for those compounds which were detected in air and for which toxicological data are available. The Method B and ASIL values were determined previously in Chapter 4 and are summarized in Table 4-4.

Exceedance of a screening value in a soil vapor or skirt air sample does not necessarily constitute evidence of a risk to human health. However, the Method B values are compared to all of the site air data presented herein in order to provide preliminary and conservative indications of potential risk from all media sampled. ASIL values are only used to screen "outdoor" air quality skirt air and ambient air samples.

Tentatively Identified Compounds (TICs) are included in the data evaluations conducted herein. Toxicological data are not available for most TICs, however, and therefore the TIC data cannot be compared to any regulatory criteria.

It is important to acknowledge that the regulatory screening values (Method B and ASIL values) for a number of compounds analyzed for in this RI are lower than the method detection limits which are usually achievable in standard laboratory analyses. Table 5-6 lists the lower regulatory screening value (Method B or ASIL values) for air and detection limits for the TO-14 list of volatile organic compounds. These compounds represent many of the primary constituents of interest detected in air media at the site. As seen in the table, the method detection limits for several compounds exceed the Method B values by as much as 1 to 2 orders of magnitude. These include vinyl chloride, 1,1-dichloroethene, chloroform, carbon tetrachloride, benzene, 1,2-dichloroethane, and others. If one of these compounds is not detected, therefore, it does not necessarily mean that the compound is of no concern from a regulatory screening standpoint.

5.3.1 Qualitative Observations of Site Odors

5.3.1.1 Site Questionnaire Responses

This sub-section summarizes the results of the Norseland Site Condition Questionnaire. The questionnaire, which was prepared by Golder and approved by KPAT and Ecology prior to distribution, was submitted to solicit opinion about odor events, ground stability and sanitary waste issues at the site. The questionnaires were circulated at the Norseland site itself, as well as to nearby residents and employees at the Olympic View office park. A complete compilation of the questionnaire responses is included in Appendix A. Primary findings of the survey pertaining to odors include the following:

- Among site residents, 64% (50) responded that they smell odors at the site. 36% (28) indicated that they do not ever notice any odors. Anecdotal information indicates that some residents reported a loss or reduction in their sense of smell.

- Of those that notice the odors, most indicated that the odors occur "infrequently" (23) or "several times a month" (18). The most frequent term used to describe the odor (Figure 5-1) is "garbage" (16), followed by "oily or gassy" (14), and then "sulfurous" (9) and "natural gas" (9). Most people (36) said the smell was the same each time they noticed it.

- "Foggy" (28) and "still" (21) were the most frequent terms used to describe weather conditions typical of odor events.

- Early morning (40) was by far the most frequent time of day associated with odors.

- Most people (48) smell the odors outdoors only.

5.3.1.2 Observations of the Golder Site Personnel

This sub-section provides a summary of the site odor observations made by the Golder field personnel who were present at Norseland from December 1994 through March 21, 1995. Golder field personnel were present at the site during this period to determine the nature and extent of odors which have been reported by Norseland residents, and identify the source(s), as outlined in the site Work Plan.

The sources of information used in this evaluation are as follows:

- the three field log books documenting the daily activities associated with this task;
- Norseland resident observations as recorded in the telephone log forms prepared by Laird Harris Associates and the Golder telephone log book; and
- weather observations from the meteorological recording stations at the Olympic View Sanitary Landfill (OVSL) and the Bremerton National Airport (i.e., the Automated Weather Observation Service [AWOS] station). The locations of these stations are shown in Figure 5-2.

Appendix E contains two tables summarizing the Golder observations and the Norseland site resident observations, respectively, with the corresponding weather data from both stations.

5.3.1.2.1 Odor Types and Frequency at the Norseland Site

As shown in Figure 5-1, the predominant odor type identified by the Golder staff was classified as a sulfur - mercaptan-like smell. The detection frequency of this odor was 92% (24 of 26 events). The log documents this odor as "the odor" because of its predominance and because of its similarity to odors detected adjacent to the OVSL. Another odor observed was characterized as a sulfide odor, similar to a Kraft Process smell associated with pulp and paper mills. The detection frequency of this odor was 4% (1 out of 26 events). A third odor observed was characterized as chlorine-like, which also was detected once, or representing 4% of the odor events.

The characterization by the Golder site representatives of the predominant site odor as a sulfur-mercaptan-like smell (92% of the time) compares favorably with the observations of the site residents who characterized the predominant smells as "garbage" (33%), oily or gassy (29%), sulfurous (19%), and natural gas (19%) (Figure 5-1). Mercaptans are sulfurous compounds that are used for odor detection in natural gas and are often associated with "garbage" odors since they are a bio-degradation product of landfills. The Golder site odor monitors were tested for their odor detection threshold and discrimination, and were trained using odor samples and placebos to correctly identify certain odors typical of landfills. The site residents were not trained or tested for their odor detection abilities.

It should also be noted that other types of odors were recorded in the Golder log book, such as wood smoke odor, cigarette odor, and pine odor. However, these were considered normal ambient odors, and not from a possible landfill source, and therefore not generally relevant to the investigation. Therefore, these odors were not summarized in Table 1 of Appendix E or this evaluation.

5.3.1.2.2 Overall Percentage of Time Odors were Present at the Norseland Site

Odors detected by Golder personnel during the winter of 1995 represent approximately 1.6% of the active odor event monitoring time, i.e. between 6:00 AM and 11:00 AM, when odor monitoring was occurring. This figure was calculated by dividing the total elapsed time for all onsite odor events by the total number of minutes Golder was onsite (during the morning hours) for December through March 21, 1995.

The monthly percentages are as follows:

December 1994: 56 min. of localized odors/3000 total minutes observed x 100 = 1.9%
January 1995: 37 min. of localized odors/5700 total minutes observed x 100 = 0.65 %
February 1995: 34 min. of localized odors/6000 total minutes observed x 100 = 0.57%
March 1995: 108 min. of localized odors/3900 total minutes observed x 100 = 2.8%

5.3.1.2.3 Primary and Secondary Times of Day Odors are Present at the Norseland Site

Two one-hour time periods were the predominant time when odors occurred at the site, based on Golder observations. These were from 6:00 AM to 7:00 AM, and 8:00 AM to 9:00 AM. The secondary time period was between 11:00 AM and 12:00 AM.

5.3.1.2.4 Scale of Onsite Odors at the Norseland Site

The strength of site odors was characterized on a 1 to 10 scale, 1 to 2 being faint and intermittent, 3 to 6 being constant and moderate to strong, and 7 to 10 being very strong to rank. The frequency of these odors was calculated as follows:

- Scale 1 to 2: 19 out of 38 recorded odors, or 50 %
- Scale 3 to 4: 12 out of 38 recorded odors, or 32 %
- Scale 5 to 6: 8 out of 38 recorded odors, or 21 %
- Scale 6 to 10: 1 out of 38 recorded odors, or 3 %

The total percentage (106 %) is attributed to overlap between scales, i.e., a ranking of 4-5 is counted twice.

5.3.1.2.5 Locations of Onsite Odors at the Norseland Site

The site was divided into four areas, as illustrated on Figure 5-3. Recorded odors in these sections are as follows:

- Area 1: 2 recorded odors
- Area 2: 16 recorded odors
- Area 3: 10 recorded odors

- Area 4: 14 recorded odors

The extent of site odors varied, but the majority of odors were localized to within a section, and occasionally involved more than one section. However, none of the events was classified as "site-wide", i.e., covering all four sections, or even entirely covering Sections 2 and 4, at one time.

5.3.1.2.6 Meteorological Conditions when Odors Occurred at the Norseland Site

The wind direction during odor events that Golder observed was as follows:

Based on the OVSL Meteorological Station
Fifteen events out of 25 total events with data (i.e., 60%) correlate to a general prevailing wind direction from the OVSL and the Olympic View Industrial Park sewage treatment lagoons (i.e., treatment lagoons) (Figure 5-1). That is, wind direction readings from a range of $\geq$ 220° through $\leq$ 46° (true north); both the OVSL and the treatment lagoons are at an approximately 315° (true north) orientation from the Norseland site (Figure 5-2), or within an approximately 180° directional wedge with the OVSL and treatment lagoons along a line through the median point. The other ten events were characterized by wind directions not from OVSL. These include the two odor events that were not characterized as sulfur-mercaptan.

Based on the AWOS Meteorological Station
Six events out of 12 total events with detectable wind directional data (i.e., 50%) correlate to a general wind direction from the OVSL (Figure 5-1). However, 50% of all odor events (i.e., 12 of 24) correlate to "calm" wind conditions, when the AWOS reading for wind direction = 000 at 00 knots. During calm days, thermal effects associated with temperature increases in the early morning hours after sunrise can preferentially dominate local wind conditions at the site, that is, as the cooler air in the valley below the site (to the northwest) heats up and expands it travels up the slopes from the valley below. Odors trapped in the condensed air of the valley may travel up the slope with the expanding air as the rising temperature "burns off" the fog.

This may explain why odors are associated with a raising fog in the early morning, which is a phenomenon that mainly occurs during the colder months (i.e., late fall and early winter). Every odor event associated with calm wind conditions occurred in the morning hours, 83% of which occurred between 05:00 and 09:00. Additionally, 75% of the odor events that occurred when the AWOS station reported calm wind conditions, occurred when there was a corresponding OVSL wind directional reading from the northwest, i.e., from the direction of the OVSL and treatment lagoons.

The barometric pressure trends that Golder observed were as follows:

<u>Based on the OVSL Meteorological Station</u>
Rising BP Trend = 12 / 25 events = 48 %
Falling BP Trend = 8 / 25 events = 32 %
Stable BP Trend = 5 / 25 events = 20 %

<u>Based on the AWOS Meteorological Station</u>
Rising BP Trend = 6 / 23 events = 26 %
Falling BP Trend = 7 / 23 events = 30 %
Stable BP Trend = 10 / 23 events = 44 %

There is a 66 % correspondence between barometric pressure value trends (e.g., rising, falling or stable) between the two weather stations. The barometric pressure trends that did not correspond were not diametrically opposed, i.e., OVSL with a rising trend, while AWOS had a falling trend. All of the differences in barometric pressure trends related to one station recording a rising or falling barometric pressure trend while the other related a stable trend.

5.3.1.2.7 Summary

The Golder field observations indicate that odors detected in ambient air at the Norseland site are primarily of a sulfur/mercaptan-like smell (92%) similar to the odor associated with areas on the perimeter of the OVSL. The odors observed by Golder were mainly faint to moderate in strength, were primarily detected between 06:00 AM to 09:00 AM, and could be detected in localized areas evenly spread around the southern half of the site for less than 2 % of the morning hours (06:00 to 11:00) during the winter.

The weather data reviewed at two local meteorological stations indicate that the majority of site odors occur when prevailing winds are coming from the direction of the OVSL or occur during calm wind conditions. During calm conditions, it is possible that thermal effects after sunrise may result in upslope air movement from the direction of the OVSL. However, since not all of the odor events occur under these conditions, other odor sources, including the former Puget Service Company Landfill, may also contribute to odor observations by residents and as noted during Golder's study.

Barometric pressure trends are inconclusive because it appears that odors occur relatively evenly under rising, falling and stable conditions.

Based on the nature of the predominant odors smelled onsite at Norseland and offsite around OVSL, and the direction of prevailing winds when odors were observed, the primary source of the odors at the Norseland site appears to be the Olympic View Sanitary landfill. The former Puget Service Company Landfill also may contribute to localized odor events observed in the Norseland community.

The Olympic View Industrial Park sewage treatment lagoons do not appear to be a secondary source. The sulfur odors associated with the treatment lagoons are different than the predominant mercaptan-like sulfur odor usually detected at the site and adjacent to

OVSL. Odor complaints began in 1991 which corresponds to construction efforts and changes in landfill gas management at OVSL. Testimony provided during the Coleman litigation (Coleman et al. vs. Port of Bremerton et al. 1994) indicates that the construction of the cap and the operation of the temporary gas collection system at OVSL in the years 1991 through 1993 could have resulted in atmospheric emissions of landfill gases. These emissions could have resulted in increased odors in the vicinity of the landfill. On the other hand, the Olympic View Industrial Park sewage treatment ponds began operations in 1973 with the only major change in the system occurring in 1988 when the capacity was increased. There is no correlation in time when the odor complaints started with operational changes to the treatment lagoons.

These observations are consistent with the results of the site questionnaire discussed above, and the Odor Monitoring Network Report conducted by the Bremerton-Kitsap County Health District (BKCHD 1995). While there is some uncertainty, mainly due to the subjective nature of using olfactory sensation to determine an "odor event", and the non site-specific meteorological data used to distinguish between possible sources of the odor, the OVSL and a site over an old landfill (i.e., the Norseland site), there is a reasonable degree of confidence in these observations based on the following:

- The duration of field testing;
- The redundancy of similar odors detected by multiple Golder field representatives, who were tested and trained for their olfactory discrimination;
- The status of the OVSL as an active site that is probably more capable of generating significant landfill-type emissions than the inactive closed, capped landfill underlying portions of the Norseland site;
- The meteorological data from two local meteorological stations which favors the conclusion that the active (i.e., exposed, fresh and manipulated debris) OVSL is the primary source of the odor, rather than the inactive landfill underlying portions of the Norseland site.

5.3.2 Initial Soil Gas Study

This section describes the results of the Initial Soil Gas Study. The performance of this study is described in Section 2.4.1.

5.3.2.1 Results of Chemical Analysis

VOCs detected in soil gas at the site as part of this study are presented in Table 5-7. Table 5-8 shows the results for fixed gases, sulfur gases, aldehydes and amines analyses. Table 5-9 depicts the distribution across the site of all compounds detected (except atmospheric gases).

Figure 5-4 depicts the total VOC concentrations and numbers of compounds detected at each probe. The distribution of compounds across the site which exceed screening values is shown in Figure 5-5.

5.3.2.2 Data Summary

Review of the data shown in Tables 5-7, 5-8 and 5-9, and Figures 5-4 and 5-5 indicates the following:

- A variety of volatile organic compounds, including a number of TICs, were detected in the soil vapor throughout the site. The most frequently detected VOCs at the site include acetaldehyde (18 locations), acetone (17 locations), formaldehyde (16 locations), and unknown hydrocarbons (11 locations).

- Elevated values of total VOCs in this Initial Soil Gas Study, as compared to other locations, are associated with probes SV-10 (8317 ppb), SV-45 (1310 ppb), and SV-49 (522 ppb). The elevated values are largely due to the presence of a number of TICs in each sample.

- No mercaptans, other sulfides or amines were detected. The detection limit for these compounds was often up to 2 orders of magnitude greater than the human odor threshold (American Industrial Hygiene Association, 1989).

- Compounds detected which exceed the screening values and/or compounds which have detection limits which exceed the screening values consist of acetaldehyde, benzene, chloroform, chloromethane, formaldehyde, tetrachlorethene (PCE), trichloroethene (TCE), and 2-propenenitrile. An exceedance of at least one screening value occurred at every probe but two (SV-46 and SV-1).

- Methane was detected at one location (SV-10). The concentration at SV-10 was 2.2%. This concentration exceeds 25% of the lower explosive limit (LEL) for methane. This location also demonstrated the maximum total VOC concentration in this Initial Soil Gas Study. Methane detection limits were between 0.001 and 0.002 percent (10 to 20 ppm). WAC 173-304-460(2)(b)(i)(A) limits explosive gases at on-site landfill facilities to 25% of the lower explosive limit (LEL) of methane. WAC 173-304-460(2)(b)(i)(C) limits explosive gases at off-site facilities to 100 ppm (0.01%) methane. Each of these, however, is only applicable to the interiors of building structures. These data, however, indicate the potential to exceed these criteria at the SV-10 location.

5.3.3 Soil Gas and Skirt Study

This section describes the results of the Soil Gas and Skirt Study. The performance of this study is described in Section 2.4.2. As described in Section 2.4.2.1, the results of this Initial Soil Gas Study raised concerns about potential on-site exposure to compounds originating from the former Norseland Landfill. Accordingly, additional soil gas data was collected in conjunction with a study of the skirt air beneath the residents' trailer homes that are located above landfilled materials. The conclusions presented in Section 5.4 below are based on both soil gas sampling events and the skirt air investigation.

5.3.3.1 Results of Chemical Analysis

The results of the Soil Gas and Skirt Study are summarized in Tables 5-10 and 5-11 which present the results by lot for detected VOCs and atmospheric gases, respectively. Table 5-12 depicts the distribution across the site by lot of all compounds detected (except atmospheric gases). Figure 5-6 shows the distribution across the site of total volatile organic concentrations. Figures 5-7 through 5-14 depict the distribution by lot of compounds which exceed regulatory screening values. The distribution of other key constituents of interest, toluene and m,p-xylene, is shown in Figures 5-15 and -16, respectively. Chemical analyses conducted for soil gas and skirt samples (Table 2-1) included volatile organics. TICs were restricted to acetone, tetrahydrofuran, and 2-butanone only. Atmospheric gases were analyzed only for the skirt air samples.

5.3.3.2 Data Summary

Review of the data shown in Tables 5-10, 5-11 and 5-12 indicates the following:

- As in the Initial Soil Gas Study, a variety of organic constituents (approximately 20 organic chemicals) were detected throughout the site in soil gas and skirt air samples. At least one VOC was detected in every soil gas and skirt air sample collected. The maximum total VOC concentration measured in a skirt sample was about 140 ppb-v. Assuming all VOCs are explosive, this concentration is far below the 100 ppm threshold specified in WAC 173-304-460 for the interior of off-site structures. Other VOCs were detected sporadically throughout the site with a few detections in the soil gas and skirt air samples.

- The most frequently detected compounds (Table 5-12) in the Soil Gas and Skirt Study were acetone, benzene, freon-12, toluene, xylene, carbon tetrachloride, methylene chloride and chloromethane. Acetone was detected in 24 soil gas samples (maximum value of 95 ppb-v) and 22 skirt air samples (maximum value of 130 ppb-v). Benzene was detected at 16 soil gas locations (maximum value of 15 ppb-v) and 27 skirt air locations (maximum value of 4.4 ppb-v). Freon-12 was detected in 6 soil gas samples (maximum value of 18 ppb-v) and 12 skirt air samples (maximum value of 3.3 ppb-v). Toluene was detected at 18 soil gas locations (maximum value of 17 ppb-v) and 28 skirt air locations (maximum value of 7.2 ppb-v). m,p,-xylene was detected at 14 soil gas locations (maximum value of 18 ppb-v) and 21 skirt air locations (maximum value of 3.8 ppb-v). Carbon tetrachloride was detected in five skirt air samples (maximum value of 0.2 ppbv). Methylene chloride was detected in five skirt air samples (maximum value of 0.4 ppbv). Chloromethane was detected at 2 soil gas locations (maximum value of 1.4 ppb-v) and 14 skirt air locations (maximum value of .42 ppb-v). As discussed in Section 2.4.2, the ambient air sample was collected upwind of the Puget Service Company landfill area and therefore represents air unaffected by the Norseland landfill (i.e. background). Seven of the 22 VOCs were also detected in ambient air.

- Most of the above compounds were also detected in the upwind ambient air with levels of 3.1 ppb-v for benzene, 5.1 ppb-v for toluene, 2.8 ppb-v for m,p,-xylene, and 0.26 ppb-v for chloromethane.

- Elevated levels of total volatile organics, as compared to ambient levels measured in the field blank, were observed at many sampling sites throughout the site in both soil gas and skirt air. Figure 5-6 shows the distribution of total volatile organic concentrations included in the soil vapor and skirt air study by lot.

- Methane was not detected in any skirt sample collected as part of this task. Lot 62, the one location where methane was detected earlier in SV-10 probe, was not sampled under this task, because lot 62 was a vacant lot during this investigation.

- Compounds exceeding the screening levels are shown in Tables 5-10 and 5-12. These compounds include benzene, carbon tetrachloride, methylene chloride, chloroform, 1,2-dichloropropane in skirt air samples and benzene, freon-12, tetrachloroethene (PCE) chloromethane, chloroform, and trichloroethene (TCE) in soil gas samples. Figures 5-7 through 5-14 depict the levels of each of these compounds at the site by lot. In addition, the levels of toluene and m,p-xylene, two frequently detected compounds, are shown in Figures 5-15 and 5-16, respectively. It should be noted that VOC detection limits were frequently above Method B and ASIL screening levels. Additional VOCs may be present in the samples above the screening levels, but could not be detected.

- Both carbon tetrachloride and methylene chloride appear to be grouped in skirt air along the eastern edge of the landfill boundary, although these compounds were not detected in the underlying soil gas samples. 1,2-dichloropropane was not detected in lot 39 soil gas or any subsequent skirt air sample of lot 39 (see Comparative Ambient Air Study in Section 5.3.5).

5.3.4 Investigation of Ambient Air During Odor Events

This section describes the results of the investigation of ambient air during odor events. The performance of this study is described in Section 2.6.2.

5.3.4.1 Results of Chemical Analysis

Results of chemical analysis for this task are summarized in Table 5-13. Sampling under this study consisted of soil gas and ambient air sampling to identify potential contaminants that may be present in the ambient air during odor events. Sampling took place during two odor events. During the first event, which occurred March 9, 1995, four soil vapor samples, 2 on-site ambient air samples, and 2 off-site ambient air samples were collected. During the second event, which occurred March 17, 1995, three soil vapor samples, 2 on-site ambient air samples, and 2 off-site ambient air samples were collected. The off-site samples were collected in the vicinity of OVSL. The locations of sampling are shown in Figures 2-7 and

2-8. Analyses conducted included (Table 2-1) sulfides, aldehydes, amines, fixed gases, and volatile organics, including TICs.

Both odor events were described by Golder staff as a sulfur-mercaptan-like odor with a strength of 3 to 4, and 1 to 5 for the March 9 and 17 events, respectively. The weather before the odor event of March 9 was rainy with winds out of the southwest, temperature of 46°F, and a barometric pressure of approximately 28.86 with a decreasing trend. During the odor event, the weather was overcast with no rain, temperature of 49°F, and little to no wind. The March 9 odor event lasted from approximately 1105 to 1120. After the odor event the wind was light from the southwest. The weather before the odor event on March 17 was cloudy with winds from the west, temperature of 41°F, and a barometric pressure of approximately 29.76. During the odor event, the wind became out of the east. The odor event on March 17 lasted from approximately 0930 to 1045. Conditions during all of the odor events observed by Golder staff at the site are summarized in Table E-1 in Appendix E.

5.3.4.2 Data Summary

Review of the data shown in Table 5-13 indicates the following:

- Compounds detected during the odor events were similar to those observed during earlier sampling efforts at the site. No sulfur gases or amines, which are compounds with the potential to produce odors like those which have been observed during odor monitoring, were detected in any of the ambient air or soil gas samples. Only one aldehyde detection (formaldehyde in an off-site ambient air sample) was observed. It should be noted, however, that the detection limits for the sulfur gases and amines were in some cases 2 orders of magnitude higher than their human odor thresholds.

- Apart from the TICs, the most frequently detected compounds in ambient air were benzene, toluene, ethylbenzene, xylenes, chloromethane, freon-11, freon-12, tetrachloroethene (PCE), and 1,2,4-trimethylbenzene. Out of 14 total ambient air samples collected over the two odor events (including 6 QA samples), benzene was detected 13 times, toluene 11 times, ethylbenzene was detected in 9 samples, xylenes in 13 samples, chloromethane was detected 10 times, freon-11 and freon-12 were detected 13 times each, PCE 5 times, and 1,2,4-trimethylbenzene 9 times. The maximum detected concentration for benzene was 0.85 ppb-v, for toluene it was 2.9 ppb-v, for ethylbenzene it was 0.42 ppb-v, for m,p-xylene it was 1.2 ppb-v, for chloromethane it was 2.1 ppb-v, for freon-11 it was 0.9 ppb-v, for freon-12 it was 1.7 ppb-v, for PCE the maximum concentration was 1.3 ppb-v, and for 1,2,4-trimethylbenzene the maximum value was 0.5 ppb-v.

- For soil vapor, a very similar list of compounds was observed. Benzene was detected at a maximum value of 11 ppb-v (SV-10), toluene at a maximum value of 67 ppb-v (SV-45), m,p-xylene at a maximum value of 0.58 ppb-v (SV-45), chloromethane at a maximum value of 0.95 ppb-v (equipment blank sample), freon-11 at a maximum value of 0.7 ppb-v (SVP-19), and freon-12 at a maximum value of 42 ppb-v (SVP-36). PCE, 1,2,4-trimethylbenzene and ethylbenzene were not detected.

- TICs were observed in most samples, but especially in a soil gas sample at the SVP-10 location (previous SV-10 location). Total TICs from three SVP-10 samples measured 117400, 125900, and 43800 ppb-v. This compares to total TIC concentrations in all of the other soil gas and ambient air samples of about 10 to 200 ppb-v. TICs observed at SVP-10 appear to be representative of fuel hydrocarbons.

- Methane was detected in four ambient air samples: Constance Rd., the Constance Rd. duplicate and the Saw Mill Rd. samples for the March 17 event, and the Saw Mill Rd. sample for the March 9 event. All of these samples represent off-site samples near OVSL. In soil vapor, all of the methane detects occurred at location SVP-10, the only place methane has been previously detected.

The results are compared in Table 5-13 to the regulatory screening criteria. As seen in Table 5-13, benzene, chloromethane, formaldehyde and tetrachloroethene (PCE) were detected in ambient air at levels above the screening concentrations, and benzene, toluene, freon-12 and PCE exceeded the screening value in soil vapor.

- In ambient air, benzene and chloromethane exceeded the screening values far more frequently than formaldehyde and PCE. Benzene exceeded the screening value in 13 of 14 ambient air samples (including field blank samples). For chloromethane, nine of 14 samples (including the field blank) exceeded the screening value. Formaldehyde and PCE exceeded the screening values in 1 and 3 samples, respectively. All of the formaldehyde and PCE (except once at AA-3 on March 17 event) exceedances in ambient air were associated with the off-site sample locations near OVSL. Therefore, benzene and chloromethane are the key chemicals above levels of concern in ambient air.

- In soil vapor, benzene exceeded the screening value in two instances, and toluene, freon-12, and PCE exceeded the screening value in one instance each. Benzene was observed at SV-10 at a concentration of 11 ppb-v which was the highest benzene concentration observed during this sampling task. Tetrachloroethene was detected in soil gas (SVP-36) and in several previous soil gas samples at Norseland.

In order to evaluate the nature of the source of chemicals observed in ambient air at Norseland (i.e. whether it is an on- or off-site source), ambient air results from the odor investigation are plotted in Figure 5-17. The figure compares on-site and off-site ambient air data for benzene, chloromethane, and total VOCs. As seen in the figure, the highest ambient air values for benzene during both events occurred in the off-site samples, while for chloromethane, the maximum values occurred in the on-site samples. For total VOCs, the highest values were with the on-site samples during the first event, and with the off-site samples during the second event.

5.3.5 Comparative Ambient Air Investigation

This section describes the results of the comparative ambient air investigation. The performance of this study is described in Section 2.6.3.

5.3.5.1 Results of Chemical Analysis

This study was conducted to characterize local off-site air versus on-site air, air in mobile home skirts, and soil vapor. Thirteen samples were collected from each sampling event during 6 separate events. The events occurred on May 30, June 1, June 6, June 7, June 14, and June 16, 1995. Sampling locations are shown in Figures 2-9 to 2-15. Samples were analyzed for VOCs with TICs (Table 2-1). Sampling was conducted when barometric pressure was stable or falling and wind direction was detectable and steady from one general direction. Table 5-14 lists the chemicals detected in ambient air, soil gas and skirt air during this task.

General review of the data in Table 5-14 indicates the following:

- Very similar types of compounds were detected as in the previous studies, primarily consisting of benzene, chloromethane, freon, xylenes, and toluene, as well as a number of TICs, consisting of a variety of organic compounds that are typically contained in petroleum fuels.

- Compounds exceeding regulatory criteria in the ambient air included benzene, chloromethane, methylene chloride, 1,1-dichloroethene (1,1-DCE), tetrachloroethene (PCE), and trichloroethene (TCE). By far the most frequent exceedances were for benzene and chloromethane, which each had more than 10 sample exceedances. This is consistent with the data from the odor event sampling. Methylene chloride exceeded the screening value twice (on-site and an off site sample), 1,1-DCE one time (offsite), PCE had two exceedances (offsite), and TCE had one exceedance (offsite). The benzene and chloromethane exceedances were in both on and offsite samples. Benzene was detected at a maximum concentration in ambient air of 1.1 ppbv, and chloromethane was detected at a maximum ambient air level of 1.4 ppbv.

- Compounds exceeding regulatory criteria in soil vapor and skirt air included benzene, chloromethane, methylene chloride, 1,1-dichloroethene, 1,2-dichloroethane, tetrachloroethene (PCE), trichloroethene (TCE), vinyl chloride, 1,1,2-trichloroethane, 1,3-butadiene. By far the most frequent exceedances were for benzene and chloromethane, which each had at least 10 sample exceedances. All of the other compounds had three or fewer exceedances, except for 1,2-dichloroethane which had 9 exceedances. Methylene chloride was detected several times in skirt air and soil gas samples. Most of the methylene chloride detections occurred during the first sampling period.

5.3.5.2 Statistical Analysis of Benzene, Chloromethane and TIC Data

The results of the odor event sampling and the comparative ambient air sampling have shown that benzene and chloromethane are the most frequently detected compounds exceeding air criteria at Norseland. Evaluations conducted as part of the odor investigation suggested that the source of these compounds may be off-site; however, the data were ambiguous and inconclusive in this regard. In order to more fully evaluate the source(s) of these compounds at the site, the data that was generated from the comparative Ambient Air

Investigation are analyzed statistically for these constituents. Appendix J describes the statistical analyses performed on the Norseland data. The statistical analysis is performed for benzene and chloromethane. Additionally, total TICs are also analyzed. TICs are included in the evaluation because they are pervasive at the site in soil gas, skirt air, and ambient air samples but cannot be evaluated from a health risk standpoint due to of a lack of toxicological data. Figures 5-18, 5-19 and 5-20 present the results for the six events for benzene, chloromethane and total TICs, respectively.

ANOVA Test

The results of the ANOVA are shown in Table 5-15. The purpose of this analysis was to determine whether or not there are significant differences in the constituent concentrations measured in the skirt, onsite and offsite ambient air samples. As seen in this table, the concentration of benzene in the skirt air is significantly greater than in the offsite air. The other comparisons (hypotheses) for benzene are not significant at the 0.10 level (90% confidence level), indicating that the onsite air is not elevated over offsite air, nor is skirt air elevated over onsite air.

For chloromethane, the significance level of the skirt versus offsite air concentration comparison test is so small, that if the hypotheses had been reversed, there would be a significant difference. That is, the skirt air concentration of chloromethane is significantly less than the offsite air concentration at between the 97.9% and 98.0% confidence level. The other comparisons for chloromethane are not significant at the 90% confidence level. In other words, skirt air chloromethane is not elevated over offsite air, onsite air is not elevated over offsite air, and skirt air is not elevated over onsite air. Also, the analysis actually indicates that offsite air is elevated over skirt air.

For TICs, all three comparisons are not significant at the 0.10 level (90% confidence level). In other words, skirt air TICs are not elevated over off-site air, onsite air is not elevated over off-site air, and skirt air is not elevated over onsite air.

Wilcoxon Rank Sum (WRS) Test

The results of the WRS test are shown in Table 5-16. The purpose of this analysis is to determine during which individual sampling events significant differences occurred. Benzene concentration is significantly higher in the skirt air as compared to the offsite air for only the first and third sampling events. For the other events, the benzene level in the skirt air is not significantly elevated over the off-site air. The confidence levels are lower for the WRS test, as compared to the ANOVA, because of the small sample sizes for each sampling event. Chloromethane concentration is significantly lower in the skirt air as compared to the offsite air for only the first sampling event. The TICs are significantly higher in the skirt air compared to the offsite air for only the first sampling event.

The estimates of the difference between the skirt and offsite air concentrations of benzene, chloromethane and TICs are shown in Table 5-17. Benzene concentrations in the skirt air are greater than offsite by 0.248 ppbv and 0.323 ppbv during the first and third sampling event, where the difference between skirt and offsite air concentration is significant, according to the WRS test. As indicated above, skirt air benzene concentrations for sampling events other than the first and third event were not significantly elevated over offsite air. The chloromethane concentrations in the skirt air are less than the offsite air by between 0.519 and 0.560 ppbv during the first sampling event. The TICs concentration in skirt air is greater than the offsite air by 33.8 ppb-v during the first sampling event. The other estimates shown in Table 5-17 are not significantly different than zero.

Therefore, the results of this analysis have indicated that there was no significant difference noted between onsite air and offsite air benzene levels. Benzene in the skirt air was slightly higher in concentration than in the offsite air, but this difference occurred only during two of the six sampling events. For the other four events, there was no significant difference. When the difference was significant (first and third events), the magnitude of the difference between skirt air and offsite air was small - skirt air levels were estimated to be higher by about 0.2 to 0.3 ppbv.

Upper Confidence Level Test of Individual Skirts

Another way of evaluating these data is to look at the benzene levels at each individual skirt and compare them to background. In Table 5-18, all of the benzene data from the comparative ambient air study are tabulated. Since the offsite samples were collected upwind of Norseland, these samples represent air not impacted by the site, and can be considered as background samples. Using guidance presented in Ecology (1992b), the skirt air data are compared to the background data to determine whether any of the skirts exhibit benzene levels above background. A 90th percentile concentration (.58 ppb-v) is used to represent benzene background at the site based on the offsite samples. 95% upper confidence limits (UCL_{95}) are used to represent the average benzene concentration at each skirt location. As seen in the table, the only location where the skirt air exceeds the background concentration is lot 63. This indicates that lot 63 is the only skirt where benzene levels exceeded the natural benzene concentration in ambient air during the ambient air study. Lots 63 and 62 were the location where the highest benzene levels were observed in previous soil gas samples.

5.4 Air Pathway Fate and Transport

Subsurface VOC sources have been identified within the former Norseland Landfill. These sources occur on a spotty or patchy basis, which is consistent with the spatial heterogeneity expected within landfilled wastes. The presence of these sources results in exceedances of certain regulatory screening criteria in soil gas and skirt air in a number of locations.

The detection limits in many air samples are higher than regulatory or screening levels which creates difficulty and uncertainty in evaluations of their presence. In addition, background air quality contains many of the detected VOCs which are commonly used chemicals in our industrial society. In an attempt to gain clarity about the nature and extent of contamination present at the Norseland Site, a modeling effort presented below in Section 5.4.1 was conducted and information on anticipated VOCs in background air is provided in

Section 5.4.2. Section 5.5.3 provides the overall conclusions regarding air quality at the Norseland Site.

Concentrations of organic vapors observed in ambient air indicate no site-wide human health risk. Due to the relocation of the Norseland residents, there are no potential receptors left on site that could be subject to localized exposure.

5.4.1 Conceptual Model

5.4.1.1 Introduction

One result of this RI is that subsurface sources of VOCs have been identified in the former landfill. These sources produce VOC concentrations that exceed regulatory screening values at some locations in the soil gas throughout the site. In addition, detection limits for many analytes on soil gas samples are above regulatory screening values. Soil gas is not in the breathable zone, however, and mixes with ambient air prior to exposure to any receptors. These results nonetheless indicate the *potential* for possible health concerns regarding site exposures to vapors emanating from the landfill, and there is some uncertainty as to the risk posed, if any.

In addition to this area of uncertainty, some chemicals with the potential to cause odors at the site (sulfides, amines, and aldehydes) have detection limits which are, in some cases, several orders of magnitude higher than their human odor thresholds. These chemicals have not been detected in soil gas or ambient air at the site to any significant extent during odor events. This leads to some uncertainty as to the nature of the chemicals causing site odors. However, there is still the potential that sources within the landfill may serve as secondary sources on a localized bases. In addition, some residents may be more sensitive to odors than others.

This section of the report consists of a conceptual model of site air which will be used to help further resolve these issues. The conceptual model describes the primary migration pathways of soil gas at the site and means of exposure. It is not intended to describe every aspect of soil gas movement and contaminant migration, but rather to be a general tool which can be useful in evaluating site conditions. This conceptual model is primarily used herein to provide additional insight into the two areas of uncertainty described above:

- whether chemicals in soil gas that exceed or have detection values above regulatory screening values represent a potential health hazard, and

- if the former landfill beneath the site represents a source of odors.

5.4.1.2 Description of Model

A fundamental objective of the RI is to gather sufficient data to evaluate the nature and extent of contamination from the Norseland landfill. The landfill contains hazardous substances as evident from the analysis of subsurface soil gas. The primary pathway of exposure to onsite residents is the migration of landfill soil vapors to the surface and dispersion into the atmosphere or into homes. For Norseland landfill soil gas to enter the home, the most direct route is through the skirt air then into the house through its floor.

In United States (U.S.) ambient atmospheres, as well as within U.S. home atmospheres, it has been well documented that many hazardous substances exist at detectable concentrations (Environmental International, 1986; Evans et al. 1992). Sources of hazardous substances in the ambient air and home atmosphere are many and are beyond the scope of this RI. This RI evaluates the incremental impacts to the ambient air and skirt air at the Norseland site from hazardous substances originating from the Norseland landfill.

Figure 5-21 illustrates the migration of contaminants originating from within the landfill as a subsurface source. Volatile compounds volatilize from the Norseland landfill sources to the soil gas (soil atmosphere or air between the grains of soils). The concentration of volatile compounds in the soil gas will be the greatest nearest to the actual source. Volatile compounds migrate in the soil gas at Norseland primarily by gaseous diffusion. Advection (soil gas air currents) is not significant at Norseland because active decomposition (generating gases mainly methane and carbon dioxide) is only observed to be occurring at one location (from probe SV-10 in the vicinity of lots 62 and 63) and advection due to barometric changes only temporarily effect near surface exchanges of air. Gas diffusion (migration of a gas due to concentration gradients) in the subsurface environment spreads volatile organic compounds away from the original landfill source and is at lower concentrations in the soil gas at further distances from this source.

Volatile compounds in the subsurface soil gas eventually migrate or diffuse toward land surface and into the ambient atmosphere (Figure 5-21). The emission of subsurface volatile compounds to the atmosphere reduces the concentration dramatically mainly because wind (advective movement of ambient air) is so great relative to soil gas diffusion. This emission also creates an average emission rate to the ambient air that is sustained as long as the original source in the landfill is not significantly depleted.

The emission rate of soil gas volatile compound to the atmosphere can be estimated using Fick's Law of Diffusion through a porous medium using the following equation:

$$Emission\ Rate = \frac{-\tau_a D_a \theta_{sa} (C_{AA} - C_{SG})}{Z}$$

Where:

τ_a = tortuosity of porous medium (.2 to .4)
Da = molecular diffusion of gases (almost all are between 0.07 and 0.12 cm^2/sec)
θ_{SA} = air filled porosity (assume 0.25)
C_{AA} = Concentration of volatile compound in ambient air (assume 0 to maximize emission rate).
C_{SG} = Concentration of volatile compound in the soil gas ($\mu g/cm^3$)
Z = Distance from C_{SG} to the ambient atmosphere or the length of the soil gas probe ≈ 3 feet or 90 cm.
Emission Rate = $\mu g/cm^2$ sec

From the calculation of emission rate, it is then possible to estimate the concentration that would result in the ambient air. Exact modeling of such phenomenon can be rigorous or made very simple depending on how exact an answer is required. For the purposes of this RI, estimates are made based on a simple model using input parameters that would conservatively maximize the calculated concentrations in the ambient air at Norseland. The equation used in this model is as follows:

$$\textit{Ambient Air Concentration} = \frac{\textit{Downwind Length of Emission Source} \times \textit{Emission Rate}}{\textit{Average Wind Speed} \times \textit{Mixing height}}$$

Where:

Ambient Air Concentration = $\mu g/cm^3$

Downwind Length of Emission Source = Assumed about 500 feet (15,000 cm) about the width of the landfill

Emission Rate = From previous equation

Wind Speed = Assumed 2.5 miles/hours or about 110 cm/sec. (this is 1/2 the EPA default value for air modeling)

Mixing height = 6 feet (about 180 cm). This is the EPA normal breathing zone value but is very conservative since it acts like a ceiling and does not allow volatile compounds to disperse higher than 6 feet above the ground over a total path of 500 feet.

From the results of this model, a Natural Dilution Factor can be calculated by simply the following:

$$\text{Natural Dilution Factor (dimensionless)} = \frac{\text{Concentration of Volatile Compound in Ambient Air}}{\text{Concentration of Volatile compound in soil gas from soil gas probes}}$$

The Natural Dilution Factor represents the reduction in concentration to the ambient air due to natural processes that result from an initial concentration of a volatile compound in the RI measured soil gas. The equations reveal that this dilution factor is independent of the actual soil gas concentration. Although the resulting ambient air concentration is calculated to be higher when the initial soil gas concentration is higher, the ratio of these concentrations are the same. When the model conditions such as wind speed or length of emission source is changed, only then does the calculated Natural Dilution Factor change.

Our simple but very conservative model results in a Natural Dilution Factor less than 0.0001 (1E-04). This indicates that a volatile compound having a soil gas concentration of 10 ppb will result in an incremental increase in the ambient air of about 0.001 ppb. In other words, soil gas concentrations will be reduced 10,000 times in the ambient air environment.

5.4.1.3 Model Application

This dilution factor is significant in addressing the two areas of uncertainty discussed at the beginning of this section. In Table 5-19, all of the soil gas exceedances observed during the RI are listed. In the table, the ratio of the screening value to each sample result is shown. This ratio indicates the dilution needed to reduce the soil gas concentration to below screening values. Since the model predicted a natural reduction of 10,000 times, ratios in Table 5-19 would have to be greater than 10,000 to be a potential concern for impacting ambient air. As seen in the table, the calculated ratio exceeds the 10,000 times in only a single sample (shaded 1,3-Butadiene). In addition, as shown in Table 5-6, none of the analyte detection limits exceed the VOC regulatory screening values by 10,000 times. In other words, when dilution of the soil gas with ambient air is considered using the conceptual model described above and the calculated dilution factor is applied to each of the screening value exceedances, only a single sample could result in an exceedance in the ambient air. None of the other instances would be expected to result in ambient air impacts above regulatory screening values. The conclusion of this simple but very conservative calculation is that soil gas at the site is not expected to result in impacts to ambient air which would be considered hazardous to health based upon regulatory screening values. This is consistent with ambient air monitoring data which have shown that onsite air is not elevated over offsite air for the key contaminants detected in ambient air at the site.

With respect to the issue concerning odors, the conceptual model conservatively estimates that soil gas undergoes a dilution of approximately four orders of magnitude when it is emitted to the atmosphere. Since the detection limits for the sulfide, amines and aldehydes, which are odorous compounds potentially causing the odors, are only about 2 to 3 orders of magnitude above human odor thresholds, these compounds should have been detected in the soil gas at the site during the odor event sampling if the soil gas was the source of the odors and the compounds were present in the soil gas. The fact that they were not detected in the soil gas suggests that they are not present in the soil gas at levels high enough to cause site odors. This supports the view that the former landfill beneath the site is probably not a primary source of odors at Norseland. However, as noted above, due to spatial or temporal variability and variable resident sensitivity, the landfill may serve as a source of other odors on a localized basis.

5.4.2 Off-Site Sources of VOCs at Norseland

The odor event sampling provided data which suggested that offsite sources may be responsible for the levels of benzene and other VOCs (toluene, ethylbenzene, xylenes, carbon tetrachloride, tetrachloroethene, and methylene chloride) noted in ambient air and skirt air at the site. The data were not adequate to fully validate this conclusion, however, and as a result, the comparative ambient air investigation was conducted to more fully evaluate the sources of chemicals in ambient air at the site. The results of the comparative ambient air study have indicated that while skirt air benzene is elevated over offsite air at lot 63, skirt air benzene at the other lots sampled is not elevated nor is onsite ambient air elevated over offsite air. This raises the question as to what constitutes the source of the benzene (other than the source at lot 63) and potentially other VOCs in ambient air and other skirts air.

In order to address this question, information on ambient air concentrations of benzene was obtained from toxicological profiles prepared by the Agency for Toxic Substances and Disease Registry (ATSDR). In addition, profiles were also obtained for toluene, ethylbenzene, and xylenes, carbon tetrachloride, tetrachloroethene, and methylene chloride. The data discussed below is summarized in Figure 5-22.

Benzene. Daily median benzene concentrations were reported in the Volatile Organic Compound National Ambient Database (ATSDR, 1992 update) over the period 1975 to 1985. Outdoor air data from 300 cities and within 42 states were tallied with the following results: remote air (0.16 ppb), rural air (0.47 ppb), suburban air (1.8 ppb), and urban air (1.8 ppb). City-specific values, measured with a range of 12 to 18 samples during the summer of 1986 by EPA, included: Houston (7.5 to 112 ppb, with a median of 22.5 ppb); St. Louis (3.8 to 73 ppb, with a median of 11.1 ppb); Denver (17.9 ppb to 39.5 ppb, with a median of 24.5 ppb); Philadelphia (1.9 to 17.9 ppb, with a median of 6 ppb); New York (5.3 to 31.8 ppb, with a median of 10.5 ppb); and Chicago (3.8 to 30.3 ppb, with a median of 20.7 ppb). Ambient air values for benzene measured at Norseland during the odor event sampling ranged from 0.85 to 0.36 ppb.

Toluene. Outdoor air data for toluene are based on a 1990 update to the Volatile Organic Compound National Ambient Database. The following results were obtained: remote air (0.008 ppb), rural air (5.0 ppb), suburban air (2.7 ppb), and urban air (42.0 ppb). Ambient air values for toluene measured at Norseland during the odor event sampling ranged from 2.9 to 0.71 ppb.

Ethylbenzene. Outdoor air data for ethylbenzene is provided in a 1990 update to the Volatile Organic Compound National Ambient Database. Outdoor air data from 6 remote and 122 rural locations were tallied with the following results: remote air (0.16 ppb) and rural air (0.013 ppb). Outdoor air data for 886 suburban and 1,532 urban locations were tallied with the following results: suburban air (0.62 ppb) and urban air (0.62 ppb). City-specific values measured with approximately 100 samples between 1980 and 1984 include: Houston (1.5 ± 1.6 ppb, St. Louis (0.6 ± 0.5 ppb), Denver (2.2 ± 3.1 ppb), Philadelphia (0.8 ± 0.8 ppb), Staten Island, NY (2.7 ± 4.2 ppb), and Chicago (0.8 ± 1.2 ppb). Ambient air values for ethylbenzene measured at Norseland during the odor event sampling ranged from 0.42 to 0.27 ppb.

Xylenes. Ambient air levels for xylenes in industrial and urban areas of the United States were to range from 0.69 to 88 ppb. The median concentration of total xylenes based on an ATSDR 1990 update for approximately 115 rural/remote areas was reported to be 3.5 ppb based on a compilation of published and unpublished atmospheric data. For urban/suburban locations, a median concentration of 76.0 ppb was reported based on approximately 1,900 observations in published and unpublished atmospheric data. Ambient air values for xylenes measured at Norseland during the odor event sampling ranged from 1.64 to 0.56 ppb.

Carbon Tetrachloride: National values compiled from over 3700 locations around the country varied widely, ranging from non-detectable to high of 70$\mu g/m^3$ (i.e., 11 ppb). The average value for rural areas was reported as 0.8$\mu g/m^3$ (i.e., 0.13 ppb). This average value was also detected in 5 coastal monitoring stations located throughout the world. Average values in suburban and urban areas located near CCl_4 sources were reported at 1.2$\mu g/m^3$ (i.e., 0.19ppb), and 3.7$\mu g/m^3$ (i.e., 0.59ppb), respectively.

Tetrachloroethylene (PCE): Tetrachloroethylene is a widely distributed compound which is released to the environment from industrial emissions and consumer products. Ambient air concentrations of tetrachloroethylene prior to 1981, taken from over 2,500 monitoring points have been reported in the range from non-detectable to 31 ppb in New Jersey. Data from Portland, OR in 1984 indicated that ambient air concentrations ranged from .058 to 0.305 ppb. Average ambient air concentrations have been reported as 0.16ppb in rural and remote areas, 0.79 ppb in urban and suburban areas. Recent studies support the widespread occurrence of this compound in urban areas. In 1987, air concentration from three urban areas in the United States were reported in that range of .035 to 1.3 ppb.

Methylene Chloride: Methylene Chloride has been detected in ambient air samples from around the world. Average background concentrations have been estimated at 0.05 ppb. However, concentrations occurring in urban areas are generally one to two orders of magnitude higher than background averages. Although maximum values from 6.2 to 56 ppb have been reported. Estimates for rural and suburban areas range from 0.23 to 1.9 ppb.

The concentrations of BTEX compounds observed in ambient air at Norseland appear to correspond with similar concentrations noted in rural and suburban/urban ambient air presented above.

5.5 Conclusions

Primary conclusions of this RI are separated into the following sections dealing with soil, groundwater, and air.

5.5.1 Soil

As discussed in Section 5.1, no chemical constituent compounds above MTCA cleanup standards were detected in the soil samples collected at the site. However, landfilled materials are typically heterogeneous and very difficult to characterize. Based on the soil gas analyses, landfilled waste at the Norseland site probably contains compounds which are considered hazardous under current law. Subsurface sources of VOCs are present on a patchy basis at the site. In addition, some landfilled materials are exposed at the site, particularly on steep slopes and densely vegetated areas. These materials are subject to erosion and dispersal in the surface environment.

5.5.2 Groundwater

While some compounds were detected at levels above potential regulatory criteria in groundwater, the source of the compounds does not appear to be associated with the site. Some organic compounds were detected, but the highest values were generally associated with the upgradient well. None of the organics detected at the site exceeded any regulatory criteria. Therefore, the former landfill does not appear to be impacting groundwater beneath the site, and no COPC are identified for groundwater in this RI.

5.5.3 Air Conclusions

Therefore, the following primary conclusions are reached with regard to air:

SUBSURFACE VOC SOURCES.

- Subsurface VOC sources have been identified within the former Puget Service Company landfill. These sources occur on a spotty or patchy basis, which is consistent with the spatial heterogeneity expected based upon the types of wastes known to have been received at the site. The presence of these sources results in exceedances of certain regulatory screening criteria in soil gas and skirt air in a number of locations; however, due to dilution which occurs when soil gas is emitted to the air, available data indicate that these chemicals will not be expected to result in unacceptable impacts to ambient air. The most significant subsurface sources detected are associated with the vicinity of lots 62 and 63, where several VOC constituents were consistently observed, including benzene, TICs and methane.

- Concentrations of organic vapors in ambient air indicate no site-wide human health risk. Due to the relocation of the Norseland residents, there are no potential receptors left on site that could be subject to localized exposure.

ODORS

- Odorous compounds (sulfides, amines and acetaldehydes) were not detected to any significant extent in the soil gas or ambient air at the former landfill. Even though the detection limits of these compounds are 2 to 3 orders of magnitude higher than human odor thresholds, these compounds should have been detected in the soil gas beneath the site if they were present and causing odors that were observed in the ambient air. The fact that these compounds were not detected in the former landfill, combined with the results of onsite odor monitoring by Golder staff, results in the conclusion that the primary source of odors in the area is the OVSL. The former landfill beneath Norseland may contribute to odors in localized areas under certain meteorologic conditions and subsurface emissions. Subsurface odors were observed from test pit TP-7 in lot 62 when exposed by excavation.

IMPACTS TO SKIRT AIR AND AMBIENT AIR FROM THE FORMER LANDFILL

- Subsurface sources of VOCs exist at Norseland and are emitting to the ambient atmosphere. The incremental increase in VOC concentrations to the local atmosphere is estimated to be insignificant. A simple but very conservative model predicts on the average that incremental ambient air impacts from subsurface sources at Norseland would be 10,000 times less than the concentration of VOCs in the subsurface environment, and on the average would be less than regulatory screening levels.

- Benzene and chloromethane were the only compounds consistently observed above screening levels in skirt air and ambient air at the site. Statistical analyses of the skirt and ambient air data showed that skirt air benzene levels were indeed elevated over offsite air benzene. This occurred, however, in only two of six monitoring events, and the increase in the skirt air over offsite air was only about .3 ppb-v. In addition, when the data were examined by individual lots, the exceedance of offsite benzene levels in skirt air was shown to be confined to a single lot - Lot 63. The other three tested skirts were not elevated over offsite air. For chloromethane and the TICs, skirt air was not elevated over onsite air, onsite air was not elevated over offsite air, and skirt air was not elevated over offsite air.

- Carbon tetrachloride and methylene chloride were observed in several skirt air samples above regulatory screening values. The source of these compounds within these skirts are uncertain, but subsurface sources could be a contributing factor. Since the detected concentrations of these compounds are comparable to average levels expected for ambient rural and suburban air quality, the presence of these compounds may merely represent background.

- Apart from the skirt air at lot 63, an important source of detected chemicals in air at Norseland appears to be off-site sources, presumably regional air pollution. Benzene (in most air samples), methylene chloride (within several skirt air samples and carbon tetrachloride (within several skirt air samples) levels occur above screening values at the site, but the levels of these constituents in site skirt air and site ambient air appear to be typical of most rural and suburban settings in the United States, and therefore may be representative of general air quality in the area.

METHANE

- Methane concentrations above 25% of the lower explosive limit (LEL) and total hydrocarbon TICs in excess of 100 ppm-v were detected in soil gas in the vicinity of lots 62 and 63. This indicates that a potential concern regarding explosive hazard may be present in this area if methane were to accumulate in an enclosed space. Methane was not detected in any skirt air from lots located above the landfill or in any other on site sampling location. Detection limits for methane was 10 to 20 ppm. These results indicate that active methane production at the site is highly localized.

6. IDENTIFICATION AND SCREENING OF REMEDIATION TECHNOLOGIES

This section presents the initial components of the Feasibility Study (FS) for the Norseland site, as follows:

- **Development of remedial action objectives.** Objectives and cleanup levels are established that provide the basis for developing and evaluating alternatives for remediation of the site.

- **Identification and screening of remediation technologies.** Candidate technologies are screened on a site-specific basis to obtain a list of technologies feasible for use in assembling remediation alternatives.

These components are presented in the following sections. Remediation alternatives are assembled and developed from the retained technologies in Section 7, and evaluated in Section 8. Together, these three sections provide a complete FS for this site.

6.1 Development Of Remedial Action Objectives

Remedial action objectives (RAOs) are site-specific goals based on acceptable exposure levels that are protective of human health and the environment and consider applicable or relevant and appropriate requirements (ARARs). RAOs combine consideration of applicable or relevant and appropriate requirements (ARARs) and the specific constituents, affected media, and potential exposure pathways of the site. Remedial action objectives identify risk pathways that remedial actions should address, and identify acceptable exposure levels for residual constituents of concern.

6.1.1 Remedial Action Objectives

Based on the data collected during the RI, adverse impacts attributable to the landfill at Norseland include:

- Potential odors to residents of Norseland, although the primary source of odors is believed to originate from off site.

- Landfill gases contain hazardous substances above acceptable regulatory levels.

- Skirt air is affected from landfill gases in several lots.

The RI data did not indicate that groundwater or surface water are adversely impacted by the Norseland landfill. Ambient air impacts from the Norseland landfill, if any, are not significant and are not statistically above off-site ambient air entering Norseland.

The residents at Norseland will be relocated and Norseland closed for residential uses. Therefore, resident on-site human receptors will be removed and decrease any potential future site risks. In addition, relocation of residents is part of the implementation of closure actions at the site.

Because the RI investigators believe that the majority of odors at Norseland originate from off-site sources, remedial actions conducted at the Norseland Mobile Estates will not mitigate all odors from occurring in the future.

Based on soil gas surveys, landfill waste at the Norseland site may contain what are now considered to be "hazardous substances" under current law. Waste is exposed in a few areas, particularly on the sides of steep slopes. There is therefore the potential for direct contact with the waste and for the waste to be entrained in stormwater run-off and airborne dust. In addition, site topography is irregular and contains many steep slopes. Steep slopes are prone to erosion, which could expose additional landfill waste.

As indicated above, no unacceptable impacts, to soils, air, groundwater or surface water from the landfill at Norseland have been identified in the RI, based upon regulatory or screening levels. Accordingly, the remedial action objectives for this site are:

- Reduce the potential for migration of landfill waste or waste constituents in surface water run-off or airborne dust.
- Reduce the potential for future direct exposure of human or ecological receptors to landfill waste and waste constituents at the site via direct contact or exposure to potentially hazardous constituents in stormwater run-off or airborne dust. Special attention should be given to areas with elevated concentrations of detected compounds as observed beneath Lot 62 and 63.
- Remedial actions should be consistent with potential future land uses.

6.1.2 Preliminary Remediation Goals

Preliminary remediation goals are numeric expressions of remedial action objectives. A remediation goal is the maximum acceptable concentration of a constituent of concern to which the human or ecological receptors would be exposed via a specified exposure route (e.g., direct contact) under a specified exposure scenario (e.g., industrial land use). Remediation goals are generally established for constituents of concern as the lower of a numeric chemical-specific ARAR or a risk-based cleanup concentration. Remediation goals are presented as preliminary in the FS because the final remediation goals, or cleanup levels, are set in the Cleanup Action Plan (CAP). Remediation goals are only applicable to constituents of concern from landfill waste at the Norseland site.

The general framework which would be used to determine remediation goals for any identified constituents of concern can be established. Under MTCA, acceptable exposure levels for carcinogens are concentration levels that represent potential lifetime incremental cancer risk to an individual of 10^{-6} for individual constituents in a residential exposure scenario, 10^{-5} for individual constituents in an industrial exposure scenario, and 10^{-5} for combined constituent risks in both scenarios. For non-carcinogens, acceptable exposures levels are concentrations that correspond to a hazard index less than 1.0.

For reasons discussed below, no waste removal is included in any of the final alternatives. Therefore, it is neither necessary nor appropriate to set remediation goals or cleanup standards for site waste. Remediation goals for groundwater, for purposes of monitoring or groundwater removal, are set as the MTCA Method B levels for site constituents of concern. Remediation goals for air are set as the ambient air quality standards applicable to the site.

6.2 Identification And Screening Of Technologies

This section identifies and screens technologies that may be included as part of remediation alternatives for the Norseland site. A comprehensive list of technologies and process options that are potentially applicable to this site is developed to cover all the applicable general response actions. The list of technologies are then screened to develop a refined list of potentially feasible technologies that can then be used to develop remediation alternatives for the site. The remediation technologies are screened using the following criteria:

> **Effectiveness** - The potential effectiveness of the technology to (1) address site-specific conditions, including applicability to the media, constituents of concern and areas having elevated concentrations (such as in the vicinity of lots 62 and 63) for this site, (2) meet remedial action objectives, (3) minimize human health and environmental impacts during implementation, and (4) provide proven and reliable remediation under site conditions.
>
> **Implementability** - The technical and administrative feasibility of implementing a technology. Technical Implementability considers site-specific factors that could prevent successful use of a technology, such as physical interferences or constraints, practical limitations of a technology, and soil properties. Administrative implementability considers the ability to obtain permits required to use the technology, and the availability of qualified contractors, equipment, and disposal services.
>
> **Cost** - The capital and operation and maintenance costs associated with the technology. Costs that are excessive compared to the overall effectiveness of the technology may be considered as one of several factors used to eliminate technologies. Technologies providing effectiveness and implementability similar to that of another technology by employing a similar method of treatment or engineering control, but at greater cost, may be eliminated. At the screening level, the cost evaluation is based on engineering judgment of relative costs.

The technologies and process options are screened against the criteria in the priority order listed above using the "fatal flaw" approach. This approach ranks the criteria in order of importance, as listed above. Once a technology is rejected based on effectiveness, it is not further evaluated based on implementability or cost. Similarly, if a technology is effective, but not implementable, the technology is rejected and evaluation of cost is not undertaken.

This approach streamlines the evaluation of technologies while maintaining the MTCA screening methodology.

Evaluation and screening of technologies are performed in a single step. The key criterion in selecting the screening level (technology class, individual technology, or process option) is whether there is a significant difference between the technologies or process options when evaluated against the screening criteria (effectiveness, implementability, and cost). Technologies and process options that are judged to have significant differences are screened separately, and the retained technologies or process options will be developed into separate remediation alternatives to allow full evaluation and comparison.

The potentially applicable technologies considered for the Norseland site are presented in Table 6-1. The technology screening is also summarized in this table. Brief descriptions of the listed technologies and discussions of the screening evaluations are provided below. Technologies retained through this screening process are then incorporated into remediation alternatives in Section 7.

6.2.1 General Response Actions

General response actions are broad categories of remedial actions that can be combined to meet remedial goals at a site. The following general response actions are generally applicable to most sites, including the Norseland site:

- No action
- Institutional controls (including monitoring)
- Containment (on-site disposal)
- Treatment (including reuse and recycling), ex-situ or in-situ
- Off-Site Disposal
- Removal

Except for "no action," each of these response actions represents a category of technologies. The applicable technologies will vary depending on the media (e.g., soil or groundwater) and constituents of concern (e.g., organic compounds or metals). The discussion of technologies is organized below by general response actions for groundwater and aquifer soil (the applicable media).

6.2.2 Institutional Controls And Monitoring

Institutional controls are legal and physical restrictions to exposure to constituents of concern at the site. Risk is eliminated by institutional controls to the extent that they prevent exposure to affected media including areas where elevated concentrations are present. However, institutional controls do not prevent off-site transport of constituents. Institutional controls include any maintenance required for ongoing effectiveness. Institutional controls are effective within their limitations, are easily implemented, and are low in cost. Institutional controls are typically included in any remedy where constituents of concern will remain after completion of remediation.

Site Access Restrictions. Access restrictions involve preventing access by unauthorized persons. Fencing, combined with warning signs, is the most common means of restricting access. Security patrols are sometimes included for high-risk areas, but would not be warranted for this site. Fencing provides a physical barrier to site access. Warning signs discourage trespass by warning potential intruders of the hazards of entering the area. Fencing and warning signs are retained for further consideration.

Land Use Restrictions. Land use restrictions are legal controls such as deed restrictions and zoning that limit development or activities at the site. Deed restrictions are notices of land use restrictions that accompany the deed to the property in a manner that is legally binding and must be transferred to all subsequent owners of the property. The restrictions would include a description of the site and reasons for the limits on future activity. Such restrictions would prevent activities or development that could cause direct exposure to constituents of concern, or that would compromise the integrity of the remedy. For example, deed restrictions would prohibit site development that could impair the effectiveness of a cap remedy. Land use restrictions are retained for further consideration.

Groundwater Use Restrictions. Withdrawal or use of site groundwater can be restricted by legal controls. These controls can eliminate or minimize risk due to exposure to groundwater affected by constituents of concern. For this site, there is no identified affected groundwater. However, groundwater use restrictions could be combined with monitoring to prevent exposure in the event that site groundwater were to become affected by waste constituents. Groundwater use restrictions are retained for further consideration.

Alternate Water Supply. Where constituents of concern are impacting an existing drinking water supply, an alternate source of drinking water may be supplied. Drinking water supplies are not currently impacted by the Norseland site. Monitoring would detect any groundwater problems and allow remedial action before drinking water supplies became affected. Therefore, this technology is not retained.

Monitoring. Site monitoring is a required component of any site remedy. Short-term monitoring is conducted to ensure that potential risks to human health and the environment are controlled while a site remedy is being implemented. Long-term monitoring is conducted to measure the effectiveness of the remedy and thereby ensure that the remedy continues to be protective of human health and the environment. Long-term monitoring would include periodic site inspections as necessary to determine maintenance needs (e.g., for fencing or a cap). A monitoring plan will be developed for the selected remedial action. The type of monitoring performed will depend on the nature of the remedy. Monitoring could include periodic sampling and analysis of air, surface water, and groundwater, as appropriate.

6.2.3 Containment (On-Site Disposal)

In-situ containment is a general response action used to prevent exposure to material affected by constituents of concern that are left in place, and to control migration of constituents. Containment technologies are identified and screened in this section.

6.2.3.1 Capping

Capping is proven, effective technology for providing reliable long-term containment and preventing or minimizing off-site migration of constituents. Capping minimizes risk by preventing direct contact with waste and affected soil, and preventing off-site migration of constituents in surface water or airborne dust. Where infiltration through waste or affected soil is a concern, a low-permeability cap design is used to minimize the potential for constituent migration into groundwater by minimizing infiltration of precipitation. Capping is effective for a landfill having areas with variable concentrations of constituents.

Caps may be constructed of a variety of natural materials (i.e., clay, sand, and other soils), synthetic liners, geotextiles, and other geomembranes, and other synthetic materials (e.g., asphalt or concrete). They may consist of a single layer or be a composite of several layers. Caps provide containment in three primary ways:

- A cap serves as a physical barrier to prevent humans, other animals, and vegetation from coming in contact with materials affected by constituents of concern.
- A cap prevents erosion of soil by surface water and wind, thereby preventing off-site transport of constituents of concern via these media.
- A low-permeability cap minimizes infiltration of surface water, decreasing the potential for transport of constituents of concern from waste to groundwater.

Caps can be designed to be compatible with many potential future site uses. Land use restrictions and other institutional controls are typically employed along with capping to prevent future site activities that could violate the integrity of the cap (e.g., excavation or support pilings for buildings). Long-term maintenance and monitoring are required.

Capping is readily implemented using standard design and construction techniques. It is relatively low cost, and thus highly cost-effective (i.e., high incremental protection relative to remediation cost). A wide variety of cap designs are possible that vary in effectiveness, implementability and cost. The following representative cap designs have been identified and screened for consideration:

- Permeable soil cap
- Paving
- Low-permeability soil cap with vegetative soil cover
- Synthetic membrane cap with vegetative soil cover
- RCRA Subtitle C design

Permeable Soil Cap. A permeable soil cap would consist of clean fill soil beneath vegetated topsoil. This type of soil cover would be just as effective as low-permeability cap designs at preventing direct contact and off-site migration of constituents in surface water or airborne dust. The term "permeable" is used to indicate that a permeability specification would not be included in the cap design (to distinguish it from a low-permeability cap); the cap would not be intentionally made permeable. This cap would be designed to exceed the landfill closure requirements of WAC 173-304-461 by providing greater cover thickness than required. This would not meet all of the landfill closure requirements of WAC 173-304-460, because no low-permeability liner is included, but would provide the required 2-ft cap thickness. A permeable soil cap would be relatively inexpensive and easy to construct and maintain. This cap design is retained for further consideration.

Paving. Asphalt and/or concrete pavement is suitable for providing a cap for some sites. However, paving as a cap is generally considered for developed areas where there is a need to combine containment with continued commercial or industrial use (e.g., as a parking lot). Paving requires higher maintenance than caps with soil or synthetic liners, and is prone to cracking. Landfill settlement would increase maintenance costs. Paving would increase stormwater run-off velocities, which could enhance erosion of surrounding areas. Paving is therefore not retained as a cap design for landfill closure, although paving may be appropriate as a part of subsequent commercial or industrial development.

Low-Permeability Soil Cap. A low-permeability soil cap would primarily consist of a liner of 2 feet of compacted low-permeability soil, overlain by 6 inches of vegetated topsoil. The cap would be designed to meet all of the landfill closure standards of WAC 173-304-460. This cap type would provide all of the benefits of a permeable soil cap, and also the benefit of decreasing infiltration through landfill waste. Because of the need to maintain liner integrity, development of property for beneficial uses with a low-permeability cap would be difficult and expensive. Theoretically, the low-permeability liner would decrease the potential for groundwater becoming affected by constituents of concern. However, given that no adverse groundwater affects have been observed from the landfill more than 30 years after initial closure, it is not clear that any real benefit would be gained by use of a low-permeability cap for this site. This cap design is retained for further consideration.

Low-Permeability FML Cap. A FML cap would primarily consist of a synthetic flexible membrane liner (FML) under 6 inches of clean fill soil and 6 inches of vegetated topsoil. As with the low-permeability soil cap, this cap would be designed to meet all of the landfill closure standards of WAC 173-304-460. This cap type would provide all of the benefits of a permeable soil cap, and also the benefit of decreasing infiltration through landfill waste. Because of the need to maintain liner integrity, development of property for beneficial uses with a low-permeability cap would be difficult and expensive. Theoretically, the low-permeability liner would decrease the potential for groundwater becoming affected by constituents of concern. However, given that no adverse groundwater affects have been observed from the landfill more than 30 years after initial closure, it is not clear that any real benefit would be gained by use of a low-permeability cap for this site. This cap design is retained for further consideration.

RCRA Subtitle C Cap. Design standards for hazardous waste landfills under RCRA (40 CFR 264) provide the most conservative cap design. A typical RCRA cap design consists of (from top to bottom: topsoil, clean fill, a drainage layer (sand or geosynthetic) to direct infiltration away from the liners, a synthetic liner, and a low-permeability soil liners. The soil liner typically has a lower permeability soil (10^{-7} cm/sec instead of 10^{-6} cm/sec) than MFS. The RCRA cap is designed to provide additional protection by adding reliability, in the form of redundant protection against infiltration. This complex design would be significantly more difficult to install and much more expensive than the other designs. Development of property for beneficial uses with a RCRA cap that maintained cap integrity would be more difficult and expensive than with other low-permeability caps. Given the questionable added benefit of any low-permeability cap type compared to the permeable soil cap, the significantly more difficult implementability and much higher cost are not justified. This cap type is therefore not retained.

6.2.3.2 Surface Water Controls

Surface water management involves controlling surface water run-on and run-off at the site. The purpose of these controls is to minimize erosion that can entrain exposed soil affected by constituents of concern, and expose underlying affected materials. Surface water controls by themselves are not generally effective as a permanent remedy. These controls may be used as short-term measures (e.g., during excavation), or as long-term measures (e.g., as part of capping). Surface water controls are proven technology, effective, easily implemented and inexpensive. They are therefore retained for use in conjunction with other remediation technologies.

Grading. Grading is used to promote stormwater drainage, which reduces infiltration through a cap, while minimizing erosion. Grading is desirable at this site to remove existing landfill slopes that are susceptible to erosion.

Stormwater Drainage Controls. In addition to grading, stormwater drainage can be controlled by berms and ditches or swales. Ditches and swales are channels designed to collect stormwater and route it to a desired discharge point. They may be unlined or, to reduce erosion, lined with gravel, concrete, synthetic membranes, or other materials. Piping can also be used to route collected stormwater to the desired discharge point. Retention basins can be used to slow flow velocities and trap sediment, thereby decreasing erosion potential.

Vegetative Cover. Vegetative cover is a common, highly effective means of reducing soil erosion. Once established, vegetation requires little or no maintenance. Vegetation also provides evapotranspiration that reduces infiltration of stormwater through a cap.

6.2.3.3 Vertical Barriers

Vertical barriers are intended to minimize lateral flow of groundwater, thereby preventing or minimizing migration of constituents of concern. For reliable containment, vertical barriers should be keyed into a continuous low-permeability stratum or an artificial horizontal barrier to prevent migration underneath the vertical barrier. Slurry walls, sheet pile walls, and grout walls are established technologies for constructing vertical barriers. However, there is no need for containment of groundwater at this site, and therefore no vertical barrier technologies are retained.

6.2.3.4 Horizontal Barriers

Horizontal barriers are intended to minimize the vertical migration of constituents of concern in groundwater in an aquifer, into deeper aquifers, or under vertical barriers. Grout injection is an example of a technology that could be used to construct horizontal barriers under appropriate site conditions. However, there is no need for containment of groundwater at this site, and therefore no horizontal barrier technologies are retained.

6.2.3.5 Hydraulic Groundwater Containment

Hydraulic containment consists of active manipulation of groundwater heads to prevent off-site migration of groundwater. The containment may be accomplished by lowering groundwater elevations so that groundwater flows into (and not out of) the zone affected by constituents of concern. Alternatively, groundwater may be intercepted at the boundary of the affected zone to prevent off-site migration. At this site, groundwater already meets remediation goals. Therefore, hydraulic containment is not necessary and hydraulic containment technologies are not retained.

6.2.4 Treatment

6.2.4.1 Waste and Affected Soil

Reuse or recycling are desirable when feasible and cost-effective. However, at this site, the waste is believed to be a heterogeneous mixture not amenable to reuse or recycling. No waste components have been identified that warrant reuse or recycling. Therefore, reuse and recycling are not retained.

The heterogeneous nature of the landfilled materials make treatment of landfilled waste difficult to implement and may be ineffective. This is also true for portions of the landfill exhibiting elevated concentrations of volatile organics such as in the vicinity of lots 62 and 63. Data concerning groundwater and ambient air and the low rate of gas generation are indicative of relatively inert waste. Therefore, treatment would not be more protective than capping and no waste treatment technologies are retained.

6.2.4.2 Groundwater

Groundwater at this site already meets remediation goals; therefore, there is no need to treat the groundwater. In the unlikely event that groundwater became affected in the future, groundwater treatment technologies would be selected based on the constituents of concern identified at that time. However, as there is no current need to treat groundwater and groundwater treatment is not expected to be required in the future, groundwater treatment technologies are not retained.

6.2.4.3 Landfill Gases

Due to lack of continued residential use, ambient air at this site already meets remediation goals; therefore, there is no need to collect or treat landfill gases. In the unlikely event that gas treatment is required in the future, appropriate treatment would be selected based on the constituents of concern identified at that time. However, as there is no current need to treat landfill gases and gas treatment is not expected to be required in the future, gas treatment technologies are not retained.

6.2.5 Off-Site Disposal

Disposal is a general response action for final disposition of excavated waste and affected soil, or waste generated by treatment processes. This FS is for an existing disposal site. The site appears suitable as a landfill site for the waste it contains since the RI data did not detect impacts to media outside the landfilled area. In permitting the landfill, the Bremerton-Kitsap County Department of Health identified the site as an acceptable location for permanent waste disposal. On-site closure activities would be sufficient to address any potential threats to human health or the environment. Containment technologies amount to on-site disposal, which is retained. There is no point in removing the landfill waste and simply moving it to another location for disposal, and off-site disposal. Therefore, off-site disposal is not retained.

An option considered for the Norseland site is partial excavation, removal and off-site disposal of materials in areas exhibiting elevated concentrations of constituents. The subsurface soils and landfilled materials in the area around lots 62 and 63 may be an example of such an area for partial removal. Although subsurface gases beneath lots 62 and 63 displayed the highest concentrations of volatile organics, tested soils did not indicate constituent concentrations of hazardous substances in excess of MTCA cleanup levels. Organic compounds that account for most of the elevated soil gas concentrations are typically associated and are components of petroleum hydrocarbons. Total petroleum hydrocarbons in the soil samples beneath lot 62 analyzed to be below MTCA cleanup levels, but were at concentrations that could explain the observed soil gas concentrations. Since this specific area (lots 62 and 63) does not appear to be impacting surrounding media (ambient air, groundwater or surface water) above MTCA cleanup standards and the concentrations of the analyzed waste materials are below cleanup levels, excavation, removal and off-site disposal of such areas does not appear warranted. Again as mentioned above, there is no benefit in partial excavation and disposal to another landfill located off-site when in place containment is effective. Therefore, partial excavation and off-site disposal of areas containing elevated concentrations of constituents is not retained.

6.2.6 Removal

Removal is a general response action for media affected by constituents of concern prior to ex-situ treatment (on-site or off-site) or disposal. Removal by itself is not a complete remedial action, but must be combined with subsequent disposition of the removed media.

As discussed above, at this site there is no need for waste treatment or off-site disposal. Therefore, there is no need for waste removal, and waste excavation technologies are not retained. Excavation technologies are retained as they apply to regrading the site and cap construction.

Groundwater already meets remediation goals. Therefore, there is no need for groundwater removal, and no groundwater extraction technologies are retained.

Without residential use of the site and elimination of confined skirt air under homes, ambient air at this site already meets remediation goals. Therefore, there is no need to extract or treat landfill gases, and no gas extraction technologies are retained.

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7. DEVELOPMENT OF ALTERNATIVES

In this section, remediation alternatives are developed from the remediation technologies retained after screening. The alternatives are then evaluated in Section 8.

Remediation alternatives are developed to meet the following MTCA requirements:

- Protect human health and the environment.
- Comply with cleanup standards.
- Comply with applicable laws and regulations.
- Utilize permanent solutions to the maximum extent practicable.
- Provide for a reasonable restoration time frame.

Clean up technologies are considered in the following order of descending preference per WAC 173-340-360(4):

1. Reuse or recycling
2. Destruction or detoxification
3. Separation or volume reduction
4. Immobilization of hazardous substances
5. On-site or off-site disposal at an engineered facility
6. Isolation or containment with attendant engineering controls
7. Institutional controls and monitoring.

As discussed in Section 6, reuse/recycling and treatment are neither necessary nor appropriate for this site. Considering MTCA regulations and other ARARs, remedial action objectives (Section 6.1), and the technology screening (Section 6.2), the following alternatives have been assembled. All alternatives presented below were developed with the knowledge that residents would be relocated. Hence, remedial alternatives appropriate for an unoccupied site were developed.

Alternative 1: No Action
Alternative 2: Institutional Controls and Monitoring
Alternative 3: Permeable Soil Cap
Alternative 4: Low-Permeability Cap

These alternatives are described and developed below. It is necessary to make a number of design assumptions to fully develop and evaluate each alternative. These design assumptions are representative of the technologies used in the alternatives. However, the design assumptions used here are not necessarily the same as the design basis that would be used for the final, detailed design. In most cases, additional investigations would be necessary to allow final design.

7.1 Common Elements

Several alternatives share common elements in their formulation. To avoid repetition, this section presents the descriptions of elements common to two or more alternatives. These common elements are then referenced in the descriptions of the alternatives.

7.1.1 Institutional Controls

All of the alternatives include institutional controls, with the exception of Alternative 1 (No Action). Institutional controls are a key component of the alternatives for maintaining long-term effectiveness.

Outside of the landfill boundary (waste or capped area), land use restrictions for the site would be the same for all alternatives. Prohibited uses would consist of residential use and recreational use that involved overnight stays (e.g., a campground). All other uses, including other recreational uses, would be permitted. For the landfill proper, acceptable land uses vary with the alternative. Acceptable landfill uses are discussed in the description of each alternative.

Deed restrictions would be instituted to ensure that site use restrictions remain in force regardless of the property owner, and to notify any prospective purchasers of the presence of subsurface waste. Site use restrictions would remain in force indefinitely.

Fencing is included in Alternative 2 to provide a physical barrier against trespass, in order to prevent direct contact with landfill waste. In the other alternatives, the cap provides sufficient protection against direct contact, and fencing the entire site is not necessary. Alternative 3 does not include any fencing because it is not needed to achieve remedial action objectives. Alternative 4 includes limited fencing to protect gas venting piping and prevent exposure to vented gases. No other fencing is needed in Alternative 4 to achieve remedial action objectives.

Periodic site inspections and maintenance of a cap, fencing, signs, and any other physical components of the institutional controls would be included in all alternatives with institutional controls.

Groundwater currently meets remediation goals. Therefore, no groundwater containment or treatment is currently necessary. Use of site groundwater would be prohibited, thereby preventing exposures to constituents of concern if site groundwater were to become affected. Exposure to groundwater could then occur only after off-site migration. If a release were to occur, groundwater monitoring (Section 7.1.2) would detect constituents of concern in site groundwater prior to off-site migration, which would be followed by appropriate remedial action.

7.1.2 Monitoring

Monitoring is included as part of all alternatives, except Alternative 1 (No Action). Separate monitoring programs will be used for the short term (during remedial action) and the long term (following completion of remediation). Ecology will evaluate monitoring requirements in the Cleanup Action Plan (CAP). In particular, monitoring frequency and number of years over which monitoring will be required will be defined in the CAP. Detailed monitoring plans will be developed for the selected remedy during final design for public comment and Ecology approval.

7.1.2.1 Short-Term Monitoring

Short-term monitoring is conducted during remediation to ensure that there are no adverse effects from remediation activities, to provide quality control, and to confirm the attainment of cleanup standards and/or relevant performance criteria. Health and safety monitoring is also performed to ensure that site workers are not exposed to undue or unexpected risks.

Attainment of cleanup standards by removal is not applicable for the alternatives because they use containment and monitoring rather than removal. Short-term monitoring for the other alternatives would primarily consist of construction quality assurance (CQA) to confirm attainment of construction specifications. CQA specifications would address compaction specifications (for stability of fill material), final grades, liner installation (i.e., for the FML cap), and other aspects of the remedy that affect performance.

7.1.2.2 Long-Term Monitoring

Long-term, or confirmational, monitoring is conducted to 1) verify that the remedy performs as expected over time, and 2) allow timely maintenance of a cap and other physical components of the alternative. Periodic site inspections and surveys would be sufficient for determining maintenance needs and monitoring cap performance. Cap performance is also monitored by groundwater monitoring. Long-term cap and groundwater monitoring would continue during the post-closure period, assumed for the purposes of the FS to last 20 years per WAC 173-304, and then cease.

Cap Monitoring. Cap monitoring would consist primarily of visual inspections for damage and subsidence. The cap would be periodically examined for the presence of off-sets, scarps, low-points, ponded water, odd changes in grade, excessive erosion, and the condition of the vegetative layer. For the first year, such inspections may be performed semi-annually and may then be reduced to once per year. The cap monitoring program would essentially be identical for all cap alternatives.

Groundwater Monitoring. Groundwater monitoring would include periodic groundwater sampling and analysis at selected key locations throughout the site to confirm that concentrations of constituents of concern from waste disposal activities do not exceed acceptable limits. Site groundwater currently meets remediation goals, so the monitoring program will be designed for detection of release of waste constituents into site groundwater, should it occur. Four wells (one upgradient and three downgradient) are sufficient for this purpose. Because of the long time that has elapsed since original landfill closure without adverse affects on groundwater, quarterly monitoring is unnecessary. Semi-annual monitoring should be sufficient, if performed once in the wet season and once in the dry season, for the first five (5) years. If the monitoring results does not indicate groundwater impacts to be of concern or concentrations of key parameters to be increasing, further groundwater monitoring is unnecessary and would be discontinued after the first five (5) years. The first semi-annual monitoring event would consist of analysis for landfill indicator parameters (WAC 173-304-490) and for volatile organic compounds (EPA Method 8260) and target metals. The second semi-annual monitoring event would include full analysis for landfill indicator parameters (WAC 173-304-490), volatile and semi-volatile organic compounds (EPA Methods 8260, 8240 and 8080) and a broader list of key toxic metals.

Air Monitoring. Because constituents of potential concern have been detected in subsurface landfill gases, monitoring would be performed to ensure that these gases do not cause problems with ambient air quality. Landfill gas monitoring would be conducted along with the groundwater monitoring. Air samples would be analyzed for hazardous air constituents and methane per EPA Method TO-14. For Alternatives 2 (Institutional Controls and Monitoring) and 3 (Permeable Soil Cap), air monitoring would consist of obtaining and analyzing 4 samples: one representative sample of air from above the landfill, one upwind air sample, and two downwind air samples. For Alternative 4 (Low-Permeability Cap), air monitoring would consist of obtaining and analyzing 6 samples: one gas sample from each of the three vents (see Section 7.2.3), , one upwind air sample, and two downwind air samples.

Twenty (20) years of monitoring is probably not necessary. Landfill gas generation is primarily a result of biological degradation of putrescible waste. RI data indicate that most of the gas generation associated with municipal sanitary landfills has already occurred, as would be expected more than 30 years after closure. Gas generation rates decrease steadily over time as the supply of putrescible waste is exhausted. If a problem with landfill gases were to occur with one of the remediation alternatives, it would be detected soon after remedial action. However, to be conservative, air monitoring will continue for five (5) years following remedial action, and then cease.

7.1.3 Grading and Surface Water Management

Current site conditions include steep slopes that are not desirable for long-term erosion control. For the capping alternatives, a significant component of the alternative would be grading the site for shallower slopes over the landfill area (assumed to be 5% for this FS). A conceptual grading plan is shown in Figure 7-1.

The grading will allow improved stormwater management. The grading would route stormwater run-off from the landfill area to the western edge of the landfill as sheet flow (i.e., not collected in ditches). As part of the grading, stormwater ditches would be created along the eastern and southern edges of the cap to route stormwater run-off from higher elevations around the cap. A stormwater ditch would not be needed along the western and northern edges because the landfill grade would be higher than the surrounding area.

7.2 Description of Remediation Alternatives

7.2.1 Alternative 1: No Action

A "no action" alternative is included as a baseline for comparison to the other alternatives. This alternative would leave the site in its current state after Norseland residents are relocated, assuming no restrictions on future site use and no site maintenance or monitoring.

7.2.2 Alternative 2: Institutional Controls and Monitoring

This alternative would decrease potential site risks by preventing exposure to constituents of concern resulting from waste disposal activities at the site. Institutional controls and monitoring would be effective for areas having variable concentrations of constituents. Exposure would be prevented by a physical barrier in the form of fencing with warning signs, and by preventing site use via deed restrictions.

Long-term maintenance and monitoring would be included to ensure the continued effectiveness of the remedy. This alternative would consist of implementing and maintaining institutional controls as described in Section 7.1.1 and long-term monitoring as described in Section 7.1.2. Institutional controls would prevent direct exposure to waste or affected soil through fencing and site use restrictions. Because this alternative relies on institutional controls more than physical covering of the waste for its effectiveness, the site would be dedicated as a waste site and not available for beneficial use.

Use of site groundwater would be prohibited, thereby preventing exposures to constituents of concern if site groundwater were to become affected. Exposure to groundwater could then occur only after off-site migration. If a release were to occur, groundwater monitoring (Section 7.1.2) would detect constituents of concern in site groundwater prior to off-site migration, which would be followed by appropriate remedial action.

7.2.3 Alternative 3: Permeable Soil Cap

This alternative provides a cap consisting essentially of clean soil cover. Because it does not include a low-permeability liner, this cap would not meet all of the closure specifications of WAC 173-304-460. However, this cap would meet the cap thickness requirement of WAC 173-304-460 and would exceed the closure specifications of WAC 173-304-461. In addition, as discussed in the evaluation of this alternative in Section 8.1.3, this cap meets the requirements for a variance under WAC 173-304-700.

The major steps in this alternative are:

1. Fill and grade the site for even slope and good stormwater drainage (see Section 7.1.3).
2. Place a soil cap over the landfill area.
3. Maintain the cap for at least 20 years.

4. Implement and maintain institutional controls and monitoring as described in Sections 7.1.1 and 7.1.2.

The permeable soil cap consists of 18 inches of clean fill soil overlain by 6 inches of vegetated topsoil (Figure 7-2). The vegetative layer would promote evapotranspiration and decrease erosion. The topsoil would not be compacted so that it would provide a loose medium for establishing the vegetative cover. To establish vegetation, the topsoil would be seeded with grasses suitable for the local climate. It was assumed that about half of the topsoil would be from the site, and the remainder purchased from an off-site source.

The clean fill beneath the topsoil would be established as part of site grading (step 1). Comparison of the conceptual grading plan (Figure 7-1) and site topography (Figure 2-1) reveals that balanced cut and fill can provide sufficient clean soil for the cap fill soil. The fill would be compacted to provide long-term stability, but this cap does not include a permeability specification. The permeability of this cap would be greater than the low-permeability cap of Alternative 4. The area that would be capped is shown on Figure 7-2. This area covers the areas of landfill waste determined in the RI (see Section 3, especially Figure 3-4).

Landfill gases would slowly permeate up through the cap into the atmosphere. As discussed in Section 5.3, subsurface landfill gases contained some hazardous substances. However, the concentration of methane in these gas samples indicated little biodegradation and a low methane generation rate (see Section 5.4). By providing a more even landfill cap than is currently present, this alternative should prevent potential localized concentration of landfill gas emissions. Gas release at a low rate, dispersed over a large area (approximately 11 acres), should not produce measurable impacts on ambient air quality. Gas monitoring (see Section 7.1.2) would confirm that no unacceptable ambient air concentrations of landfill waste constituents result from this alternative.

Installation of this cap could be performed readily using standard earth-moving equipment. A large number of qualified contractors are available. CQA would primarily consist of verifying cap thickness and grading. Because of its simplicity, little maintenance would be required for this alternative. Any settling after cap installation would be repaired by filling and regrading in the same manner as initial installation. The thickness of the cap would provide long-term protection against erosion.

Capping this site would protect against direct contact with landfill waste, and also prevent off-site migration of waste or waste constituents in stormwater. Because direct contact with the waste is prevented, the site would be available for beneficial uses. Suitable landfill area uses would include commercial, industrial, and/or recreational, but not residential. Any site use would be subject to restrictions to prevent long-term exposure of waste. Short-term exposure of the waste (i.e., during construction) would not be a problem with proper health and safety controls, providing after construction the waste were still recovered to prevent exposure. Special health and safety considerations during grading and construction would need to be implemented in areas exhibiting elevated concentrations of constituents such as in the vicinity of lots 62 and 63.

The State of Washington is currently establishing policies (1994 Wash. Laws Ch. 254, and "brownfields initiatives") that encourage remedial actions allowing beneficial reuse and redevelopment of contaminated sites consistent with current or planned land uses. With proper design and construction, buildings or other structures could be considered over the landfill after installation of a permeable soil cap. Load imposed by a building or other structure would be restricted based on the load capacity of the landfill, as determined by geotechnical investigations made during detailed building design in accordance with applicable building codes. Support pilings or similar measures into the cap would be acceptable so long as it does not result in long-term exposure of waste. Buried utilities would not be placed directly in waste, but would be placed in engineered fill. Any excess landfill waste from construction excavation would be disposed off-site.

Landfill gas controls would be necessary for buildings having building foundation or floor slabs directly in contact with the soil cap to avoid the possibility of buildup of landfill gases with flammable methane or hazardous constituents. Basements would not be permitted to avoid excessive waste excavation and to avoid landfill gas buildup. For a building or a slab foundation, a passive gas vent system beneath the building consisting of six inches of pea gravel, with above-grade vents outside the building, would be sufficient (or equivalent). An application for new construction on the landfill cap would be subject to review by agencies with applicable authority.

7.2.4 Alternative 4: Low-Permeability Cap

This alternative provides a low-permeability cap over the landfill area. The cap would be designed to meet all of the landfill closure requirements of WAC 173-304-460. For the purposes of this FS, a cap design using synthetic flexible membrane liner (FML) has been assumed (Figure 7-3). A local (i.e., inexpensive) source of clay or other low-permeability soil is not known or believed to be available for this site. Therefore, the FML cap has been assumed because it is expected to be less expensive than a low-permeability soil cap for this site (see Table G-4). The FML design is representative of the performance and cost of a cap meeting the low-permeability specifications of WAC 173-304-460(3)(e). However, the specific cap design would be selected during final design, should this alternative be selected.

The major steps in this alternative are:

1. Fill and grade the site for even slope and good stormwater drainage (see Section 7.1.3).
2. Place a low-permeability cap over the landfill area.
3. Maintain the cap for 20 years.
4. Implement and maintain institutional controls and monitoring as described in Sections 7.1.1 and 7.1.2.

The low-permeability FML cap consists of a FML overlain by 6 inches of clean fill and 6 inches of vegetated topsoil (Figure 7-3), plus a gravel gas collection layer. An FML thickness of 50 mil would be used to meet the low-permeability requirements of WAC 173-304-460(3)(e).

The vegetation layer would promote evapotranspiration and decrease erosion. The topsoil would not be compacted so that it would provide a loose medium for establishing the vegetative cover. To establish vegetation, the topsoil would be seeded with grasses suitable for the local climate. It was assumed that about half of the topsoil would be from the site, and the remainder purchased from an off-site source.

As with the permeable soil cap in Alternative 3, the clean fill beneath the topsoil would come from soil removed during site grading. With the low-permeability cap, however, this fill soil must be stockpiled first. After the gravel, geotextile, and FML are installed, the stockpiled soil is then used for the clean fill. The fill would be compacted to provide long-term stability (but not to a permeability specification). The area that would be capped is shown on Figure 7-3. This area covers the areas of landfill waste determined in the RI (see Section 3, especially Figure 3-4). As with the permeable cap (Alternative 3), special health and safety considerations during grading and construction need to be implemented in areas exhibiting elevated concentrations of constituents such as in the vicinity of lots 62 and 63.

The FML would prevent upward migration of landfill gases. This creates the possibility of buildup of gas pressure beneath the cap, which could lead to landfill gases migrating to the edges of the cap where they could escape off-site. For this reason, the bottom layer of the cap would be a gravel layer (above a variable layer of clean fill resulting from the grading in step 1). A geotextile cushion would protect the FML from the gravel. With the gravel layer, gases would instead tend to collect and concentrate at cap high points (i.e., the eastern edge). To prevent off-site escape of these gases, an interceptor trench would be installed along the eastern edge of the landfill as shown in Figure 7-3. This trench would be 10 to 15 feet deep with a trapezoidal cross section averaging approximately 3 feet in width. The trench would be filled with pea gravel and contain a perforated collector pipe. The pipe would route the collected gases to passive above-ground vents, where the gas composition would be monitored. Gas treatment could be added if necessary.

By collecting the landfill gases and venting them at centralized locations, this alternative creates relatively more chance of localized adverse affects on ambient air. However, based on ambient air monitoring and the low gas generation rate inferred in the RI (see Sections 5.3 and 5.4), no measurable off-site impacts are expected. Gas monitoring (see Section 7.1.2) would confirm that no unacceptable ambient air concentrations of landfill waste constituents result from this alternative.

Installation of this cap requires specialized contractors qualified in FML installation. However, a reasonable number of qualified contractors are available. The most important part of CQA for an FML cap is testing liner integrity after installation. The thickness and quality of the FML would also be subject to CQA, as well as cover soil thickness and grading.

FML is more susceptible to failure on settling than a soil cap. FML is able to stretch in response to settling, but within limits. The detrimental effects of settling on a soil cap are easily repaired by simply replacing the soil. FML settling requires removing and replacing the settled cap section. The repaired area would require careful subgrade preparation to avoid low spots in the liner. New seams, which are a weak point, are created around the repaired area.

Capping this site would protect against direct contact with landfill waste, and also prevent off-site migration of waste or waste constituents in airborne dust or stormwater. The low permeability of the cap would minimize the chances for future groundwater impacts by decreasing infiltration of precipitation through the landfill waste. However, considering no groundwater impacts have been observed more than 30 years following closure (see Section 5.2.1), the low-permeability liner in the cap of this alternative adds no significant benefit over simple soil cover.

With proper design and construction, buildings or other structures could also be considered over the landfill. However, development would be more difficult and expensive than with Alternative 3 because of the need to maintain the integrity of the FML liner.

With proper design and construction, buildings or other structures could be considered over the landfill. Load imposed by a building or other structure would be restricted based on the load capacity of the landfill, as determined by geotechnical investigations made during detailed building design in accordance with applicable building codes. Support pilings or similar measures through the cap would be acceptable so long as it ties into the FML liner and prevents emissions of landfill gases. Buried utilities would not be placed directly in waste, but would be placed in engineered fill. Buried utilities would require cutting into the existing liner, lining the trench bottom and sides with FML, and welding the trench FML to the cap FML. Any excess landfill waste from construction excavation would be disposed off-site.

Landfill gas controls would be necessary for buildings to avoid the possibility of buildup of landfill gases with flammable methane or hazardous constituents. Basements would not be permitted to avoid excessive waste excavation and to avoid landfill gas buildup. A passive gas vent system beneath the building and above the FML consisting of six inches of pea gravel, with above-grade vents outside the building, would be sufficient (or equivalent). Buildings would be required to maintain the FML liner and underlying gravel layer beneath them, connected to the cap liner, to prevent preferential gas migration into the buildings. An application for new construction on the landfill cap would be subject to review by agencies with applicable authority.

8. EVALUATION OF ALTERNATIVES

The remediation alternatives described in Section 7 are evaluated in this section. The evaluation concludes with a discussion of the overall evaluation and scoring, and identification of the preferred alternative.

8.1 Threshold Evaluation

Under MTCA, remediation alternatives must meet the following threshold requirements (WAC 173-340-360(2)):

- Protection of human health and the environment
- Compliance with cleanup standards
- Compliance with ARARs
- Provision for compliance monitoring

Each alternative is evaluated individually against the threshold criteria in the following sections.

8.1.1 Protection of Human Health and the Environment

As a threshold criterion, protection of human health and the environment addresses whether a remediation alternative would result in sufficiently low residual risk to human and ecological receptors after completion of the alternative, resulting in a minimum acceptable level of protection. The relative degree of protection provided by the alternatives is considered in the comparative evaluation. One measure of sufficient protectiveness is the second threshold criteria, compliance with cleanup standards (see Section 8.1.2). Evaluation of protection of human health and the environment also considers short-term risks posed by remedial action.

All of the alternatives except potentially Alternative 1 (No Action) would provide acceptable protection of human health and the environment. The fact that no significant ambient air and groundwater impacts were found more than 30 years after landfill closure indicates the low risk posed by this site. However, Alternative 1 does not mitigate potential exposure pathways (i.e., exposed landfill waste).

All of the other alternatives prevent direct exposure to any landfill waste, or site groundwater in the event it were to become affected by landfill waste constituents. The cap alternatives (3 and 4) also prevent off-site migration in surface water or airborne dust. Alternative 4 also provides a low-permeability cap, which theoretically decreases risk to groundwater. However, given the long time that has already elapsed without adverse affect on groundwater, it is questionable that a low-permeability cap provides any real added protection over a simple soil cover.

8.1.1.1 Consideration of Presumptive Remedies

Presumptive remedies may be appropriate for certain categories of sites which experience has shown to have common characteristics. *See* Presumptive Remedy for CERCLA Municipal Landfill sites (EPA Directive No. 9355.0-49FS, EPA 540-F-93-035). The implementation of presumptive remedies can streamline site investigation and speed up selection of remedial action.

Because the Puget Service Company landfill received municipal waste, the consideration of presumptive remedies is appropriate. The presumptive remedies appropriate for this site include: (1) preventing contact with landfill materials; (2) curtailing human exposure to potential or residual landfill emissions; (3) containment; and (4) controlling surface water runoff and erosion.

Except for the no action alternative, the remedial alternative evaluated in this section of the RI/FS reflect a consideration of presumptive remedies and MTCA threshold requirements.

8.1.2 Compliance with Cleanup Standards

Compliance with cleanup standards is defined by meeting the requirements of WAC 173-340-700 through -760. Compliance with cleanup standards does not require removal of all waste or affected soil from a site; these regulations include provisions for meeting cleanup standards through containment (e.g., WAC 173-340-700(2)(b) and (c)). All of the alternatives except Alternative 1 (No Action) would comply with MTCA cleanup standards. Alternative 1 would have exposed landfill waste and would not provide compliance monitoring. Alternative 2 (Institutional Controls and Monitoring) would rely on institutional controls to comply with cleanup standards, although total reliance on institutional controls is not usually allowed where it is technically possible to implement a cleanup action alternative that utilizes a higher preference cleanup technology. Alternatives 3 and 4 rely on engineered containment.

8.1.3 Compliance with ARARs

Compliance with ARARs addresses whether an alternative complies with all applicable or relevant and appropriate regulations (ARARs), as defined in Section 4.

Alternatives 1 (No Action) and 2 (Institutional Controls and Monitoring) do not comply with all ARARs because they do not meet landfill closure standards under WAC 173-304 as required under WAC 173-340-710 (6)(c).

The Norseland landfill has characteristics of both municipal sanitary landfills and inert waste landfills. Therefore, as discussed in Section 4.3, the closure standards of both WAC 173-304-460 and -461 are relevant and appropriate. WAC 173-304-460 requires a cap with a minimum 2-ft thickness and an low-permeability liner. Alternative 3 (Permeable Soil Cap) provides a cap with the required thickness but without the low-permeability liner. Thus, Alternative 3 does not meet all of the closure standards under WAC 173-304-460. However, Alternative 3 exceeds the requirements of WAC 173-304-461, which only requires one foot of cover. Thus, the cap design for Alternative 3 is a hybrid of the cap designs required under the -460 and -461 standards, which is appropriate for the hybrid nature of the Norseland landfill. In addition, compliance with closure standards may be demonstrated, if necessary, through the variance provisions of WAC 173-304-700. As discussed in Section 8.4.8, Alternative 3 meets the substantive requirements for a variance, should it be required. Therefore, Alternative 3 is believed to comply with ARARs, including WAC 173-304.

Alternative 4 provides an alternative that meets all of the WAC 173-304-460 closure standards.

8.1.4 Provision for Compliance Monitoring

Compliance monitoring requirements are defined at WAC 173-340-410. Compliance monitoring includes: 1) "protection monitoring" to confirm that human health and the environment are adequately protected during implementation of an alternative; 2) "performance monitoring" to confirm that cleanup standards or other performance standards (e.g., cap permeability) have been attained; and 3) "confirmational monitoring" to monitor the long-term effectiveness of the remedy after completion of the alternative. Alternative 1 (No Action) does not provide compliance monitoring, and therefore does not meet this requirement. The remaining alternatives meet this requirement by providing appropriate protection, performance, and confirmational monitoring.

8.1.5 Summary of Threshold Evaluation

Based on the foregoing evaluation, the following alternatives do not meet threshold criteria:

Alternative 1 (No Action)
Alternative 2 (Institutional Controls and Monitoring).

Alternative 3 (Permeable Soil Cap) meets all threshold criteria. Alternative 3 meets the substantive requirements of WAC 173-304-700, although a variance to WAC 173-304-460(3)(e) would be required (see Section 8.4.8). Alternative 4 (Low-Permeability Cap) meets the threshold criteria, including meeting WAC 173-304-460(3)(e) without need for a variance.

8.2 Use of Permanent Solutions

WAC 173-340-360(3) specifies that the remediation alternatives must use permanent solutions to the maximum extent practicable. WAC 173-340-360(5) specifies that "Ecology recognizes that permanent solutions [defined at WAC 173-340-360(5)(b)] may not be practicable for all sites. A determination that a cleanup action satisfies the requirement to use permanent solutions to the maximum extent practicable is based on consideration of a number of factors." The specified factors, or "permanence criteria," are:

- Overall protectiveness
- Long-term effectiveness and reliability

- Short-term effectiveness
- Reduction in toxicity, mobility, and volume
- Implementability
- Cost
- Community acceptance

These criteria and the basis for evaluating the alternatives against them are defined and discussed below. These definitions are consistent with MTCA regulations, but have been refined to minimize the overlap of considerations in the criteria. This allows decision makers to consider each criterion independently and minimizes double-counting of criteria. In addition, use of independent criteria allows better comparisons between the criteria; i.e., determining the value of each criterion in terms of the other criteria. Well-defined criteria minimize misunderstandings between the concerned parties and facilitate effective communication during selection of a preferred alternative.

8.2.1 Overall Protectiveness

Overall protectiveness addresses the degree to which each alternative attains cleanup standards and is protective of human health and the environment, considering both long-term and short-term risks. This criterion is derived from the evaluation of the other criteria. It is not an independent criterion, but more a summary of the overall evaluation. Therefore, the overall comparative evaluation (net benefit) of the other non-cost criteria is taken as the overall protectiveness of the alternative. In addition, overall protectiveness is evaluated as a threshold criterion is Section 8.1.1.

8.2.2 Long-Term Effectiveness and Reliability

This criterion addresses risks remaining at the site after the remediation alternative has been implemented, and the reliability of the alternative at reducing risks over an extended period of time. Risks during the implementation period are addressed under short-term effectiveness. Evaluation of long-term effectiveness involves estimation of the residual risk associated with each alternative, and can be measured by the degree to which remedial action objectives are met (Section 6.1). Reliability involves estimating the longevity of the remedy, (e.g., the lifespan of institutional controls or containment) and the chances of remedy failure.

This criterion is evaluated using the following two sub-criteria:

1. **Long-term effectiveness**

- The alternatives are qualitatively compared for reducing the magnitude of residual risk, including meeting RAOs. The long-term effectiveness criterion addresses both residual human health and ecological risk. However, for this site there is no need to evaluate alternatives for these risks separately. Each alternative provides long-term effectiveness by eliminating or controlling pathways of exposure for human health risks in the same manner as ecological risks. Therefore, there would be no difference in the comparative analysis between alternatives if these risks were evaluated separately.

- Relative reduction in infiltration after remediation was taken as an objective measure of long-term effectiveness or risk reduction.

2. **Reliability**

- Reliability addresses "the degree of certainty that the alternative will be successful" as specified in WAC 173-340-360(5)(d)(ii).

- Alternatives are qualitatively evaluated for their reliability in achieving the anticipated degree of effectiveness (i.e., immediately after completion of remedial action).

- Alternatives are qualitatively evaluated for the estimated longevity of the remedy *at its expected degree of effectiveness*. An alternative that scores less than another for effectiveness can score higher for reliability if it is expected to maintain its effectiveness longer or more reliably.

- Reliability includes qualitative evaluation of the amount of long-term maintenance and monitoring required. The greater the requirement for maintenance and monitoring, the lower the reliability.

The overall score for this criterion is obtained by giving equal weight to the two sub-criteria.

8.2.3 Short-Term Effectiveness

This criterion addresses short-term effects on human health and the environment while the alternative is being implemented. The evaluation includes consideration of the following factors:

- Risk to site workers
- Risk to the community
- Risk to the environment (short-term ecological risk).

Short-term effectiveness was primarily scored based on evaluation of the degree of risk to site workers. The primary risk to site workers would be due to construction accidents and inhalation exposure to landfill gas during grading. In addition, for cap alternatives, the relative complexity of the caps is a measure of the relative man-hours required, and therefore the relative worker risk.

Because remedial action would include controls as necessary to ensure that the remedy does not create an unacceptable risk to the community and the environment, risk to the community and risk to the environment are not as significant in distinguishing between alternatives as worker risk.

8.2.4 Reduction of Toxicity, Mobility, and Volume

This criterion addresses the degree to which a remediation alternative reduces the inherent toxicity, ability of contaminants to migrate in the environment, or the quantity of contaminated material. This criterion is also used to express the preference hierarchy for cleanup technologies under 173-340-360(4), and the use of recycling or treatment under WAC 173-340-360(5). Effectiveness and reliability of the treatment, which are addressed under long-term effectiveness and permanence, are not addressed under this criterion.

8.2.5 Implementability

This criterion addresses the degree of difficulty in implementing each alternative. Implementability issues are important because they address the potential for delays, cost overruns, and failure. Known implementation difficulties with quantifiable cost impacts are included in the cost estimates. The implementability criterion focuses on less quantifiable known and potential difficulties. Implementability is evaluated considering the following:

- **Technical Feasibility.** Technical feasibility addresses the potential for problems during implementation of the alternative and related uncertainties. The evaluation includes the likelihood of delays due to technical problems and the ease of modifying the alternative, if required.

- **Availability of Services and Materials.** The availability of experienced contractors and personnel, equipment, and materials needed to implement the alternative. Availability of disposal capacity is also included in the evaluation.

- **Administrative Feasibility.** The degree of difficulty anticipated due to regulatory constraints and the degree of coordination required between various agencies.

- **Scheduling.** The time required until remedial action would be complete, and any difficulties associated with scheduling.

- **Complexity and Size.** The more complex or larger a remedial action, the more difficult it is to construct or implement. In addition, the more items there are that can go wrong, the greater the chance of failure that could affect remedy effectiveness.

- **Other Considerations.** Monitoring requirements, access for construction and operation and maintenance, integration with existing operations and current or potential remedial action, and other factors were considered in accordance with WAC 173-340-360(5)(d)(v).

8.2.6 Cost

This criterion is used to consider the costs of performing each alternative, including capital, operation and maintenance, and monitoring costs. Alternative costs are compared on a net

5. Sensitivity analyses are provided to show how remedy selection is affected by potential variations in scoring or relative criteria values.

As the expression of a value system, relative criteria values are inherently subjective. For this FS, criteria values were assigned relative to the criterion of long-term effectiveness and permanence. For example, assigning a relative value of 0.5 to a short-term effectiveness means that this criterion is taken to be half as important as long-term effectiveness. In terms of trade-offs between criteria, decreasing the short-term effectiveness score of an alternative by 2 (for a given scale used to score short-term effectiveness) would be equivalent to increasing the long-term effectiveness and reliability score by 1 (for a given scale used to score long-term effectiveness and reliability), since this would result in no net change in the overall score.

The best professional judgment of the FS authors was used to set the relative criteria values for this FS. Given the criteria definitions and basis for scoring used in this FS, the following criteria values were assumed relative to the criterion of long-term effectiveness and reliability:

Criterion	Relative Value
Long-term effectiveness and reliability	1
Short-term effectiveness	0.2
Reduction in toxicity, mobility, and volume	0.05
Implementability	0.2

The relative value assumed for reduction in toxicity, mobility, and volume is based on the definition of this criterion in Section 8.2.4. Reduction in toxicity, mobility, and volume is generally considered important because it is associated with improved long-term effectiveness and reliability. However, the comparative evaluation used herein assumes independent criteria. Therefore, the reduction criterion has been defined as expressing the cleanup technology hierarchy under WAC 173-340-360(4) and the preference for permanent solutions under WAC 173-340-360(5)(a), *apart from the resultant improvements to long-term effectiveness and reliability*. The improvements to long-term effectiveness and reliability resulting from treatment or other reduction in toxicity, mobility, and volume are accounted for under the criterion of long-term effectiveness and reliability. This approach avoids double-counting benefits.

8.4 Evaluation of Remediation Alternatives for Permanence

This section provides a comparative evaluation of the alternatives using 5 of the 7 permanence criteria (see Sections 8.2 and 8.3). For completeness and perspective, all of the retained alternatives are included in the evaluation, even if they do not meet the threshold criteria (evaluated in Section 8.1). The basis for the scoring is provided below. The evaluation and scoring of the alternatives is summarized in Table 8-1.

8.4.1 Long-Term Effectiveness and Reliability

Past closure cover over the landfill already limits direct exposure to constituents of concern. However, portions of the site have slopes higher than desirable for long-term erosion protection. Additional cover thickness is also desirable in portions of the site.

The fact that no current groundwater contamination was found more than 30 years after initial closure indicates the very low groundwater risk posed by this site.

8.4.1.1 Effectiveness

Alternative 1 (No Action) does not decrease potential future site risks. After existing residences are removed from the site, there will be even less potential risk due to the site. However, there is exposed landfill waste at the site and therefore some possibility of future problems. Alternative 1 is therefore given the lowest effectiveness score of 3.

Alternative 2 (Institutional Controls and Monitoring) prevents direct-contact exposure by means of physical barriers (fencing with warning signs) and restricting site use (deed restrictions). However, this alternative does not prevent off-site migration of waste in airborne dust or stormwater (i.e., currently exposed or exposed by erosion of the current landfill cover). Alternative 2 is therefore more effective than Alternative 1, but less effective than the capping alternatives, and is given an effectiveness score of 4.

Alternative 3 (Permeable Soil Cap) would achieve all remedial action objectives. It would provide a thicker, more uniform, and more reliable cap to prevent direct contact with landfill waste. Adding a permeable soil cap would decrease the possibility migration of waste or waste constituents by providing a consistent cover over all landfill waste. Erosion would be significantly decreased by improved grading and stormwater controls. Landfill gas would be able to slowly permeate into the atmosphere, which ambient air monitoring in the RI has been shown not to be a problem. Air monitoring included in this alternative would confirm that ambient air continues to meet remediation goals (i.e., air quality standards). Alternative 3 is therefore given an effectiveness score of 9.

Alternative 4 (Low-Permeability Cap) would provide the benefits just given for Alternative 3, and add the benefit of minimizing infiltration of rainwater through the waste. However, given the lack of a groundwater problem without a low-permeability cover after over 30 years, this benefit is theoretical and of questionable real value. Although Alternative 3 and 4 would result in the same quantity of landfill gas release, Alternative 4 has the disadvantage of releasing landfill gases at centralized, discrete points (via the gas collection system). Point release increases the possibility of exceeding air quality standards near the release points. If air quality standards are exceeded, then the vented gases would require treatment to avoid exposing site users to unacceptable concentrations of hazardous constituents. Alternative 4 is given an effectiveness score of 9.5.

8.4.1.2 Reliability

The sub-criterion of reliability is scored based on professional judgment and experience in the ability of the remedies to achieve and maintain their estimated effectiveness. Although current risk due to the site is low, Alternative 1 (No Action) does not include any provisions to prevent future exposure to or release of landfill waste. Alternative 1 is therefore given the lowest reliability score of 1.

Alternative 2 does not include engineered containment as part of the remedial action. However, most of the landfill already has a variable thickness of soil cover. Under MTCA, the reliability of institutional controls is considered low in comparison to engineered containment or removal. Alternative 2 is therefore given a reliability score of 4.

The cap in Alternative 3 (Permeable Soil Cap) would be highly reliable because of its thickness and ease of repair. Alternative 3 is given a reliability score of 9.

A flexible membrane liner or FML is the cap for Alternative 4 (Low-Permeability Cap). FML will deteriorate and lose effectiveness over time. For this site, retaining low permeability characteristics is not important. Therefore, Alternative 4 is given the slightly lower score of 8.5.

8.4.1.3 Overall Score for the Long-Term Effectiveness and Reliability Criterion

The overall score for the criterion of long-term effectiveness and reliability is taken as the average of the two sub-criteria, which gives equal weight to the sub-criteria. The overall criterion scores are:

Alternative	Score
Alternative 1: No Action	2
Alternative 2: Institutional Controls	4
Alternative 3: Permeable Soil Cap	9
Alternative 5: Low-Permeability Cap	9

8.4.2 Short-Term Effectiveness

Alternative 1 (No Action) does not subject site workers to any risk, and is given a score of 10. Alternative 2 (Institutional Controls and Monitoring) involves relatively little site work, and is therefore given a score of 9. For cap alternatives, the required grading would increase the potential for inhalation exposure to landfill soil gas. The relative complexity of the caps is also a measure of the relative man-hours required, and therefore the relative worker risk to construction accidents. On this basis, Alternative 3 (Permeable Soil Cap) is given a score of 6. Alternative 4 (Low-Permeability Cap) is at least twice as complex as Alternative 3, and is therefore given a score of 3.

8.4.3 Reduction in Toxicity, Mobility and Volume

Alternatives 1 (No Action), (Institutional Controls and Monitoring), and 3 (Permeable Soil Cap) do not provide any reduction in toxicity, mobility, and volume, and are therefore given scores of 0.

Treatment is the most effective means of providing permanent reduction in toxicity, mobility, and volume. However, as discussed in Section 7, treatment alternatives are neither necessary nor appropriate for this site. Alternative 4 (Low-Permeability Cap) provides limited reduction in the mobility of constituents of concern by reducing infiltration of rainwater through the landfill waste. For this reason, Alternative 4 is given a score of 2. However, the lack of groundwater problems more than 30 years after landfill closure indicates that the mobility of waste constituents at the Norseland site is already low.

8.4.4 Implementability

Alternative 1 (No Action) would be the easiest to implement; therefore, it is given a score of 10. Alternative 2 (Institutional Controls and Monitoring) would be very easy to implement, and is therefore given a score of 9.

Both cap alternatives would be relatively easy to implement. Alternative 3 (Permeable Soil Cap) would be relatively easier to implement than Alternative 4 (Low-Permeability Cap) because of its simplicity, and is given a score of 7. Alternative 4 would require specialized contractors for synthetic liner installation, or soil compaction to permeability specifications if a soil liner were used. Alternative 4 is therefore scored at 4.

8.4.5 Net Benefit (Overall Non-Cost Evaluation)

The net benefit of the alternatives is determined by combining the criteria scores, weighting the criteria based on the relative values assigned to the criteria (see Section 8.3). The net benefit, or overall non-cost scores, are given in Table 8-1. Using these scores, the alternatives rank in the following order (most to least preferred):

1. Alternative 3 (Permeable Soil Cap)
2. Alternative 4 (Low-Permeability Cap)
3. Alternative 2 (Institutional Controls and Monitoring)
4. Alternative 1 (No Action).

8.4.6 Cost

The estimated costs for the alternatives are summarized in Table 8-2. Detailed cost estimates are presented in Appendix G. The cost for Alternative 1 (No Action) is zero because it does not include any remedial action or monitoring.

The cost estimates in this FS are based on the description of the alternatives and associated design assumptions in Section 7. The design assumptions used here are representative and sufficient for the purposes of comparative evaluation of the alternatives, but are not necessarily the same as the design basis that would be used for the final, detailed design. Pre-design investigations would be included in the final design phase for any of these remedial actions, and the results of these investigations could result in changes from the preliminary designs presented in this FS.

The estimates were prepared to allow comparative evaluation of alternatives, not for budgeting purposes. The design basis is subject to change during final, detailed design of the selected alternative, and these changes would affect the cost of the remedy. The uncertainties in the FS designs and associated cost estimates are such that actual costs could vary significantly from these estimates. However, the uncertainty in the *relative* cost of the alternatives is much less than the uncertainty in the magnitude of the costs, and these cost estimates are suitable for comparative evaluation of the alternatives. Cost uncertainties were estimated stochastically (probabilistically), and are presented in the uncertainty analysis (Section 8.4.9).

Because restrictions on land use affect the sale value and earning potential of the land, these factors were reflected in the cost estimates. In Alternative 2 (Institutional Controls and Monitoring), the land would not be available for beneficial use. Therefore, the value of the land (without use restrictions) and the earning potential of the land would be lost, and have been included as costs of implementing Alternative 2.

Alternatives 3 (Permeable Soil Cap) and 4 (Low-Permeability Cap) would be available for beneficial uses. Therefore, the costs of lost land value and earning potential are $0. However, development on a sanitary landfill requires construction measures beyond development on normal, non-fill land. These costs would consist of additional support as determined necessary through a geotechnical investigation and incorporated into the engineering of the building or other structure. In addition, the gas venting specified for Alternatives 3 and 4 (see Sections 7.2.3 and 7.2.4) would be additional development cost. These additional development costs would in effect subtract from the value and earning potential of the land. For consistent comparison of these two alternatives to Alternative 2, these costs have been added to Alternatives 3 and 4 as costs necessary to provide the land value and earning potential specified in the Alternative 2 cost estimate.

Alternative 4 would have incremental development costs in addition to those of Alternative 3, because of the need to maintain liner integrity (see Section 7.2.4). These costs have been added to the Alternative 4 cost estimate in addition to the development costs common to Alternatives 3 and 4.

8.4.7 Cost/Benefit Analysis and Overall Evaluation

Under WAC 173-340-360(5)(d)(vi), "a cleanup action shall not be considered practicable if the incremental cost of the cleanup action is substantial and disproportionate to the incremental degree of protection it would achieve over a lower preference cleanup action." The determination of practicability is made using an analysis of cost vs. benefit. The cost benefit analysis can be performed quantitatively using the overall scoring of the non-cost criteria as the net benefit.

Figure 8-1 shows a graph of cost versus net benefit for the alternatives. The error bars on these graphs show the range from the 10th to the 90th percentiles from the stochastic uncertainty analysis (see Section 8.4.9).

The ratio of net benefit to estimated cost, which is a measure of cost-effectiveness, is given in Table 8-1. On a strict cost/benefit basis, Alternative 3 (Permeable Soil Cap) is preferred, followed in order by Alternative 2 (Institutional Controls and Monitoring) and Alternative 4 (Low-Permeable Cap).

However, the MTCA regulations refer to incremental cost and benefit. To evaluate incremental cost-effectiveness, the difference in cost between alternatives is calculated, going from the least costly alternative to the most costly. The corresponding difference in net benefit (overall non-cost score) is then calculated. Dividing the incremental benefit by the incremental cost results in a value that is the incremental cost-effectiveness. These values are shown for the alternatives in Table 8-1.

Based on the cost-benefit graph (Figure 8-1) and the incremental cost-effectiveness values (Table 8-1), Alternative 3 (Permeable Soil Cap) provides the best incremental cost-effectiveness, in addition to providing good net benefit.

Alternative 3 meets the threshold criteria of protection of human health and the environment, compliance with cleanup standards, and provision for compliance monitoring. Alternative 3 also complies with ARARs, including landfill closure standards under WAC 173-304.

Alternative 3 (Permeable Soil Cap) provides the optimum combination of long-term effectiveness and reliability, short-term effectiveness, implementability, and reduction of toxicity, mobility, and volume. In addition, this alternative provides good cost/benefit. Considering the criteria and approach specified in WAC 173-340-360(5), Alternative 3 is the remediation alternative for the Norseland site that is "permanent to the maximum extent practicable", and is therefore the preferred alternative.

8.4.8 Basis for Variance under WAC 173-304-700 for Alternative 3

Minimum functional standards (MFS) for landfills are found in WAC 173-304. These regulations contain three landfill closure standards, two of which are relevant for this site. First, general landfill closure standards under WAC 173-304-460(3)(e) require closure caps to have at least either two feet of low-permeability (10^{-6} cm/sec) soil or a synthetic liner with a minimum thickness of 50 mils (e.g., the 50-mil FML of the Alternative 4 cap). Second, inert waste and demolition waste landfill closure standards under WAC 173-304-461(6) require closure by leveling the waste and covering with one foot of soil cover. As discussed in Section 4.3, these standards are not legally applicable but are relevant and appropriate under MTCA.

Alternative 3 (Permeable Soil Cap) does not provide a low-permeability cap, and therefore does not meet all of the specific design standards of WAC 173-304-460(3)(e). Alternative 3 does provide regrading the site and covering with a minimum of two feet of soil cover as required by these standards. Alternative 3 also exceeds the landfill closure standards of WAC 173-304-461(6).

A variance from 173-304-460 closure standards may be obtained if the following conditions are met (WAC 173-304-700):

> "(a) The solid waste handling practices or location do not endanger public health, safety, or the environment; and
>
> (b) Compliance with the regulation from which variance is sought would produce hardship without equal or greater benefits to the public."

The Norseland landfill received municipal solid waste; the general landfill standards of WAC 173-304-460 are therefore considered ARAR (see Section 4). However, much of the waste was burned, which results in a relatively inert ash. In addition, municipal landfill waste degrades biologically over time; it has been over 30 years since initial landfill closure. Therefore, significant waste degradation is expected to have occurred. The relatively inert current state of the Norseland landfill waste is evidenced by the low methane concentrations found in subsurface landfill gas. A normal municipal landfill generates significant volumes of gas with high concentrations of methane, which is the primary gaseous product of anaerobic biological degradation. In addition, the lack of waste constituents in groundwater is further evidence of the relatively inert nature of the landfill. Therefore, the Norseland landfill exhibits characteristics similar to inert waste landfills and unlike typical municipal sanitary landfills. On this basis, the closure standards of WAC 173-304-460 are not necessarily appropriate. These considerations support that grading and simple soil cover, in compliance with the landfill closure standards of WAC 173-304-461, are sufficient for protection of public health, safety, and the environment.

The landfill does not significantly impact either ambient air or groundwater. As discussed above (Sections 8.4.1 and 8.4.7), Alternative 3 would decrease the already low potential risk posed by this site. Therefore, Alternative 3 meets variance condition (a).

As shown in Table 8-2, Alternative 4 (Low-Permeability Cap) would cost approximately twice as much as Alternative 3. Thus, meeting the closure standard of WAC 173-304-460 instead of the closure standard of WAC 173-304-461 would produce the hardship of significant additional expenditure without corresponding environmental benefits. In addition, Alternative 4 could create localized ambient air quality problems that do not currently exist due to collection and point discharge of landfill gases (see Sections 7.2.4 and 8.4.1). The cap liner (FML) of Alternative 4 would decrease infiltration of water through landfill waste, thus minimizing the potential for constituents of concern to reach groundwater via leachate. However, infiltration comparable to the permeable cap of Alternative 3 has been occurring for more than 30 years without a groundwater problem being created. Thus, the theoretical benefit of a low-permeability cap does not provide significant additional long-term protectiveness for this site. As shown in the overall evaluation, Alternative 3 has greater net benefit than Alternative 4.

Alternative 4 would impose the additional hardship of being more difficult and costly to develop for most beneficial uses than Alternative 3. Pursuant to the "Ports Bill" (1994 Wash. Laws Ch. 254) and recent "brownfields initiatives", the State of Washington is establishing policies that encourage remedial actions allowing beneficial reuse and redevelopment of contaminated sites consistent with current or planned land uses. Selection of Alternative 3 is consistent with this policy while still protecting human health and the environment.

Considering the above factors, Alternative 3 meets the conditions for a variance under WAC 173-304-700, and therefore complies with all ARARs including WAC-173-304.

8.4.9 Uncertainty Analysis

The uncertainty analysis examines the possibility that the preferred alternative could be other than the one identified in Section 8.4.8 by deterministic evaluation (Alternative 3 - Permeable Soil Cap). As performed here, the uncertainty analysis considers the following uncertainties:

- **Evaluation scores.** The evaluation scores in this FS are semi-quantitative expressions of professional judgment. The uncertainty in these scores reflects potential differences in professional judgment affecting the ranking and relative merit of the alternatives for each of the criteria. The uncertainties in the evaluation scores reflects both known variation and unknowns in performance against the criteria.

- **Cost.** Cost is an objective, quantitative measure. The uncertainty in the costs reflects both known variations in cost items and unknown factors affecting cost.

- **Relative criteria values (criteria weightings).** The relative values, or weighting, of the criteria reflect a value system, and are inherently subjective. The criteria weightings used in this FS reflect the best professional judgment of the FS authors, given the criteria definitions and basis for scoring described above, and considering regulatory and societal norms for site remediation decisions. For this FS, the uncertainty in the relative criteria values reflects the uncertainty that the value systems used by the decision makers that actually select the alternative will match the value system assumed in this FS.

The uncertainty analysis was conducted by simultaneously varying all of the above factors in a manner that allows observation of the overall, combined effect of the interacting uncertainties. This approach is more accurate than varying one factor at a time, because the result of variation in one factor often depends on other variations. For example, in practice the weighting of a single criterion is seldom changed alone. Rather, other criteria weightings are usually changed at the same time (i.e., the relative value of short-term effectiveness and implementability are often close, so that one would be unlikely to be changed without also changing the other).

The uncertainty analysis was performed stochastically (probabilistically). Probability distribution functions (PDFs) were estimated for non-cost scores, key cost parameters, and relative criteria values (documented in Appendix H). Using these PDFs, a Monte Carlo simulation (i.e., stochastic analysis) was performed to obtain PDFs for the net benefit values and costs of the alternatives (calculated as in Table 8-1). The output from this analysis is summarized in Table 8-3 and details are provided in Appendix H. This approach allows consideration of the full range of uncertainties without over-emphasis of extreme, unlikely cases.

The error bars in Figure 8-1 show the range from the 10th to the 90th percentiles for the values from the stochastic analysis. In other words, it is estimated that there is an 80% probability that the value of the calculated parameter (net benefit or cost) lies in the range shown by the error bars. The error bars for Alternative 3 (Permeable Soil Cap) do not overlap for the net benefit with those of any other alternative, although the error bar for costs does overlap with the cost error bar of Alternative 2.. From this, it is concluded that no defensible combination of evaluation scores or relative criteria values (criteria weightings) would result in preference for an alternative other than Alternative 3.

Overlap of error bars (e.g., net benefit for Alternatives 1 and 2) is not necessarily indicative of reversal of relative ranking. For many of the parameters affecting cost and benefit, the overall values rise and fall together. Thus, the uncertainty in the relative ranking of alternatives is less than the uncertainty in the specific evaluation and cost scores.

Uncertainty in relative ranking of alternatives may be examined by considering the ratio of the values for any two alternatives (i.e., the ratio of net benefits or costs). In this analysis, the relative net benefit and relative costs were calculated to compare Alternative 3 to Alternative 4 and to Alternative 2. The PDFs for these ratios are shown in Figure 8-2. Two alternatives are equivalent (for either net benefit or cost) if their values are the same, meaning a ratio 1. In Figure 8-2, the ratio of net benefit of Alternative 3 to Alternative 4 is always greater than 1, meaning that Alternative 4 would never be preferred to Alternative 3 on the basis of the evaluation in this FS, even considering potentially defensible variation in values systems (i.e., different criteria weightings) and different (but similar) evaluation scores. Similarly, the cost ratio is always less than 1, meaning that Alternative 3 would always cost less than Alternative 4.

The conclusion of the uncertainty analysis is that the preference for Alternative 3 over the other alternatives has very low uncertainty. No reasonable and defensible combination of evaluation scores, relative criteria values, and costs would result in preference for one of the other alternatives.

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TABLES

TABLE 2-1

AIR SAMPLING ANALYSIS MATRIX

	Initial Soil Vapor Survey, 3/94			Soil Gas/Skirt Air Survey, 9/94			Odor Events, 3/95			Comparative Air Study, 6/95		
	SG	SK	AA	SG	SK	AA	SG	SK	AA	SG	SK	AA
Sulfides per EPA Method 15/16	X						X		X			
Aldehydes per EPA Method T0-11	X						X		X			
Amines	X						X		X			
Fixed Gases per ASTM D-3416	X				X		X		X			
VOCs per EPA Method T0-14	X			X	X	X	X		X	X	X	X
TICs	X			X[a]	X[a]	X[a]	X		X	X	X	X

SG = Soil Gas
SK = Skirt Air
AA = Ambient Air
X = Analysis performed
[a] = Specific TICs only (acetone, tetrahydrofuran and 2-butanone)

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TABLE 3-1

WATER WELLS WITHIN ONE MILE OF THE NORSELAND SITE

Golder Well ID	Well Location	Year Installed	Owner at Time of Installation	Apx. Distance & Direction From Norseland (miles)	Primary Formation Material(s)	Depth to Water (FBC)	Bottom of Screen (FBC)	Yield (GPM)
1	SE SW Sec 2	1987	City of Bremerton	0.75 N	Brown SAND & GRAVEL	44	65	13
2	NW NE Sec 10	1991	Tom Jones	1.0 NW	Silty SAND	29	117(NS)	15
3	NE NE Sec 11	1987	City of Bremerton	0.75 NE	Brown SAND & CLAY	58	82	7.5
4	NE SW Sec 12	1981	John Powless	1.0 E	GRAVEL & CLAY	160	219	8
5	SW SE Sec 12	1978	Ernest Wolf	1.0 E	SAND, CLAY & GRAVEL	177	203	15
6	SW SE Sec 12	1980	Dennis Ridenour	1.0 E	Brown SAND	198	228	15
7	SE NW Sec 13	1993	Robert Kanekkeberg	1.0 SE	SAND & CLAY	114	126.5	6
8	SE NW Sec 13	1992	Gary Calvert	1.0 SE	"Hard Pan" & SAND	143.5	188	20
9	SE NW Sec 13	1988	David Frick	1.0 SE	SAND & Till	150	195	20

Notes:
1. FBC means "Feet Below Casing"
2. GPM means "Gallons per Minute"
3. NS indicates no screen was installed in the well. The value given indicates the depth where the casing ends.
4. Water levels were measured at various times after well installation.
5. Well locations shown in Figure 3-5.

TABLE 4-1

IDENTIFICATION OF POTENTIAL FEDERAL ARARS FOR THE NORSELAND SITE

Requirements	Applicable or Relevant & Appropriate	Comment
Clean Air Act of 1977, as amended 42 USC 7401 et seq.	Potentially Applicable	The Clean Air Act (CAA) regulates emission of hazardous pollutants to the air. Controls for emissions are implemented through federal, state, and local programs. Pursuant to the CAA, EPA has promulgated National Ambient Air Quality Standards, National Emission Standards for Hazardous Air Pollutants, and New Source Performance Standards. Implementation of the Clean Air Act has been delegated to the State of Washington (see the Washington Clean Air Act, Table 4-2). The CAA would be applicable only if remedial action at the site created new sources of regulated air emissions.
Hazardous Materials Transportation Act 49 USC 1801, et seq. Hazardous Materials Transportation Regulations 49 CFR 171 and 172	Potentially Applicable	This act and associated regulations applies to transportation of hazardous materials. These requirements would be applicable only if hazardous waste or other hazardous material (as defined in the regulations) were generated during site remediation for off-site disposal.
Resource Conservation and Recovery Act (RCRA) 42 USC 6901, et seq.		RCRA and the associated regulations defines "hazardous waste" and regulates management of such wastes. The State of Washington has been delegated authority for implementation of RCRA under Washington's Hazardous Waste Management Act and Dangerous Waste Regulations (see Table 4-2).
Closure and post-closure requirements 40 CFR 264 and 265	Not ARAR	The Norseland site was not a hazardous waste facility. In addition, the site stopped receiving waste prior to the effective date of these regulations. Therefore, RCRA closure and post closure requirements of 40CFR264 and 265 for hazardous waste facilities is not applicable to the Norseland site. Because it was a municipal solid waste (rather than hazardous waste) landfill, RCRA is neither relevant nor appropriate for closure of the Norseland site.
Definitions and general requirements 40 CFR 260 and 261 Generator standards 40 CFR 262	Potentially Applicable	RCRA would be ARAR only if hazardous waste were generated during remedial action. The EPA has granted the State of Washington the authority to implement RCRA through the Department of Ecology's dangerous waste program (WAC 173-303), presented in Table 4-2.
Safe Drinking Water Act of 1974 42 USC 300, et seq. National Primary and Secondary Drinking Water Standards 40 CFR 141, 143	Applicable	MTCA requires that cleanup standards for groundwater be at least as stringent as maximum contaminant levels (MCLs), secondary maximum contaminant levels (SMCLs), and non-carcinogen maximum contaminant level goals (MCLGs) established under the Safe Drinking Water Act where groundwater is a current or future source of drinking water. Since groundwater is currently not used for drinking at the Norseland site, these requirements may not be applicable for site groundwater; however, private residences in the area of the site could potentially use groundwater as their drinking water source and site groundwater could be classified as a future potential source of drinking water. These standards are therefore consider applicable. MCLs, SMCLs and non-carcinogen MCLGs for public drinking water are presented in Table 4-5 for selected compounds.

TABLE 4-2

IDENTIFICATION OF POTENTIAL STATE AND LOCAL ARARS FOR THE NORSELAND SITE

Requirements	Applicable or Relevant & Appropriate	Comment
Model Toxics Control Act Ch. 70.105D RCW Regulations WAC 173-340	Applicable	MTCA is the key governmental regulation governing the site investigation and remediation in the State of Washington. MTCA describes the requirements for selecting cleanup actions, preferred technologies, policies for use of permanent solutions, the time frame for cleanup, and the decision-making process. Recently, MTCA was amended to achieve the following purposes [see RCW 70.105D.010(4)]: 1) to promote the public's interest to efficiently use the finite land base; 2) to integrate land use planning policies; 3) to cleanup and reuse contaminated industrial properties in order to minimize industrial development pressures on undeveloped land; and 4) to make clean land available for future social use. Recent amendments to MTCA (RCW 70.105D.090) exempt remedial actions conducted pursuant to a Consent Decree or an Agreed Order from the procedural requirements of certain state and all local laws and regulations, including permitting. The substantive requirements of applicable laws, regulations, and ordinances must still be met. However, permits and separate approvals within the exemption are not required for remedial actions at the site. Ecology determines substantive compliance with ARARs through review of the RI/FS and draft CAP. Approval of the RI/FS and issuance of the final CAP (after public review and comment pursuant to WAC 173-340-600) constitutes Ecology's determination that the selected remedy will be in substantive compliance with the final ARARs. Regulations under WAC Chapter 173-340, which implement the requirements of MTCA, are the primary regulatory vehicle under which Norseland site remediation is being conducted. MTCA regulations are therefore applicable. These regulations establish administrative processes and standards to identify, investigate and cleanup facilities where hazardous substances have been released. Additional discussion of MTCA as it applies to this site is provided in the text.
Regulation of Public Groundwater Ch. 90.44 RCW Water Quality Standards for Groundwater WAC 173-200	Not ARAR	The rule establishes groundwater quality standards to provide for the protection of public health and existing/future beneficial uses. The rule (WAC 173-200(2)(c)) specifies that cleanup actions approved by Ecology under the Model Toxics Control Act are exempt from WAC 173-200 and shall use ground water cleanup standards developed under the Model Toxics Control Act Regulation, WAC 173-340-720.

TABLE 4-2

IDENTIFICATION OF POTENTIAL STATE AND LOCAL ARARS FOR THE NORSELAND SITE

Requirements	Applicable or Relevant & Appropriate	Comment
Department of Health Standards for Public Water Supplies WAC 246-290	Applicable	The rule established under WAC 246-290 defines the regulatory requirements necessary to protect consumers using public drinking water supplies. The rules are intended to conform with the federal Safe Drinking Water Act (SDWA), as amended. WAC 246-290-310 establishes maximum contaminant levels (MCLs) which define the water quality requirements for public water supplies. The requirements of WAC 246-290-310 may not be applicable to the Norseland site because surface and groundwater at the site are not used as a source of public drinking water. However, these standards are applicable since private residences in the area could potentially use groundwater as their source of drinking water. WAC 246-290-310 establishes both primary and secondary MCLs and identifies that enforcement of the primary standards is the Department of Health's first priority. The standards set under WAC 246-290-310 are set at the levels established under the federal SDWA. These levels are shown in Table 4-5.
State Environmental Policy Act (SEPA) Ch. 43-21C RCW SEPA Rules WAC 197-11 SEPA Procedures WAC 173-802	Applicable	SEPA is triggered when a governmental action is taken on a public or private proposal. Under WAC 197-11-784, a proposal includes both regulatory decisions of agencies and actions proposed by applicants. Under WAC 197-11-253, Ecology is the lead agency for site cleanup actions performed under MTCA. SEPA is applicable to remedial actions at the Norseland site. If the proposal is not "exempt", Ecology will require the submission of a SEPA checklist giving information regarding how the proposal will affect elements of the environment, such as air and water. If the proposal is determined by Ecology to have a "probable significant adverse environmental impact", an environmental impact statement (EIS) is required. The EIS examines the potential environmental problems that would be result from the proposed action, and options for mitigation of adverse affects. If there will be no significant adverse environmental impact, Ecology issues Determination of Nonsignificance (DNS) and no EIS is required. Any public comment period required under SEPA must be combined with any comment period under MTCA in order to expedite and streamline public input. According to WAC 197-11-259, if Ecology makes a determination that the proposal will not have a probable significant adverse environmental impact, a DNS can be issued with the draft CAP.

TABLE 4-2

IDENTIFICATION OF POTENTIAL STATE AND LOCAL ARARS FOR THE NORSELAND SITE

Requirements	Applicable or Relevant & Appropriate	Comment
Hazardous Waste Management Act 70.105 RCW		This law and associated regulations defines "dangerous waste" and regulates management of such wastes.
Closure and post-closure requirements for hazardous and dangerous waste landfills WAC 173-303-610 and -665	Not ARAR	The Norseland site was not a hazardous or dangerous waste facility. In addition, the site stopped receiving waste prior to the effective date of these regulations. Therefore, the hazardous waste law and dangerous waste regulations are not applicable to the Norseland site. Because it was a municipal solid waste (rather than hazardous waste) landfill, these requirements are neither relevant nor appropriate for closure of the Norseland site.
Designation of dangerous waste WAC 173-303-070 Generator requirements WAC 173-303-170	Potentially Applicable	These requirements would be ARAR only if hazardous or dangerous waste were generated during remedial action. Certain wastes may also be exempt from regulation pursuant to MTCA if the cleanup is performed under a Consent Decree.
Solid Waste Management, Recovery, and Recycling Act Ch. 70.95 RCW Minimum Functional Standards (MFS) for Solid Waste Handling WAC 173-304	Applicable	WAC 173-304 ("Minimum Functional Standards for Solid Waste Handling") contains requirements for the management of solid waste. Because the Norseland site stopped receiving waste materials prior to the effective date of these regulations and does not meet the definition of a regulated facility, WAC 173-304 is not legally applicable to the Norseland site. However, MTCA regulations [WAC 173-340-710(6)(c)] specify that for "solid waste landfills, the solid waste closure requirements in chapter 173-304 WAC shall be minimum requirements for cleanup actions"; i.e., applicable. WAC 173-304-407 contains general closure and post-closure standards. There are three separate landfill closure standards: WAC 173-304-460 (for most solid waste landfills), WAC 173-304-461 (for inert waste and demolition waste landfills), and WAC 173-304-462 (for woodwaste landfills). The woodwaste landfill standards are neither relevant nor appropriate to the Norseland site. For reasons discussed in Section 4.3, both the -460 and -461 standards are applicable for the Norseland landfill. WAC 173-304-700 provides for variances from the WAC 173-304 closure standards.
Water Well Construction CH. 18.104 RCW Minimum Standards for Construction and Maintenance of Water Wells WAC 173-160	Applicable	These requirements are applicable to remedial actions that include construction of wells used for groundwater extraction, monitoring, or injection of treated groundwater or wastes. These requirements also include standards for well abandonment.

TABLE 4-2

IDENTIFICATION OF POTENTIAL STATE AND LOCAL ARARS FOR THE NORSELAND SITE

Requirements	Applicable or Relevant & Appropriate	Comment
Water Pollution Control/Water Resources Act Ch. 90.48 RCW/Ch. 90.54 RCW Surface Water Quality Standards WAC 173-201A	Not ARAR	Since water quality standards are set at levels protective of aquatic life, these standards are only applicable to surface waters at the site which either support or have the potential to support aquatic life. Since surface water was not observed at the site, these requirements are not considered to be an ARAR.
Washington Clean Air Act Ch. 70.94 RCW and Ch. 43.21A RCW General Regulations for Air Pollution Sources WAC 173-400 Controls for New Sources of Air Pollution WAC 173-460 Puget Sound Air Pollution Control Agency (PSAPCA) regulations	Applicable	The Washington State Clean Air Act is the state equivalent of the federal Clean Air Act. The regulation requires that all sources of air contaminants meet emission standards for visible, particulate, fugitive, odors, and hazardous air emissions. Under WAC 173-340-710(6)(b), air emissions are required to use best available control technologies (BACT) consistent with 70.94 RCW and its implementing regulations. Substantive standards established for the control and prevention of air pollution would be applicable if remedial action created sources of regulated air emissions. The Puget Sound Air Pollution Control Agency (PSAPCA) has jurisdiction over regulation and control of the emission of air contaminants and the requirements of state and federal Clean Air Acts from all sources in King, Pierce, Snohomish and Kitsap county areas. PSAPCA Regulations 1 and 3 are applicable to the Norseland site since the landfill appear to meet the definition of a source. Regulation 2, however, is not considered applicable or relevant and appropriate because the landfill does not fall into any of the specific industrial activities which are identified under the regulation. Acceptable Source Impact Limits (ASILs) identified under Regulation 3 are applicable to the site, but only to outdoor air. Outdoor air is defined as that portion of the atmosphere, external to buildings, which the general public has access. Therefore, ASILs are not ARAR to soil gas.

TABLE 4-3

AIR TOXICITY VALUES AND REFERENCES

Contaminant	Toxicity Values and References						Toxicity Value Source Date		
	RfC (mg/m3)	RfD (mg/kg-d)	Ref	Unit Risk (m3/ug)	SF (kg-d/mg)	Ref	IRIS[1]	HEAST[2]	STSC[3]
1,1,1-Trichloroethane	2	5.71E-01	STSC						10/14/93[4]
1,2,4-Trichlorobenzene	0.2	5.71E-02	HEAST					May-99	
1,2,4-Trimethylbenzene	no data								
1,3,5-Trimethylbenzene	no data								
4-Pentenal	no data								
Benzene					2.90E-02	HEAST		May-99	
CO2	no data								
Chlorobenzene		5.00E-03	HEAST					May-99	
Chloromethane					6.30E-03	HEAST		May-99	
Chlorotoluene	no data								
Ethyl benzene		2.86E-01	IRIS				Mar-95		
Formaldehyde					4.50E-02	HEAST		May-99	
Freon 11	0.7	2.00E-01	HEAST					May-99	
Freon 113	30	8.57E+00	HEAST					May-99	
Freon 12		5.00E-02	HEAST					May-99	
Methane	no data								
Methylene chloride	3	8.57E-01	HEAST	4.70E-07	1.65E-03	IRIS	8/31/97	May-99	
N	no data								
O	no data								
Styrene	1	2.86E-01	IRIS				3/5/97		
PCE					2.00E-03	STSC			2/26/93[5]
Toluene	0.4	1.14E-01	IRIS				5/24/98		
TCE					6.00E-03	STSC			2/26/93[5]
m,p-Xylene	no data								
o-Xylene	no data								
1,1-Dichloroethene					1.20E+00	HEAST		May-99	
(Z)-2-Nonenal	no data								
1,1,2-Trichloroethane					5.70E-02	HEAST		May-99	
1,1-Dichloroethane		1.00E-01	HEAST					May-99	
1,2,3-Trimethylbenzene	no data								
1,2-Dichlorobenzene		4.00E-02	HEAST					May-99	
1,2-Dichloroethane				2.60E-05	9.10E-02	IRIS	8/4/97		
1,2-Dichloropropane	4.00E-03	1.14E-03	IRIS				7/27/00		
1,2-Dimethyl-3-(1-methylethyl)cyclopentane	no data								
1,3-Butadiene					1.80E+00	HEAST		May-99	

TABLE 4-3

AIR TOXICITY VALUES AND REFERENCES

Contaminant	Toxicity Values and References						Toxicity Value Source Date		
	RfC (mg/m3)	RfD (mg/kg-d)	Ref	Unit Risk (m3/ug)	SF (kg-d/mg)	Ref	IRIS[1]	HEAST[2]	STSC[3]
1,4-Dichlorobenzene	8.00E-01	2.29E-01					IRIS	7/27/00	
1-Ethyl-1-methylcyclohexane	no data								
1-Hexanol	no data								
1-Methyl-napthalene	no data								
1-Pentyne	no data								
2 (1H)-Pyridinone	no data								
2,2-Dimethyl-4-pentenal	no data								
2,6-Dimethylnonane	no data								
2-Bromo-1-phenyl-1-propanone	no data								
2-Methyl-1-butanamine	no data								
2-Methyl-1-propene	no data								
2-Methyl-2-undecanethiol	no data								
2-Methyl-pentane	no data								
2-Propanol	no data								
2-Propenenitrile	2.00E-03	5.71E-04	IRIS	6.80E-05	2.38E-01	IRIS	7/27/00		
3,4,4-Trimethyl-2-hexene	no data								
3-Carene	no data								
4-Hydroxy-benzenesulfonic acid	no data								
4-Methyl-2-pentanone		2.00E-02	HEAST					May-99	
4-Methyl-decane	no data								
5-Methyl-1-hexene	no data								
Acetaldehyde	9.00E-03	2.57E-03	HEAST	2.20E-06	7.70E-03	IRIS	7/27/00	May-99	
Acetone	no data								
Benzenemethanol	no data								
Butanal	no data								
Butylcyclopropane	no data								
Carbamic acid, 2-propenyl ester	no data								
Carbamic acid, phenyl ester	no data								
Carbon disulfide	7.00E-01	2.00E-01	IRIS				7/27/00		
Carbon tetrachloride				1.50E-05	5.25E-02	IRIS	3/6/97		
Cchlorodifluoromethane	5.00E+01	1.43E+01	IRIS				7/27/00		
Chloroethane	1.00E+01	2.86E+00	IRIS				7/27/00		
Chloroform				2.30E-05	8.05E-02	IRIS	1/10/00		
cis-1,2-Dichloroethene	no data								
Decahydronapthalene	no data								

TABLE 4-3

AIR TOXICITY VALUES AND REFERENCES

Contaminant	Toxicity Values and References						Toxicity Value Source Date		
	RfC (mg/m3)	RfD (mg/kg-d)	Ref	Unit Risk (m3/ug)	SF (kg-d/mg)	Ref	IRIS[1]	HEAST[2]	STSC[3]
Decane	no data								
Dimethyl disulfide	no data								
Dodecane	no data								
Dodecanoic acid, methyl ester	no data								
Ethanedioic acid, dibutyl ester	no data								
Ethanol	no data								
Freon 114	no data								
Hexanal	no data								
Hexane	2.00E-01	5.71E-02	IRIS				9/21/97		
Isocyanomethane	no data								
Methane	no data								
Methyl ethyl ketone	1	2.86E-01	IRIS				9/21/97		
Methyl(1-methyl ethyl-)benzene	no data								
N-Propyl S-butyl disulfide	nodata								
Nonane	no data								
Octadecanal	no data								
Phenol	no data								
Propyl-cyclopropane	no data								
Tetrahydrofuran	no data								
THC*	no data								
Tridecane	no data								
Undecane	no data								
Vinyl chloride					3.00E-01	HEAST		May-99	

1 Integrated Risk Information System (IRIS) data file, U.S. Department of Health and Human Services, National Library of Medicine Toxicology Data Network (TOXNET), Bethesda, Maryland 1996.

2- Health Effects Assessment Summary Tables (HEAST): Annual FY-1995, EPA /540-R-95/ 142 U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington D.C. 1995

3- Superfund Health Risk Technical Support Center (STSC), Chemical Mixtures Assessment Branch, U.S. Environmental Protection Agency, Cincinnati, Ohio.

4-Provisional Inhalation RfD for 1,1,1-Trichloroethane, U.S. Environmental Protection Agency, Superfund Health Risk Technical Support Center, Chemical Mixtures Assessment Branch, Cincinnati, Ohio 1993.

5- Provisional Inhalation Slope Factors for Trichoroethylene and Tetrachloroethylene, U.S. Environmental Protection Agency, Superfund Health Risk Technical Support Chemical Mixtures Assessment Branch, Cincinnati, Ohio 1993.

RfC means reference concentration

RfD means reference dose

SF means carcinogenic slope factor

POTENTIAL ARAR VALUES FOR AIR

Contaminant	MTCA Air Standards (WAC 173-340-750) Method B (mg/m3) Carc	Method B (mg/m3) Noncarc	Method C (mg/m3) Carc	Method C (mg/m3) Noncarc	MTCA Air Standards (WAC 173-340-750) Method B ppb (v/v) Carc	Method B ppb (v/v) Noncarc	Method C ppb (v/v) Carc	Method C ppb (v/v) Noncarc
1,1,1-trichloroethane		9.14E-01		2.00E+00		1.68E+02		3.67E+02
1,2,4-trichlorobenzene		9.14E-02		2.00E-01		1.23E+01		2.69E+01
1,2,4-trimethylbenzene								
1,3,5-trimethylbenzene								
4-pentenal								
benzene	3.02E-04		3.02E-03		9.45E-02		9.45E-01	
Carbon dioxide								
Chlorobenzene		8.00E-03		1.75E-02		1.74E+00		3.80E+00
Chloromethane	1.39E-03		1.39E-02		6.73E-01		6.73E+00	
Chlorotoluene								
Ethyl benzene		4.57E-01		1.00E+00		1.05E+02		2.30E+02
Formaldehyde	1.94E-04		1.94E-03		1.58E-01		1.58E+00	
Freon 11		3.20E-01		7.00E-01		5.70E+01		1.25E+02
Freon 113		1.37E+01		3.00E+01		1.79E+03		3.91E+03
Freon 12		8.00E-02		1.75E-01		1.62E+01		3.54E+01
Methane								
Methylene Chloride	5.32E-03	1.37E+00	5.32E-02	3.00E+00	1.53E+00	3.95E+02	1.53E+01	8.64E+02
Nitrogen								
Oxygen								
Styrene		4.57E-01		1.00E+00		1.07E+02		2.35E+02
Tetrachloroethene	4.38E-03		4.38E-02		6.45E-01		6.45E+00	
toluene		1.83E-01		4.00E-01		4.85E+01		1.06E+02
Trichloroethene	1.46E-03		1.46E-02	0.00E+00	2.71E-01		2.71E+00	
m,p-Xylene								
o-Xylene								
1,1-Dichloroethene	7.29E-06		7.29E-05		1.84E-03		1.84E-02	
(Z)-2-Nonenal								
1,1,2-Trichloroethane	1.54E-04		1.54E-03		2.81E-02		2.81E-01	
1,1-Dichloroethane		1.60E-01		3.50E-01		3.95E+01		8.65E+01
1,2,3-Trimethylbenzene								
1,2-Dichlorobenzene		6.40E-02		1.40E-01		1.06E+01		2.33E+01
1,2-Dichloroethane	9.62E-05		9.62E-04		2.38E-02		2.38E-01	
1,2-Dichloropropane		1.83E-03		4.00E-03		3.96E-01		8.66E-01
1,2-Dimethyl-3-(1-methylethyl)cyclopentane								
1,3-Butadiene	4.86E-06		4.86E-05		2.20E-03		2.20E-02	
1,4-Dichlorobenzene		3.66E-01		8.00E-01		6.08E+01		1.33E+02
1-Ethyl-1-methylcyclohexane								
1-HEXANOL								
1-METHYL-NAPTHALENE								
1-Pentyne								
2 (1H)-Pyridinone								
2,2-Dimethyl-4-pentenal								
2,6-Dimethylnonane								
2-Bromo-1-phenyl-1-propanone								
2-Methyl-1-butanamine								
2-Methyl-1-propene								
2-Methyl-2-undecanethiol								
2-METHYL-PENTANE								
2-PROPANOL								
2-PROPENENITRILE	3.68E-05	9.14E-04	3.68E-04	2.00E-03	1.58E-02	3.92E-01	1.58E-01	8.57E-01
3,4,4-Trimethyl-2-hexene								
3-CARENE								
4-Hydroxy-benzenesulfonic Acid								
4-Methyl-2-pentanone		3.20E-02		7.00E-02		7.81E+00		1.71E+01
4-METHYL-DECANE								
5-Methyl-1-hexene								
ACETALDEHYDE	1.14E-03	4.11E-03	1.14E-02	9.00E-03	6.31E-01	2.28E+00	6.31E+00	4.99E+00
Acetone								
Benzenemethanol								
BUTANAL								
Butylcyclopropane								
Carbamic Acid, 2-propenyl ester								
Carbamic Acid, phenyl ester								
CARBON DISULFIDE		3.20E-01		7.00E-01		1.03E+02		2.25E+02
Carbon tetrachloride	1.67E-04		1.67E-03		2.66E-02		2.66E-01	
CHLORODIFLUOROMETHANE		2.29E+01		5.00E+01		6.39E+03		1.40E+04
Chloroethane		4.57E+00		1.00E+01		1.73E+03		3.79E+03
CHLOROFORM	1.09E-04		1.09E-03		2.23E-02		2.23E-01	
cis-1,2-Dichloroethene								
DECAHYDRONAPTHALENE								
DECANE								

TABLE 4-4

POTENTIAL ARAR VALUES FOR AIR

	MTCA Air Standards (WAC 173-340-750)				MTCA Air Standards (WAC 173-340-750)			
	Method B (mg/m3)		Method C (mg/m3)		Method B ppb (v/v)		Method C ppb (v/v)	
Contaminant	Carc	Noncarc	Carc	Noncarc	Carc	Noncarc	Carc	Noncarc
Dimethyl Disulfide								
DODECANE								
Dodecanoic Acid, methyl ester								
Ethanedioic Acid, Dibutyl Ester								
ETHANOL								
Freon 114								
HEXANAL								
HEXANE		9.14E-02		2.00E-01		2.59E+01		5.67E+01
ISOCYANOMETHANE								
Methane								
Methyl Ethyl Ketone		4.57E-01		1.00E+00		1.55E+02		3.39E+02
METHYL(1-METHYL ETHYL-)BENZENE								
N-Propyl S-butyl Disulfide								
NONANE								
OCTADECANAL								
Phenol								
PROPYL-CYCLOPROPANE								
TETRAHYDROFURAN								
THC*								
TRIDECANE								
UNDECANE								
Vinyl Chloride	2.92E-05		2.92E-04		1.14E-02		1.14E-01	

1 Integrated Risk Information System (IRIS) data file, U.S. Department of Health and Human Services, National Library of Medicine Toxicology Data Network (TOXNET), Bethesda, Maryland 1996.
2- Health Effects Assessment Summary Tables (HEAST): Annual FY-1995, EPA/540-R-95/ 142 U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington D.C. 1995
3- Superfund Health Risk Technical Support Center (STSC), Chemical Mixtures Assessment Branch, U.S. Environmental Protection Agency, Cincinnati, Ohio.
4-Provisional Inhalation RfD for 1,1,1-Trichloroethane, U.S. Environmental Protection Agency, Superfund Health Risk Technical Support Center, Chemical Mixtures Assessment Branch, Cincinnati, Ohio 1993.
5- Provisional Inhalation Slope Factors for Trichoroethylene and Tetrachloroethylene, U.S. Environmental Protection Agency, Superfund Health Risk Technical Support Center, Chemical Mixtures Assessment Branch, Cincinnati, Ohio 1993.

POTENTIAL ARAR VALUES FOR GROUNDWATER

Compound Detected[j]	Washington State Model Toxics Control Act WAC 173-340-720[g] Method B, mg/L		Drinking Water Standards[k] 40 CFR 141[a] and 40 CFR 143[b] mg/L	Minimum Value[i], mg/L
	Carcinogenic	Non-carcinogenic		
METALS (and Cyanide)				
Aluminum		16	.05[b]	0.05
Antimony		0.0064	.006[a,c]	0.006
Arsenic		.005[d]	.05[a]	0.005
Barium		1.12	2[a,c]	1.12
Beryllium	0.0000203	0.08	.004[a]	0.0000203
Cadmium		0.008	.005[a,c]	0.005
Calcium				-
Chromium		.08[h]	.1[a,c]	0.08
Cobalt		0.96		0.96
Copper		0.592	1[b]	0.592
Cyanide		0.32	.2[a]	0.2
Iron			.3[b]	0.3
Lead		.005[e]	.015[a]	0.005
Magnesium				-
Manganese		0.08	.05[b]	0.05
Mercury		0.0048	.002[a,c]	0.002
Nickel		0.32	.1[a,c]	0.1
Potassium				-
Selenium		0.08	.05[a,c]	0.05
Silicon				-
Silver		0.08	.1[b]	0.08
Sodium				-
Strontium		9.6		9.6
Thallium		0.00112	.0005[c]	0.0005
Titanium				-
Vanadium		0.112		0.112
Zinc		4.8	5[b]	4.8
GENERAL CHEMISTRY				
pH			6.5-8.5[b]	6.5-8.5
Carbonate, mg/L $CaCO_3$				-
Bicarbonate, mg/L $CaCO_3$				-
Hardness, µg/L $CaCO_3$				-
Conductivity, µmhos/cm				-
TDS, mg/L			500[b]	500
Turbidity, NTU				-
Fluoride		0.96	2[b]	0.96
Chloride			250[b]	250
Nitrate (as N)		5.78	10[a,c]	5.78
Nitrite (as N)		0.487	1[a,c]	0.487
Nitrate + Nitrite (NO2+NO3) (as N)			10[a,c]	10
Sulfate			250[b]	250
ORGANICS	(µg/L)	(µg/L)	(µg/L)	(µg/L)
Bis(2-ethylhexyl)phthalate	6.25	320	6[f]	6
Butylbenzylphthalate		3200		3200
Di-n-octyl phthalate		320		320
Diethylphthalate		12,800		12800

[a] Primary MCLs or Action Levels.
[b] Secondary MCLs.
[c] Non-carginogen MCLGs under 40 CFR 141.51.
[d] Cleanup level based on background concentration for the State of Washington as noted in Table 1, footnote b, WAC 173-340-720.
[e] There is no Method B cleanup level for lead. Cleanup level based on MTCA Method A.
[f] Used di(2-ethylhexyl)phthalate as a surrogate.
[g] Cleanup levels based on the January 1995 Update to the MTCA Cleanup Levels and Risk Calculations (CLARC II) Database (WDOE 1995).
[h] Assumes Cr(VI).
[i] Utilized in Chapter 5 for comparison to site data.
[j] Compounds detected in this RI (See Chapter 5).
[k] Value shown is the minimum of MCL, SMCL and non-carcinogen MCLG.

POTENTIAL ARAR VALUES FOR SOIL

Compounds Detected[e]	Washington State Model Toxics Control Act WAC 173-340-720[d]			
	Method B, mg/kg		Method C, mg/kg	
	Carcinogenic	Non-carcinogenic	Carcinogenic	Non-carcinogenic
METALS				
Antimony		32		128
Arsenic[a]		20	57.1	240
Beryllium	0.233	400	9.3	1600
Cadmium		80		320
Chromium[b]		80000		320000
Copper		2960		11800
Lead[c]		250		1000
Mercury		24		96
Nickel		1600		6400
Selenium		400		1600
Silver		400		1600
Thallium		5.6		22.4
Zinc		24000		96000
ORGANICS	(μg/kg)	(μg/kg)	(μg/kg)	(μg/kg)
Acetone		8000000		32000000
Benzene	34500		1380000	
Bis(2-ethylhexyl)phthalate	71400	1600000	2860000	6400000
2-Butanone (MEK)		48000000		192000000
Butylbenzylphthalate		16000000		64000000
Carbon disulfide		8000000		32000000
d-n-Butylphthalate		8000000		32000000
1,4-Dichlorobenzene	41700		1670000	
Diethylphthalate		64000000		256000000
Ethylbenzene		8000000		32000000
2-Methylnaphthalene[f]		3200000		12800000
4-Methylphenol		400000		1600000
Naphthalene		3200000		12800000
Phenanthrene		2400000		9600000
Total xylenes		160000000		640000000

[a] Method B cleanup level based on background concentration for the State of Washington as noted in Table 2, footnote b, WAC 173-340-740.

[b] Assumes Cr(III). Cr(III) is the thermodynamically stable valance state and is expected to be the predominant form of chromium in soil.

[c] There is no Method B or C cleanup level for lead. Cleanups level based on MTCA Method A and Method A (Industrial).

[d] Cleanup levels based on the January 1995 Update to the MTCA Cleanup Levels and Risk Calculations (CLARC II) Database (WDOE 1995).

[e] Compounds detected in soil in this RI (See Chapter 5).

[f] Naphthalene used as a surrogate.

TABLE 5-1

FIELD MEASUREMENTS IN TEST PIT SOILS
AND DRILL CUTTINGS

Test Pit #	Depth, feet	OVA (ppm)	H_2S (ppm)	O_2 (%)	LEL (%)	Alpha (cpm)	Beta/ Gamma[4] (cpm)
TP-1	0 - 1.5	0	0	21	0	0	20 - 40
TP-2	1.0-3.5	0	0	21	0	NA	NA
TP-3	0.0-5.0 5.0-7.0	0 0	0 0	21 21	0 0	0 1	20 - 40 20 - 60
TP-4	0.0-1.2 1.2 - 6	1 - 2 0 - 6	0 0	20.9 20.9	0 0	2 -3 2 -3	20 - 30 30 - 50
TP-5	≈ 2	8	0	NA	NA	<1	20 - 30
TP-6	2.5 6.0	0 - 2 0	0 NA	NA NA	2 NA	0 0	20 - 30 20 - 30
TP-7	3	100-150	0	NA	NA	0	20 - 30
TP-8[3]	3	0 - 1	NA	NA	NA	0	20 - 30
TP-9[3]	4	0	NA	NA	NA	0	20 - 30
TP-10[1]	4	NA	NA	NA	NA	NA	NA
TP-11[2]	2	NA	NA	NA	NA	0	20 - 30

TABLE 5-1 (cont.)

FIELD MEASUREMENTS IN TEST PIT SOILS
AND DRILL CUTTINGS

Well #	Depth, feet	OVA (ppm)	Beta/Gamma Soils (cpm)	Gross Alpha in Groundwater (pCi/L)	Gross Beta in Groundwater (pCi/L)
MW-1[5]	surface	0.5	660	<5	<5
MW-2[5]	surface	0	800 (coleman lantern mantle = 6500)	<5	<5
	9.0	0	1000		
	20	0.5	500		
MW-3[5]	surface	0.2	710	<5	<5
	4.5	0	600		
	16		800		
	25	0	700		
	34.5	0	400		
	36	0	850		
	45	0	450		
	surface	0	620		

bg - background
NA - Not analyzed

1 - Not surveyed due to presence of aggressive hornets.
2 - Organic vapor measurements not taken due to sewer line breakage.
3 - MSA 361 measurements not taken because excavated debris consisted almost entirely of broken glass and metal fragments, with insufficient matrix to scan with field instrument.
4 - "Beta/Gamma" measurement consists of the total beta and gamma radiation. Beta and gamma were not measured separately.
5 - Wells MW-1, -2 and -3 are installed in native soils and not in garbage. The beta/ gamma measurements are nearly constant with depth which does not indicate the presence of radioactive contamination. Because of this, the beta/gamma measurements for monitoring well cuttings are highly suspect and considered erroneous. Groundwater samples were obtained from each well and analyzed for Gross Beta and Gross Alpha radiation. These results are presented in Table 5-1 and are identified as groundwater samples. Gross Alpha and Gross Beta radiation was below detection limits and comparable to a water blank sample. These results are a strong indication that the elevated Beta/Gamma measurements for soils from the boreholes used for installing the monitoring wells are erroneous.

1120rlt.5-1

SOIL ANALYTICAL RESULTS AND SCREENING LEVELS

Sample Location	Sampling Date	Analytical Method	CAS #	Compounds Detected	Golder Detected Value	Q	Ecology Detected Value[b]	Q	Regulatory Screening Value[a]	Units
TP-7-A	7/25/94	SW8270	106-46-7	1,4-Dichlorobenzene	140		141	J	41700	ug/kg-dry
TP-7-A	7/25/94	SW8260	78-93-3	2-Butanone	16		ND		48000000	ug/kg-dry
TP-7-A	7/25/94	SW8270	105-67-9	2-4-Dimethylphenol	ND		468		1600000	mg/kg-dry
TP-7-A	7/25/94	SW8270	91-57-6	2-Methylnaphthalene	770		697		3200000	ug/kg-dry
TP-7-A	7/25/94	SW8270	106-44-5	4-Methylphenol	290		793		400000	ug/kg-dry
TP-7-A	7/25/94	SW8260	95-63-6	1,2,4-Trimethylbenzene	ND		1280	J		mg/kg-dry
TP-7-A	7/25/94	SW8270	120-12-7	Acenaphthene	ND		40	J	4800000	mg/kg-dry
TP-7-A	7/25/94	7041	7440-36-0	Antimony	0.2	J	ND	U	32	mg/kg-dry
TP-7-A	7/25/94	7060	7440-38-2	Arsenic	4.5		38.3		20	mg/kg-dry
TP-7-A	7/25/94	SW8260	71-43-2	Benzene	1.7		ND		34500	ug/kg-dry
TP-7-A	7/25/94	6010	7440-41-7	Beryllium	0.8		1.22		0.233	mg/kg-dry
TP-7-A	7/25/94	SW8270	117-81-7	bis(2-Ethylhexyl)phthalate	2000		ND		71400	ug/kg-dry
TP-7-A	7/25/94	SW8260	104-51-8	Butylbenzene	ND		642	J		mg/kg-dry
TP-7-A	7/25/94	6010	7440-43-9	Cadmium	0.5		ND		80	mg/kg-dry
TP-7-A	7/25/94	SW8260	75-15-0	Carbon Disulfide	2.6		ND		8000000	ug/kg-dry
TP-7-A	7/25/94	6010	7440-47-3	Chromium	34.5		40.8		80000	mg/kg-dry
TP-7-A	7/25/94	6010	7440-50-8	Copper	43.7		58.2		2960	mg/kg-dry
TP-7-A	7/25/94	SW8270	84-66-2	Diethylphthalate	130		136	J	64000000	ug/kg-dry
TP-7-A	7/25/94	SW8260	100-41-4	Ethylbenzene	6.9		ND		8000000	ug/kg-dry
TP-7-A	7/25/94	7421	7439-92-1	Lead	50	J	21.7		250	mg/kg-dry
TP-7-A	7/25/94	7470 7471	7439-97-6	Mercury	0.23		ND		24	mg/kg-dry
TP-7-A	7/25/94	SW8270	91-20-3	Naphthalene	2100		1810		3200000	ug/kg-dry
TP-7-A	7/25/94	6010	7440-02-0	Nickel	26		24.7		1600	mg/kg-dry
TP-7-A	7/25/94	SW8270	86-30-6	N-Nitrosodiphenylamine	ND		64	J	204000	mg/kg-dry
TP-7-A	7/25/94	SW8270	108-95-2	Phenol	ND		149	J	48000000	mg/kg-dry
TP-7-A	7/25/94	SW8270		Retene	ND		375			mg/kg-dry
TP-7-A	7/25/94	7740	7782-49-2	Selenium	1.1		ND		400	mg/kg-dry
TP-7-A	7/25/94	6010	7440-22-4	Silver	1.1		ND		400	mg/kg-dry
TP-7-A	7/25/94	SW8260	108-88-3	Toluene	ND		428	J	16000000	mg/kg-dry
TP-7-A	7/25/94	418.1		Total Petroleum Hydrocarbons	53		37	J	100	mg/kg-dry
TP-7-A	7/25/94	SW8260	1330-20-7	Total Xylenes	9.7		366	J	160000000	ug/kg-dry
TP-7-A	7/25/94	6010	7440-66-6	Zinc	71.9		33.3		24000	mg/kg-dry
TP-7-B	7/25/94	SW8260	78-93-3	2-Butanone	26		3.2	J	48000000	ug/kg-dry
TP-7-B	7/25/94	SW8270	59-50-7	4-Chloro-3-Methylphenol	ND		372			mg/kg-dry
TP-7-B	7/25/94	SW8270	106-46-7	1,4-Dichlorobenzene	ND		254		41700	mg/kg-dry
TP-7-B	7/25/94	SW8270	91-57-6	2-Methylnaphthalene	450		641		3200000	ug/kg-dry
TP-7-B	7/25/94	SW8270	106-44-5	4-Methylphenol	170		627		400000	ug/kg-dry
TP-7-B	7/25/94	SW8270	120-12-7	Acenaphthene	ND		44	J	4800000	mg/kg-dry
TP-7-B	7/25/94	SW8260	67-64-1	Acetone	95	B	ND		8000000	ug/kg-dry
TP-7-B	7/25/94	7041	7440-36-0	Antimony	0.2	J	ND		32	mg/kg-dry
TP-7-B	7/25/94	7060	7440-38-2	Arsenic	1.6		26		20	mg/kg-dry
TP-7-B	7/25/94	6010	7440-41-7	Beryllium	0.2		0.33		0.233	mg/kg-dry
TP-7-B	7/25/94	SW8270	117-81-7	bis(2-Ethylhexyl)phthalate	3800		11600		71400	ug/kg-dry
TP-7-B	7/25/94	6010	7440-47-3	Chromium	22.5		43.2		80000	mg/kg-dry
TP-7-B	7/25/94	6010	7440-50-8	Copper	18.2		132		2960	mg/kg-dry
TP-7-B	7/25/94	SW8270	84-74-2	Di-n-Butylphthalate	140		361		8000000	ug/kg-dry
TP-7-B	7/25/94	SW8270	132-64-9	Dibenzofuran	ND		45	J		mg/kg-dry
TP-7-B	7/25/94	SW8270	84-66-2	Diethylphthalate	97		288		64000000	ug/kg-dry
TP-7-B	7/25/94	SW8260	100-41-4	Ethylbenzene	6		ND		8000000	ug/kg-dry
TP-7-B	7/25/94	SW8270	86-73-7	Fluorene	ND		76	J	3200000	mg/kg-dry
TP-7-B	7/25/94	7421	7439-92-1	Lead	39	J	232		250	mg/kg-dry
TP-7-B	7/25/94	7470 7471	7439-97-6	Mercury	0.25		ND		24	mg/kg-dry

SOIL ANALYTICAL RESULTS AND SCREENING LEVELS

Sample Location	Sampling Date	Analytical Method	CAS #	Compounds Detected	Golder Detected Value	Q	Ecology Detected Value[b]	Q	Regulatory Screening Value[a]	Units
TP-7-B	7/25/94	SW8270	86-30-6	N-Nitrosodiphenylamine	ND		103		204000	mg/kg-dry
TP-7-B	7/25/94	SW8270	91-20-3	Naphthalene	620		1440		3200000	ug/kg-dry
TP-7-B	7/25/94	6010	7440-02-0	Nickel	26		34.6		1600	mg/kg-dry
TP-7-B	7/25/94	SW8270	85-01-8	Phenanthrene	88		179		2400000	ug/kg-dry
TP-7-B	7/25/94	SW8270	129-00-0	Pyrene	ND		66	J	2400000	mg/kg-dry
TP-7-B	7/25/94	SW8270		Retene	ND		33000			mg/kg-dry
TP-7-B	7/25/94	7740	7782-49-2	Selenium	0.2		ND		400	mg/kg-dry
TP-7-B	7/25/94	6010	7440-22-4	Silver	0.5		0.36		400	mg/kg-dry
TP-7-B	7/25/94	7841	7440-28-0	Thallium	0.1		ND		5.6	mg/kg-dry
TP-7-B	7/25/94	418.1		Total Petroleum Hydrocarbons	84		>125	J	100	mg/kg-dry
TP-7-B	7/25/94	SW8260	1330-20-7	Total Xylenes	8.3		ND		160000000	ug/kg-dry
TP-7-B	7/25/94	6010	7440-66-6	Zinc	91.2		1240		24000	mg/kg-dry

Shading indicates exceedance of the screening value.
[a] Minimum Method B value from Ecology CLARC II February 1996 update.
ND - means analyte was not detected
Blank space indicates data was not available
[b] Analytical results from Ecology soil samples from TP-7 Test Pit. Soil samples were obtained from the same soil horizon as the Golder samples but should not be considered a split. Results are comparable between the analyized results of each set of samples.

AUGUST 94 GROUNDWATER ANALYTICAL RESULTS AND SCREENING LEVELS

Well	Sampling Date	Filtration	CAS #	Compounds Detected	Value	Q	Screening Value[a]	Units
MW-1	8/12/94	Unfiltered		Alkalinity	79.3		-	mg/L CaCO3
MW-1	8/12/94	Filtered	7429-90-5	Aluminum	0.03		0.05	mg/L
MW-1	8/12/94	Unfiltered	7429-90-5	Aluminum	14.2		NA	mg/L
MW-1	8/12/94	Unfiltered	7440-38-2	Arsenic	0.001		NA	mg/L
MW-1	8/12/94	Filtered	7440-39-3	Barium	0.03		1.12	mg/L
MW-1	8/12/94	Unfiltered	7440-39-3	Barium	0.073		NA	mg/L
MW-1	8/12/94	Unfiltered		Bicarbonate (Alkalinity)	79.3		-	mg/L CaCO3
MW-1	8/12/94	Unfiltered	117-81-7	Bis(2-ethylhexyl)phthalate	1		6	ug/L
MW-1	8/12/94	Unfiltered	85-68-7	Butylbenzylphthalate	54		3200	ug/L
MW-1	8/12/94	Filtered	7440-70-2	Calcium	33.2		-	mg/L
MW-1	8/12/94	Unfiltered	7440-70-2	Calcium	37.9		NA	mg/L
MW-1	8/12/94	Unfiltered		Chloride	17.4		250	mg/L
MW-1	8/12/94	Unfiltered	7440-47-3	Chromium	0.041		NA	mg/L
MW-1	8/12/94	Unfiltered	7440-48-4	Cobalt	0.006		NA	mg/L
MW-1	8/12/94	Unfiltered		Conductivity	324		-	umhos/cm
MW-1	8/12/94	Unfiltered	7440-50-8	Copper	0.014		NA	mg/L
MW-1	8/12/94	Unfiltered	117-84-0	Di-n-octyl phthalate	5		320	ug/L
MW-1	8/12/94	Unfiltered		Hardness (by Calculation)	163		-	mg/L CaCO3
MW-1	8/12/94	Filtered	7439-89-6	Iron	0.017		0.3	mg/L
MW-1	8/12/94	Unfiltered	7439-89-6	Iron	15.5		NA	mg/L
MW-1	8/12/94	Filtered	7439-95-4	Magnesium	12.9		-	mg/L
MW-1	8/12/94	Unfiltered	7439-95-4	Magnesium	16.6		NA	mg/L
MW-1	8/12/94	Filtered	7439-96-5	Manganese	0.078		0.05	mg/L
MW-1	8/12/94	Unfiltered	7439-96-5	Manganese	0.339		NA	mg/L
MW-1	8/12/94	Unfiltered		N-Nitrate	17		5.78	mg-N/L
MW-1	8/12/94	Unfiltered		N-Nitrite	0.032		0.487	mg-N/L
MW-1	8/12/94	Unfiltered	7440-02-0	Nickel	0.04		NA	mg/L
MW-1	8/12/94	Unfiltered		Nitrate + Nitrite (NO2+NO3)	17		10	mg-N/L
MW-1	8/12/94	Unfiltered		pH	6.62		6.5-8.5	std units
MW-1	8/12/94	Filtered	7440-09-7	Potassium	0.7		-	mg/L
MW-1	8/12/94	Unfiltered	7440-09-7	Potassium	1.7		NA	mg/L
MW-1	8/12/94	Filtered	7782-49-2	Selenium	0.002		0.05	mg/L
MW-1	8/12/94	Filtered	7440-21-3	Silica	15.1		-	mg/L
MW-1	8/12/94	Unfiltered	7440-21-3	Silica	32.2		NA	mg/L
MW-1	8/12/94	Filtered	7440-23-5	Sodium	13		-	mg/L
MW-1	8/12/94	Unfiltered	7440-23-5	Sodium	9.46		NA	mg/L
MW-1	8/12/94	Unfiltered		Sulfate	4.3		250	mg/L
MW-1	8/12/94	Unfiltered		Total dissolved solids	235		500	mg/L
MW-1	8/12/94	Unfiltered		Turbidity	250		-	NTU
MW-1	8/12/94	Filtered	7440-62-2	Vanadium	0.003		0.112	mg/L
MW-1	8/12/94	Unfiltered	7440-62-2	Vanadium	0.039		NA	mg/L
MW-1	8/12/94	Filtered	7440-66-6	Zinc	0.009		4.8	mg/L
MW-1	8/12/94	Unfiltered	7440-66-6	Zinc	0.035		NA	mg/L
MW-2	8/11/94	Unfiltered		Alkalinity	51.6		-	mg/L CaCO3
MW-2	8/11/94	Unfiltered	7429-90-5	Aluminum	34.3		NA	mg/L
MW-2	8/11/94	Unfiltered	7440-38-2	Arsenic	0.001		NA	mg/L
MW-2	8/11/94	Filtered	7440-39-3	Barium	0.006		1.12	mg/L
MW-2	8/11/94	Unfiltered	7440-39-3	Barium	0.158		NA	mg/L
MW-2	8/11/94	Unfiltered		Bicarbonate (Alkalinity)	51.6		-	mg/L CaCO3
MW-2	8/11/94	Unfiltered	117-81-7	Bis(2-ethylhexyl)phthalate	1.4		6	ug/L
MW-2	8/11/94	Unfiltered	85-68-7	Butylbenzylphthalate	22		3200	ug/L
MW-2	8/11/94	Filtered	7440-70-2	Calcium	12.5		-	mg/L
MW-2	8/11/94	Unfiltered	7440-70-2	Calcium	20		NA	mg/L
MW-2	8/11/94	Unfiltered		Chloride	3.7		250	mg/L
MW-2	8/11/94	Unfiltered	7440-47-3	Chromium	0.056		NA	mg/L

AUGUST 94 GROUNDWATER ANALYTICAL RESULTS AND SCREENING LEVELS

Well	Sampling Date	Filtration	CAS #	Compounds Detected	Value	Q	Screening Value*	Units
MW-2	8/11/94	Unfiltered	7440-48-4	Cobalt	0.02		NA	mg/L
MW-2	8/11/94	Unfiltered		Conductivity	120		-	umhos/cm
MW-2	8/11/94	Unfiltered	7440-50-8	Copper	0.034		NA	mg/L
MW-2	8/11/94	Unfiltered	117-84-0	Di-n-octyl phthalate	1.9		320	ug/L
MW-2	8/11/94	Unfiltered		Hardness (by Calculation)	94		-	mg/L CaCO3
MW-2	8/11/94	Filtered	7439-89-6	Iron	0.067		0.3	mg/L
MW-2	8/11/94	Unfiltered	7439-89-6	Iron	39.6		NA	mg/L
MW-2	8/11/94	Filtered	7439-95-4	Magnesium	4.09		-	mg/L
MW-2	8/11/94	Unfiltered	7439-95-4	Magnesium	10.7		NA	mg/L
MW-2	8/11/94	Filtered	7439-96-5	Manganese	0.023		0.05	mg/L
MW-2	8/11/94	Unfiltered	7439-96-5	Manganese	0.898		NA	mg/L
MW-2	8/11/94	Unfiltered		N-Nitrate	2.59		5.78	mg-N/L
MW-2	8/11/94	Unfiltered	7440-02-0	Nickel	0.11		NA	mg/L
MW-2	8/11/94	Unfiltered		Nitrate + Nitrite (NO2+NO3)	2.59		10	mg-N/L
MW-2	8/11/94	Unfiltered		pH	6.8		6.5-8.5	std units
MW-2	8/11/94	Filtered	7440-09-7	Potassium	0.5		-	mg/L
MW-2	8/11/94	Unfiltered	7440-09-7	Potassium	1.9		NA	mg/L
MW-2	8/11/94	Filtered	7782-49-2	Selenium	0.001		0.05	mg/L
MW-2	8/11/94	Filtered	7440-21-3	Silica	14.4		-	mg/L
MW-2	8/11/94	Unfiltered	7440-21-3	Silica	58.4		NA	mg/L
MW-2	8/11/94	Filtered	7440-23-5	Sodium	7.99		-	mg/L
MW-2	8/11/94	Unfiltered	7440-23-5	Sodium	6.02		NA	mg/L
MW-2	8/11/94	Unfiltered		Sulfate	3		250	mg/L
MW-2	8/11/94	Filtered	7440-28-0	Thallium	0.001		0.0005	mg/L
MW-2	8/11/94	Unfiltered		Total dissolved solids	103		500	mg/L
MW-2	8/11/94	Unfiltered		Turbidity	390		-	NTU
MW-2	8/11/94	Filtered	7440-62-2	Vanadium	0.002		0.112	mg/L
MW-2	8/11/94	Unfiltered	7440-62-2	Vanadium	0.048		NA	mg/L
MW-2	8/11/94	Filtered	7440-66-6	Zinc	0.007		4.8	mg/L
MW-2	8/11/94	Unfiltered	7440-66-6	Zinc	0.065		NA	mg/L
MW-3	8/10/94	Unfiltered		Alkalinity	43.2		-	mg/L CaCO3
MW-3	8/10/94	Unfiltered	7429-90-5	Aluminum	21.2		NA	mg/L
MW-3	8/10/94	Filtered	7440-39-3	Barium	0.049		1.12	mg/L
MW-3	8/10/94	Unfiltered	7440-39-3	Barium	0.095		NA	mg/L
MW-3	8/10/94	Unfiltered		Bicarbonate (Alkalinity)	43.2		-	mg/L CaCO3
MW-3	8/10/94	Unfiltered	117-81-7	bis(2-ethylhexyl)phthalate	1.5		6	ug/L
MW-3	8/10/94	Unfiltered	85-68-7	Butylbenzylphthalate	22		3200	ug/L
MW-3	8/10/94	Filtered	7440-70-2	Calcium	9.41		-	mg/L
MW-3	8/10/94	Unfiltered	7440-70-2	Calcium	13.3		NA	mg/L
MW-3	8/10/94	Unfiltered		Chloride	3.4		250	mg/L
MW-3	8/10/94	Unfiltered	7440-47-3	Chromium	0.059		NA	mg/L
MW-3	8/10/94	Unfiltered	7440-48-4	Cobalt	0.009		NA	mg/L
MW-3	8/10/94	Unfiltered		Conductivity	86		-	umhos/cm
MW-3	8/10/94	Unfiltered	7440-50-8	Copper	0.019		NA	mg/L
MW-3	8/10/94	Unfiltered	117-84-0	Di-n-octyl phthalate	1.4		320	ug/L
MW-3	8/10/94	Unfiltered		Hardness (by Calculation)	63		-	mg/L CaCO3
MW-3	8/10/94	Filtered	7439-89-6	Iron	0.025		0.3	mg/L
MW-3	8/10/94	Unfiltered	7439-89-6	Iron	21.8		NA	mg/L
MW-3	8/10/94	Filtered	7439-95-4	Magnesium	2.86		-	mg/L
MW-3	8/10/94	Unfiltered	7439-95-4	Magnesium	7.23		NA	mg/L
MW-3	8/10/94	Filtered	7439-96-5	Manganese	0.024		0.05	mg/L
MW-3	8/10/94	Unfiltered	7439-96-5	Manganese	0.336		NA	mg/L
MW-3	8/10/94	Unfiltered		N-Nitrate	0.18		5.78	mg-N/L
MW-3	8/10/94	Unfiltered		N-Nitrite	0.029		0.487	mg-N/L
MW-3	8/10/94	Unfiltered	7440-02-0	Nickel	0.08		NA	mg/L

AUGUST 94 GROUNDWATER ANALYTICAL RESULTS AND SCREENING LEVELS

Well	Sampling Date	Filtration	CAS #	Compounds Detected	Value	Q	Screening Value*	Units
MW-3	8/10/94	Unfiltered		Nitrate + Nitrite (NO2+NO3)	0.207		10	mg-N/L
MW-3	8/10/94	Unfiltered		pH	6.67		6.5-8.5	std units
MW-3	8/10/94	Unfiltered	7440-09-7	Potassium	1.6		NA	mg/L
MW-3	8/10/94	Filtered	7440-21-3	Silica	14.1		-	mg/L
MW-3	8/10/94	Unfiltered	7440-21-3	Silica	43.8		NA	mg/L
MW-3	8/10/94	Filtered	7440-23-5	Sodium	4.89		-	mg/L
MW-3	8/10/94	Unfiltered	7440-23-5	Sodium	4.37		NA	mg/L
MW-3	8/10/94	Unfiltered		Sulfate	3.2		250	mg/L
MW-3	8/10/94	Unfiltered		Total dissolved solids	80		500	mg/L
MW-3	8/10/94	Unfiltered		Turbidity	210		-	NTU
MW-3	8/10/94	Unfiltered	7440-62-2	Vanadium	0.035		NA	mg/L
MW-3	8/10/94	Filtered	7440-66-6	Zinc	0.035		4.8	mg/L
MW-3	8/10/94	Unfiltered	7440-66-6	Zinc	0.04		NA	mg/L

* From Table 4-5.
Shading indicates exceedance of the screening value. Comparison for metals data is not made with un-filtered sample data.
NA - Not Applicable. These metals data are for unfiltered samples which are not representative of actual groundwater conditions. It is therefore not appropriate to compare screening criteria to these data.

TABLE 5-4

DECEMBER 94 GROUNDWATER ANALYTICAL RESULTS AND SCREENING LEVELS

Well	Sampling Date	Filtration	CAS #	Compounds Detected	Value	Q	Screening Value[a]	Units
MW-1	12/13/94	Unfiltered		Alkalinity	81		-	mg/L CaCO3
MW-1	12/13/94	Unfiltered	7429-90-5	Aluminum	109		NA	mg/L
MW-1	12/13/94	Unfiltered	7440-38-2	Arsenic	0.003		NA	mg/L
MW-1	12/13/94	Unfiltered	7440-39-3	Barium	0.477		NA	mg/L
MW-1	12/13/94	Unfiltered	7440-41-7	Beryllium	0.002		NA	mg/L
MW-1	12/13/94	Unfiltered		Bicarbonate (Alkalinity)	81		-	mg/L CaCO3
MW-1	12/13/94	Unfiltered	117-81-7	Bis(2-ethylhexyl)phthalate	2.8		6	ug/L
MW-1	12/13/94	Unfiltered	85-68-7	Butylbenzylphthalate	1		3200	ug/L
MW-1	12/13/94	Unfiltered	7440-70-2	Calcium	86.3		NA	mg/L
MW-1	12/13/94	Unfiltered		Chloride	16		250	mg/L
MW-1	12/13/94	Unfiltered	7440-47-3	Chromium	0.48		NA	mg/L
MW-1	12/13/94	Unfiltered	7440-48-4	Cobalt	0.059		NA	mg/L
MW-1	12/13/94	Unfiltered		Conductivity	340		-	umhos/cm
MW-1	12/13/94	Unfiltered	7440-50-8	Copper	0.132		NA	mg/L
MW-1	12/13/94	Unfiltered		Hardness (by Calculation)	408		-	mg/L CaCO3
MW-1	12/13/94	Unfiltered	7439-89-6	Iron	129		NA	mg/L
MW-1	12/13/94	Unfiltered	7439-92-1	Lead	0.016		NA	mg/L
MW-1	12/13/94	Unfiltered	7439-95-4	Magnesium	46.7		NA	mg/L
MW-1	12/13/94	Unfiltered	7439-96-5	Manganese	2.3		NA	mg/L
MW-1	12/13/94	Unfiltered		N-Nitrate	17		5.78	mg-N/L
MW-1	12/13/94	Unfiltered		N-Nitrite	0.016		0.487	mg-N/L
MW-1	12/13/94	Unfiltered	7440-02-0	Nickel	0.4		NA	mg/L
MW-1	12/13/94	Unfiltered		Nitrate + Nitrite (NO2+NO3	17		10	mg-N/L
MW-1	12/13/94	Unfiltered		pH	6.5		6.5-8.5	std units
MW-1	12/13/94	Unfiltered	7440-09-7	Potassium	5.3		NA	mg/L
MW-1	12/13/94	Unfiltered	7440-21-3	Silica	66.5		NA	mg/L
MW-1	12/13/94	Unfiltered	7440-22-4	Silver	0.005		NA	mg/L
MW-1	12/13/94	Unfiltered	7440-23-5	Sodium	14.4		NA	mg/L
MW-1	12/13/94	Unfiltered		Sulfate	3.4		250	mg/L
MW-1	12/13/94	Unfiltered	7440-28-0	Thallium	0.003		NA	mg/L
MW-1	12/13/94	Unfiltered		Total cyanide	0.007		0.2	mg/L
MW-1	12/13/94	Unfiltered		Total dissolved solids	240		500	mg/L
MW-1	12/13/94	Unfiltered		Turbidity	2800		-	NTU
MW-1	12/13/94	Unfiltered	7440-62-2	Vanadium	0.358		NA	mg/L
MW-1	12/13/94	Unfiltered	7440-66-6	Zinc	0.266		NA	mg/L
MW-2	12/13/94	Unfiltered		Alkalinity	46		-	mg/L CaCO3
MW-2	12/13/94	Unfiltered	7429-90-5	Aluminum	29.9		NA	mg/L
MW-2	12/13/94	Unfiltered	7440-38-2	Arsenic	0.002		NA	mg/L
MW-2	12/13/94	Unfiltered	7440-39-3	Barium	0.143		NA	mg/L
MW-2	12/13/94	Unfiltered		Bicarbonate (Alkalinity)	46		-	mg/L CaCO3
MW-2	12/13/94	Unfiltered	117-81-7	Bis(2-ethylhexyl)phthalate	1.4		6	ug/L
MW-2	12/13/94	Unfiltered	7440-70-2	Calcium	19.8		NA	mg/L
MW-2	12/13/94	Unfiltered		Chloride	7.6		250	mg/L
MW-2	12/13/94	Unfiltered	7440-47-3	Chromium	0.049		NA	mg/L
MW-2	12/13/94	Unfiltered	7440-48-4	Cobalt	0.018		NA	mg/L
MW-2	12/13/94	Unfiltered		Conductivity	100		-	umhos/cm
MW-2	12/13/94	Unfiltered	7440-50-8	Copper	0.03		NA	mg/L
MW-2	12/13/94	Unfiltered		Hardness (by Calculation)	92.7		-	mg/L CaCO3
MW-2	12/13/94	Unfiltered	7439-89-6	Iron	35		NA	mg/L
MW-2	12/13/94	Unfiltered	7439-92-1	Lead	0.006		NA	mg/L
MW-2	12/13/94	Unfiltered	7439-95-4	Magnesium	10.5		NA	mg/L
MW-2	12/13/94	Unfiltered	7439-96-5	Manganese	0.639		NA	mg/L

DECEMBER 94 GROUNDWATER ANALYTICAL RESULTS AND SCREENING LEVELS

Well	Sampling Date	Filtration	CAS #	Compounds Detected	Value	Q	Screening Value[a]	Units
MW-2	12/13/94	Unfiltered		N-Nitrate	1.2		5.78	mg-N/L
MW-2	12/13/94	Unfiltered		N-Nitrite	0.019		0.487	mg-N/L
MW-2	12/13/94	Unfiltered	7440-02-0	Nickel	0.08		NA	mg/L
MW-2	12/13/94	Unfiltered		Nitrate + Nitrite (NO2+NO3	1.2		10	mg-N/L
MW-2	12/13/94	Unfiltered		pH	6.4		6.5-8.5	std units
MW-2	12/13/94	Unfiltered	7440-09-7	Potassium	1.6		NA	mg/L
MW-2	12/13/94	Unfiltered	7440-21-3	Silica	56.1		NA	mg/L
MW-2	12/13/94	Unfiltered	7440-23-5	Sodium	5.68		NA	mg/L
MW-2	12/13/94	Unfiltered		Sulfate	2.7		250	mg/L
MW-2	12/13/94	Unfiltered		Total dissolved solids	83		500	mg/L
MW-2	12/13/94	Unfiltered		Turbidity	240		-	NTU
MW-2	12/13/94	Unfiltered	7440-62-2	Vanadium	0.05		NA	mg/L
MW-2	12/13/94	Unfiltered	7440-66-6	Zinc	0.06		NA	mg/L
MW-2 DUP	12/13/94	Unfiltered		Alkalinity	47		-	mg/L CaCO3
MW-2 DUP	12/13/94	Unfiltered	7429-90-5	Aluminum	17.5		NA	mg/L
MW-2 DUP	12/13/94	Unfiltered	7440-38-2	Arsenic	0.001		NA	mg/L
MW-2 DUP	12/13/94	Unfiltered	7440-39-3	Barium	0.132		NA	mg/L
MW-2 DUP	12/13/94	Unfiltered		Bicarbonate (Alkalinity)	47		-	mg/L CaCO3
MW-2 DUP	12/13/94	Unfiltered	7440-70-2	Calcium	21.3		NA	mg/L
MW-2 DUP	12/13/94	Unfiltered		Chloride	1.9		250	mg/L
MW-2 DUP	12/13/94	Unfiltered	7440-47-3	Chromium	0.027		NA	mg/L
MW-2 DUP	12/13/94	Unfiltered	7440-48-4	Cobalt	0.012		NA	mg/L
MW-2 DUP	12/13/94	Unfiltered		Conductivity	100		-	umhos/cm
MW-2 DUP	12/13/94	Unfiltered	7440-50-8	Copper	0.023		NA	mg/L
MW-2 DUP	12/13/94	Unfiltered		Hardness (by Calculation)	91.4		-	mg/L CaCO3
MW-2 DUP	12/13/94	Unfiltered	7439-89-6	Iron	19.7		NA	mg/L
MW-2 DUP	12/13/94	Unfiltered	7439-92-1	Lead	0.007		NA	mg/L
MW-2 DUP	12/13/94	Unfiltered	7439-95-4	Magnesium	9.28		NA	mg/L
MW-2 DUP	12/13/94	Unfiltered	7439-96-5	Manganese	0.465		NA	mg/L
MW-2 DUP	12/13/94	Unfiltered		N-Nitrate	1.5		5.78	mg-N/L
MW-2 DUP	12/13/94	Unfiltered		N-Nitrite	0.012		0.487	mg-N/L
MW-2 DUP	12/13/94	Unfiltered	7440-02-0	Nickel	0.05		NA	mg/L
MW-2 DUP	12/13/94	Unfiltered		Nitrate + Nitrite (NO2+NO3	1.5		10	mg-N/L
MW-2 DUP	12/13/94	Unfiltered		pH	6.5		6.5-8.5	std units
MW-2 DUP	12/13/94	Unfiltered	7440-09-7	Potassium	0.8		NA	mg/L
MW-2 DUP	12/13/94	Unfiltered	7440-21-3	Silica	34.8		NA	mg/L
MW-2 DUP	12/13/94	Unfiltered	7440-23-5	Sodium	5.09		NA	mg/L
MW-2 DUP	12/13/94	Unfiltered		Sulfate	2.6		250	mg/L
MW-2 DUP	12/13/94	Unfiltered		Total dissolved solids	81		500	mg/L
MW-2 DUP	12/13/94	Unfiltered		Turbidity	28		-	NTU
MW-2 DUP	12/13/94	Unfiltered	7440-62-2	Vanadium	0.037		NA	mg/L
MW-2 DUP	12/13/94	Unfiltered	7440-66-6	Zinc	0.058		NA	mg/L
MW-3	12/13/94	Unfiltered		Alkalinity	43		-	mg/L CaCO3
MW-3	12/13/94	Unfiltered	7429-90-5	Aluminum	9.11		NA	mg/L
MW-3	12/13/94	Unfiltered	7440-39-3	Barium	0.048		NA	mg/L
MW-3	12/13/94	Unfiltered		Bicarbonate (Alkalinity)	43		-	mg/L CaCO3
MW-3	12/13/94	Unfiltered	117-81-7	Bis(2-ethylhexyl)phthalate	1.6		6	ug/L
MW-3	12/13/94	Unfiltered	7440-70-2	Calcium	11.8		NA	mg/L
MW-3	12/13/94	Unfiltered		Chloride	1.8		250	mg/L
MW-3	12/13/94	Unfiltered	7440-47-3	Chromium	0.015		NA	mg/L
MW-3	12/13/94	Unfiltered	7440-48-4	Cobalt	0.003		NA	mg/L
MW-3	12/13/94	Unfiltered		Conductivity	91		-	umhos/cm

DECEMBER 94 GROUNDWATER ANALYTICAL RESULTS AND SCREENING LEVELS

Well	Sampling Date	Filtration	CAS #	Compounds Detected	Value	Q	Screening Value[a]	Units
MW-3	12/13/94	Unfiltered	7440-50-8	Copper	0.009		NA	mg/L
MW-3	12/13/94	Unfiltered	84-66-2	Diethylphthalate	1.5		12800	ug/L
MW-3	12/13/94	Unfiltered		Hardness (by Calculation)	49.4		-	mg/L CaCO3
MW-3	12/13/94	Unfiltered	7439-89-6	Iron	9.12		NA	mg/L
MW-3	12/13/94	Unfiltered	7439-92-1	Lead	0.002		NA	mg/L
MW-3	12/13/94	Unfiltered	7439-95-4	Magnesium	4.84		NA	mg/L
MW-3	12/13/94	Unfiltered	7439-96-5	Manganese	0.145		NA	mg/L
MW-3	12/13/94	Unfiltered		N-Nitrate	0.37		5.78	mg-N/L
MW-3	12/13/94	Unfiltered		N-Nitrite	0.016		0.487	mg-N/L
MW-3	12/13/94	Unfiltered	7440-02-0	Nickel	0.02		NA	mg/L
MW-3	12/13/94	Unfiltered		Nitrate + Nitrite (NO2+NO3	0.39		10	mg-N/L
MW-3	12/13/94	Unfiltered		pH	6.5		6.5-8.5	std units
MW-3	12/13/94	Unfiltered	7440-09-7	Potassium	0.8		NA	mg/L
MW-3	12/13/94	Unfiltered	7782-49-2	Selenium	0.001		NA	mg/L
MW-3	12/13/94	Unfiltered	7440-21-3	Silica	28.4		NA	mg/L
MW-3	12/13/94	Unfiltered	7440-23-5	Sodium	4.24		NA	mg/L
MW-3	12/13/94	Unfiltered		Sulfate	2.7		250	mg/L
MW-3	12/13/94	Unfiltered		Total dissolved solids	60		500	mg/L
MW-3	12/13/94	Unfiltered		Turbidity	72		-	NTU
MW-3	12/13/94	Unfiltered	7440-62-2	Vanadium	0.014		NA	mg/L
MW-3	12/13/94	Unfiltered	7440-66-6	Zinc	0.025		NA	mg/L

[a] From Table 4-5.
Shading indicates exceedance of the screening value. Comparison for metals data is not made with un-filtered sample data.
NA - Not Applicable. These metals data are for unfiltered samples which are not representative of actual groundwater conditions. It is therefore not appropriate to compare screening criteria to these data.

TABLE 5-5

FEBRUARY 1995 GROUNDWATER ANALYTICAL RESULTS AND SCREENING FOR MW-1

Well	Sampling Date	Filtration	CAS #	Compounds Detected	Value	Q	Screening Value[a]	Units
MW-1	3/2/95	Filtered	7429-90-5	Aluminum	1.5		0.05	mg/l
MW-1	3/2/95	Unfiltered	7429-90-5	Aluminum	12.4		NA	mg/l
MW-1	3/2/95	Unfiltered	7440-38-2	Arsenic	0.001		NA	mg/l
MW-1	3/2/95	Filtered	7440-39-3	Barium	0.013		1.12	mg/l
MW-1	3/2/95	Unfiltered	7440-39-3	Barium	0.064		NA	mg/l
MW-1	3/2/95	Filtered	7440-70-2	Calcium	39		-	mg/l
MW-1	3/2/95	Unfiltered	7440-70-2	Calcium	42.7		NA	mg/l
MW-1	3/2/95	Unfiltered	7440-47-3	Chromium	0.028		NA	mg/l
MW-1	3/2/95	Unfiltered	7440-48-4	Cobalt	0.007		NA	mg/l
MW-1	3/2/95	Filtered	7440-50-8	Copper	0.005		0.592	mg/l
MW-1	3/2/95	Unfiltered	7440-50-8	Copper	0.019		NA	mg/l
MW-1	3/2/95	Filtered	7439-89-6	Iron	1.6		0.3	mg/l
MW-1	3/2/95	Unfiltered	7439-89-6	Iron	13.3		NA	mg/l
MW-1	3/2/95	Unfiltered	7439-92-1	Lead	0.002		NA	mg/l
MW-1	3/2/95	Filtered	7439-95-4	Magnesium	14.6		-	mg/l
MW-1	3/2/95	Unfiltered	7439-95-4	Magnesium	17.1		NA	mg/l
MW-1	3/2/95	Filtered	7439-96-5	Manganese	0.084		0.05	mg/l
MW-1	3/2/95	Unfiltered	7439-96-5	Manganese	0.275		NA	mg/l
MW-1	3/2/95	Unfiltered	7440-02-0	Nickel	0.02		NA	mg/l
MW-1	3/2/95	Filtered	7440-09-7	Potassium	1		-	mg/l
MW-1	3/2/95	Unfiltered	7440-09-7	Potassium	1.7		NA	mg/l
MW-1	3/2/95	Filtered	7440-21-3	Silicon	15		-	mg/l
MW-1	3/2/95	Unfiltered	7440-21-3	Silicon	31.5		NA	mg/l
MW-1	3/2/95	Filtered	7440-23-5	Sodium	9.71		-	mg/l
MW-1	3/2/95	Unfiltered	7440-23-5	Sodium	10.9		NA	mg/l
MW-1	3/2/95	Filtered	7440-24-6	Strontium	0.168		9.6	mg/l
MW-1	3/2/95	Unfiltered	7440-24-6	Strontium	0.199		NA	mg/l
MW-1	3/2/95	Filtered	7440-32-6	Titanium	0.13		-	mg/l
MW-1	3/2/95	Unfiltered	7440-32-6	Titanium	1.04		NA	mg/l
MW-1	3/2/95	Filtered	7440-62-2	Vanadium	0.007		0.112	mg/l
MW-1	3/2/95	Unfiltered	7440-62-2	Vanadium	0.039		NA	mg/l
MW-1	3/2/95	Filtered	7440-66-6	Zinc	0.009		4.8	mg/l
MW-1	3/2/95	Unfiltered	7440-66-6	Zinc	0.031		NA	mg/l

[a] From Table 4-5.

Shading indicates exceedance of the screening value. Comparison for metals data is not made with un-filtered sample data.

NA - Not Applicable. These metals data are for unfiltered samples which are not representative of actual groundwater conditions. It is therefore not appropriate to compare screening criteria to these data.

RATIO OF MTCA METHOD B OR ASIL SCREENING LEVELS TO DETECTION LIMIT FOR TO-14 COMPOUNDS

TO-14 Target Compounds	Screening Value[c] (ppb-V)	Typical Detection Limit[b] (ppb-V)	Ratio of Detection Limit to Screening Value[a]
Freon-12	16.18	1	0.1
Freon-114	3290.14	1	0.0
Chloromethane	0.67	1	1
Vinyl Chloride	0.005	1	213
Bromomethane	0.58	1	2
Chloroethane	1732.35	1	0.001
Freon-11	56.95	1	0.02
1,1-Dichloroethene	0.002	1	544
Freon-113	1789.49	1	0.001
Methylene Chloride	0.16	1	6.2
1,1-Dichloroethane	39.53	1	0.025
cis-1,2-Dichloroethene	655.77	1	0.0
Chloroform	0.01	1	114
1,1,1-trichloroethane	167.55	1	0.006
Carbon Tetrachloride	0.01	1	94
Benzene	0.04	1	27
1,2-Dichloroethane	0.01	1	107
Trichloroethene	0.11	1	9
1,2-Dichloropropane	0.40	1	3
cis-1,3-Dichloropropene	0.01	1	83
Toluene	48.53	1	0.021
trans-1,3-Dichloropropene	0.01	1	83
1,1,2-Trichloroethane	0.03	1	36
Tetrachloroethene	0.16	1	6
Ethylene Dibromide	ND	1	
Chlorobenzene	1.74	1	0.6
Ethylbenzene	105.28	1	0.009
m,p-Xylene	345.40	1	0.0
o-Xylene	345.40	1	0.0
Styrene	107.32	1	0.009
1,1,2,2-Tetrachloroethane	0.005	1	200
1,3,5-Trimethylbenzene	85.43	1	0.0
1,2,4-Trimethylbenzene	85.43	1	0.0
1,3-Dichlorobenzene	ND	1	
1,4-Dichlorobenzene	0.25	1	4
Chlorotoluene	166.10	1	0.0
1,2-Dichlorobenzene	10.64	1	0.1
1,2,4-Trichlorobenzene	12.32	1	0.1
Hexachlorobutadiene	0.009	1	111

ND - No Data

[a] Ratio greater than 1 indicates that the detection limit exceeds the screening value. All compounds with ratio > 1 are shaded.

[b] The actual detection limits for each compound varied between samples, and between tasks. Most of the time, the detection limit was less than 1 ppb-V.

[c] Minimum screening value from Table 4-4.

TABLE 5-7

Initial Soil Gas Study:
VOCs Detected

Sample Location	Date Sampled	Media	QA Type	VOC Compounds Detected[b]	Result	Q	Screening Value[a]	Units
SV-1	3-24-94	Soil Gas		ACETONE	6.5		ND	ppbV
SV-1	3-24-94	Soil Gas		TOLUENE	0.94		48.53	ppbV
SV-1	3-24-94	Soil Gas		UNKNOWN DIMETHYL-UNDECANE	3.7		ND	ppbV
SV-3	3-25-94	Soil Gas		ACETONE	10		ND	ppbV
SV-5	3-25-94	Soil Gas		ACETONE	12		ND	ppbV
SV-5	3-25-94	Soil Gas		TETRAHYDROFURAN	10		ND	ppbV
SV-5	3-25-94	Soil Gas		UNKNOWN	3.8		ND	ppbV
SV-6	3-25-94	Soil Gas		ACETONE	11		ND	ppbV
SV-6	3-25-94	Soil Gas		UNKNOWN HYDROCARBON	4		ND	ppbV
SV-9	3-25-94	Soil Gas		2-PROPENENITRILE	8.9		0.016	ppbV
SV-9	3-25-94	Soil Gas		ACETALDEHYDE	7		0.631	ppbV
SV-9	3-25-94	Soil Gas		ACETONE	15		ND	ppbV
SV-9	3-25-94	Soil Gas		FREON-12	0.97		16.18	ppbV
SV-9	3-25-94	Soil Gas		UNKNOWN DIMETHYL-UNDECANE	14		ND	ppbV
SV-9	3-25-94	Soil Gas		UNKNOWN HYDROCARBON	6		ND	ppbV
SV-10	3-24-94	Soil Gas		BENZENE	14		0.094	ppbV
SV-10	3-24-94	Soil Gas		FREON 114	4.5		ND	ppbV
SV-10	3-24-94	Soil Gas		FREON 12	6.3		16.18	ppbV
SV-10	3-24-94	Soil Gas		TOLUENE	2.3		48.53	ppbV
SV-10	3-24-94	Soil Gas		UNKNOWN	600		ND	ppbV
SV-10	3-24-94	Soil Gas		UNKNOWN DIMETHYL OCTANE	1600		ND	ppbV
SV-10	3-24-94	Soil Gas		UNKNOWN DIMETHYL OCTANE	830		ND	ppbV
SV-10	3-24-94	Soil Gas		UNKNOWN HYDROCARBON	1400		ND	ppbV
SV-10	3-24-94	Soil Gas		UNKNOWN HYDROCARBON	670		ND	ppbV
SV-10	3-24-94	Soil Gas		UNKNOWN HYDROCARBON	640		ND	ppbV
SV-10	3-24-94	Soil Gas		UNKNOWN HYDROCARBON	620		ND	ppbV
SV-10	3-24-94	Soil Gas		UNKNOWN METHYL-NONANE	600		ND	ppbV
SV-10	3-24-94	Soil Gas		UNKNOWN TRIMETHYL HEXANE	830		ND	ppbV
SV-10	3-24-94	Soil Gas		UNKNOWN TRIMETHYL-HEPTANE	500		ND	ppbV
SV-15	3-25-94	Soil Gas		2-BUTANONE	3.8		155.02	ppbV
SV-15	3-25-94	Soil Gas	duplicate	2-BUTANONE	4.7		155.02	ppbV
SV-15	3-25-94	Soil Gas		ACETALDEHYDE	6.5		0.631	ppbV
SV-15	3-25-94	Soil Gas	duplicate	ACETALDEHYDE	9.3		0.631	ppbV
SV-15	3-25-94	Soil Gas		ACETONE	13		ND	ppbV
SV-15	3-25-94	Soil Gas	duplicate	ACETONE	16		ND	ppbV
SV-15	3-25-94	Soil Gas		FREON 12	2		16.18	ppbV
SV-15	3-25-94	Soil Gas	duplicate	FREON 12	2.2		16.18	ppbV
SV-15	3-25-94	Soil Gas		ISOCYANOMETHANE	4.6		ND	ppbV
SV-15	3-25-94	Soil Gas	duplicate	ISOCYANOMETHANE	10		ND	ppbV
SV-15	3-25-94	Soil Gas		TETRAHYDROFURAN	8.9		ND	ppbV
SV-15	3-25-94	Soil Gas	duplicate	TETRAHYDROFURAN	11		ND	ppbV
SV-15	3-25-94	Soil Gas		UNKNOWN	6.3		ND	ppbV
SV-15	3-25-94	Soil Gas	duplicate	UNKNOWN	4.1		ND	ppbV
SV-19	3-25-94	Soil Gas		1-HEXANOL	10		ND	ppbV
SV-19	3-25-94	Soil Gas		2-BUTANONE	6		155.02	ppbV
SV-19	3-25-94	Soil Gas		2-PROPANOL	4.5		ND	ppbV
SV-19	3-25-94	Soil Gas		ACETONE	15		ND	ppbV
SV-19	3-25-94	Soil Gas		ETHANOL	46		ND	ppbV
SV-19	3-25-94	Soil Gas		METHYL(1-METHYL ETHYL-)BENZEN	22		ND	ppbV
SV-19	3-25-94	Soil Gas		METHYLENE CHLORIDE	1.2		1.53	ppbV
SV-19	3-25-94	Soil Gas		TOLUENE	1.2		48.53	ppbV
SV-19	3-25-94	Soil Gas		UNKNOWN DIETHYL-CYCLOBUTAN	9		ND	ppbV
SV-19	3-25-94	Soil Gas		UNKNOWN DIMETHYL-UNDECANE	13		ND	ppbV
SV-19	3-25-94	Soil Gas		UNKNOWN HYDROCARBON	8.6		ND	ppbV

Initial Soil Gas Study:
VOCs Detected

Sample Location	Date Sampled	Media	QA Type	VOC Compounds Detected[b]	Result	Q	Screening Value[a]	Units
SV-19	3-25-94	Soil Gas		UNKNOWN HYDROCARBON	5.7		ND	ppbV
SV-22	3-24-94	Soil Gas		ACETONE	16		ND	ppbV
SV-22	3-24-94	Soil Gas		CHLOROFORM	16		0.022	ppbV
SV-22	3-24-94	Soil Gas		FREON 12	2.2		16.18	ppbV
SV-22	3-24-94	Soil Gas		TOLUENE	4.1		48.53	ppbV
SV-22	3-24-94	Soil Gas		UNKNOWN HYDROCARBON	11		ND	ppbV
SV-25	3-25-94	Soil Gas		NOT ANALYZED				
SV-26	3-25-94	Soil Gas		1-METHYLNAPTHALENE	6.9		ND	ppbV
SV-26	3-25-94	Soil Gas		2,6-DIMETHYLNONANE	6		ND	ppbV
SV-26	3-25-94	Soil Gas		ACETONE	7.7		ND	ppbV
SV-26	3-25-94	Soil Gas		DECAHYDRONAPTHALENE	12		ND	ppbV
SV-26	3-25-94	Soil Gas		FREON 12	1.1		16.18	ppbV
SV-26	3-25-94	Soil Gas		UNKNOWN	12		ND	ppbV
SV-26	3-25-94	Soil Gas		UNKNOWN	12		ND	ppbV
SV-26	3-25-94	Soil Gas		UNKNOWN	8.2		ND	ppbV
SV-26	3-25-94	Soil Gas		UNKNOWN CYCLOHEXANE	6		ND	ppbV
SV-26	3-25-94	Soil Gas		UNKNOWN HYDROCARBON	9		ND	ppbV
SV-26	3-25-94	Soil Gas		UNKNOWN HYDROCARBON	7.8		ND	ppbV
SV-31	3-25-94	Soil Gas		2-METHYL-PENTANE	6.9		ND	ppbV
SV-31	3-25-94	Soil Gas		ACETONE	7.8		ND	ppbV
SV-31	3-25-94	Soil Gas		FREON 12	3.6		16.18	ppbV
SV-31	3-25-94	Soil Gas		HEXANE	5.7		25.94	ppbV
SV-31	3-25-94	Soil Gas		TETRACHLOROETHENE	2.4		0.271	ppbV
SV-32	3-24-94	Soil Gas		2-BUTANONE	18		155.02	ppbV
SV-32	3-24-94	Soil Gas	duplicate	2-BUTANONE	21		155.02	ppbV
SV-32	3-24-94	Soil Gas		ACETALDEHYDE	8.4		0.631	ppbV
SV-32	3-24-94	Soil Gas		ACETONE	16		ND	ppbV
SV-32	3-24-94	Soil Gas	duplicate	ACETONE	11		ND	ppbV
SV-32	3-24-94	Soil Gas	duplicate	CARBON DISULFIDE	6.3		102.6906418	ppbV
SV-32	3-24-94	Soil Gas		FREON 12	2.2		16.18	ppbV
SV-32	3-24-94	Soil Gas	duplicate	FREON 12	2.4		16.18	ppbV
SV-32	3-24-94	Soil Gas	duplicate	STYRENE	0.73		107.32	ppbV
SV-32	3-24-94	Soil Gas	duplicate	TOLUENE	0.95		48.53	ppbV
SV-32	3-24-94	Soil Gas		UNKNOWN AROMATIC	5.3		ND	ppbV
SV-32	3-24-94	Soil Gas		UNKNOWN HYDROCARBON	5.2		ND	ppbV
SV-32	3-24-94	Soil Gas		UNKNOWN HYDROCARBON	3.9		ND	ppbV
SV-35	3-25-94	Soil Gas		2-PROPANOL	6.2		ND	ppbV
SV-35	3-25-94	Soil Gas		ACETONE	11		ND	ppbV
SV-35	3-25-94	Soil Gas		ETHANOL	39		ND	ppbV
SV-35	3-25-94	Soil Gas		UNKNOWN	14		ND	ppbV
SV-35	3-25-94	Soil Gas		UNKNOWN	7.3		ND	ppbV
SV-36	3-24-94	Soil Gas		2-BUTANONE	8		155.02	ppbV
SV-36	3-24-94	Soil Gas		ACETONE	20		ND	ppbV
SV-36	3-24-94	Soil Gas		FREON 12	3.5		16.18	ppbV
SV-36	3-24-94	Soil Gas		TETRACHLOROETHENE	5.5		0.271	ppbV
SV-36	3-24-94	Soil Gas		UNKNOWN HYDROCARBON	12		ND	ppbV
SV-42	3-24-94	Soil Gas		2-BUTANONE	7.3		155.02	ppbV
SV-42	3-24-94	Soil Gas	duplicate	2-BUTANONE	6		155.02	ppbV
SV-42	3-24-94	Soil Gas		ACETONE	14		ND	ppbV
SV-42	3-24-94	Soil Gas	duplicate	ACETONE	13		ND	ppbV
SV-42	3-24-94	Soil Gas		CHLOROFORM	1.8		0.022	ppbV
SV-42	3-24-94	Soil Gas		CHLOROMETHANE	0.87		0.673	ppbV
SV-42	3-24-94	Soil Gas		FREON 113	2		1789.49	ppbV
SV-42	3-24-94	Soil Gas		FREON 12	1		16.18	ppbV

Initial Soil Gas Study:
VOCs Detected

Sample Location	Date Sampled	Media	QA Type	VOC Compounds Detected[b]	Result	Q	Screening Value[a]	Units
SV-42	3-24-94	Soil Gas		NONANE	5		ND	ppbV
SV-42	3-24-94	Soil Gas		STYRENE	0.73		107.32	ppbV
SV-42	3-24-94	Soil Gas		TOLUENE	0.81		48.53	ppbV
SV-42	3-24-94	Soil Gas		UNKNOWN HYDROCARBON	5.6		ND	ppbV
SV-42	3-24-94	Soil Gas	duplicate	UNKNOWN HYDROCARBON	5.7		ND	ppbV
SV-44	3-24-94	Soil Gas		UNKNOWN HYDROCARBON	7.1		ND	ppbV
SV-45	3-24-94	Soil Gas		1-METHYL-NAPTHALENE	7		ND	ppbV
SV-45	3-24-94	Soil Gas		2-BUTANONE	36		155.02	ppbV
SV-45	3-24-94	Soil Gas		ACETONE	7.2		ND	ppbV
SV-45	3-24-94	Soil Gas		DECANE	8.5		ND	ppbV
SV-45	3-24-94	Soil Gas		NONANE	1000		ND	ppbV
SV-45	3-24-94	Soil Gas		PROPYL-CYCLOPROPANE	10		ND	ppbV
SV-45	3-24-94	Soil Gas		STYRENE	1.2		107.32	ppbV
SV-45	3-24-94	Soil Gas		TOLUENE	1.2		48.53	ppbV
SV-45	3-24-94	Soil Gas		UNDECANE	210		ND	ppbV
SV-45	3-24-94	Soil Gas		UNKNOWN	12		ND	ppbV
SV-45	3-24-94	Soil Gas		UNKNOWN HYDROCARBON	8.7		ND	ppbV
SV-45	3-24-94	Soil Gas		UNKNOWN HYDROCARBON	8.4		ND	ppbV
SV-46	3-25-94	Soil Gas		3-CARENE	5.7		ND	ppbV
SV-46	3-25-94	Soil Gas		OCTADECANAL	5.3		ND	ppbV
SV-47	3-24-94	Soil Gas		2-BUTANONE	7.7		155.02	ppbV
SV-47	3-24-94	Soil Gas		ACETONE	12		ND	ppbV
SV-47	3-24-94	Soil Gas		BUTANAL	5.3		ND	ppbV
SV-47	3-24-94	Soil Gas		FREON 12	0.7		16.18	ppbV
SV-47	3-24-94	Soil Gas		HEXANAL	5.5		ND	ppbV
SV-49	3-24-94	Soil Gas		2-BUTANONE	7.1		155.02	ppbV
SV-49	3-24-94	Soil Gas	duplicate	2-BUTANONE	7.8		155.02	ppbV
SV-49	3-24-94	Soil Gas		2-PROPENENITRILE	8.3		0.016	ppbV
SV-49	3-24-94	Soil Gas	duplicate	2-PROPENENITRILE	7.6		0.016	ppbV
SV-49	3-24-94	Soil Gas		ACETONE	11		ND	ppbV
SV-49	3-24-94	Soil Gas	duplicate	ACETONE	13		ND	ppbV
SV-49	3-24-94	Soil Gas		CARBON DISULFIDE	5.3		102.69	ppbV
SV-49	3-24-94	Soil Gas	duplicate	CARBON DISULFIDE	6.1		102.69	ppbV
SV-49	3-24-94	Soil Gas		CHLORODIFLUOROMETHANE	490		6389.13	ppbV
SV-49	3-24-94	Soil Gas	duplicate	CHLORODIFLUOROMETHANE	600		6389.13	ppbV
SV-51	3-24-94	Soil Gas		ALL TO14 TARGET COMPOUNDS	ND		ND	ppbV
SV-EB	3-25-94	Soil Gas		4-METHYL-DECANE	4.4		ND	ppbV
SV-EB	3-25-94	Soil Gas		ACETONE	8.8		ND	ppbV
SV-EB	3-25-94	Soil Gas		DECANE	4.4		ND	ppbV
SV-EB	3-25-94	Soil Gas		DODECANE	20		ND	ppbV
SV-EB	3-25-94	Soil Gas		TRIDECANE	5.5		ND	ppbV
SV-EB	3-25-94	Soil Gas		UNKNOWN HYDROCARBON	12		ND	ppbV
SV-EB	3-25-94	Soil Gas		UNKNOWN HYDROCARBON	4.9		ND	ppbV
SV-EB	3-25-94	Soil Gas		UNKNOWN HYDROCARBON	4.2		ND	ppbV
SV-EB	3-25-94	Soil Gas		UNKNOWN SUBSTITUTED CYCLOHE	8.8		ND	ppbV

SV-EB Equipment Blank Sample
ND - No Data
Shading indicates exceedance of the screening value.

[a] Minimum screening value from Table 4-4, excluding ASILs which are only applicable to outdoor air.
[b] Compounds detected per EPA Method TO-14 analysis.

TABLE 5-8

INITIAL SOIL GAS STUDY:
ATMOSPHERIC AND SULFUR GASES, ALDEHYDES AND AMINES

PARAMETER	Screening Value*	SV-1	SV-3	SV-5	SV-6	SV-9	SV-10	SV-15	SV-16	SV-18	SV-19	SV-22	SV-25	SV-26	SV-31	SV-32	SV-35	SV-36	SV-40	SV-42	SV-44	SV-45	SV-46	SV-47	SV-49	SV-51	SV-EB
Atmospheric Gases (%)																											
OXYGEN	ND	22	21	21	21	21	1.5	20	NA	NA	21	7.5	NA	21	17	17	9.5	14	NA	19	21	21	19	20	14	20	22
NITROGEN	ND	78	78	78	79	78	90	79	NA	NA	78	84	NA	78	80	81	84	83	NA	79	79	78	78	78	81	79	78
CARBON MONOXIDE	NA	ND	ND	ND	ND	ND	ND	ND	NA	NA	ND	ND	NA	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND	ND
METHANE	ND	ND	ND	ND	ND	ND	2.2	ND	NA	NA	ND	ND	NA	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND	ND
CARBON DIOXIDE	ND	0.46	1.1	0.54	0.48	0.56	5.8	1.3	NA	NA	0.82	8.8	NA	0.71	3.2	2.4	6.7	3.1	NA	2.3	0.31	0.74	2.9	1.5	4.5	0.76	0.039
TNMHC	NA	ND	ND	ND	ND	ND	0.016	ND	NA	NA	ND	ND	NA	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND	ND
Sulfur Gases (PPM-V)																											
HYDROGNE SULFIDE	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CARBONYL SULFIDE	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
METHYL MERCAPTAN	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DIMETHYL SULFIDE	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CARBON DISULFIDE	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DIMETHYL DISULFIDE	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ALDEHYDES (PPB-V)																											
VOLUME (liters)		21	21	20	20	21	21	20	20	20	22	21	20	22	21	21	25.3	20	20	23	21	21	24	22	22	21	20
FORMALDEHYDE	0.158	ND	6.2	8.1	20	13	ND	15	NA	NA	17	14	NA	20	5.0	3.9	6.4	6.1	NA	5.0	3.9	ND	ND	7.0	5.6	ND	ND
ACETALDEHYDE	0.631	ND	10	19	23	22	ND	24	NA	NA	28	24	NA	12	6.6	9	19	6.9	NA	7.5	8.5	4.2	ND	7.1	11	5.3	ND
ACROLEIN	NA	ND	ND	ND	ND	ND	ND	ND	NA	NA	ND	ND	NA	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND	ND
ALDEHYDES (ug)																											
FORMALDEHYDE		ND	0.16	0.20	0.49	0.33	ND	0.38	NA	NA	0.46	0.36	NA	0.54	0.13	0.10	0.20	0.15	NA	0.14	0.10	ND	ND	0.19	0.15	ND	ND
ACETALDEHYDE		ND	0.38	0.70	0.82	0.84	ND	0.85	NA	NA	1.10	0.92	NA	0.46	0.25	0.35	0.88	0.25	NA	0.31	0.32	0.16	ND	0.28	0.43	0.20	ND
ACROLEIN		ND	ND	ND	ND	ND	ND	ND	NA	NA	ND	ND	NA	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND	ND
AMINES (PPM-V)																											
N-BUTYL AMINE	NA	ND	ND	ND	ND	ND	ND	ND	NA	NA	ND	ND	NA	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND	ND

SV-EB Equipment Blank Sample.
ND - Do Date
NA - Not Applicable because the compound was not detected.
Shading indicates exceedance of the screening value.

*Minimum screening value from Table 4-4, excluding ASILs which are only applicable to outdoor air.

TABLE 5-9

VOCs DETECTED IN THE INITIAL SOIL VAPOR SURVEY

Compounds Detected	Soil Vapor Probe Number: 1	3	5	6	9	10	15	19	22	26	31	32	35	36	42	44	45	46	47	49	51	EB	Number *
ACETALDEHYDE		■	■	■	■		■	■	■	■	■	■	■	■	■	■	■		■	■	■		18
ACETONE	■	■	■	■	■		■	■	■	■	■	■	■	■	■		■		■	■		■	18
BENZENE						■																	1
BUTANAL																			■				1
BUTANONE, 2-							■	■				■		■	■		■		■	■			8
CARBON DISULFIDE												■								■			2
CARENE, 3-																		■					* 1
CHLORODIFLUOROMETHANE																				■			1
CHLOROFORM									■						■								2
CHLOROMETHANE															■								1
DECAHYDRONAPTHALENE										■													1
DECANE																	■					■	2
DIMETHYLNONANE, 2,6-										■													1
DODECANE																						■	1
ETHANOL								■					■										2
FORMALDEHYDE		■	■	■	■		■	■	■	■	■	■	■	■	■	■			■	■			16
FREON 113															■								1
FREON 114						■																	1
FREON-12					■	■	■		■	■	■	■		■	■				■				10
HEXANAL																			■				1
HEXANE											■												1
HEXANOL, 1-								■															1
ISOCYANOMETHANE							■																1
METHANE						■																	1
METHYL(1-METHYL ETHYL-)BENZENE								■															1
METHYL-DECANE, 4-																						■	1
METHYL-PENTANE, 2-											■												1
METHYLENE CHLORIDE								■															1
METHYLNAPTHALENE, 1-										■							■						2
NONANE															■		■						2
OCTADECANAL																		■					1
PROPANOL, 2-								■					■										2
PROPENENITRILE, 2-					■															■			2
PROPYL-CYCLOPROPANE																	■						1
STYRENE												■			■		■						3
TETRACHLOROETHENE											■			■									2
TETRAHYDROFURAN			■				■																2
TOLUENE	■					■		■	■			■			■		■					■	7
TRIDECANE																	■						1
UNDECANE																	■						1
UNKNOWN			■			■	■			■			■				■						6
UNKNOWN AROMATIC												■											1
UNKNOWN CYCLOHEXANE										■													1
UNKNOWN DIETHYL-CYCLOBUTANE								■															1
UNKNOWN DIMETHYL OCTANE						■																	1
UNKNOWN DIMETHYL-UNDECANE	■				■			■															3
UNKNOWN HYDROCARBON				■	■	■		■	■	■		■		■	■	■	■					■	12
UNKNOWN METHYL-NONANE						■																	1
UNKNOWN SUBSTITUTED CYCLOHEXANE																						■	1
UNKNOWN TRIMETHYL HEXANE						■																	1
UNKNOWN TRIMETHYL-HEPTANE						■																	1
No. Detects	3	3	5	4	7	10	8	13	7	10	7	10	6	7	12	3	12	2	7	7	1	7	

¦ - Indicates exceedance of the screening value.

* - Number of probes where the compound was detected. Excludes the equipment blank.

SOIL GAS AND SKIRT AIR SAMPLING STUDY: VOCs DETECTED

Lot#	Date	Media	QA Type	CAS Number	Compounds Detected	Result	Q	Screening Value[a]	Units
39	9/23/94	SKIRT AIR		95-63-6	1,2,4-Trimethylbenzene	0.99		85.43	ppbv
39	9/23/94	SKIRT AIR		78-87-5	1,2-Dichloropropane	1.2		0.40	ppbv
39	9/23/94	SKIRT AIR		71-43-2	Benzene	4.4		0.04	ppbv
39	9/23/94	SKIRT AIR		74-87-3	Chloromethane	0.16		0.67	ppbv
39	9/23/94	SKIRT AIR		100-41-4	Ethylbenzene	0.88		105.28	ppbv
39	9/23/94	SKIRT AIR		freon12	Freon 12	0.7		16.18	ppbv
39	9/23/94	SKIRT AIR		136777-61-2	m,p-Xylene	3.3		345.40	ppbv
39	9/23/94	SKIRT AIR		oxylene	o-Xylene	1.3		345.40	ppbv
39	9/23/94	SKIRT AIR		108-88-3	Toluene	6.3		48.53	ppbv
39	9/23/94	SOIL GAS		71-43-2	Benzene	7.3		0.09	ppbv
39	9/23/94	SOIL GAS		136777-61-2	m,p-Xylene	5.8		ND	ppbv
39	9/23/94	SOIL GAS		oxylene	o-Xylene	2.1		ND	ppbv
39	9/23/94	SOIL GAS		108-88-3	Toluene	12		48.53	ppbv
42	9/23/94	SKIRT AIR		78-93-3	2-Butanone	3.6		ND	ppbv
42	9/23/94	SKIRT AIR		67-64-1	Acetone	28	B	2483.30	ppbv
42	9/23/94	SKIRT AIR		71-43-2	Benzene	2.6		0.04	ppbv
42	9/23/94	SKIRT AIR		freon12	Freon 12	0.76		16.18	ppbv
42	9/23/94	SKIRT AIR		136777-61-2	m,p-Xylene	0.86		345.40	ppbv
42	9/23/94	SKIRT AIR		75-09-2	Methylenechloride	0.24		0.16	ppbv
42	9/23/94	SKIRT AIR		108-88-3	Toluene	2.2		48.53	ppbv
42	9/23/94	SOIL GAS		78-93-3	2-Butanone	6.1		155.02	ppbv
42	9/23/94	SOIL GAS		67-64-1	Acetone	33	B	ND	ppbv
42	9/23/94	SOIL GAS		108-88-3	Toluene	3.8		48.53	ppbv
44	9/23/94	SKIRT AIR		71-55-6	1,1,1-Trichloroethane	0.95		167.55	ppbv
44	9/23/94	SKIRT AIR		78-93-3	2-Butanone	1.5		ND	ppbv
44	9/23/94	SKIRT AIR		67-64-1	Acetone	12	B	2483.30	ppbv
44	9/23/94	SKIRT AIR		71-43-2	Benzene	0.97		0.04	ppbv
44	9/23/94	SKIRT AIR		56-23-5	Carbon tetrachloride	0.2		0.01	ppbv
44	9/23/94	SKIRT AIR		136777-61-2	m,p-Xylene	1.7		345.40	ppbv
44	9/23/94	SKIRT AIR		108-88-3	Toluene	2.3		48.53	ppbv
44	9/23/94	SOIL GAS		78-93-3	2-Butanone	3.5	B	155.02	ppbv
44	9/23/94	SOIL GAS		127-18-4	Tetrachloroethene	22		0.65	ppbv
44	9/23/94	SOIL GAS		108-88-3	Toluene	1.7		48.53	ppbv
46	9/23/94	SKIRT AIR		78-93-3	2-Butanone	2.4		ND	ppbv
46	9/23/94	SKIRT AIR		67-64-1	Acetone	18		2483.30	ppbv
46	9/23/94	SKIRT AIR		71-43-2	Benzene	1.2		0.04	ppbv
46	9/23/94	SKIRT AIR		freon12	Freon 12	0.75		16.18	ppbv
46	9/23/94	SKIRT AIR		136777-61-2	m,p-Xylene	1		345.40	ppbv
46	9/23/94	SKIRT AIR		75-09-2	Methylenechloride	0.27		0.16	ppbv
46	9/23/94	SKIRT AIR		108-88-3	Toluene	2.1		48.53	ppbv
46	9/23/94	SOIL GAS		78-93-3	2-Butanone	2.5		155.02	ppbv
46	9/23/94	SOIL GAS	Dup	78-93-3	2-Butanone	1.6		155.02	ppbv
46	9/23/94	SOIL GAS		67-64-1	Acetone	30		ND	ppbv
46	9/23/94	SOIL GAS	Dup	67-64-1	Acetone	21		ND	ppbv
46	9/23/94	SOIL GAS		71-43-2	Benzene	1.1		0.09	ppbv

SOIL GAS AND SKIRT AIR SAMPLING STUDY: VOCs DETECTED

Lot#	Date	Media	QA Type	CAS Number	Compounds Detected	Result	Q	Screening Value[a]	Units
46	9/23/94	SOIL GAS		136777-61-2	m,p-Xylene	1.1		ND	ppbv
46	9/23/94	SOIL GAS		108-88-3	Toluene	2.7		48.53	ppbv
47	9/23/94	SKIRT AIR		78-93-3	2-Butanone	1.7		ND	ppbv
47	9/23/94	SKIRT AIR		67-64-1	Acetone	21		2483.30	ppbv
47	9/23/94	SKIRT AIR		71-43-2	Benzene	1.2		0.04	ppbv
47	9/23/94	SKIRT AIR		67-66-3	Chloroform	0.52		0.01	ppbv
47	9/23/94	SKIRT AIR		freon11	Freon 11	1.3		56.95	ppbv
47	9/23/94	SKIRT AIR		freon12	Freon 12	3.1		16.18	ppbv
47	9/23/94	SKIRT AIR		136777-61-2	m,p-Xylene	1.7		345.40	ppbv
47	9/23/94	SKIRT AIR		75-09-2	Methylenechloride	0.33		0.16	ppbv
47	9/23/94	SKIRT AIR		oxylene	o-Xylene	0.72		345.40	ppbv
47	9/23/94	SKIRT AIR		108-88-3	Toluene	3.5		48.53	ppbv
47	9/23/94	SOIL GAS		78-93-3	2-Butanone	4.8		155.02	ppbv
47	9/23/94	SOIL GAS		67-64-1	Acetone	30		ND	ppbv
47	9/23/94	SOIL GAS		71-43-2	Benzene	1.1		0.09	ppbv
47	9/23/94	SOIL GAS		freon12	Freon 12	0.85		16.18	ppbv
47	9/23/94	SOIL GAS		136777-61-2	m,p-Xylene	1.1		ND	ppbv
47	9/23/94	SOIL GAS		108-88-3	Toluene	2.1		48.53	ppbv
48	9/23/94	SKIRT AIR		78-93-3	2-Butanone	2.4		ND	ppbv
48	9/23/94	SKIRT AIR		67-64-1	Acetone	20		2483.30	ppbv
48	9/23/94	SKIRT AIR		71-43-2	Benzene	0.97		0.04	ppbv
48	9/23/94	SKIRT AIR		56-23-5	Carbon tetrachloride	0.19		0.01	ppbv
48	9/23/94	SKIRT AIR		freon12	Freon 12	0.74		16.18	ppbv
48	9/23/94	SKIRT AIR		136777-61-2	m,p-Xylene	0.96		345.40	ppbv
48	9/23/94	SKIRT AIR		75-09-2	Methylenechloride	0.4		0.16	ppbv
48	9/23/94	SKIRT AIR		108-88-3	Toluene	1.7		48.53	ppbv
48	9/23/94	SOIL GAS		78-93-3	2-Butanone	1.1		155.02	ppbv
48	9/23/94	SOIL GAS	Dup	78-93-3	2-Butanone	3.7		155.02	ppbv
48	9/23/94	SOIL GAS		67-64-1	Acetone	14		ND	ppbv
48	9/23/94	SOIL GAS	Dup	67-64-1	Acetone	25		ND	ppbv
48	9/23/94	SOIL GAS		71-43-2	Benzene	0.69	J	0.09	ppbv
48	9/23/94	SOIL GAS		freon12	Freon 12	0.57	J	16.18	ppbv
48	9/23/94	SOIL GAS		136777-61-2	m,p-Xylene	1.3		ND	ppbv
48	9/23/94	SOIL GAS		127-18-4	Tetrachloroethene	1.4		0.65	ppbv
48	9/23/94	SOIL GAS		108-88-3	Toluene	1.1		48.53	ppbv
49	9/23/94	SKIRT AIR		71-55-6	1,1,1-Trichloroethane	2.2		167.55	ppbv
49	9/23/94	SKIRT AIR		78-93-3	2-Butanone	1.7	B	ND	ppbv
49	9/23/94	SKIRT AIR		67-64-1	Acetone	31	B	2483.30	ppbv
49	9/23/94	SKIRT AIR		71-43-2	Benzene	1.4		0.04	ppbv
49	9/23/94	SKIRT AIR		56-23-5	Carbon tetrachloride	0.19		0.01	ppbv
49	9/23/94	SKIRT AIR		freon11	Freon 11	0.8		56.95	ppbv
49	9/23/94	SKIRT AIR		freon12	Freon 12	0.84		16.18	ppbv
49	9/23/94	SKIRT AIR		136777-61-2	m,p-Xylene	1.4		345.40	ppbv
49	9/23/94	SKIRT AIR		108-88-3	Toluene	3.1		48.53	ppbv
49	9/23/94	SOIL GAS		67-64-1	Acetone	6.3	B	ND	ppbv

SOIL GAS AND SKIRT AIR SAMPLING STUDY: VOCs DETECTED

Lot#	Date	Media	QA Type	CAS Number	Compounds Detected	Result	Q	Screening Value[a]	Units
50	9/23/94	SKIRT AIR		78-93-3	2-Butanone	2.1	B	ND	ppbv
50	9/23/94	SKIRT AIR		67-64-1	Acetone	17	B	2483.30	ppbv
50	9/23/94	SKIRT AIR		71-43-2	Benzene	1.2		0.04	ppbv
50	9/23/94	SKIRT AIR		56-23-5	Carbon tetrachloride	0.19		0.01	ppbv
50	9/23/94	SKIRT AIR		freon12	Freon 12	0.85		16.18	ppbv
50	9/23/94	SKIRT AIR		136777-61-2	m,p-Xylene	1.3		345.40	ppbv
50	9/23/94	SKIRT AIR		108-88-3	Toluene	2.3		48.53	ppbv
50	9/23/94	SOIL GAS		78-93-3	2-Butanone	10	B	155.02	ppbv
50	9/23/94	SOIL GAS		67-64-1	Acetone	95	B	ND	ppbv
50	9/23/94	SOIL GAS		136777-61-2	m,p-Xylene	0.9		ND	ppbv
50	9/23/94	SOIL GAS		108-88-3	Toluene	2		48.53	ppbv
51	9/23/94	SKIRT AIR		78-93-3	2-Butanone	1.6	B	ND	ppbv
51	9/23/94	SKIRT AIR		67-64-1	Acetone	38	B	2483.30	ppbv
51	9/23/94	SKIRT AIR		71-43-2	Benzene	1		0.04	ppbv
51	9/23/94	SKIRT AIR		56-23-5	Carbon tetrachloride	0.19		0.01	ppbv
51	9/23/94	SKIRT AIR		freon11	Freon 11	0.74		56.95	ppbv
51	9/23/94	SKIRT AIR		freon12	Freon 12	0.92		16.18	ppbv
51	9/23/94	SKIRT AIR		136777-61-2	m,p-Xylene	1.5		345.40	ppbv
51	9/23/94	SKIRT AIR		108-88-3	Toluene	3.1		48.53	ppbv
51	9/23/94	SOIL GAS		78-93-3	2-Butanone	2.1	B	155.02	ppbv
51	9/23/94	SOIL GAS		67-64-1	Acetone	13	B	ND	ppbv
51	9/23/94	SOIL GAS		71-43-2	Benzene	0.86		0.09	ppbv
52	9/23/94	SKIRT AIR		78-93-3	2-Butanone	1.4	B	ND	ppbv
52	9/23/94	SKIRT AIR		67-64-1	Acetone	3.2	B	2483.30	ppbv
52	9/23/94	SKIRT AIR		71-43-2	Benzene	0.88		0.04	ppbv
52	9/23/94	SKIRT AIR		freon12	Freon 12	0.83		16.18	ppbv
52	9/23/94	SKIRT AIR		136777-61-2	m,p-Xylene	1		345.40	ppbv
52	9/23/94	SKIRT AIR		108-88-3	Toluene	1.6		48.53	ppbv
52	9/23/94	SOIL GAS		67-64-1	Acetone	9.9		ND	ppbv
53	9/23/94	SKIRT AIR		67-64-1	Acetone	14		2483.30	ppbv
53	9/23/94	SKIRT AIR		71-43-2	Benzene	1.2		0.04	ppbv
53	9/23/94	SKIRT AIR		74-87-3	Chloromethane	0.25		0.67	ppbv
53	9/23/94	SKIRT AIR		136777-61-2	m,p-Xylene	0.88		345.40	ppbv
53	9/23/94	SKIRT AIR		108-88-3	Toluene	1.8		48.53	ppbv
53	9/23/94	SOIL GAS		67-64-1	Acetone	12		ND	ppbv
53	9/23/94	SOIL GAS		freon12	Freon 12	0.76		16.18	ppbv
53	9/23/94	SOIL GAS		108-88-3	Toluene	2		48.53	ppbv
54	9/23/94	SKIRT AIR		95-63-6	1,2,4-Trimethylbenzene	1.1		85.43	ppbv
54	9/23/94	SKIRT AIR		67-64-1	Acetone	8		2483.30	ppbv
54	9/23/94	SKIRT AIR		71-43-2	Benzene	3.6		0.04	ppbv
54	9/23/94	SKIRT AIR		100-41-4	Ethylbenzene	1.2		105.28	ppbv
54	9/23/94	SKIRT AIR		freon12	Freon 12	3.3		16.18	ppbv
54	9/23/94	SKIRT AIR		136777-61-2	m,p-Xylene	3.8		345.40	ppbv
54	9/23/94	SKIRT AIR		oxylene	o-Xylene	1.4		345.40	ppbv
54	9/23/94	SKIRT AIR		108-88-3	Toluene	7.2		48.53	ppbv

TABLE 5-10

SOIL GAS AND SKIRT AIR SAMPLING STUDY: VOCs DETECTED

Lot#	Date	Media	QA Type	CAS Number	Compounds Detected	Result	Q	Screening Value[a]	Units
54	9/23/94	SOIL GAS		95-63-6	1,2,4-Trimethylbenzene	1.7		ND	ppbv
54	9/23/94	SOIL GAS		67-64-1	Acetone	33		ND	ppbv
54	9/23/94	SOIL GAS		71-43-2	Benzene	8.9		0.09	ppbv
54	9/23/94	SOIL GAS		74-87-3	Chloromethane	1.4		0.67	ppbv
54	9/23/94	SOIL GAS		100-41-4	Ethylbenzene	2.2		105.28	ppbv
54	9/23/94	SOIL GAS		136777-61-2	m,p-Xylene	7.6		ND	ppbv
54	9/23/94	SOIL GAS		oxylene	o-Xylene	2.7		ND	ppbv
54	9/23/94	SOIL GAS		100-42-5	Styrene	0.96		107.32	ppbv
54	9/23/94	SOIL GAS		108-88-3	Toluene	17		48.53	ppbv
55	9/23/94	SKIRT AIR		71-55-6	1,1,1-Trichloroethane	0.98		167.55	ppbv
55	9/23/94	SKIRT AIR		67-64-1	Acetone	5.5		2483.30	ppbv
55	9/23/94	SKIRT AIR		71-43-2	Benzene	0.72		0.04	ppbv
55	9/23/94	SKIRT AIR		74-87-3	Chloromethane	0.31		0.67	ppbv
55	9/23/94	SKIRT AIR		108-88-3	Toluene	1		48.53	ppbv
55	9/23/94	SOIL GAS		67-64-1	Acetone	11		ND	ppbv
55	9/23/94	SOIL GAS		71-43-2	Benzene	1.2		0.09	ppbv
55	9/23/94	SOIL GAS		136777-61-2	m,p-Xylene	1.1		ND	ppbv
55	9/23/94	SOIL GAS		108-88-3	Toluene	4.1		48.53	ppbv
56	9/23/94	SKIRT AIR		67-64-1	Acetone	9.9		2483.30	ppbv
56	9/23/94	SKIRT AIR		71-43-2	Benzene	1.8		0.04	ppbv
56	9/23/94	SKIRT AIR		74-87-3	Chloromethane	0.4		0.67	ppbv
56	9/23/94	SKIRT AIR		136777-61-2	m,p-Xylene	0.7		345.40	ppbv
56	9/23/94	SKIRT AIR		108-88-3	Toluene	1.4		48.53	ppbv
56	9/23/94	SOIL GAS		67-64-1	Acetone	11		ND	ppbv
60	9/23/94	SKIRT AIR		95-63-6	1,2,4-Trimethylbenzene	1.2		85.43	ppbv
60	9/23/94	SKIRT AIR		71-43-2	Benzene	3.8		0.04	ppbv
60	9/23/94	SKIRT AIR		74-87-3	Chloromethane	0.22		0.67	ppbv
60	9/23/94	SKIRT AIR		100-41-4	Ethylbenzene	1		105.28	ppbv
60	9/23/94	SKIRT AIR		136777-61-2	m,p-Xylene	3.8		345.40	ppbv
60	9/23/94	SKIRT AIR		oxylene	o-Xylene	1.4		345.40	ppbv
60	9/23/94	SKIRT AIR		108-88-3	Toluene	7		48.53	ppbv
60	9/23/94	SOIL GAS		95-63-6	1,2,4-Trimethylbenzene	1.3	J	ND	ppbv
60	9/23/94	SOIL GAS		67-64-1	Acetone	7.4		ND	ppbv
60	9/23/94	SOIL GAS		71-43-2	Benzene	3.2	J	0.09	ppbv
60	9/23/94	SOIL GAS		136777-61-2	m,p-Xylene	3.4	J	ND	ppbv
60	9/23/94	SOIL GAS		oxylene	o-Xylene	1.5	J	ND	ppbv
60	9/23/94	SOIL GAS		108-88-3	Toluene	5.4	J	48.53	ppbv
61	9/23/94	SKIRT AIR		95-63-6	1,2,4-Trimethylbenzene	1.2		85.43	ppbv
61	9/23/94	SKIRT AIR		71-43-2	Benzene	3.6		0.04	ppbv
61	9/23/94	SKIRT AIR		74-87-3	Chloromethane	0.21		0.67	ppbv
61	9/23/94	SKIRT AIR		100-41-4	Ethylbenzene	0.95		105.28	ppbv
61	9/23/94	SKIRT AIR		136777-61-2	m,p-Xylene	3.5		345.40	ppbv
61	9/23/94	SKIRT AIR		oxylene	o-Xylene	1.3		345.40	ppbv
61	9/23/94	SKIRT AIR		108-88-3	Toluene	6.5		48.53	ppbv
61	9/23/94	SOIL GAS		67-64-1	Acetone	12		ND	ppbv

SOIL GAS AND SKIRT AIR SAMPLING STUDY: VOCs DETECTED

Lot#	Date	Media	QA Type	CAS Number	Compounds Detected	Result	Q	Screening Value[a]	Units
61	9/23/94	SOIL GAS		71-43-2	Benzene	2.3		0.09	ppbv
61	9/23/94	SOIL GAS		136777-61-2	m,p-Xylene	2		ND	ppbv
61	9/23/94	SOIL GAS		108-88-3	Toluene	4.3		48.53	ppbv
63	9/23/94	SKIRT AIR		95-63-6	1,2,4-Trimethylbenzene	0.89		85.43	ppbv
63	9/23/94	SKIRT AIR		71-43-2	Benzene	3.1		0.04	ppbv
63	9/23/94	SKIRT AIR		74-87-3	Chloromethane	0.31		0.67	ppbv
63	9/23/94	SKIRT AIR		100-41-4	Ethylbenzene	0.71		105.28	ppbv
63	9/23/94	SKIRT AIR		136777-61-2	m,p-Xylene	2.6		345.40	ppbv
63	9/23/94	SKIRT AIR		75-09-2	Methylenechloride	0.23		0.16	ppbv
63	9/23/94	SKIRT AIR		oxylene	o-Xylene	1		345.40	ppbv
63	9/23/94	SKIRT AIR		108-88-3	Toluene	4.5		48.53	ppbv
63	9/23/94	SOIL GAS		71-43-2	Benzene	15		0.09	ppbv
64	9/23/94	SKIRT AIR		71-43-2	Benzene	2.5		0.04	ppbv
64	9/23/94	SKIRT AIR		74-87-3	Chloromethane	0.26		0.67	ppbv
64	9/23/94	SKIRT AIR		136777-61-2	m,p-Xylene	2.4		345.40	ppbv
64	9/23/94	SKIRT AIR		oxylene	o-Xylene	0.94		345.40	ppbv
64	9/23/94	SKIRT AIR		108-88-3	Toluene	3.6		48.53	ppbv
64	9/23/94	SOIL GAS		freon11	Freon 11	0.75		56.95	ppbv
65	9/23/94	SKIRT AIR		67-64-1	Acetone	5.1		2483.30	ppbv
65	9/23/94	SKIRT AIR		71-43-2	Benzene	1.6		0.04	ppbv
65	9/23/94	SKIRT AIR		74-87-3	Chloromethane	0.24		0.67	ppbv
65	9/23/94	SKIRT AIR		136777-61-2	m,p-Xylene	1.2		345.40	ppbv
65	9/23/94	SKIRT AIR		108-88-3	Toluene	2.4		48.53	ppbv
65	9/23/94	SOIL GAS		67-64-1	Acetone	4.9		ND	ppbv
65	9/23/94	SOIL GAS		71-43-2	Benzene	1.3		0.09	ppbv
65	9/23/94	SOIL GAS		136777-61-2	m,p-Xylene	0.98		ND	ppbv
65	9/23/94	SOIL GAS		100-42-5	Styrene	0.81		107.32	ppbv
65	9/23/94	SOIL GAS		108-88-3	Toluene	2.6		48.53	ppbv
66	9/23/94	SKIRT AIR		67-64-1	Acetone	7		2483.30	ppbv
66	9/23/94	SKIRT AIR		71-43-2	Benzene	1.2		0.04	ppbv
66	9/23/94	SKIRT AIR		74-87-3	Chloromethane	0.41		0.67	ppbv
66	9/23/94	SKIRT AIR		136777-61-2	m,p-Xylene	0.96		345.40	ppbv
66	9/23/94	SKIRT AIR		100-42-5	Styrene	0.7		107.32	ppbv
66	9/23/94	SKIRT AIR		108-88-3	Toluene	1.6		48.53	ppbv
66	9/23/94	SOIL GAS		67-64-1	Acetone	7.3		ND	ppbv
66	9/23/94	SOIL GAS		109-99-9	Tetrahydrofuran	3.5		ND	ppbv
119	9/23/94	SKIRT AIR		67-64-1	Acetone	3.9		2483.30	ppbv
119	9/23/94	SKIRT AIR		71-43-2	Benzene	0.95		0.04	ppbv
119	9/23/94	SKIRT AIR		74-87-3	Chloromethane	0.3		0.67	ppbv
119	9/23/94	SKIRT AIR		136777-61-2	m,p-Xylene	1.2		345.40	ppbv
119	9/23/94	SKIRT AIR		108-88-3	Toluene	1.2		48.53	ppbv
119	9/23/94	SOIL GAS		67-64-1	Acetone	8.6		ND	ppbv
119	9/23/94	SOIL GAS		71-43-2	Benzene	1.6		0.09	ppbv
119	9/23/94	SOIL GAS		136777-61-2	m,p-Xylene	1		ND	ppbv
119	9/23/94	SOIL GAS		108-88-3	Toluene	2.2		48.53	ppbv

SOIL GAS AND SKIRT AIR SAMPLING STUDY: VOCs DETECTED

Lot#	Date	Media	QA Type	CAS Number	Compounds Detected	Result	Q	Screening Value[a]	Units
121	9/23/94	SKIRT AIR		71-43-2	Benzene	0.88		0.04	ppbv
121	9/23/94	SKIRT AIR		freon12	Freon 12	0.83		16.18	ppbv
121	9/23/94	SKIRT AIR		108-88-3	Toluene	1.1		48.53	ppbv
121	9/23/94	SOIL GAS		95-63-6	1,2,4-Trimethylbenzene	3		ND	ppbv
121	9/23/94	SOIL GAS		108-67-8	1,3,5-Trimethylbenzene	0.78		ND	ppbv
121	9/23/94	SOIL GAS		67-64-1	Acetone	24		ND	ppbv
121	9/23/94	SOIL GAS		71-43-2	Benzene	0.75		0.09	ppbv
121	9/23/94	SOIL GAS		100-41-4	Ethylbenzene	1.7		105.28	ppbv
121	9/23/94	SOIL GAS		freon114	Freon 114	0.88		ND	ppbv
121	9/23/94	SOIL GAS		freon12	Freon 12	18		16.18	ppbv
121	9/23/94	SOIL GAS		136777-61-2	m,p-Xylene	7.4		ND	ppbv
121	9/23/94	SOIL GAS		oxylene	o-Xylene	2.8		ND	ppbv
121	9/23/94	SOIL GAS		127-18-4	Tetrachloroethene	5.1		0.65	ppbv
121	9/23/94	SOIL GAS		108-88-3	Toluene	4.8		48.53	ppbv
122	9/23/94	SKIRT AIR		67-64-1	Acetone	26		2483.30	ppbv
122	9/23/94	SKIRT AIR		71-43-2	Benzene	0.81		0.04	ppbv
122	9/23/94	SKIRT AIR		108-88-3	Toluene	1.2		48.53	ppbv
122	9/23/94	SOIL GAS		95-63-6	1,2,4-Trimethylbenzene	6.5		ND	ppbv
122	9/23/94	SOIL GAS		108-67-8	1,3,5-Trimethylbenzene	2.2		ND	ppbv
122	9/23/94	SOIL GAS		67-64-1	Acetone	13		ND	ppbv
122	9/23/94	SOIL GAS		71-43-2	Benzene	1.8		0.09	ppbv
122	9/23/94	SOIL GAS		74-87-3	Chloromethane	1.2		0.67	ppbv
122	9/23/94	SOIL GAS		100-41-4	Ethylbenzene	4		105.28	ppbv
122	9/23/94	SOIL GAS		freon12	Freon 12	1.1		16.18	ppbv
122	9/23/94	SOIL GAS		136777-61-2	m,p-Xylene	18		ND	ppbv
122	9/23/94	SOIL GAS		oxylene	o-Xylene	7.2		ND	ppbv
122	9/23/94	SOIL GAS		109-99-9	Tetrahydrofuran	8.4		ND	ppbv
122	9/23/94	SOIL GAS		108-88-3	Toluene	12		48.53	ppbv
122	9/23/94	SOIL GAS		79-01-6	Trichloroethene	1		0.27	ppbv
123	9/23/94	SKIRT AIR		67-64-1	Acetone	7.9		2483.30	ppbv
123	9/23/94	SKIRT AIR		71-43-2	Benzene	0.91		0.04	ppbv
123	9/23/94	SKIRT AIR		108-88-3	Toluene	1.5		48.53	ppbv
123	9/23/94	SOIL GAS		67-64-1	Acetone	4.9		ND	ppbv
123	9/23/94	SOIL GAS		67-66-3	Chloroform	1.5		0.02	ppbv
123	9/23/94	SOIL GAS		127-18-4	Tetrachloroethene	4		0.65	ppbv
125	9/23/94	SKIRT AIR		67-64-1	Acetone	5.5		2483.30	ppbv
125	9/23/94	SKIRT AIR		136777-61-2	m,p-Xylene	1.4		345.40	ppbv
125	9/23/94	SKIRT AIR		108-88-3	Toluene	1.3		48.53	ppbv
125	9/23/94	SOIL GAS		95-63-6	1,2,4-Trimethylbenzene	2.8		ND	ppbv
125	9/23/94	SOIL GAS		67-64-1	Acetone	17		ND	ppbv
125	9/23/94	SOIL GAS		71-43-2	Benzene	1.8		0.09	ppbv
125	9/23/94	SOIL GAS		100-41-4	Ethylbenzene	1.9		105.28	ppbv
125	9/23/94	SOIL GAS		136777-61-2	m,p-Xylene	8		ND	ppbv
125	9/23/94	SOIL GAS		oxylene	o-Xylene	3.3		ND	ppbv
125	9/23/94	SOIL GAS		108-88-3	Toluene	8.2		48.53	ppbv
134	9/23/94	SKIRT AIR		67-64-1	Acetone	14		2483.30	ppbv

SOIL GAS AND SKIRT AIR SAMPLING STUDY: VOCs DETECTED

Lot#	Date	Media	QA Type	CAS Number	Compounds Detected	Result	Q	Screening Value[a]	Units
134	9/23/94	SKIRT AIR		71-43-2	Benzene	1.7		0.04	ppbv
134	9/23/94	SKIRT AIR		74-87-3	Chloromethane	0.42		0.67	ppbv
134	9/23/94	SKIRT AIR		108-88-3	Toluene	1.2		48.53	ppbv
134	9/23/94	SOIL GAS		67-64-1	Acetone	9		ND	ppbv
135	9/23/94	SKIRT AIR		67-64-1	Acetone	12		2483.30	ppbv
135	9/23/94	SKIRT AIR		71-43-2	Benzene	0.9		0.04	ppbv
135	9/23/94	SKIRT AIR		74-87-3	Chloromethane	0.25		0.67	ppbv
135	9/23/94	SKIRT AIR		108-88-3	Toluene	1.3		48.53	ppbv
135	9/23/94	SOIL GAS		67-64-1	Acetone	3.7		ND	ppbv
136	9/23/94	SKIRT AIR		67-64-1	Acetone	130		2483.30	ppbv
136	9/23/94	SKIRT AIR		71-43-2	Benzene	1.7		0.04	ppbv
136	9/23/94	SKIRT AIR		74-87-3	Chloromethane	0.38		0.67	ppbv
136	9/23/94	SKIRT AIR		freon12	Freon 12	1.2		16.18	ppbv
136	9/23/94	SKIRT AIR		108-88-3	Toluene	1.2		48.53	ppbv
136	9/23/94	SOIL GAS		78-93-3	2-Butanone	5.5		155.02	ppbv
136	9/23/94	SOIL GAS		67-64-1	Acetone	18		ND	ppbv
136	9/23/94	SOIL GAS		71-43-2	Benzene	2.2		0.09	ppbv
136	9/23/94	SOIL GAS		freon12	Freon 12	1		16.18	ppbv
136	9/23/94	SOIL GAS		108-88-3	Toluene	1.3		48.53	ppbv
Field Bl	9/23/94	AIR BLAN	FIELD BL	95-63-6	1,2,4-Trimethylbenzene	0.94		85.43	ppbv
Field Bl	9/23/94	AIR BLAN	FIELD BL	71-43-2	Benzene	3.1		0.04	ppbv
Field Bl	9/23/94	AIR BLAN	FIELD BL	74-87-3	Chloromethane	0.26		0.67	ppbv
Field Bl	9/23/94	AIR BLAN	FIELD BL	100-41-4	Ethylbenzene	0.77		105.28	ppbv
Field Bl	9/23/94	AIR BLAN	FIELD BL	136777-61-2	m,p-Xylene	2.8		345.40	ppbv
Field Bl	9/23/94	AIR BLAN	FIELD BL	oxylene	o-Xylene	1		345.40	ppbv
Field Bl	9/23/94	AIR BLAN	FIELD BL	108-88-3	Toluene	5.1		48.53	ppbv

ND - No Data
Shading indicates exceedance of the screening value.

[a] Minimum screening value from Table 4-4. ASILs are not used, however, in comparisons to soil gas data since ASILs are applicable only to outdoor air.
[b] Compounds detected per EPA Method TO-14 analysis. No TICs were run.

SOIL GAS AND SKIRT AIR SAMPLING STUDY: FIXED GASES DETECTED

Lot #	Date	Media	Compounds Detected	Result	Q	Units
39	23-Sep-94	SKIRT AIR	OXYGEN	22		%
39	23-Sep-94	SKIRT AIR	NITROGEN	78		%
39	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.059		%
42	23-Sep-94	SKIRT AIR	OXYGEN	22		%
42	23-Sep-94	SKIRT AIR	NITROGEN	78		%
42	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.046		%
44	23-Sep-94	SKIRT AIR	OXYGEN	22		%
44	23-Sep-94	SKIRT AIR	NITROGEN	78		%
44	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.046		%
46	23-Sep-94	SKIRT AIR	OXYGEN	22		%
46	23-Sep-94	SKIRT AIR	NITROGEN	78		%
46	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.058		%
47	23-Sep-94	SKIRT AIR	OXYGEN	22		%
47	23-Sep-94	SKIRT AIR	NITROGEN	78		%
47	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.05		%
48	23-Sep-94	SKIRT AIR	OXYGEN	21		%
48	23-Sep-94	SKIRT AIR	NITROGEN	79		%
48	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.048		%
49	23-Sep-94	SKIRT AIR	OXYGEN	22		%
49	23-Sep-94	SKIRT AIR	NITROGEN	78		%
49	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.049		%
50	23-Sep-94	SKIRT AIR	OXYGEN	22		%
50	23-Sep-94	SKIRT AIR	NITROGEN	78		%
50	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.048		%
51	23-Sep-94	SKIRT AIR	OXYGEN	22		%
51	23-Sep-94	SKIRT AIR	NITROGEN	78		%
51	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.06		%
52	23-Sep-94	SKIRT AIR	OXYGEN	22		%
52	23-Sep-94	SKIRT AIR	NITROGEN	78		%
52	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.052		%
53	23-Sep-94	SKIRT AIR	OXYGEN	23		%
53	23-Sep-94	SKIRT AIR	NITROGEN	77		%
53	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.049		%
54	23-Sep-94	SKIRT AIR	OXYGEN	22		%
54	23-Sep-94	SKIRT AIR	NITROGEN	78		%
54	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.05		%
55	23-Sep-94	SKIRT AIR	OXYGEN	22		%
55	23-Sep-94	SKIRT AIR	NITROGEN	78		%
55	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.048		%
56	23-Sep-94	SKIRT AIR	OXYGEN	22		%
56	23-Sep-94	SKIRT AIR	NITROGEN	78		%
56	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.051		%

SOIL GAS AND SKIRT AIR SAMPLING STUDY: FIXED GASES DETECTED

Lot #	Date	Media	Compounds Detected	Result	Q	Units
60	23-Sep-94	SKIRT AIR	OXYGEN	22		%
60	23-Sep-94	SKIRT AIR	NITROGEN	78		%
60	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.056		%
61	23-Sep-94	SKIRT AIR	OXYGEN	22		%
61	23-Sep-94	SKIRT AIR	NITROGEN	78		%
61	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.055		%
63	23-Sep-94	SKIRT AIR	OXYGEN	22		%
63	23-Sep-94	SKIRT AIR	NITROGEN	78		%
63	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.056		%
64	23-Sep-94	SKIRT AIR	OXYGEN	22		%
64	23-Sep-94	SKIRT AIR	NITROGEN	78		%
64	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.058		%
65	23-Sep-94	SKIRT AIR	OXYGEN	22		%
65	23-Sep-94	SKIRT AIR	NITROGEN	78		%
65	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.049		%
66	23-Sep-94	SKIRT AIR	OXYGEN	22		%
66	23-Sep-94	SKIRT AIR	NITROGEN	78		%
66	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.051		%
119	23-Sep-94	SKIRT AIR	OXYGEN	22		%
119	23-Sep-94	SKIRT AIR	NITROGEN	78		%
119	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.048		%
121	23-Sep-94	SKIRT AIR	OXYGEN	22		%
121	23-Sep-94	SKIRT AIR	NITROGEN	78		%
121	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.06		%
122	23-Sep-94	SKIRT AIR	OXYGEN	22		%
122	23-Sep-94	SKIRT AIR	NITROGEN	78		%
122	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.052		%
123	23-Sep-94	SKIRT AIR	OXYGEN	22		%
123	23-Sep-94	SKIRT AIR	NITROGEN	78		%
123	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.053		%
125	23-Sep-94	SKIRT AIR	OXYGEN	22		%
125	23-Sep-94	SKIRT AIR	NITROGEN	78		%
125	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.053		%
134	23-Sep-94	SKIRT AIR	OXYGEN	19		%
134	23-Sep-94	SKIRT AIR	NITROGEN	81		%
134	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.049		%
135	23-Sep-94	SKIRT AIR	OXYGEN	22		%
135	23-Sep-94	SKIRT AIR	NITROGEN	78		%
135	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.053		%
136	23-Sep-94	SKIRT AIR	OXYGEN	22		%
136	23-Sep-94	SKIRT AIR	NITROGEN	78		%
136	23-Sep-94	SKIRT AIR	CARBON DIOXIDE	0.046		%

COMPOUNDS DETECTED IN THE SOIL GAS AND SKIRT STUDY

Compounds Detected		LOTS 39	42	44	46	47	48	49	50	51	52	53	54	55	56	60	61	63	64	65	66	119	121	122	123	125	134	135	136	FB	Number Detects
Acetone	SG																														24
	SK																														22
Benzene	SG																														16
	SK																														27
Butanone, 2-	SG																														8
	SK																														9
Carbon tetrachloride	SG																														0
	SK																														5
Chloroform	SG																														1
	SK																														1
Chloromethane	SG																														2
	SK																														14
Dichloropropane, 1,2-	SG																														0
	SK																														1
Ethylbenzene	SG																														4
	SK																														5
Freon 11	SG																														1
	SK																														3
Freon 114	SG																														1
	SK																														0
Freon 12	SG																														6
	SK																														12
Methylenechloride	SG																														0
	SK																														5
Styrene	SG																														2
	SK																														1
Tetrachloroethene	SG																														4
	SK																														0
Tetrahydrofuran	SG																														2
	SK																														0
Toluene	SG																														18
	SK																														28
Trichloroethane, 1,1,1-	SG																														0
	SK																														3
Trichloroethene	SG																														1
	SK																														0
Trimethylbenzene, 1,2,4-	SG																														5
	SK																														5
Trimethylbenzene, 1,3,5-	SG																														2
	SK																														0
Xylene, m,p-	SG																														14
	SK																														21
Xylene, o-	SG																														6
	SK																														7

FB - Field Blank
¦ - Indicates exceedance of the screening value.
Shading indicates a detected compound

ODOR EVENTS:
COMPOUNDS DETECTED

Sample name	Date	Method	Media	QA Type	CAS No.	Compounds Detected	Result	Q	Screening Value*	Units
AMBIENT BLK	3/9/95	GC/MS TO-14	AMBIENT AIR	BLANK	95-63-6	1,2,4-Trimethylbenzene	0.13	J	85.43	ppbv
AMBIENT BLK	3/9/95	GC/MS TO-14	AMBIENT AIR	BLANK	71-43-2	Benzene	0.36	J	0.04	ppbv
AMBIENT BLK	3/9/95	ASTM D-3416	AMBIENT AIR	BLANK	124-38-9	Carbon dioxide	0.041		ND	%
AMBIENT BLK	3/9/95	GC/MS TO-14	AMBIENT AIR	BLANK	75-69-4	Freon 11	0.35	J	56.95	ppbv
AMBIENT BLK	3/9/95	GC/MS TO-14	AMBIENT AIR	BLANK	75-71-8	Freon 12	0.89	J	16.18	ppbv
AMBIENT BLK	3/9/95	GC/MS TO-14	AMBIENT AIR	BLANK	1330-20-7	m,p-Xylene	0.36	J	345.40	ppbv
AMBIENT BLK	3/9/95	ASTM D-3416	AMBIENT AIR	BLANK	7727-37-9	Nitrogen	78		ND	%
AMBIENT BLK	3/9/95	ASTM D-3416	AMBIENT AIR	BLANK	7782-44-7	Oxygen	22		ND	%
AMBIENT BLK	3/9/95	GC/MS TO-14	AMBIENT AIR	BLANK	108-88-3	Toluene	0.71	J	48.53	ppbv
AMBIENT BLK	3/9/95	GC/MS TO-14	AMBIENT AIR	BLANK		Unknown hydrocarbon	4.5	JN	ND	ppbv
AMBIENT BLK	3/9/95	GC/MS TO-14	AMBIENT AIR	BLANK		Unknown hydrocarbon	3.9	JN	ND	ppbv
AMBIENT BLK	3/9/95	GC/MS TO-14	AMBIENT AIR	BLANK		Unknown hydrocarbon	2.9	JN	ND	ppbv
AMBIENT BLK	3/9/95	GC/MS TO-14	AMBIENT AIR	BLANK		Unknown hydrocarbon	1.7	JN	ND	ppbv
AMBIENT BLK	3/9/95	GC/MS TO-14	AMBIENT AIR	BLANK		Unknown hydrocarbon	1.6	JN	ND	ppbv
AMBIENT BLK	3/9/95	GC/MS TO-14	AMBIENT AIR	BLANK		Unknown hydrocarbon	1.6	JN	ND	ppbv
AMBIENT BLK	3/9/95	GC/MS TO-14	AMBIENT AIR	BLANK		Unknown hydrocarbon	1.6	JN	ND	ppbv
AMBIENT BLK	3/9/95	GC/MS TO-14	AMBIENT AIR	BLANK		Unknown hydrocarbon	1.4	JN	ND	ppbv
AMBIENT BLK	3/9/95	GC/MS TO-14	AMBIENT AIR	BLANK		Unknown hydrocarbon	1.4	JN	ND	ppbv
AMBIENT BLK	3/9/95	GC/MS TO-14	AMBIENT AIR	BLANK		Unknown oxygenated hydrocarbon	5.5	JN	ND	ppbv
APARTMENT	3/9/95	GC/MS TO-14	AMBIENT AIR		120-82-1	1,2,4-Trichlorobenzene	0.33	J	12.32	ppbv
APARTMENT	3/9/95	GC/MS TO-14	AMBIENT AIR		95-63-6	1,2,4-Trimethylbenzene	0.4	J	85.43	ppbv
APARTMENT	3/9/95	GC/MS TO-14	AMBIENT AIR		71-43-2	Benzene	0.75	J	0.04	ppbv
APARTMENT	3/9/95	ASTM D-3416	AMBIENT AIR		124-38-9	Carbon dioxide	0.038		ND	%
APARTMENT	3/9/95	GC/MS TO-14	AMBIENT AIR		74-87-3	Chloromethane	2.1	J	0.67	ppbv
APARTMENT	3/9/95	GC/MS TO-14	AMBIENT AIR		100-41-4	Ethyl benzene	0.36	J	105.28	ppbv
APARTMENT	3/9/95	GC/MS TO-14	AMBIENT AIR		75-69-4	Freon 11	0.9	J	56.95	ppbv
APARTMENT	3/9/95	GC/MS TO-14	AMBIENT AIR		75-71-8	Freon 12	1.6	J	16.18	ppbv
APARTMENT	3/9/95	GC/MS TO-14	AMBIENT AIR		1330-20-7	m,p-Xylene	1.2	J	345.40	ppbv
APARTMENT	3/9/95	ASTM D-3416	AMBIENT AIR		7727-37-9	Nitrogen	79		ND	%
APARTMENT	3/9/95	GC/MS TO-14	AMBIENT AIR		95-47-6	o-Xylene	0.39	J	345.40	ppbv
APARTMENT	3/9/95	ASTM D-3416	AMBIENT AIR		7782-44-7	Oxygen	21		ND	%
APARTMENT	3/9/95	GC/MS TO-14	AMBIENT AIR		108-88-3	Toluene	2	J	48.53	ppbv
APARTMENT	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	23	JN	ND	ppbv
APARTMENT	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	15	JN	ND	ppbv
APARTMENT	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	7	JN	ND	ppbv
APARTMENT	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	6.5	JN	ND	ppbv
APARTMENT	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	5.2	JN	ND	ppbv
APARTMENT	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	4.7	JN	ND	ppbv
APARTMENT	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	4.4	JN	ND	ppbv
APARTMENT	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown oxygenated hydrocarbon	19	JN	ND	ppbv
APARTMENT	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown oxygenated hydrocarbon	7.1	JN	ND	ppbv
APARTMENT	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown oxygenated hydrocarbon	7.1	JN	ND	ppbv
END BARNEY DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP	71-43-2	Benzene	0.81		0.04	ppbv
END BARNEY DUP	3/9/95	ASTM D-3416	AMBIENT AIR	DUP	124-38-9	Carbon dioxide	0.041		ND	%
END BARNEY DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP	74-87-3	Chloromethane	0.76		0.67	ppbv
END BARNEY DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP	75-69-4	Freon 11	0.4		56.95	ppbv
END BARNEY DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP	75-71-8	Freon 12	0.7		16.18	ppbv
END BARNEY DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP	1330-20-7	m,p-Xylene	0.27		345.40	ppbv
END BARNEY DUP	3/9/95	ASTM D-3416	AMBIENT AIR	DUP	7727-37-9	Nitrogen	78		ND	%
END BARNEY DUP	3/9/95	ASTM D-3416	AMBIENT AIR	DUP	7782-44-7	Oxygen	22		ND	%
END BARNEY DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP	127-18-4	Tetrachloroethene	0.85		0.16	ppbv
END BARNEY DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP	108-88-3	Toluene	1.1		48.53	ppbv
END BARNEY DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown oxygenated hydrocarbon	4.9	JN	ND	ppbv
END BARNEY DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown oxygenated hydrocarbon	2.7	JN	ND	ppbv
END BARNEY RD	3/9/95	GC/MS TO-14	AMBIENT AIR		95-63-6	1,2,4-Trimethylbenzene	0.5		85.43	ppbv
END BARNEY RD	3/9/95	GC/MS TO-14	AMBIENT AIR		71-43-2	Benzene	0.85		0.04	ppbv
END BARNEY RD	3/9/95	ASTM D-3416	AMBIENT AIR		124-38-9	Carbon dioxide	0.045		ND	%
END BARNEY RD	3/9/95	GC/MS TO-14	AMBIENT AIR		74-87-3	Chloromethane	0.78		0.67	ppbv
END BARNEY RD	3/9/95	GC/MS TO-14	AMBIENT AIR		100-41-4	Ethyl benzene	0.32		105.28	ppbv
END BARNEY RD	3/9/95	GC/MS TO-14	AMBIENT AIR		75-69-4	Freon 11	0.42		56.95	ppbv
END BARNEY RD	3/9/95	GC/MS TO-14	AMBIENT AIR		75-71-8	Freon 12	0.61		16.18	ppbv
END BARNEY RD	3/9/95	GC/MS TO-14	AMBIENT AIR		1330-20-7	m,p-Xylene	1.1		345.40	ppbv
END BARNEY RD	3/9/95	ASTM D-3416	AMBIENT AIR		7727-37-9	Nitrogen	78		ND	%

ODOR EVENTS:
COMPOUNDS DETECTED

Sample name	Date	Method	Media	QA Type	CAS No.	Compounds Detected	Result	Q	Screening Value*	Units
END BARNEY RD	3/9/95	GC/MS TO-14	AMBIENT AIR		95-47-6	o-Xylene	0.44		345.40	ppbv
END BARNEY RD	3/9/95	ASTM D-3416	AMBIENT AIR		7782-44-7	Oxygen	22		ND	%
END BARNEY RD	3/9/95	GC/MS TO-14	AMBIENT AIR		127-18-4	Tetrachloroethene	1.3		0.16	ppbv
END BARNEY RD	3/9/95	GC/MS TO-14	AMBIENT AIR		108-88-3	Toluene	1.8		48.53	ppbv
END BARNEY RD	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	2.6	JN	ND	ppbv
END BARNEY RD	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	2	JN	ND	ppbv
END BARNEY RD	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown oxygenated hydrocarbon	6.5	JN	ND	ppbv
END BARNEY RD	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown oxygenated hydrocarbon	3	JN	ND	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK	71-43-2	Benzene	0.6		0.09	ppbv
EQUIP BLANK	3/9/95	ASTM D-3416	SOIL VAPOR	BLANK	124-38-9	Carbon dioxide	0.041		ND	%
EQUIP BLANK	3/9/95	ASTM D-3416	SOIL VAPOR	BLANK	124-38-9	Carbon dioxide	0.039		ND	%
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK	74-87-3	Chloromethane	0.95		0.67	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK	75-69-4	Freon 11	0.34	J	56.95	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK	75-69-4	Freon 11	0.3		56.95	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK	75-71-8	Freon 12	0.71	J	16.18	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK	75-71-8	Freon 12	0.71		16.18	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK	1330-20-7	m,p-Xylene	0.43		ND	ppbv
EQUIP BLANK	3/9/95	ASTM D-3416	SOIL VAPOR	BLANK	7727-37-9	Nitrogen	78		ND	%
EQUIP BLANK	3/9/95	ASTM D-3416	SOIL VAPOR	BLANK	7727-37-9	Nitrogen	78		ND	%
EQUIP BLANK	3/9/95	ASTM D-3416	SOIL VAPOR	BLANK	7782-44-7	Oxygen	22		ND	%
EQUIP BLANK	3/9/95	ASTM D-3416	SOIL VAPOR	BLANK	7782-44-7	Oxygen	22		ND	%
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK	108-95-2	Phenol	1.7	JN	ND	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK	108-88-3	Toluene	0.88		48.53	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK	108-88-3	Toluene	0.19	J	48.53	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown alkane	3.2		ND	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown hydrocarbon	12		ND	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown hydrocarbon	5.7	JN	ND	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown hydrocarbon	5	JN	ND	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown hydrocarbon	5		ND	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown hydrocarbon	4.8		ND	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown hydrocarbon	4.8		ND	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown hydrocarbon	4.6		ND	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown hydrocarbon	3.8		ND	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown hydrocarbon	3.7		ND	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown hydrocarbon	2.2	JN	ND	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown hydrocarbon	2	JN	ND	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown hydrocarbon	1.7	JN	ND	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown hydrocarbon	1.3	JN	ND	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown hydrocarbon	1.2	JN	ND	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown oxygenated hydrocarbon	6		ND	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown oxygenated hydrocarbon	5.9	JN	ND	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown oxygenated hydrocarbon	4		ND	ppbv
EQUIP BLANK	3/9/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown oxygenated hydrocarbon	1.7	JN	ND	ppbv
INSTAL SVP-10	3/9/95	GC/MS TO-14	SOIL VAPOR			1-Ethyl-1-methylcyclohexane	8600	JN	ND	ppbv
INSTAL SVP-10	3/9/95	ASTM D-3416	SOIL VAPOR		124-38-9	Carbon dioxide	5.2		ND	%
INSTAL SVP-10	3/9/95	ASTM D-3416	SOIL VAPOR		74-82-8	Methane	2.6		ND	%
INSTAL SVP-10	3/9/95	ASTM D-3416	SOIL VAPOR		7727-37-9	Nitrogen	90		ND	%
INSTAL SVP-10	3/9/95	ASTM D-3416	SOIL VAPOR		7782-44-7	Oxygen	2.3		ND	%
INSTAL SVP-10	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown branched alkane	15000	JN	ND	ppbv
INSTAL SVP-10	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown branched alkane	11000	JN	ND	ppbv
INSTAL SVP-10	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown cycloalkane	8200	JN	ND	ppbv
INSTAL SVP-10	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	20000	JN	ND	ppbv
INSTAL SVP-10	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	15000	JN	ND	ppbv
INSTAL SVP-10	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	12000	JN	ND	ppbv
INSTAL SVP-10	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	11000	JN	ND	ppbv
INSTAL SVP-10	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	8400	JN	ND	ppbv
INSTAL SVP-10	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	8200	JN	ND	ppbv
L LOW @ MATT	3/9/95	GC/MS TO-14	AMBIENT AIR		71-55-6	1,1,1-Trichloroethane	0.28	J	167.55	ppbv
L LOW @ MATT	3/9/95	GC/MS TO-14	AMBIENT AIR		95-63-6	1,2,4-Trimethylbenzene	0.3	J	85.43	ppbv
L LOW @ MATT	3/9/95	GC/MS TO-14	AMBIENT AIR		71-43-2	Benzene	0.74	J	0.04	ppbv
L LOW @ MATT	3/9/95	ASTM D-3416	AMBIENT AIR		124-38-9	Carbon dioxide	0.043		ND	%
L LOW @ MATT	3/9/95	GC/MS TO-14	AMBIENT AIR		74-87-3	Chloromethane	2	J	0.67	ppbv
L LOW @ MATT	3/9/95	GC/MS TO-14	AMBIENT AIR		100-41-4	Ethyl benzene	0.3	J	105.28	ppbv

ODOR EVENTS:
COMPOUNDS DETECTED

Sample name	Date	Method	Media	QA Type	CAS No.	Compounds Detected	Result	Q	Screening Value*	Units
L LOW @ MATT	3/9/95	GC/MS TO-14	AMBIENT AIR		75-69-4	Freon 11	0.87	J	56.95	ppbv
L LOW @ MATT	3/9/95	GC/MS TO-14	AMBIENT AIR		75-71-8	Freon 12	1.7	J	16.18	ppbv
L LOW @ MATT	3/9/95	GC/MS TO-14	AMBIENT AIR		1330-20-7	m,p-Xylene	0.93	J	345.40	ppbv
L LOW @ MATT	3/9/95	ASTM D-3416	AMBIENT AIR		7727-37-9	Nitrogen	78		ND	%
L LOW @ MATT	3/9/95	GC/MS TO-14	AMBIENT AIR		95-47-6	o-Xylene	0.32	J	345.40	ppbv
L LOW @ MATT	3/9/95	ASTM D-3416	AMBIENT AIR		7782-44-7	Oxygen	22		ND	%
L LOW @ MATT	3/9/95	GC/MS TO-14	AMBIENT AIR		108-88-3	Toluene	1.8	J	48.53	ppbv
L LOW @ MATT	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	6.6	JN	ND	ppbv
L LOW @ MATT	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	6.6	JN	ND	ppbv
L LOW @ MATT	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	6.4	JN	ND	ppbv
L LOW @ MATT	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	4.3	JN	ND	ppbv
L LOW @ MATT	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	4.2	JN	ND	ppbv
L LOW @ MATT	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	4.1	JN	ND	ppbv
L LOW @ MATT	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	3.4	JN	ND	ppbv
L LOW @ MATT	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	3.1	JN	ND	ppbv
L LOW @ MATT	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	2	JN	ND	ppbv
L LOW @ MATT	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown oxygenated hydrocarbon	16	JN	ND	ppbv
L LOW MATT DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP	71-55-6	1,1,1-Trichloroethane	0.24	J	167.55	ppbv
L LOW MATT DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP	95-63-6	1,2,4-Trimethylbenzene	0.3		85.43	ppbv
L LOW MATT DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP	71-43-2	Benzene	0.76		0.04	ppbv
L LOW MATT DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP	74-87-3	Chloromethane	1.9		0.67	ppbv
L LOW MATT DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP	100-41-4	Ethyl Benzene	0.32		105.28	ppbv
L LOW MATT DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP	75-69-4	Freon 11	0.89		56.95	ppbv
L LOW MATT DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP	75-71-8	Freon 12	1.7		16.18	ppbv
L LOW MATT DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP	1330-20-7	m,p-Xylene	0.98		345.40	ppbv
L LOW MATT DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP	95-47-6	o-Xylene	0.32		345.40	ppbv
L LOW MATT DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP	108-88-3	Toluene	1.7		48.53	ppbv
L LOW MATT DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown hydrocarbon	6.9	JN	ND	ppbv
L LOW MATT DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown hydrocarbon	6.4	JN	ND	ppbv
L LOW MATT DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown hydrocarbon	6.3	JN	ND	ppbv
L LOW MATT DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown hydrocarbon	5.4	JN	ND	ppbv
L LOW MATT DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown hydrocarbon	3.6	JN	ND	ppbv
L LOW MATT DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown hydrocarbon	1.8	JN	ND	ppbv
L LOW MATT DUP	3/9/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown oxygenated hydrocarbon	11	JN	ND	ppbv
NEW SVP-10	3/9/95	GC/MS TO-14	SOIL VAPOR			2,6-Dimethylnonane	16000		ND	ppbv
NEW SVP-10	3/9/95	GC/MS TO-14	SOIL VAPOR			3,4,4-Trimethyl-2-hexene	8100		ND	ppbv
NEW SVP-10	3/9/95	GC/MS TO-14	SOIL VAPOR		71-43-2	Benzene	11		0.09	ppbv
NEW SVP-10	3/9/95	ASTM D-3416	SOIL VAPOR		124-38-9	Carbon dioxide	5.5		ND	%
NEW SVP-10	3/9/95	GC/MS TO-14	SOIL VAPOR			Ethanedioic acid, dibutyl ester	11000		ND	ppbv
NEW SVP-10	3/9/95	ASTM D-3416	SOIL VAPOR		74-82-8	Methane	2.5		ND	%
NEW SVP-10	3/9/95	ASTM D-3416	SOIL VAPOR		7727-37-9	Nitrogen	91		ND	%
NEW SVP-10	3/9/95	ASTM D-3416	SOIL VAPOR		7782-44-7	Oxygen	1.2		ND	%
NEW SVP-10	3/9/95	ASTM D-3416	SOIL VAPOR			Total non-methane hydrocarbons*	0.021		ND	%
NEW SVP-10	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown branched alkane	18000		ND	ppbv
NEW SVP-10	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown branched alkane	11000		ND	ppbv
NEW SVP-10	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown cycloalkane	12000		ND	ppbv
NEW SVP-10	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	19000		ND	ppbv
NEW SVP-10	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	12000		ND	ppbv
NEW SVP-10	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	9800		ND	ppbv
NEW SVP-10	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	9000		ND	ppbv
SAW MILL	3/9/95	GC/MS TO-14	AMBIENT AIR		71-43-2	Benzene	0.63		0.04	ppbv
SAW MILL	3/9/95	ASTM D-3416	AMBIENT AIR		124-38-9	Carbon dioxide	0.045		ND	%
SAW MILL	3/9/95	GC/MS TO-14	AMBIENT AIR		74-87-3	Chloromethane	0.73		0.67	ppbv
SAW MILL	3/9/95		AMBIENT AIR		50-00-0	Formaldehyde	41		0.06	ppbv
SAW MILL	3/9/95	GC/MS TO-14	AMBIENT AIR		75-69-4	Freon 11	0.42		56.95	ppbv
SAW MILL	3/9/95	GC/MS TO-14	AMBIENT AIR		75-71-8	Freon 12	0.72		16.18	ppbv
SAW MILL	3/9/95	GC/MS TO-14	AMBIENT AIR		1330-20-7	m,p-Xylene	0.28		345.40	ppbv
SAW MILL	3/9/95	ASTM D-3416	AMBIENT AIR		74-82-8	Methane	0.001		ND	%
SAW MILL	3/9/95	ASTM D-3416	AMBIENT AIR		7727-37-9	Nitrogen	78		ND	%
SAW MILL	3/9/95	ASTM D-3416	AMBIENT AIR		7782-44-7	Oxygen	22		ND	%
SAW MILL	3/9/95	GC/MS TO-14	AMBIENT AIR		127-18-4	Tetrachloroethene	0.84		0.16	ppbv
SAW MILL	3/9/95	GC/MS TO-14	AMBIENT AIR		108-88-3	Toluene	1.1		48.53	ppbv
SAW MILL	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	2.6	JN	ND	ppbv

ODOR EVENTS:
COMPOUNDS DETECTED

Sample name	Date	Method	Media	QA Type	CAS No.	Compounds Detected	Result	Q	Screening Value[a]	Units
SAW MILL	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	2.1	JN	ND	ppbv
SAW MILL	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown oxygenated hydrocarbon	4.6	JN	ND	ppbv
SAW MILL	3/9/95	GC/MS TO-14	AMBIENT AIR			Unknown oxygenated hydrocarbon	2.8	JN	ND	ppbv
SV.36	3/9/95	ASTM D-3416	SOIL VAPOR		124-38-9	Carbon dioxide	1.3		ND	%
SV.36	3/9/95	ASTM D-3416	SOIL VAPOR		7727-37-9	Nitrogen	82		ND	%
SV.36	3/9/95	ASTM D-3416	SOIL VAPOR		7782-44-7	Oxygen	17		ND	%
SV.45	3/9/95	GC/MS TO-14	SOIL VAPOR		L75	1,2-Dichlorobenzene	0.36	J	10.64	ppbv
SV.45	3/9/95	GC/MS TO-14	SOIL VAPOR		71-43-2	Benzene	0.48	J	0.09	ppbv
SV.45	3/9/95	ASTM D-3416	SOIL VAPOR		124-38-9	Carbon dioxide	0.04		ND	%
SV.45	3/9/95	GC/MS TO-14	SOIL VAPOR		75-69-4	Freon 11	0.7	J	56.95	ppbv
SV.45	3/9/95	GC/MS TO-14	SOIL VAPOR		75-71-8	Freon 12	1.4	J	16.18	ppbv
SV.45	3/9/95	GC/MS TO-14	SOIL VAPOR		1330-20-7	m,p-Xylene	0.58	J	ND	ppbv
SV.45	3/9/95	ASTM D-3416	SOIL VAPOR		7727-37-9	Nitrogen	78		ND	%
SV.45	3/9/95	ASTM D-3416	SOIL VAPOR		7782-44-7	Oxygen	22		ND	%
SV.45	3/9/95	GC/MS TO-14	SOIL VAPOR		108-88-3	Toluene	67	J	48.53	ppbv
SV.45	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	21	JN	ND	ppbv
SV.45	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown oxygenated hydrocarbon	15	JN	ND	ppbv
SVP-19	3/9/95	ASTM D-3416	SOIL VAPOR		124-38-9	Carbon dioxide	0.67		ND	%
SVP-19	3/9/95	GC/MS TO-14	SOIL VAPOR		74-87-3	Chloromethane	0.52	J	0.67	ppbv
SVP-19	3/9/95	GC/MS TO-14	SOIL VAPOR		75-69-4	Freon 11	0.7	J	56.95	ppbv
SVP-19	3/9/95	GC/MS TO-14	SOIL VAPOR		75-71-8	Freon 12	0.52	J	16.18	ppbv
SVP-19	3/9/95	GC/MS TO-14	SOIL VAPOR		1330-20-7	m,p-Xylene	0.32	J	ND	ppbv
SVP-19	3/9/95	ASTM D-3416	SOIL VAPOR		7727-37-9	Nitrogen	78		ND	%
SVP-19	3/9/95	ASTM D-3416	SOIL VAPOR		7782-44-7	Oxygen	21		ND	%
SVP-19	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	8	JN	ND	ppbv
SVP-19	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	5.4	JN	ND	ppbv
SVP-19	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	4.8	JN	ND	ppbv
SVP-19	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	4.5	JN	ND	ppbv
SVP-19	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	2.1	JN	ND	ppbv
SVP-19	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	1.7	JN	ND	ppbv
SVP-19	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown oxygenated hydrocarbon	16	JN	ND	ppbv
SVP-19	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown oxygenated hydrocarbon	4.1	JN	ND	ppbv
SVP-19	3/9/95	GC/MS TO-14	SOIL VAPOR			Unknown oxygenated hydrocarbon	1.8	JN	ND	ppbv
AA-3	3/17/95	GC/MS TO-14	AMBIENT AIR		71-43-2	Benzene	0.62		0.04	ppbv
AA-3	3/17/95	ASTM D-3416	AMBIENT AIR		124-38-9	Carbon dioxide	0.047		ND	%
AA-3	3/17/95	GC/MS TO-14	AMBIENT AIR		74-87-3	Chloromethane	0.76		0.67	ppbv
AA-3	3/17/95	GC/MS TO-14	AMBIENT AIR		100-41-4	Ethyl benzene	0.27		105.28	ppbv
AA-3	3/17/95	GC/MS TO-14	AMBIENT AIR		75-69-4	Freon 11	0.37		56.95	ppbv
AA-3	3/17/95	GC/MS TO-14	AMBIENT AIR		75-71-8	Freon 12	0.76		16.18	ppbv
AA-3	3/17/95	GC/MS TO-14	AMBIENT AIR		1330-20-7	m,p-Xylene	0.96		345.40	ppbv
AA-3	3/17/95	ASTM D-3416	AMBIENT AIR		7727-37-9	Nitrogen	78		ND	%
AA-3	3/17/95	GC/MS TO-14	AMBIENT AIR		95-47-6	o-Xylene	0.29		345.40	ppbv
AA-3	3/17/95	ASTM D-3416	AMBIENT AIR		7782-44-7	Oxygen	22		ND	%
AA-3	3/17/95	GC/MS TO-14	AMBIENT AIR		127-18-4	Tetrachloroethene	0.38		0.16	ppbv
AA-3	3/17/95	GC/MS TO-14	AMBIENT AIR		108-88-3	Toluene	2.9	B	48.53	ppbv
AA-3	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	36	JN	ND	ppbv
AA-3	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	5.3	JN	ND	ppbv
AA-3	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	5.1	JN	ND	ppbv
AA-3	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	4.3	JN	ND	ppbv
AA-3	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown alkane	14	JN	ND	ppbv
AA-3	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown alkane	6.3	JN	ND	ppbv
AA-3	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown oxygenated hydrocarbon	11	JN	ND	ppbv
AA-3	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown oxygenated hydrocarbon	8.6	JN	ND	ppbv
AA-3	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown oxygenated hydrocarbon	4.9	JN	ND	ppbv
AA-3	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown oxygenated hydrocarbon	4.7	JN	ND	ppbv
AA-3 DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP	71-43-2	Benzene	0.63		0.04	ppbv
AA-3 DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP	74-87-3	Chloromethane	0.66		0.67	ppbv
AA-3 DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP	100-41-4	Ethyl benzene	0.27		105.28	ppbv
AA-3 DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP	75-69-4	Freon 11	0.38		56.95	ppbv
AA-3 DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP	75-71-8	Freon 12	0.74		16.18	ppbv
AA-3 DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP	1330-20-7	m,p-Xylene	0.96		345.40	ppbv
AA-3 DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP	95-47-6	o-Xylene	0.29		345.40	ppbv
AA-3 DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP	127-18-4	Tetrachloroethene	0.38		0.16	ppbv

ODOR EVENTS:
COMPOUNDS DETECTED

Sample name	Date	Method	Media	QA Type	CAS No.	Compounds Detected	Result	Q	Screening Value*	Units
AA-3 DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP	108-88-3	Toluene	2.9	B	48.53	ppbv
AA-3 DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown hydrocarbon	28	JN	ND	ppbv
AA-3 DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown hydrocarbon	4.7	JN	ND	ppbv
AA-3 DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown hydrocarbon	4.4	JN	ND	ppbv
AA-3 DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown hydrocarbon	3.9	JN	ND	ppbv
AA-3 DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown hydrocarbon	3.9	JN	ND	ppbv
AA-3 DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown hydrocarbon	3.8	JN	ND	ppbv
AA-3 DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown hydrocarbon	3.6	JN	ND	ppbv
AA-3 DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown alkane	6.8	JN	ND	ppbv
AA-3 DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown alkane	3.7	JN	ND	ppbv
AA-3 DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown oxygenated hydrocarbon	7.5	JN	ND	ppbv
AA-3 DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP	95-63-6	1,2,4-Trimethylbenzene	0.41		85.43	ppbv
CONSTANC DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP	2100-14-6	4-Pentenal	47	JN	ND	ppbv
CONSTANC DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP	71-43-2	Benzene	0.74		0.04	ppbv
CONSTANC DUP	3/17/95	ASTM D-3416	AMBIENT AIR	DUP	124-38-9	Carbon dioxide	0.048		ND	%
CONSTANC DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP	100-41-4	Ethyl benzene	0.42		105.28	ppbv
CONSTANC DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP	75-69-4	Freon 11	0.48		56.95	ppbv
CONSTANC DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP	75-71-8	Freon 12	0.98		16.18	ppbv
CONSTANC DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP	1330-20-7	m,p-Xylene	1.2		345.40	ppbv
CONSTANC DUP	3/17/95	ASTM D-3416	AMBIENT AIR	DUP	74-82-8	Methane	0.002		ND	%
CONSTANC DUP	3/17/95	ASTM D-3416	AMBIENT AIR	DUP	7727-37-9	Nitrogen	77		ND	%
CONSTANC DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP	95-47-6	o-Xylene	0.43		345.40	ppbv
CONSTANC DUP	3/17/95	ASTM D-3416	AMBIENT AIR	DUP	7782-44-7	Oxygen	23		ND	%
CONSTANC DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP	108-88-3	Toluene	2.5	B	48.53	ppbv
CONSTANC DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown branched hydrocarbon	84	JN	ND	ppbv
CONSTANC DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown hydrocarbon	13	JN	ND	ppbv
CONSTANC DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown hydrocarbon	8.7	JN	ND	ppbv
CONSTANC DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown hydrocarbon	7.8	JN	ND	ppbv
CONSTANC DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown hydrocarbon	7	JN	ND	ppbv
CONSTANC DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown hydrocarbon	6.8	JN	ND	ppbv
CONSTANC DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown hydrocarbon	6.5	JN	ND	ppbv
CONSTANC DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown hydrocarbon	6	JN	ND	ppbv
CONSTANC DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP		Unknown hydrocarbon	5.8	JN	ND	ppbv
CONSTANC DUP	3/17/95	GC/MS TO-14	AMBIENT AIR	DUP	124-38-9	Carbon dioxide	0.053		ND	%
CONSTANCE RD	3/17/95	ASTM D-3416	AMBIENT AIR		74-82-8	Methane	0.002		ND	%
CONSTANCE RD	3/17/95	ASTM D-3416	AMBIENT AIR		7727-37-9	Nitrogen	78		ND	%
CONSTANCE RD	3/17/95	ASTM D-3416	AMBIENT AIR		7782-44-7	Oxygen	22		ND	%
CONSTANCE RD	3/17/95	ASTM D-3416	AMBIENT AIR		108-88-3	Toluene	2.4		48.53	ppbv
CONSTANCE RD	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	28	JN	ND	ppbv
CONSTANCE RD	3/17/95	GC/MS TO-14	AMBIENT AIR		71-43-2	Benzene	0.65		0.09	ppbv
EQUIP BLANK	3/17/95	GC/MS TO-14	SOIL VAPOR	BLANK	124-38-9	Carbon dioxide	0.042		ND	%
EQUIP BLANK	3/17/95	ASTM D-3416	SOIL VAPOR	BLANK	74-87-3	Chloromethane	0.77		0.67	ppbv
EQUIP BLANK	3/17/95	GC/MS TO-14	SOIL VAPOR	BLANK	75-69-4	Freon 11	0.28		56.95	ppbv
EQUIP BLANK	3/17/95	GC/MS TO-14	SOIL VAPOR	BLANK	75-71-8	Freon 12	0.64		16.18	ppbv
EQUIP BLANK	3/17/95	GC/MS TO-14	SOIL VAPOR	BLANK	1330-20-7	m,p-Xylene	0.44		ND	ppbv
EQUIP BLANK	3/17/95	GC/MS TO-14	SOIL VAPOR	BLANK	7727-37-9	Nitrogen	78		ND	%
EQUIP BLANK	3/17/95	ASTM D-3416	SOIL VAPOR	BLANK	7782-44-7	Oxygen	22		ND	%
EQUIP BLANK	3/17/95	ASTM D-3416	SOIL VAPOR	BLANK	108-88-3	Toluene	1.9		48.53	ppbv
EQUIP BLANK	3/17/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown hydrocarbon	13	JN	ND	ppbv
EQUIP BLANK	3/17/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown hydrocarbon	12	JN	ND	ppbv
EQUIP BLANK	3/17/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown hydrocarbon	12	JN	ND	ppbv
EQUIP BLANK	3/17/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown hydrocarbon	10	JN	ND	ppbv
EQUIP BLANK	3/17/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown hydrocarbon	9.8	JN	ND	ppbv
EQUIP BLANK	3/17/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown hydrocarbon	6	JN	ND	ppbv
EQUIP BLANK	3/17/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown hydrocarbon	4.2	JN	ND	ppbv
EQUIP BLANK	3/17/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown oxygenated hydrocarbon	42	JN	ND	ppbv
EQUIP BLANK	3/17/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown oxygenated hydrocarbon	15	JN	ND	ppbv
EQUIP BLANK	3/17/95	GC/MS TO-14	SOIL VAPOR	BLANK		Unknown oxygenated hydrocarbon	6.5	JN	ND	ppbv
EQUIP BLANK	3/17/95	GC/MS TO-14	SOIL VAPOR	BLANK	95-63-6	1,2,4-Trimethylbenzene	0.29		85.43	ppbv
FIELD BLANK	3/17/95	GC/MS TO-14	AMBIENT AIR	BLANK	71-43-2	Benzene	0.63		0.04	ppbv
FIELD BLANK	3/17/95	GC/MS TO-14	AMBIENT AIR	BLANK	124-38-9	Carbon dioxide	0.056		ND	%
FIELD BLANK	3/17/95	ASTM D-3416	AMBIENT AIR	BLANK	74-87-3	Chloromethane	0.69		0.67	ppbv
FIELD BLANK	3/17/95	GC/MS TO-14	AMBIENT AIR	BLANK	100-41-4	Ethyl benzene	0.33		105.28	ppbv
FIELD BLANK	3/17/95	GC/MS TO-14	AMBIENT AIR	BLANK						

ODOR EVENTS:
COMPOUNDS DETECTED

Sample name	Date	Method	Media	QA Type	CAS No.	Compounds Detected	Result	Q	Screening Value*	Units
FIELD BLANK	3/17/95	GC/MS TO-14	AMBIENT AIR	BLANK	75-69-4	Freon 11	0.3		56.95	ppbv
FIELD BLANK	3/17/95	GC/MS TO-14	AMBIENT AIR	BLANK	75-71-8	Freon 12	0.64		16.18	ppbv
FIELD BLANK	3/17/95	GC/MS TO-14	AMBIENT AIR	BLANK	1330-20-7	m,p-Xylene	1.1		345.40	ppbv
FIELD BLANK	3/17/95	ASTM D-3416	AMBIENT AIR	BLANK	7727-37-9	Nitrogen	78		ND	%
FIELD BLANK	3/17/95	GC/MS TO-14	AMBIENT AIR	BLANK	95-47-6	o-Xylene	0.43		345.40	ppbv
FIELD BLANK	3/17/95	ASTM D-3416	AMBIENT AIR	BLANK	7782-44-7	Oxygen	22		ND	%
FIELD BLANK	3/17/95	GC/MS TO-14	AMBIENT AIR	BLANK		Unknown hydrocarbon	3.5	JN	ND	ppbv
FIELD BLANK	3/17/95	GC/MS TO-14	AMBIENT AIR	BLANK		Unknown hydrocarbon	3.1	JN	ND	ppbv
FIELD BLANK	3/17/95	GC/MS TO-14	AMBIENT AIR	BLANK		Unknown oxygenated hydrocarbon	21	JN	ND	ppbv
FIELD BLANK	3/17/95	GC/MS TO-14	AMBIENT AIR	BLANK		Unknown oxygenated hydrocarbon	6.2	JN	ND	ppbv
NORSE	3/17/95	GC/MS TO-14	AMBIENT AIR		120-82-1	1,2,4-Trichlorobenzene	0.37		12.32	ppbv
NORSE	3/17/95	GC/MS TO-14	AMBIENT AIR		95-63-6	1,2,4-Trimethylbenzene	0.39		85.43	ppbv
NORSE	3/17/95	GC/MS TO-14	AMBIENT AIR		2100-14-6	4-Pentenal	23	JN	ND	ppbv
NORSE	3/17/95	GC/MS TO-14	AMBIENT AIR		71-43-2	Benzene	0.61		0.04	ppbv
NORSE	3/17/95	ASTM D-3416	AMBIENT AIR		124-38-9	Carbon dioxide	0.04		ND	%
NORSE	3/17/95	GC/MS TO-14	AMBIENT AIR		74-87-3	Chloromethane	0.73		0.67	ppbv
NORSE	3/17/95	GC/MS TO-14	AMBIENT AIR		75-69-4	Freon 11	0.33		56.95	ppbv
NORSE	3/17/95	GC/MS TO-14	AMBIENT AIR		75-71-8	Freon 12	1.3		16.18	ppbv
NORSE	3/17/95	GC/MS TO-14	AMBIENT AIR		1330-20-7	m,p-Xylene	0.61		345.40	ppbv
NORSE	3/17/95	ASTM D-3416	AMBIENT AIR		7727-37-9	Nitrogen	78		ND	%
NORSE	3/17/95	ASTM D-3416	AMBIENT AIR		7782-44-7	Oxygen	22		ND	%
NORSE	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown benzene	16	JN	ND	ppbv
NORSE	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown branched hydrocarbon	33	JN	ND	ppbv
NORSE	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown branched hydrocarbon	7.9	JN	ND	ppbv
NORSE	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown cyclic hydrocarbon	12	JN	ND	ppbv
NORSE	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	9.7	JN	ND	ppbv
NORSE	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	8.8	JN	ND	ppbv
NORSE	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	8.8	JN	ND	ppbv
NORSE	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	6.4	JN	ND	ppbv
NORSE	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown tetramethylbenzene	10	JN	ND	ppbv
SAW MILL RD	3/17/95	GC/MS TO-14	AMBIENT AIR		95-63-6	1,2,4-Trimethylbenzene	0.32		85.43	ppbv
SAW MILL RD	3/17/95	GC/MS TO-14	AMBIENT AIR		71-43-2	Benzene	0.78		0.04	ppbv
SAW MILL RD	3/17/95	ASTM D-3416	AMBIENT AIR		124-38-9	Carbon dioxide	0.046		ND	%
SAW MILL RD	3/17/95	GC/MS TO-14	AMBIENT AIR		100-41-4	Ethyl benzene	0.29		105.28	ppbv
SAW MILL RD	3/17/95	GC/MS TO-14	AMBIENT AIR		75-69-4	Freon 11	0.39		56.95	ppbv
SAW MILL RD	3/17/95	GC/MS TO-14	AMBIENT AIR		75-71-8	Freon 12	0.77		16.18	ppbv
SAW MILL RD	3/17/95	GC/MS TO-14	AMBIENT AIR		1330-20-7	m,p-Xylene	0.84		345.40	ppbv
SAW MILL RD	3/17/95	ASTM D-3416	AMBIENT AIR		74-82-8	Methane	0.001		ND	%
SAW MILL RD	3/17/95	ASTM D-3416	AMBIENT AIR		7727-37-9	Nitrogen	78		ND	%
SAW MILL RD	3/17/95	GC/MS TO-14	AMBIENT AIR		95-47-6	o-Xylene	0.32		345.40	ppbv
SAW MILL RD	3/17/95	ASTM D-3416	AMBIENT AIR		7782-44-7	Oxygen	22		ND	%
SAW MILL RD	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown alkane	24	JN	ND	ppbv
SAW MILL RD	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown alkane	21	JN	ND	ppbv
SAW MILL RD	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	24	JN	ND	ppbv
SAW MILL RD	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	18	JN	ND	ppbv
SAW MILL RD	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	7.1	JN	ND	ppbv
SAW MILL RD	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown hydrocarbon	5.3	JN	ND	ppbv
SAW MILL RD	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown oxygenated hydrocarbon	16	JN	ND	ppbv
SAW MILL RD	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown oxygenated hydrocarbon	10	JN	ND	ppbv
SAW MILL RD	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown oxygenated hydrocarbon	8.8	JN	ND	ppbv
SAW MILL RD	3/17/95	GC/MS TO-14	AMBIENT AIR			Unknown oxygenated hydrocarbon	8.4	JN	ND	ppbv
SVP-10 NEW	3/17/95	ASTM D-3416	SOIL VAPOR		124-38-9	Carbon dioxide	3.5		ND	%
SVP-10 NEW	3/17/95	ASTM D-3416	SOIL VAPOR		124-38-9	Carbon dioxide	3.5		ND	%
SVP-10 NEW	3/17/95	ASTM D-3416	SOIL VAPOR		74-82-8	Methane	2		ND	%
SVP-10 NEW	3/17/95	ASTM D-3416	SOIL VAPOR		74-82-8	Methane	2		ND	%
SVP-10 NEW	3/17/95	ASTM D-3416	SOIL VAPOR		7727-37-9	Nitrogen	93		ND	%
SVP-10 NEW	3/17/95	ASTM D-3416	SOIL VAPOR		7727-37-9	Nitrogen	93		ND	%
SVP-10 NEW	3/17/95	ASTM D-3416	SOIL VAPOR		7782-44-7	Oxygen	1.3		ND	%
SVP-10 NEW	3/17/95	ASTM D-3416	SOIL VAPOR		7782-44-7	Oxygen	1.3		ND	%
SVP-10 NEW	3/17/95	ASTM D-3416	SOIL VAPOR			Total non-methane hydrocarbons*	0.02		ND	%
SVP-10 NEW	3/17/95	ASTM D-3416	SOIL VAPOR			Total non-methane hydrocarbons*	0.018		ND	%
SVP-10-NEW	3/17/95	GC/MS TO-14	SOIL VAPOR			Unknown alkane	6200	JN	ND	ppbv
SVP-10-NEW	3/17/95	GC/MS TO-14	SOIL VAPOR			Unknown alkane	5500	JN	ND	ppbv

ODOR EVENTS:
COMPOUNDS DETECTED

Sample name	Date	Method	Media	QA Type	CAS No.	Compounds Detected	Result	Q	Screening Value*	Units
SVP-10-NEW	3/17/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	4200	JN	ND	ppbv
SVP-10-NEW	3/17/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	4100	JN	ND	ppbv
SVP-10-NEW	3/17/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	4000	JN	ND	ppbv
SVP-10-NEW	3/17/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	3900	JN	ND	ppbv
SVP-10-NEW	3/17/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	3300	JN	ND	ppbv
SVP-10-NEW	3/17/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	3100	JN	ND	ppbv
SVP-10-NEW	3/17/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	2700	JN	ND	ppbv
SVP-10-NEW	3/17/95	GC/MS TO-14	SOIL VAPOR			Unknown oxygenated hydrocarbon	6800	JN	ND	ppbv
SVP-19	3/17/95	ASTM D-3416	SOIL VAPOR		124-38-9	Carbon dioxide	0.69		ND	%
SVP-19	3/17/95	GC/MS TO-14	SOIL VAPOR		75-69-4	Freon 11	0.32		56.95	ppbv
SVP-19	3/17/95	GC/MS TO-14	SOIL VAPOR		75-71-8	Freon 12	0.41		16.18	ppbv
SVP-19	3/17/95	ASTM D-3416	SOIL VAPOR		7727-37-9	Nitrogen	78		ND	%
SVP-19	3/17/95	ASTM D-3416	SOIL VAPOR		7782-44-7	Oxygen	21		ND	%
SVP-19	3/17/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	22	JN	ND	ppbv
SVP-19	3/17/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	20	JN	ND	ppbv
SVP-19	3/17/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	17	JN	ND	ppbv
SVP-19	3/17/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	13	JN	ND	ppbv
SVP-19	3/17/95	GC/MS TO-14	SOIL VAPOR			Unknown hydrocarbon	10	JN	ND	ppbv
SVP-19	3/17/95	GC/MS TO-14,	SOIL VAPOR			Unknown hydrocarbon	9.3	JN	ND	ppbv
SVP-19	3/17/95	GC/MS TO-14	SOIL VAPOR			Unknown oxygenated hydrocarbon	5.9	JN	ND	ppbv
SVP-36	3/17/95	ASTM D-3416	SOIL VAPOR		124-38-9	Carbon dioxide	2.1		ND	%
SVP-36	3/17/95	GC/MS TO-14	SOIL VAPOR		75-71-8	Freon 12	42		16.18	ppbv
SVP-36	3/17/95	ASTM D-3416	SOIL VAPOR		7727-37-9	Nitrogen	83		ND	%
SVP-36	3/17/95	ASTM D-3416	SOIL VAPOR		7782-44-7	Oxygen	16		ND	%
SVP-36	3/17/95	GC/MS TO-14	SOIL VAPOR		127-18-4	Tetrachloroethene	6.9		0.65	ppbv
SVP-36	3/17/95	GC/MS TO-14	SOIL VAPOR		108-88-3	Toluene	3.4		48.53	ppbv

ND - No Data
Shading indicates exceedance of the screening value.

*Minimum screening value from Table 4-4. ASILs are not used, however, in comparisons to soil gas data since ASILs are applicable only to outdoor air.

COMPARATIVE AMBIENT AIR STUDY: COMPOUNDS DETECTED

LOCATION	SAMPLE DATE	Media	CAS ID	PARAMETER	RESULT	Q	Screening Value[a]	UNITS
OFA-1-210	5/30/95	Ambient Air	74-87-3	Chloromethane	0.65		0.67	PPBV
OFA-1-210	5/30/95	Ambient Air	75-69-4	Freon 11	0.24		56.95	PPBV
OFA-1-210	5/30/95	Ambient Air	75-71-8	Freon 12	0.47		16.18	PPBV
OFA-1-210	5/30/95	Ambient Air	NA	Unknown alcohol	4.4	JN	ND	PPBV
OFA-1-210	5/30/95	Ambient Air	NA	Unknown alcohol	3.7	JN	ND	PPBV
OFA-1-210	5/30/95	Ambient Air	NA	Unknown aldehyde	5.1	JN	ND	PPBV
OFA-1-210	5/30/95	Ambient Air	NA	Unknown alkane	2.2	JN	ND	PPBV
OFA-1-210	5/30/95	Ambient Air	NA	Unknown alkane	2.4	JN	ND	PPBV
OFA-1-210	5/30/95	Ambient Air	NA	Unknown aromatic	2.4	JN	ND	PPBV
OFA-1-210	5/30/95	Ambient Air	NA	Unknown hydrocarbon	4.5	JN	ND	PPBV
OFA-1-210	5/30/95	Ambient Air	NA	Unknown hydrocarbon	18	JN	ND	PPBV
OFA-1-210	5/30/95	Ambient Air	NA	Unknown hydrocarbon	8.2	JN	ND	PPBV
OFA-1-210	5/30/95	Ambient Air	NA	Unknown hydrocarbon	16	JN	ND	PPBV
OFA-1-230	5/30/95	Ambient Air	60784-31-8	(Z)-2-Nonenal	25	JN	ND	PPBV
OFA-1-230	5/30/95	Ambient Air	74-87-3	Chloromethane	0.81		0.67	PPBV
OFA-1-230	5/30/95	Ambient Air	75-69-4	Freon 11	0.3		56.95	PPBV
OFA-1-230	5/30/95	Ambient Air	75-71-8	Freon 12	0.6		16.18	PPBV
OFA-1-230	5/30/95	Ambient Air	NA	Unknown alcohol	6.2	JN	ND	PPBV
OFA-1-230	5/30/95	Ambient Air	NA	Unknown alkane	3.5	JN	ND	PPBV
OFA-1-230	5/30/95	Ambient Air	NA	Unknown alkane	2.2	JN	ND	PPBV
OFA-1-230	5/30/95	Ambient Air	NA	Unknown alkane	2.2	JN	ND	PPBV
OFA-1-230	5/30/95	Ambient Air	NA	Unknown alkane	3.2	JN	ND	PPBV
OFA-1-230	5/30/95	Ambient Air	NA	Unknown alkane	4.3	JN	ND	PPBV
OFA-1-230	5/30/95	Ambient Air	NA	Unknown alkane	2.4	JN	ND	PPBV
OFA-1-230	5/30/95	Ambient Air	NA	Unknown hydrocarbon	8.6	JN	ND	PPBV
OFA-1-240	5/30/95	Ambient Air	95-63-6	1,2,4-Trimethylbenzene	0.31		85.43	PPBV
OFA-1-240	5/30/95	Ambient Air	10059-13-9	2-Methyl-2-undecanethiol	18	JN	ND	PPBV
OFA-1-240	5/30/95	Ambient Air	108-10-1	4-Methyl-2-pentanone	4.3	JN	7.81	PPBV
OFA-1-240	5/30/95	Ambient Air	2100-17-6	4-Pentenal	7.8	JN	ND	PPBV
OFA-1-240	5/30/95	Ambient Air	71-43-2	Benzene	0.24		0.04	PPBV
OFA-1-240	5/30/95	Ambient Air	74-87-3	Chloromethane	1.2		0.67	PPBV
OFA-1-240	5/30/95	Ambient Air	100-41-4	Ethyl benzene	0.7		105.28	PPBV
OFA-1-240	5/30/95	Ambient Air	75-69-4	Freon 11	0.39		56.95	PPBV
OFA-1-240	5/30/95	Ambient Air	75-71-8	Freon 12	0.74		16.18	PPBV
OFA-1-240	5/30/95	Ambient Air	1330-20-7	m,p-Xylene	4.3		345.40	PPBV
OFA-1-240	5/30/95	Ambient Air	95-47-6	o-Xylene	1.4		345.40	PPBV
OFA-1-240	5/30/95	Ambient Air	127-18-4	Tetrachloroethene	0.3		0.16	PPBV
OFA-1-240	5/30/95	Ambient Air	108-88-3	Toluene	5		48.53	PPBV
OFA-1-240	5/30/95	Ambient Air	NA	Unknown alkane	3.4	JN	ND	PPBV
OFA-1-240	5/30/95	Ambient Air	NA	Unknown alkene	9.1	JN	ND	PPBV
OFA-1-240	5/30/95	Ambient Air	NA	Unknown branched benzene	4.3	JN	ND	PPBV
OFA-1-240	5/30/95	Ambient Air	NA	Unknown hydrocarbon	8.4	JN	ND	PPBV
OFA-1-240	5/30/95	Ambient Air	NA	Unknown hydrocarbon	7.2	JN	ND	PPBV
OFA-1-240	5/30/95	Ambient Air	NA	Unknown hydrocarbon	11	JN	ND	PPBV
OFA-1-240	5/30/95	Ambient Air	NA	Unknown hydrocarbon	10	JN	ND	PPBV
OFA-1-250	5/30/95	Ambient Air	96-15-1	2-Methyl-1-butanamine	22	JN	ND	PPBV
OFA-1-250	5/30/95	Ambient Air	3524-73-0	5-Methyl-1-hexene	4.7	JN	ND	PPBV
OFA-1-250	5/30/95	Ambient Air	71-43-2	Benzene	0.21		0.04	PPBV
OFA-1-250	5/30/95	Ambient Air	100-51-6	Benzenemethanol	5.3	JN	ND	PPBV
OFA-1-250	5/30/95	Ambient Air	930-57-4	Butylcyclopropane	5.7	JN	ND	PPBV
OFA-1-250	5/30/95	Ambient Air	74-87-3	Chloromethane	1.1		0.67	PPBV
OFA-1-250	5/30/95	Ambient Air	100-41-4	Ethyl benzene	0.26		105.28	PPBV
OFA-1-250	5/30/95	Ambient Air	75-69-4	Freon 11	0.34		56.95	PPBV
OFA-1-250	5/30/95	Ambient Air	75-71-8	Freon 12	0.72		16.18	PPBV
OFA-1-250	5/30/95	Ambient Air	1330-20-7	m,p-Xylene	1.4		345.40	PPBV
OFA-1-250	5/30/95	Ambient Air	95-47-6	o-Xylene	0.53		345.40	PPBV
OFA-1-250	5/30/95	Ambient Air	108-88-3	Toluene	1.5		48.53	PPBV
OFA-1-250	5/30/95	Ambient Air	NA	Unknown alkane	4.2	JN	ND	PPBV
OFA-1-250	5/30/95	Ambient Air	NA	Unknown alkane	3.6	JN	ND	PPBV
OFA-1-250	5/30/95	Ambient Air	NA	Unknown alkane	4.1	JN	ND	PPBV

COMPARATIVE AMBIENT AIR STUDY: COMPOUNDS DETECTED

LOCATION	SAMPLE DATE	Media	CAS ID	PARAMETER	RESULT	Q	Screening Value[a]	UNITS
OFA-1-250	5/30/95	Ambient Air	NA	Unknown alkane	4.3	JN	ND	PPBV
OFA-1-250	5/30/95	Ambient Air	NA	Unknown aromatic	3.9	JN	ND	PPBV
OFA-1-250	5/30/95	Ambient Air	NA	Unknown hydrocarbon	10	JN	ND	PPBV
ONA-1	5/30/95	Ambient Air	71-43-2	Benzene	0.33		0.04	PPBV
ONA-1	5/30/95	Ambient Air	74-87-3	Chloromethane	1.3		0.67	PPBV
ONA-1	5/30/95	Ambient Air	100-41-4	Ethyl benzene	0.36		105.28	PPBV
ONA-1	5/30/95	Ambient Air	75-69-4	Freon 11	0.24		56.95	PPBV
ONA-1	5/30/95	Ambient Air	75-71-8	Freon 12	0.46		16.18	PPBV
ONA-1	5/30/95	Ambient Air	1330-20-7	m,p-Xylene	2		345.40	PPBV
ONA-1	5/30/95	Ambient Air	95-47-6	o-Xylene	0.39		345.40	PPBV
ONA-1	5/30/95	Ambient Air	108-88-3	Toluene	2.6		48.53	PPBV
ONA-1	5/30/95	Ambient Air	NA	Umknown branched alkane	7.9	JN	ND	PPBV
ONA-1	5/30/95	Ambient Air	NA	Unknown alkane	15	JN	ND	PPBV
ONA-1	5/30/95	Ambient Air	NA	Unknown alkane	15	JN	ND	PPBV
ONA-1	5/30/95	Ambient Air	NA	Unknown alkane	11	JN	ND	PPBV
ONA-1	5/30/95	Ambient Air	NA	Unknown hydrocarbon	3.4	JN	ND	PPBV
ONA-1	5/30/95	Ambient Air	NA	Unknown hydrocarbon	4.6	JN	ND	PPBV
ONA-1	5/30/95	Ambient Air	NA	Unknown hydrocarbon	4.5	JN	ND	PPBV
ONA-1	5/30/95	Ambient Air	NA	Unknown hydrocarbon	5.9	JN	ND	PPBV
ONA-1	5/30/95	Ambient Air	NA	Unknown hydrocarbon	9.4	JN	ND	PPBV
ONA-1	5/30/95	Ambient Air	NA	Unknown hydrocarbon	5.2	JN	ND	PPBV
SK-1-39	5/30/95	Skirt Air	75-71-8	Freon 12	0.44		16.18	PPBV
SK-1-39	5/30/95	Skirt Air	108-88-3	Toluene	0.57		48.53	PPBV
SK-1-39	5/30/95	Skirt Air	NA	Unknown alkane	33	JN	ND	PPBV
SK-1-39	5/30/95	Skirt Air	NA	Unknown alkane	9.0	JN	ND	PPBV
SK-1-39	5/30/95	Skirt Air	NA	Unknown branched alkene	4.7	JN	ND	PPBV
SK-1-39	5/30/95	Skirt Air	NA	Unknown cycloalkane	10	JN	ND	PPBV
SK-1-39	5/30/95	Skirt Air	NA	Unknown hydrocarbon	9.9	JN	ND	PPBV
SK-1-39	5/30/95	Skirt Air	NA	Unknown substituted benzene	9.5	JN	ND	PPBV
SK-1-54	5/30/95	Skirt Air	71-43-2	Benzene	0.47		0.04	PPBV
SK-1-54	5/30/95	Skirt Air	76-14-2	Freon 114	0.54		3290.14	PPBV
SK-1-54	5/30/95	Skirt Air	75-71-8	Freon 12	0.52		16.18	PPBV
SK-1-54	5/30/95	Skirt Air	1330-20-7	m,p-Xylene	1.5		345.40	PPBV
SK-1-54	5/30/95	Skirt Air	95-47-6	o-Xylene	0.56		345.40	PPBV
SK-1-54	5/30/95	Skirt Air	108-88-3	Toluene	2		48.53	PPBV
SK-1-54	5/30/95	Skirt Air	NA	Unknown alkane	30	JN	ND	PPBV
SK-1-54	5/30/95	Skirt Air	NA	Unknown alkane	21	JN	ND	PPBV
SK-1-54	5/30/95	Skirt Air	NA	Unknown alkane	14	JN	ND	PPBV
SK-1-54	5/30/95	Skirt Air	NA	Unknown alkane	7.9	JN	ND	PPBV
SK-1-54	5/30/95	Skirt Air	NA	Unknown alkane	4.6	JN	ND	PPBV
SK-1-54	5/30/95	Skirt Air	NA	Unknown alkane	13	JN	ND	PPBV
SK-1-54	5/30/95	Skirt Air	NA	Unknown cycloalkane	5.0	JN	ND	PPBV
SK-1-54	5/30/95	Skirt Air	NA	Unknown hydrocarbon	5.6	JN	ND	PPBV
SK-1-60*	5/30/95	Skirt Air	2100-17-6	4-Pentenal	27	JN	ND	PPBV
SK-1-60*	5/30/95	Skirt Air	74-87-3	Chloromethane	1.9		0.67	PPBV
SK-1-60*	5/30/95	Skirt Air	75-69-4	Freon 11	0.28		56.95	PPBV
SK-1-60*	5/30/95	Skirt Air	75-71-8	Freon 12	0.56		16.18	PPBV
SK-1-60*	5/30/95	Skirt Air	75-09-2	Methylene chloride	0.68		0.16	PPBV
SK-1-60*	5/30/95	Skirt Air	108-95-2	Phenol	3.3	JN	ND	PPBV
SK-1-60*	5/30/95	Skirt Air	108-88-3	Toluene	0.39		48.53	PPBV
SK-1-60*	5/30/95	Skirt Air	NA	Unknown alkane	28	JN	ND	PPBV
SK-1-60*	5/30/95	Skirt Air	NA	Unknown alkane	4.1	JN	ND	PPBV
SK-1-60*	5/30/95	Skirt Air	NA	Unknown amine	12	JN	ND	PPBV
SK-1-60*	5/30/95	Skirt Air	NA	Unknown branched alkane	7.3	JN	ND	PPBV
SK-1-60*	5/30/95	Skirt Air	NA	Unknown hydrocarbon	5.3	JN	ND	PPBV
SK-1-60*	5/30/95	Skirt Air	NA	Unknown hydrocarbon	5.2	JN	ND	PPBV
SK-1-60*	5/30/95	Skirt Air	NA	Unknown hydrocarbon	4.1	JN	ND	PPBV
SK-1-60*	5/30/95	Skirt Air	NA	Unknown hydrocarbon	11	JN	ND	PPBV
SK-1-63	5/30/95	Skirt Air	95-63-6	1,2,4-Trimethylbenzene	1.7		85.43	PPBV
SK-1-63	5/30/95	Skirt Air	108-67-8	1,3,5-Trimethylbenzene	0.38		85.43	PPBV

COMPARATIVE AMBIENT AIR STUDY: COMPOUNDS DETECTED

LOCATION	SAMPLE DATE	Media	CAS ID	PARAMETER	RESULT	Q	Screening Value[1]	UNITS
SK-1-63	5/30/95	Skirt Air	71-43-2	Benzene	0.28		0.04	PPBV
SK-1-63	5/30/95	Skirt Air	75-00-3	Chloroethane	2.4		1732.35	PPBV
SK-1-63	5/30/95	Skirt Air	74-87-3	Chloromethane	0.57		0.67	PPBV
SK-1-63	5/30/95	Skirt Air	111-82-0	Dodecanoic acid, methyl ester	42	JN	ND	PPBV
SK-1-63	5/30/95	Skirt Air	100-41-4	Ethyl benzene	0.64		105.28	PPBV
SK-1-63	5/30/95	Skirt Air	75-69-4	Freon 11	0.29		56.95	PPBV
SK-1-63	5/30/95	Skirt Air	75-71-8	Freon 12	0.39		16.18	PPBV
SK-1-63	5/30/95	Skirt Air	1330-20-7	m,p-Xylene	1		345.40	PPBV
SK-1-63	5/30/95	Skirt Air	108-88-3	Toluene	0.5		48.53	PPBV
SK-1-63	5/30/95	Skirt Air	NA	Unknown alkene	15	JN	ND	PPBV
SK-1-63	5/30/95	Skirt Air	NA	Unknown amine	79	JN	ND	PPBV
SK-1-63	5/30/95	Skirt Air	NA	Unknown branched alkane	33	JN	ND	PPBV
SK-1-63	5/30/95	Skirt Air	NA	Unknown branched alkane	20	JN	ND	PPBV
SK-1-63	5/30/95	Skirt Air	NA	Unknown branched alkane	32	JN	ND	PPBV
SK-1-63	5/30/95	Skirt Air	NA	Unknown branched alkane	53	JN	ND	PPBV
SK-1-63	5/30/95	Skirt Air	NA	Unknown cycloalkane	34	JN	ND	PPBV
SK-1-63	5/30/95	Skirt Air	NA	Unknown cycloalkane	34	JN	ND	PPBV
SK-1-63	5/30/95	Skirt Air	NA	Unknown hydrocarbon	16	JN	ND	PPBV
SVP-1-39	5/30/95	Soil Gas	75-09-2	Methylene chloride	8.8		1.53	PPBV
SVP-1-39	5/30/95	Soil Gas	NA	Unknown alkane	98	JN	ND	PPBV
SVP-1-39	5/30/95	Soil Gas	NA	Unknown branched alkane	1700	JN	ND	PPBV
SVP-1-54	5/30/95	Soil Gas	107-06-2	1,2-Dichloroethane	1.6		0.02	PPBV
SVP-1-54	5/30/95	Soil Gas	1330-20-7	m,p-Xylene	0.63		ND	PPBV
SVP-1-54	5/30/95	Soil Gas	75-09-2	Methylene chloride	0.86		1.53	PPBV
SVP-1-54	5/30/95	Soil Gas	79-01-6	Trichloroethene	0.67		0.27	PPBV
SVP-1-54	5/30/95	Soil Gas	NA	Unknown alkane	10	JN	ND	PPBV
SVP-1-54	5/30/95	Soil Gas	NA	Unknown branched alkane	10	JN	ND	PPBV
SVP-1-54	5/30/95	Soil Gas	NA	Unknown cyclic	26	JN	ND	PPBV
SVP-1-54	5/30/95	Soil Gas	NA	Unknown hydrocarbon	7.9	JN	ND	PPBV
SVP-1-54	5/30/95	Soil Gas	NA	Unknown hydrocarbon	5.8	JN	ND	PPBV
SVP-1-54	5/30/95	Soil Gas	NA	Unknown hydrocarbon	7.8	JN	ND	PPBV
SVP-1-54	5/30/95	Soil Gas	NA	Unknown hydrocarbon	16	JN	ND	PPBV
SVP-1-54	5/30/95	Soil Gas	NA	Unknown hydrocarbon	11	JN	ND	PPBV
SVP-1-54	5/30/95	Soil Gas	NA	Unknown ketone	17	JN	ND	PPBV
SVP-1-54	5/30/95	Soil Gas	NA	Unknown substituted alkane	22	JN	ND	PPBV
SVP-1-60	5/30/95	Soil Gas	75-09-2	Methylene chloride	7.4		1.53	PPBV
SVP-1-60	5/30/95	Soil Gas	NA	Unknown alkane	47	JN	ND	PPBV
SVP-1-60	5/30/95	Soil Gas	NA	Unknown alkane	53	JN	ND	PPBV
SVP-1-60	5/30/95	Soil Gas	NA	UNknown alkane	35	JN	ND	PPBV
SVP-1-60	5/30/95	Soil Gas	NA	Unknown cycloalkane	31	JN	ND	PPBV
SVP-1-60	5/30/95	Soil Gas	NA	Unknown hydrocarbon	51	JN	ND	PPBV
SVP-1-60	5/30/95	Soil Gas	NA	Unknown substituted benzene	70	JN	ND	PPBV
SVP-1-63	5/30/95	Soil Gas	107-06-2	1,2-Dichloroethane	4.4		0.02	PPBV
SVP-1-63	5/30/95	Soil Gas	71-43-2	Benzene	12		0.04	PPBV
SVP-1-63	5/30/95	Soil Gas	100-41-4	Ethyl benzene	1.4		105.28	PPBV
SVP-1-63	5/30/95	Soil Gas	1330-20-7	m,p-Xylene	2.1		ND	PPBV
SVP-1-63	5/30/95	Soil Gas	75-09-2	Methylene chloride	10		1.53	PPBV
SVP-1-63	5/30/95	Soil Gas	95-47-6	o-Xylene	4.8		ND	PPBV
SVP-1-63	5/30/95	Soil Gas	108-88-3	Toluene	4		48.53	PPBV
SVP-1-63	5/30/95	Soil Gas	NA	Unknown alkane	770	JN	ND	PPBV
SVP-1-63	5/30/95	Soil Gas	NA	Unknown alkane	650	JN	ND	PPBV
SVP-1-63	5/30/95	Soil Gas	NA	Unknown alkane	1600	JN	ND	PPBV
SVP-1-63	5/30/95	Soil Gas	NA	Unknown alkane	750	JN	ND	PPBV
SVP-1-63	5/30/95	Soil Gas	NA	Unknown alkene	730	JN	ND	PPBV
SVP-1-63	5/30/95	Soil Gas	NA	Unknown branched alkane	1500	JN	ND	PPBV
SVP-1-63	5/30/95	Soil Gas	NA	Unknown branched alkane	800	JN	ND	PPBV
SVP-1-63	5/30/95	Soil Gas	NA	Unknown cycloalkane	980	JN	ND	PPBV
SVP-1-63	5/30/95	Soil Gas	NA	Unknown cyclohexene	640	JN	ND	PPBV
SVP-1-63	5/30/95	Soil Gas	NA	Unknown cyclopentane	650	JN	ND	PPBV
OFA-2-40	6/1/95	Ambient Air	71-43-2	Benzene	0.21		0.04	PPBV

COMPARATIVE AMBIENT AIR STUDY: COMPOUNDS DETECTED

LOCATION	SAMPLE DATE	Media	CAS ID	PARAMETER	RESULT	Q	Screening Value[1]	UNITS
OFA-2-40	6/1/95	Ambient Air	74-87-3	Chloromethane	1		0.67	PPBV
OFA-2-40	6/1/95	Ambient Air	75-69-4	Freon 11	0.26		56.95	PPBV
OFA-2-40	6/1/95	Ambient Air	75-71-8	Freon 12	0.47		16.18	PPBV
OFA-2-40	6/1/95	Ambient Air	1330-20-7	m,p-Xylene	0.55		345.40	PPBV
OFA-2-40	6/1/95	Ambient Air	108-88-3	Toluene	0.75		48.53	PPBV
OFA-2-40	6/1/95	Ambient Air	NA	Unknown alcohol	13	JN	ND	PPBV
OFA-2-40	6/1/95	Ambient Air	NA	Unknown alkene	5.0	JN	ND	PPBV
OFA-2-40	6/1/95	Ambient Air	NA	Unknown branched alkene	14	JN	ND	PPBV
OFA-2-40	6/1/95	Ambient Air	NA	Unknown branched alkane	4.8	JN	ND	PPBV
OFA-2-40	6/1/95	Ambient Air	NA	Unknown branched alkane	19	JN	ND	PPBV
OFA-2-40	6/1/95	Ambient Air	NA	Unknown branched alkane	7.5	JN	ND	PPBV
OFA-2-40	6/1/95	Ambient Air	NA	Unknown hydrocarbon	5.6	JN	ND	PPBV
OFA-2-40	6/1/95	Ambient Air	NA	Unknown hydrocarbon	4.3	JN	ND	PPBV
OFA-2-40	6/1/95	Ambient Air	NA	Unknown hydrocarbon	7.3	JN	ND	PPBV
OFA-2-40	6/1/95	Ambient Air	NA	Unknown hydrocarbon	15	JN	ND	PPBV
OFA-2-60	6/1/95	Ambient Air	75-35-4	1,1-Dichloroethene	1.9		0.002	PPBV
OFA-2-60	6/1/95	Ambient Air	95-63-6	1,2,4-Trimethylbenzene	0.21		85.43	PPBV
OFA-2-60	6/1/95	Ambient Air	71-43-2	Benzene	0.22		0.04	PPBV
OFA-2-60	6/1/95	Ambient Air	74-87-3	Chloromethane	0.61		0.67	PPBV
OFA-2-60	6/1/95	Ambient Air	75-69-4	Freon 11	0.26		56.95	PPBV
OFA-2-60	6/1/95	Ambient Air	76-13-1	Freon 113	0.84		1789.49	PPBV
OFA-2-60	6/1/95	Ambient Air	75-71-8	Freon 12	0.45		16.18	PPBV
OFA-2-60	6/1/95	Ambient Air	1330-20-7	m,p-Xylene	0.5		345.40	PPBV
OFA-2-60	6/1/95	Ambient Air	95-47-6	o-Xylene	0.2		345.40	PPBV
OFA-2-60	6/1/95	Ambient Air	108-88-3	Toluene	0.81		48.53	PPBV
OFA-2-60	6/1/95	Ambient Air	NA	Unknown alcohol	4.4	JN	ND	PPBV
OFA-2-60	6/1/95	Ambient Air	NA	Unknown alkene	2.5	JN	ND	PPBV
OFA-2-60	6/1/95	Ambient Air	NA	Unknown alkene	2.3	JN	ND	PPBV
OFA-2-60	6/1/95	Ambient Air	NA	Unknown alkene	3.4	JN	ND	PPBV
OFA-2-60	6/1/95	Ambient Air	NA	Unknown alkanoic acid	8.6	JN	ND	PPBV
OFA-2-60	6/1/95	Ambient Air	NA	Unknown hydrocarbon	2.2	JN	ND	PPBV
OFA-2-60	6/1/95	Ambient Air	NA	Unknown hydrocarbon	4.2	JN	ND	PPBV
OFA-2-60	6/1/95	Ambient Air	NA	Unknown hydrocarbon	18	JN	ND	PPBV
OFA-2-60	6/1/95	Ambient Air	NA	Unknown hydrocarbon	3.9	JN	ND	PPBV
OFA-2-60	6/1/95	Ambient Air	NA	Unknown hydrocarbon	5.4	JN	ND	PPBV
OFA-2-80	6/1/95	Ambient Air	98-67-9	4-Hydroxy-benzenesulfonic acid	25	JN	ND	PPBV
OFA-2-80	6/1/95	Ambient Air	71-43-2	Benzene	0.56		0.04	PPBV
OFA-2-80	6/1/95	Ambient Air	74-87-3	Chloromethane	0.6		0.67	PPBV
OFA-2-80	6/1/95	Ambient Air	75-71-8	Freon 12	0.48		16.18	PPBV
OFA-2-80	6/1/95	Ambient Air	1330-20-7	m,p-Xylene	0.79		345.40	PPBV
OFA-2-80	6/1/95	Ambient Air	127-18-4	Tetrachloroethene	0.67		0.16	PPBV
OFA-2-80	6/1/95	Ambient Air	108-88-3	Toluene	1.4		48.53	PPBV
OFA-2-80	6/1/95	Ambient Air	NA	Unknown alkene	92	JN	ND	PPBV
OFA-2-80	6/1/95	Ambient Air	NA	Unknown branched alkene	6.8	JN	ND	PPBV
OFA-2-80	6/1/95	Ambient Air	NA	Unknown hydrocarbon	8.0	JN	ND	PPBV
OFA-2-80	6/1/95	Ambient Air	NA	Unknown hydrocarbon	4.3	JN	ND	PPBV
OFA-2-80	6/1/95	Ambient Air	NA	Unknown hydrocarbon	4.3	JN	ND	PPBV
OFA-2-80	6/1/95	Ambient Air	NA	Unknown hydrocarbon	9.6	JN	ND	PPBV
ONA-2	6/1/95	Ambient Air	71-43-2	Benzene	0.88		0.04	PPBV
ONA-2	6/1/95	Ambient Air	74-87-3	Chloromethane	0.6		0.67	PPBV
ONA-2	6/1/95	Ambient Air	75-71-8	Freon 12	0.58		16.18	PPBV
ONA-2	6/1/95	Ambient Air	1330-20-7	m,p-Xylene	0.93		345.40	PPBV
ONA-2	6/1/95	Ambient Air	75-09-2	Methylene chloride	5.6		0.16	PPBV
ONA-2	6/1/95	Ambient Air	108-88-3	Toluene	2.1		48.53	PPBV
ONA-2	6/1/95	Ambient Air	NA	Unknown hydrocarbon	5.2	JN	ND	PPBV
ONA-2	6/1/95	Ambient Air	NA	Unknown hydrocarbon	5.4	JN	ND	PPBV
ONA-22	6/1/95	Ambient Air	526-73-8	1,2,3-Trimethylbenzene	20	JN	85.43	PPBV
ONA-22	6/1/95	Ambient Air	95-63-6	1,2,4-Trimethylbenzene	3.7		85.43	PPBV
ONA-22	6/1/95	Ambient Air	108-67-8	1,3,5-Trimethylbenzene	0.8		85.43	PPBV
ONA-22	6/1/95	Ambient Air	71-43-2	Benzene	1.1		0.04	PPBV

COMPARATIVE AMBIENT AIR STUDY: COMPOUNDS DETECTED

LOCATION	SAMPLE DATE	Media	CAS ID	PARAMETER	RESULT	Q	Screening Value[a]	UNITS
ONA-22	6/1/95	Ambient Air	74-87-3	Chloromethane	0.58		0.67	PPBV
ONA-22	6/1/95	Ambient Air	100-41-4	Ethyl Benzene	1.3		105.28	PPBV
ONA-22	6/1/95	Ambient Air	75-71-8	Freon 12	0.55		16.18	PPBV
ONA-22	6/1/95	Ambient Air	1330-20-7	m,p-Xylene	2.7		345.40	PPBV
ONA-22	6/1/95	Ambient Air	95-47-6	o-Xylene	0.35		345.40	PPBV
ONA-22	6/1/95	Ambient Air	108-88-3	Toluene	1.4		48.53	PPBV
ONA-22	6/1/95	Ambient Air	NA	Unknown alkane	27	JN	ND	PPBV
ONA-22	6/1/95	Ambient Air	NA	Unknown alkane	53	JN	ND	PPBV
ONA-22	6/1/95	Ambient Air	NA	Unknown alkane	37	JN	ND	PPBV
ONA-22	6/1/95	Ambient Air	NA	Unknown branched alkane	49	JN	ND	PPBV
ONA-22	6/1/95	Ambient Air	NA	Unknown hydrocarbon	16	JN	ND	PPBV
ONA-22	6/1/95	Ambient Air	NA	Unknown substituted benzene	18	JN	ND	PPBV
ONA-22	6/1/95	Ambient Air	NA	Unknown substituted benzene	39	JN	ND	PPBV
ONA-22	6/1/95	Ambient Air	NA	Unknown substituted benzene	20	JN	ND	PPBV
ONA-22	6/1/95	Ambient Air	NA	Unknown substituted benzene	16	JN	ND	PPBV
SK-2-39	6/1/95	Skirt Air	71-43-2	Benzene	0.49		0.04	PPBV
SK-2-39	6/1/95	Skirt Air	74-87-3	Chloromethane	0.62		0.67	PPBV
SK-2-39	6/1/95	Skirt Air	75-71-8	Freon 12	0.48		16.18	PPBV
SK-2-39	6/1/95	Skirt Air	1330-20-7	m,p-Xylene	1.2		345.40	PPBV
SK-2-39	6/1/95	Skirt Air	108-95-2	Phenol	6.5	JN	ND	PPBV
SK-2-39	6/1/95	Skirt Air	108-88-3	Toluene	0.95		48.53	PPBV
SK-2-39	6/1/95	Skirt Air	NA	Unknown alkane	6.5	JN	ND	PPBV
SK-2-39	6/1/95	Skirt Air	NA	Unknown alkane	8.8	JN	ND	PPBV
SK-2-39	6/1/95	Skirt Air	NA	Unknown alkane	5.0	JN	ND	PPBV
SK-2-39	6/1/95	Skirt Air	NA	Unknown branched alkane	7.3	JN	ND	PPBV
SK-2-39	6/1/95	Skirt Air	NA	Unknown branched alkane	4.9	JN	ND	PPBV
SK-2-39	6/1/95	Skirt Air	NA	Unknown hydrocarbon	7.3	JN	ND	PPBV
SK-2-39	6/1/95	Skirt Air	NA	Unknown hydrocarbon	4.2	JN	ND	PPBV
SK-2-54	6/1/95	Skirt Air	95-63-6	1,2,4-Trimethylbenzene	0.24	J	85.43	PPBV
SK-2-54	6/1/95	Skirt Air	71-43-2	Benzene	0.38	J	0.04	PPBV
SK-2-54	6/1/95	Skirt Air	74-87-3	Chloromethane	0.46		0.67	PPBV
SK-2-54	6/1/95	Skirt Air	75-69-4	Freon 11	0.24	J	56.95	PPBV
SK-2-54	6/1/95	Skirt Air	75-71-8	Freon 12	0.46		16.18	PPBV
SK-2-54	6/1/95	Skirt Air	1330-20-7	m,p-Xylene	0.59		345.40	PPBV
SK-2-54	6/1/95	Skirt Air	95-47-6	o-Xylene	0.22	J	345.40	PPBV
SK-2-54	6/1/95	Skirt Air	108-88-3	Toluene	0.82		48.53	PPBV
SK-2-54	6/1/95	Skirt Air	NA	Unknown aromatic	7.0	JN	ND	PPBV
SK-2-54	6/1/95	Skirt Air	NA	Unknown aromatic	5.3	JN	ND	PPBV
SK-2-54	6/1/95	Skirt Air	NA	Unknown hydrocarbon	6.2	JN	ND	PPBV
SK-2-54	6/1/95	Skirt Air	NA	Unknown hydrocarbon	14	JN	ND	PPBV
SK-2-54	6/1/95	Skirt Air	NA	Unknown hydrocarbon	6.2	JN	ND	PPBV
SK-2-54	6/1/95	Skirt Air	NA	Unknown hydrocarbon	7.9	JN	ND	PPBV
SK-2-54	6/1/95	Skirt Air	NA	Unknown hydrocarbon	6.6	JN	ND	PPBV
SK-2-60	6/1/95	Skirt Air	74-87-3	Chloromethane	0.53		0.67	PPBV
SK-2-60	6/1/95	Skirt Air	75-71-8	Freon 12	0.6		16.18	PPBV
SK-2-60	6/1/95	Skirt Air	1330-20-7	m,p-Xylene	0.43		345.40	PPBV
SK-2-60	6/1/95	Skirt Air	75-09-2	Methylene chloride	0.46		0.16	PPBV
SK-2-60	6/1/95	Skirt Air	108-88-3	Toluene	0.73		48.53	PPBV
SK-2-60	6/1/95	Skirt Air	NA	Unknown alkane	4.7	JN	ND	PPBV
SK-2-60	6/1/95	Skirt Air	NA	Unknown alkane	18	JN	ND	PPBV
SK-2-60	6/1/95	Skirt Air	NA	Unknown alkane	7.0	JN	ND	PPBV
SK-2-60	6/1/95	Skirt Air	NA	Unknown alkane	5.5	JN	ND	PPBV
SK-2-60	6/1/95	Skirt Air	NA	Unknown aromatic	4.3	JN	ND	PPBV
SK-2-60	6/1/95	Skirt Air	NA	Unknown aromatic	4.3	JN	ND	PPBV
SK-2-60	6/1/95	Skirt Air	NA	Unknown hydrocarbon	6.1	JN	ND	PPBV
SK-2-60	6/1/95	Skirt Air	NA	Unknown hydrocarbon	11	JN	ND	PPBV
SK-2-60	6/1/95	Skirt Air	NA	Unknown hydrocarbon	12	JN	ND	PPBV
SK-2-63	6/1/95	Skirt Air	71-43-2	Benzene	0.59		0.04	PPBV
SK-2-63	6/1/95	Skirt Air	74-87-3	Chloromethane	0.58		0.67	PPBV
SK-2-63	6/1/95	Skirt Air	111-82-0	Dodecanoic acid, methyl ester	15	JN	ND	PPBV

TABLE 5-14

COMPARATIVE AMBIENT AIR STUDY: COMPOUNDS DETECTED

LOCATION	SAMPLE DATE	Media	CAS ID	PARAMETER	RESULT	Q	Screening Value*	UNITS
SK-2-63	6/1/95	Skirt Air	75-71-8	Freon 12	0.5		16.18	PPBV
SK-2-63	6/1/95	Skirt Air	1330-20-7	m,p-Xylene	5.7		345.40	PPBV
SK-2-63	6/1/95	Skirt Air	108-88-3	Toluene	1.1		48.53	PPBV
SK-2-63	6/1/95	Skirt Air	NA	Unknown alcohol	6.9	JN	ND	PPBV
SK-2-63	6/1/95	Skirt Air	NA	Unknown alkane	12	JN	ND	PPBV
SK-2-63	6/1/95	Skirt Air	NA	Unknown alkane	120	JN	ND	PPBV
SK-2-63	6/1/95	Skirt Air	NA	Unknown alkane	8.8	JN	ND	PPBV
SK-2-63	6/1/95	Skirt Air	NA	Unknown branched alkane	35	JN	ND	PPBV
SK-2-63	6/1/95	Skirt Air	NA	Unknown branched alkane	11	JN	ND	PPBV
SK-2-63	6/1/95	Skirt Air	NA	Unknown cycloalkane	7.0	JN	ND	PPBV
SVP-2-60	6/1/95	Soil Gas	NA	Unknown alcohol	320	JN	ND	PPBV
SVP2-39	6/1/95	Soil Gas	95-63-6	1,2,4-Trimethylbenzene	0.26		ND	PPBV
SVP2-39	6/1/95	Soil Gas	74-87-3	Chloromethane	0.72		0.67	PPBV
SVP2-39	6/1/95	Soil Gas	75-69-4	Freon 11	0.26		56.95	PPBV
SVP2-39	6/1/95	Soil Gas	75-71-8	Freon 12	0.48		16.18	PPBV
SVP2-39	6/1/95	Soil Gas	1330-20-7	m,p-Xylene	0.75		ND	PPBV
SVP2-39	6/1/95	Soil Gas	95-47-6	o-Xylene	0.3		ND	PPBV
SVP2-39	6/1/95	Soil Gas	127-18-4	Tetrachloroethene	0.68		0.65	PPBV
SVP2-39	6/1/95	Soil Gas	108-88-3	Toluene	1.2		48.53	PPBV
SVP2-39	6/1/95	Soil Gas	NA	Unknown alkane	2.6	JN	ND	PPBV
SVP2-39	6/1/95	Soil Gas	NA	Unknown alkane	4.5	JN	ND	PPBV
SVP2-39	6/1/95	Soil Gas	NA	Unknown branched alkane	3.2	JN	ND	PPBV
SVP2-39	6/1/95	Soil Gas	NA	Unknown cycloalkane	3.6	JN	ND	PPBV
SVP2-39	6/1/95	Soil Gas	NA	Unknown hydrocarbon	5.6	JN	ND	PPBV
SVP2-39	6/1/95	Soil Gas	NA	Unknown hydrocarbon	3.4	JN	ND	PPBV
SVP2-39	6/1/95	Soil Gas	NA	Unknown hydrocarbon	13	JN	ND	PPBV
SVP2-39	6/1/95	Soil Gas	NA	Unknown hydrocarbon	6.0	JN	ND	PPBV
SVP2-39	6/1/95	Soil Gas	NA	Unknown hydrocarbon	2.7	JN	ND	PPBV
SVP2-39	6/1/95	Soil Gas	NA	Unknown hydrocarbon	4.4	JN	ND	PPBV
SVP2-54	6/1/95	Soil Gas	NA	Unknown alcohol	6.0	JN	ND	PPBV
SVP2-54	6/1/95	Soil Gas	NA	Unknown alkane	5.5	JN	ND	PPBV
SVP2-54	6/1/95	Soil Gas	NA	Unknown aromatic	7.9	JN	ND	PPBV
SVP2-54	6/1/95	Soil Gas	NA	Unknown aromatic	6.2	JN	ND	PPBV
SVP2-54	6/1/95	Soil Gas	NA	Unknown aromatic	4.9	JN	ND	PPBV
SVP2-54	6/1/95	Soil Gas	NA	Unknown hydrocarbon	7.2	JN	ND	PPBV
SVP2-63	6/1/95	Soil Gas	95-63-6	1,2,4-Trimethylbenzene	0.31		ND	PPBV
SVP2-63	6/1/95	Soil Gas	71-43-2	Benzene	0.26		0.09	PPBV
SVP2-63	6/1/95	Soil Gas	74-87-3	Chloromethane	0.66		0.67	PPBV
SVP2-63	6/1/95	Soil Gas	75-69-4	Freon 11	0.28		56.95	PPBV
SVP2-63	6/1/95	Soil Gas	75-71-8	Freon 12	0.6		16.18	PPBV
SVP2-63	6/1/95	Soil Gas	1330-20-7	m,p-Xylene	0.46		ND	PPBV
SVP2-63	6/1/95	Soil Gas	75-09-2	Methylene chloride	0.29		1.53	PPBV
SVP2-63	6/1/95	Soil Gas	108-88-3	Toluene	0.96		48.53	PPBV
SVP2-63	6/1/95	Soil Gas	NA	Unknown alkane	110	JN	ND	PPBV
SVP2-63	6/1/95	Soil Gas	NA	Unknown alkane	35	JN	ND	PPBV
SVP2-63	6/1/95	Soil Gas	NA	Unknown aromatic	8.7	JN	ND	PPBV
SVP2-63	6/1/95	Soil Gas	NA	Unknown branched alkane	28	JN	ND	PPBV
SVP2-63	6/1/95	Soil Gas	NA	Unknown branched alkane	19	JN	ND	PPBV
SVP2-63	6/1/95	Soil Gas	NA	Unknown branched alkane	11	JN	ND	PPBV
SVP2-63	6/1/95	Soil Gas	NA	Unknown branched alkane	7.8	JN	ND	PPBV
SVP2-63	6/1/95	Soil Gas	NA	Unknown branched alkane	9.0	JN	ND	PPBV
SVP2-63	6/1/95	Soil Gas	NA	Unknown hydrocarbon	8.2	JN	ND	PPBV
SVP2-63	6/1/95	Soil Gas	NA	Unknown hydrocarbon	34	JN	ND	PPBV
OFA-3-130	6/6/95	Ambient Air	95-63-6	1,2,4-Trimethylbenzene	0.74		85.43	PPBV
OFA-3-130	6/6/95	Ambient Air	71-43-2	Benzene	0.42		0.04	PPBV
OFA-3-130	6/6/95	Ambient Air	74-87-3	Chloromethane	1.4		0.67	PPBV
OFA-3-130	6/6/95	Ambient Air	75-69-4	Freon 11	0.24		56.95	PPBV
OFA-3-130	6/6/95	Ambient Air	75-71-8	Freon 12	0.44		16.18	PPBV
OFA-3-130	6/6/95	Ambient Air	1330-20-7	m,p-Xylene	0.64		345.40	PPBV
OFA-3-130	6/6/95	Ambient Air	95-47-6	o-Xylene	0.2		345.40	PPBV

COMPARATIVE AMBIENT AIR STUDY: COMPOUNDS DETECTED

LOCATION	SAMPLE DATE	Media	CAS ID	PARAMETER	RESULT	Q	Screening Value[a]	UNITS
OFA-3-130	6/6/95	Ambient Air	108-88-3	Toluene	1.2		48.53	PPBV
OFA-3-130	6/6/95	Ambient Air	NA	Unknown alkane	21	JN	ND	PPBV
OFA-3-130	6/6/95	Ambient Air	NA	Unknown alkane	8.1	JN	ND	PPBV
OFA-3-130	6/6/95	Ambient Air	NA	Unknown alkane	12	JN	ND	PPBV
OFA-3-130	6/6/95	Ambient Air	NA	Unknown branched alkane	77	JN	ND	PPBV
OFA-3-130	6/6/95	Ambient Air	NA	Unknown branched alkane	9.6	JN	ND	PPBV
OFA-3-130	6/6/95	Ambient Air	NA	Unknown branched alkane	79	JN	ND	PPBV
OFA-3-130	6/6/95	Ambient Air	NA	Unknown branched alkane	20	JN	ND	PPBV
OFA-3-130	6/6/95	Ambient Air	NA	Unknown cycloalkane	14	JN	ND	PPBV
OFA-3-130	6/6/95	Ambient Air	NA	Unknown substituted benzene	15	JN	ND	PPBV
OFA-3-130	6/6/95	Ambient Air	NA	Unknown substituted benzene	9.0	JN	ND	PPBV
OFA-3-150	6/6/95	Ambient Air	71-43-2	Benzene	0.26		0.04	PPBV
OFA-3-150	6/6/95	Ambient Air	74-87-3	Chloromethane	0.66		0.67	PPBV
OFA-3-150	6/6/95	Ambient Air	75-69-4	Freon 11	0.27		56.95	PPBV
OFA-3-150	6/6/95	Ambient Air	75-71-8	Freon 12	0.5		16.18	PPBV
OFA-3-150	6/6/95	Ambient Air	1330-20-7	m,p-Xylene	0.43		345.40	PPBV
OFA-3-150	6/6/95	Ambient Air	108-88-3	Toluene	0.73		48.53	PPBV
OFA-3-150	6/6/95	Ambient Air	NA	Unknown alkane	4.4	JN	ND	PPBV
OFA-3-150	6/6/95	Ambient Air	NA	Unknown hydrocarbon	2.8	JN	ND	PPBV
OFA-3-150	6/6/95	Ambient Air	NA	Unknown hydrocarbon	2.2	JN	ND	PPBV
OFA-3-150	6/6/95	Ambient Air	NA	Unknown hydrocarbon	4.1	JN	ND	PPBV
OFA-3-150	6/6/95	Ambient Air	NA	Unknown hydrocarbon	2.5	JN	ND	PPBV
OFA-3-170	6/6/95	Ambient Air	71-43-2	Benzene	0.25		0.04	PPBV
OFA-3-170	6/6/95	Ambient Air	74-87-3	Chloromethane	0.72		0.67	PPBV
OFA-3-170	6/6/95	Ambient Air	75-69-4	Freon 11	0.3		56.95	PPBV
OFA-3-170	6/6/95	Ambient Air	75-71-8	Freon 12	0.54		16.18	PPBV
OFA-3-170	6/6/95	Ambient Air	1330-20-7	m,p-Xylene	0.48		345.40	PPBV
OFA-3-170	6/6/95	Ambient Air	108-88-3	Toluene	0.83		48.53	PPBV
OFA-3-170	6/6/95	Ambient Air	NA	Unknown alkane	2.0	JN	ND	PPBV
OFA-3-170	6/6/95	Ambient Air	NA	Unknown hydrocarbon	2.4	JN	ND	PPBV
OFA-3-170	6/6/95	Ambient Air	NA	Unknown hydrocarbon	2.9	JN	ND	PPBV
OFA-3-170	6/6/95	Ambient Air	NA	Unknown hydrocarbon	3.2	JN	ND	PPBV
OFA-3-170	6/6/95	Ambient Air	NA	Unknown hydrocarbon	2.2	JN	ND	PPBV
OFA-3-170	6/6/95	Ambient Air	NA	Unknown hydrocarbon	2.7	JN	ND	PPBV
ONA-3	6/6/95	Ambient Air	71-43-2	Benzene	0.26		0.04	PPBV
ONA-3	6/6/95	Ambient Air	74-87-3	Chloromethane	0.77		0.67	PPBV
ONA-3	6/6/95	Ambient Air	75-69-4	Freon 11	0.31		56.95	PPBV
ONA-3	6/6/95	Ambient Air	75-71-8	Freon 12	0.58		16.18	PPBV
ONA-3	6/6/95	Ambient Air	1330-20-7	m,p-Xylene	0.43		345.40	PPBV
ONA-3	6/6/95	Ambient Air	108-88-3	Toluene	0.84		48.53	PPBV
ONA-3	6/6/95	Ambient Air	NA	Unknown alkane	2.0	JN	ND	PPBV
ONA-3	6/6/95	Ambient Air	NA	Unknown alkane	3.7	JN	ND	PPBV
ONA-3	6/6/95	Ambient Air	NA	Unknown aromatic	3.8	JN	ND	PPBV
ONA-3	6/6/95	Ambient Air	NA	Unknown branched alkane	2.5	JN	ND	PPBV
ONA-3	6/6/95	Ambient Air	NA	Unknown cyclic aromatic	4.2	JN	ND	PPBV
ONA-3	6/6/95	Ambient Air	NA	Unknown hydrocarbon	3.4	JN	ND	PPBV
ONA-3	6/6/95	Ambient Air	NA	Unknown hydrocarbon	2.1	JN	ND	PPBV
ONA-3	6/6/95	Ambient Air	NA	Unknown hydrocarbon	2.2	JN	ND	PPBV
ONA-3	6/6/95	Ambient Air	NA	Unknown hydrocarbon	2.6	JN	ND	PPBV
ONA-3	6/6/95	Ambient Air	NA	Unknown hydrocarbon	2.1	JN	ND	PPBV
SK-3-39	6/6/95	Skirt Air	71-43-2	Benzene	0.46		0.04	PPBV
SK-3-39	6/6/95	Skirt Air	622-46-8	Carbamic acid, phenyl ester	6.2	JN	ND	PPBV
SK-3-39	6/6/95	Skirt Air	75-71-8	Freon 12	0.52		16.18	PPBV
SK-3-39	6/6/95	Skirt Air	1330-20-7	m,p-Xylene	0.4		345.40	PPBV
SK-3-39	6/6/95	Skirt Air	108-88-3	Toluene	0.75		48.53	PPBV
SK-3-39	6/6/95	Skirt Air	NA	Unknown alkane	5.4	JN	ND	PPBV
SK-3-39	6/6/95	Skirt Air	NA	Unknown alkane	8.9	JN	ND	PPBV
SK-3-39	6/6/95	Skirt Air	NA	Unknown cyclic aromatic	25	JN	ND	PPBV
SK-3-39	6/6/95	Skirt Air	NA	Unknown cyclic aromatic	43	JN	ND	PPBV
SK-3-39	6/6/95	Skirt Air	NA	Unknown hydrocarbon	6.1	JN	ND	PPBV

COMPARATIVE AMBIENT AIR STUDY: COMPOUNDS DETECTED

LOCATION	SAMPLE DATE	Media	CAS ID	PARAMETER	RESULT	Q	Screening Value[a]	UNITS
SK-3-39	6/6/95	Skirt Air	NA	Unknown hydrocarbon	4.0	JN	ND	PPBV
SK-3-54	6/6/95	Skirt Air	120-82-1	1,2,4-Trichlorobenzene	0.5		12.32	PPBV
SK-3-54	6/6/95	Skirt Air	95-63-6	1,2,4-Trimethylbenzene	0.25		85.43	PPBV
SK-3-54	6/6/95	Skirt Air	106-46-7	1,4-Dichlorobenzene	0.19		0.25	PPBV
SK-3-54	6/6/95	Skirt Air	71-43-2	Benzene	0.26		0.04	PPBV
SK-3-54	6/6/95	Skirt Air	2114-11-6	Carbamic acid, 2-propenyl ester	12	JN	ND	PPBV
SK-3-54	6/6/95	Skirt Air	74-87-3	Chloromethane	0.65		0.67	PPBV
SK-3-54	6/6/95	Skirt Air	100-41-4	Ethyl benzene	0.24		105.28	PPBV
SK-3-54	6/6/95	Skirt Air	75-69-4	Freon 11	3.6		56.95	PPBV
SK-3-54	6/6/95	Skirt Air	75-71-8	Freon 12	0.75		16.18	PPBV
SK-3-54	6/6/95	Skirt Air	1330-20-7	m,p-Xylene	0.58		345.40	PPBV
SK-3-54	6/6/95	Skirt Air	78-93-3	Methyl ethyl ketone	6.0	JN	ND	PPBV
SK-3-54	6/6/95	Skirt Air	75-09-2	Methylene chloride	0.28		0.16	PPBV
SK-3-54	6/6/95	Skirt Air	95-47-6	o-Xylene	0.27		345.40	PPBV
SK-3-54	6/6/95	Skirt Air	108-88-3	Toluene	0.61		48.53	PPBV
SK-3-54	6/6/95	Skirt Air	NA	Unknown alkane	2.6	JN	ND	PPBV
SK-3-54	6/6/95	Skirt Air	NA	Unknown branched alkane	13	JN	ND	PPBV
SK-3-54	6/6/95	Skirt Air	NA	Unknown branched alkane	2.6	JN	ND	PPBV
SK-3-54	6/6/95	Skirt Air	NA	Unknown branched alkane	20	JN	ND	PPBV
SK-3-54	6/6/95	Skirt Air	NA	Unknown branched alkane	35	JN	ND	PPBV
SK-3-54	6/6/95	Skirt Air	NA	Unknown cyclic aromatic	31	JN	ND	PPBV
SK-3-54	6/6/95	Skirt Air	NA	Unknown hydrocarbon	2.0	JN	ND	PPBV
SK-3-54	6/6/95	Skirt Air	NA	Unknown ketone	4.7	JN	ND	PPBV
SK-3-60	6/6/95	Skirt Air	71-43-2	Benzene	0.71		0.04	PPBV
SK-3-60	6/6/95	Skirt Air	74-87-3	Chloromethane	0.73		0.67	PPBV
SK-3-60	6/6/95	Skirt Air	75-71-8	Freon 12	0.55		16.18	PPBV
SK-3-60	6/6/95	Skirt Air	1330-20-7	m,p-Xylene	0.7		345.40	PPBV
SK-3-60	6/6/95	Skirt Air	108-88-3	Toluene	1.1		48.53	PPBV
SK-3-60	6/6/95	Skirt Air	NA	Unknown alkane	4.0	JN	ND	PPBV
SK-3-60	6/6/95	Skirt Air	NA	Unknown alkane	7.7	JN	ND	PPBV
SK-3-60	6/6/95	Skirt Air	NA	Unknown aromatic	21	JN	ND	PPBV
SK-3-60	6/6/95	Skirt Air	NA	Unknown hydrocarbon	4.1	JN	ND	PPBV
SK-3-60	6/6/95	Skirt Air	NA	Unknown hydrocarbon	5.0	JN	ND	PPBV
SK-3-60	6/6/95	Skirt Air	NA	Unknown hydrocarbon	5.1	JN	ND	PPBV
SK-3-60	6/6/95	Skirt Air	NA	Unknown hydrocarbon	30	JN	ND	PPBV
SK-3-60	6/6/95	Skirt Air	NA	Unknown hydrocarbon	7.2	JN	ND	PPBV
SK-3-60	6/6/95	Skirt Air	NA	Unknown hydrocarbon	5.6	JN	ND	PPBV
SK-3-60	6/6/95	Skirt Air	NA	Unknown substituted benzene	5.8	JN	ND	PPBV
SK-3-63	6/6/95	Skirt Air	95-63-6	1,2,4-Trimethylbenzene	1		85.43	PPBV
SK-3-63	6/6/95	Skirt Air	108-67-8	1,3,5-Trimethylbenzene	0.41		85.43	PPBV
SK-3-63	6/6/95	Skirt Air	71-43-2	Benzene	0.93		0.04	PPBV
SK-3-63	6/6/95	Skirt Air	74-87-3	Chloromethane	1.6		0.67	PPBV
SK-3-63	6/6/95	Skirt Air	L65	cis-1,2-Dichloroethene	0.53		655.77	PPBV
SK-3-63	6/6/95	Skirt Air	100-41-4	Ethyl benzene	1.8		105.28	PPBV
SK-3-63	6/6/95	Skirt Air	75-71-8	Freon 12	0.85		16.18	PPBV
SK-3-63	6/6/95	Skirt Air	1330-20-7	m,p-Xylene	3.4		345.40	PPBV
SK-3-63	6/6/95	Skirt Air	95-47-6	o-Xylene	1.2		345.40	PPBV
SK-3-63	6/6/95	Skirt Air	108-88-3	Toluene	4.3		48.53	PPBV
SK-3-63	6/6/95	Skirt Air	NA	Unknown alkane	9.6	JN	ND	PPBV
SK-3-63	6/6/95	Skirt Air	NA	Unknown alkane	7.9	JN	ND	PPBV
SK-3-63	6/6/95	Skirt Air	NA	Unknown branched alkane	9.6	JN	ND	PPBV
SK-3-63	6/6/95	Skirt Air	NA	Unknown branched hydrocarbon	25	JN	ND	PPBV
SK-3-63	6/6/95	Skirt Air	NA	Unknown C13 hydrocarbon	15	JN	ND	PPBV
SK-3-63	6/6/95	Skirt Air	NA	Unknown cyclic aromatic	11	JN	ND	PPBV
SK-3-63	6/6/95	Skirt Air	NA	Unknown cyclic aromatic	21	JN	ND	PPBV
SK-3-63	6/6/95	Skirt Air	NA	Unknown hydrocarbon	10	JN	ND	PPBV
SK-3-63	6/6/95	Skirt Air	NA	Unknown hydrocarbon	8.6	JN	ND	PPBV
SK-3-63	6/6/95	Skirt Air	NA	Unknown hydrocarbon	20	JN	ND	PPBV
SK-3-63	6/6/95	Skirt Air	75-01-4	Vinyl chloride	1.2		0.005	PPBV
SK-3-66	6/6/95	Skirt Air	71-55-6	1,1,1-Trichloroethane	4		167.55	PPBV

COMPARATIVE AMBIENT AIR STUDY: COMPOUNDS DETECTED

LOCATION	SAMPLE DATE	Media	CAS ID	PARAMETER	RESULT	Q	Screening Value[a]	UNITS
SK-3-66	6/6/95	Skirt Air	79-00-5	1,1,2-Trichloroethane	0.69		0.03	PPBV
SK-3-66	6/6/95	Skirt Air	75-35-4	1,1-Dichloroethene	2.2		0.002	PPBV
SK-3-66	6/6/95	Skirt Air	71-43-2	Benzene	1		0.04	PPBV
SK-3-66	6/6/95	Skirt Air	108-90-7	Chlorobenzene	0.71		1.74	PPBV
SK-3-66	6/6/95	Skirt Air	74-87-3	Chloromethane	0.93		0.67	PPBV
SK-3-66	6/6/95	Skirt Air	75-69-4	Freon 11	0.41		56.95	PPBV
SK-3-66	6/6/95	Skirt Air	75-71-8	Freon 12	0.55		16.18	PPBV
SK-3-66	6/6/95	Skirt Air	1330-20-7	m,p-Xylene	2		345.40	PPBV
SK-3-66	6/6/95	Skirt Air	75-09-2	Methylene chloride	0.39		0.16	PPBV
SK-3-66	6/6/95	Skirt Air	95-47-6	o-Xylene	0.93		345.40	PPBV
SK-3-66	6/6/95	Skirt Air	108-88-3	Toluene	1.2		48.53	PPBV
SK-3-66	6/6/95	Skirt Air	NA	Unknown alkene	6.4	JN	ND	PPBV
SK-3-66	6/6/95	Skirt Air	NA	Unknown cyclic aromatic	32	JN	ND	PPBV
SK-3-66	6/6/95	Skirt Air	NA	Unknown cyclic aromatic	39	JN	ND	PPBV
SK-3-66	6/6/95	Skirt Air	NA	Unknown hydrocarbon	10	JN	ND	PPBV
SK-3-66	6/6/95	Skirt Air	NA	Unknown hydrocarbon	4.4	JN	ND	PPBV
SK-3-66	6/6/95	Skirt Air	NA	Unknown hydrocarbon	8.6	JN	ND	PPBV
SK-3-66	6/6/95	Skirt Air	NA	Unknown hydrocarbon	12	JN	ND	PPBV
SK-3-66	6/6/95	Skirt Air	NA	Unknown hydrocarbon	11	JN	ND	PPBV
SK-3-66	6/6/95	Skirt Air	NA	Unknown hydrocarbon	18	JN	ND	PPBV
SK-3-66	6/6/95	Skirt Air	NA	Unknown hydrocarbon	11	JN	ND	PPBV
SVP-3-39	6/6/95	Soil Gas	NA	Unknown alkene	82	JN	ND	PPBV
SVP-3-39	6/6/95	Soil Gas	NA	Unknown alkene	24	JN	ND	PPBV
SVP-3-39	6/6/95	Soil Gas	NA	Unknown alkene	50	JN	ND	PPBV
SVP-3-39	6/6/95	Soil Gas	NA	Unknown alkene	34	JN	ND	PPBV
SVP-3-39	6/6/95	Soil Gas	NA	Unknown cycloalkane	91	JN	ND	PPBV
SVP-3-39	6/6/95	Soil Gas	NA	Unknown cycloalkane	26	JN	ND	PPBV
SVP-3-54	6/6/95	Soil Gas	95-63-6	1,2,4-Trimethylbenzene	0.21		ND	PPBV
SVP-3-54	6/6/95	Soil Gas	107-06-2	1,2-Dichloroethane	0.55		0.02	PPBV
SVP-3-54	6/6/95	Soil Gas	622-46-8	Carbamic acid, phenyl ester	110	JN	ND	PPBV
SVP-3-54	6/6/95	Soil Gas	74-87-3	Chloromethane	0.77		0.67	PPBV
SVP-3-54	6/6/95	Soil Gas	75-69-4	Freon 11	0.39		56.95	PPBV
SVP-3-54	6/6/95	Soil Gas	1330-20-7	m,p-Xylene	0.25		ND	PPBV
SVP-3-54	6/6/95	Soil Gas	75-09-2	Methylene chloride	0.61		1.53	PPBV
SVP-3-54	6/6/95	Soil Gas	108-88-3	Toluene	0.3		48.53	PPBV
SVP-3-54	6/6/95	Soil Gas	NA	Unknown alkane	5.8	JN	ND	PPBV
SVP-3-54	6/6/95	Soil Gas	NA	Unknown alkene	6.6	JN	ND	PPBV
SVP-3-54	6/6/95	Soil Gas	NA	Unknown amine	15	JN	ND	PPBV
SVP-3-54	6/6/95	Soil Gas	NA	Unknown aromatic	6.3	JN	ND	PPBV
SVP-3-54	6/6/95	Soil Gas	NA	Unknown C13 hydrocarbon	6.3	JN	ND	PPBV
SVP-3-54	6/6/95	Soil Gas	NA	Unknown cyclic aromatic	15	JN	ND	PPBV
SVP-3-54	6/6/95	Soil Gas	NA	Unknown hydrocarbon	5.3	JN	ND	PPBV
SVP-3-54	6/6/95	Soil Gas	NA	Unknown hydrocarbon	4.5	JN	ND	PPBV
SVP-3-54	6/6/95	Soil Gas	NA	Unknown hydrocarbon	6.1	JN	ND	PPBV
SVP-3-60	6/6/95	Soil Gas	71-43-2	Benzene	0.62		0.09	PPBV
SVP-3-60	6/6/95	Soil Gas	1330-20-7	m,p-Xylene	0.67		ND	PPBV
SVP-3-60	6/6/95	Soil Gas	108-88-3	Toluene	0.82		48.53	PPBV
SVP-3-60	6/6/95	Soil Gas	NA	Unknown hydrocarbon	5.8	JN	ND	PPBV
SVP-3-63	6/6/95	Soil Gas	107-06-2	1,2-Dichloroethane	2.3		0.02	PPBV
SVP-3-63	6/6/95	Soil Gas	489-20-3	1,2-Dimethyl-3-(1-methylethyl)cyclopentane	510	JN	ND	PPBV
SVP-3-63	6/6/95	Soil Gas	108-67-8	1,3,5-Trimethylbenzene	4		ND	PPBV
SVP-3-63	6/6/95	Soil Gas	71-43-2	Benzene	12		0.09	PPBV
SVP-3-63	6/6/95	Soil Gas	100-41-4	Ethyl benzene	1.5		105.28	PPBV
SVP-3-63	6/6/95	Soil Gas	76-14-2	Freon 114	1		ND	PPBV
SVP-3-63	6/6/95	Soil Gas	1330-20-7	m,p-Xylene	2.4		ND	PPBV
SVP-3-63	6/6/95	Soil Gas	108-88-3	Toluene	2.8		48.53	PPBV
SVP-3-63	6/6/95	Soil Gas	NA	Unknown alkene	470	JN	ND	PPBV
SVP-3-63	6/6/95	Soil Gas	NA	Unknown alkene	490	JN	ND	PPBV
SVP-3-63	6/6/95	Soil Gas	NA	Unknown alkene	500	JN	ND	PPBV
SVP-3-63	6/6/95	Soil Gas	NA	Unknown branched hydrocarbon	1100	JN	ND	PPBV

COMPARATIVE AMBIENT AIR STUDY: COMPOUNDS DETECTED

LOCATION	SAMPLE DATE	Media	CAS ID	PARAMETER	RESULT	Q	Screening Value*	UNITS
SVP-3-63	6/6/95	Soil Gas	NA	Unknown branched hydrocarbon	600	JN	ND	PPBV
SVP-3-63	6/6/95	Soil Gas	NA	Unknown branched hydrocarbon	760	JN	ND	PPBV
SVP-3-63	6/6/95	Soil Gas	NA	Unknown cyclic aromatic	1200	JN	ND	PPBV
SVP-3-63	6/6/95	Soil Gas	NA	Unknown cyclic aromatic	760	JN	ND	PPBV
SVP-3-63	6/6/95	Soil Gas	NA	Unknown cyclic aromatic	390	JN	ND	PPBV
OFA-4-20	6/7/95	Ambient Air	71-43-2	Benzene	0.67		0.04	PPBV
OFA-4-20	6/7/95	Ambient Air	74-87-3	Chloromethane	0.63		0.67	PPBV
OFA-4-20	6/7/95	Ambient Air	100-41-4	Ethyl benzene	0.41		105.28	PPBV
OFA-4-20	6/7/95	Ambient Air	75-71-8	Freon 12	0.51		16.18	PPBV
OFA-4-20	6/7/95	Ambient Air	1330-20-7	m,p-Xylene	1.8		345.40	PPBV
OFA-4-20	6/7/95	Ambient Air	75-09-2	Methylene chloride	0.43		0.16	PPBV
OFA-4-20	6/7/95	Ambient Air	95-47-6	o-Xylene	0.63		345.40	PPBV
OFA-4-20	6/7/95	Ambient Air	108-88-3	Toluene	1.4		48.53	PPBV
OFA-4-20	6/7/95	Ambient Air	NA	Unknown hydrocarbon	7.1	JN	ND	PPBV
OFA-4-200	6/7/95	Ambient Air	71-43-2	Benzene	0.25		0.04	PPBV
OFA-4-200	6/7/95	Ambient Air	74-87-3	Chloromethane	0.33		0.67	PPBV
OFA-4-200	6/7/95	Ambient Air	624-92-0	Dimethyl disulfide	23	JN	ND	PPBV
OFA-4-200	6/7/95	Ambient Air	75-71-8	Freon 12	0.28		16.18	PPBV
OFA-4-200	6/7/95	Ambient Air	1330-20-7	m,p-Xylene	0.26		345.40	PPBV
OFA-4-200	6/7/95	Ambient Air	108-88-3	Toluene	0.61		48.53	PPBV
OFA-4-200	6/7/95	Ambient Air	79-01-6	Trichloroethene	1.1		0.11	PPBV
OFA-4-200	6/7/95	Ambient Air	NA	Unknown cycloalkane	7.6	JN	ND	PPBV
OFA-4-200	6/7/95	Ambient Air	NA	Unknown hydrocarbon	120	JN	ND	PPBV
OFA-4-200	6/7/95	Ambient Air	NA	Unknown hydrocarbon	8.1	JN	ND	PPBV
OFA-4-200	6/7/95	Ambient Air	NA	Unknown hydrocarbon	120	JN	ND	PPBV
OFA-4-200	6/7/95	Ambient Air	NA	Unknown hydrocarbon	56	JN	ND	PPBV
OFA-4-200	6/7/95	Ambient Air	NA	Unknown methyl butyl disulfide	36	JN	ND	PPBV
OFA-4-200	6/7/95	Ambient Air	NA	Unknown methylpropyl disulfide	24	JN	ND	PPBV
OFA-4-200	6/7/95	Ambient Air	NA	Unknown N-Propyl butyl disulfide	19	JN	ND	PPBV
OFA-4-200	6/7/95	Ambient Air	NA	Unknown sulfide	17	JN	ND	PPBV
OFA-4-40	6/7/95	Ambient Air	71-43-2	Benzene	0.46		0.04	PPBV
OFA-4-40	6/7/95	Ambient Air	108-90-7	Chlorobenzene	0.32		1.74	PPBV
OFA-4-40	6/7/95	Ambient Air	74-87-3	Chloromethane	0.9		0.67	PPBV
OFA-4-40	6/7/95	Ambient Air	100-41-4	Ethyl benzene	0.36		105.28	PPBV
OFA-4-40	6/7/95	Ambient Air	75-69-4	Freon 11	0.38		56.95	PPBV
OFA-4-40	6/7/95	Ambient Air	75-71-8	Freon 12	0.76		16.18	PPBV
OFA-4-40	6/7/95	Ambient Air	1330-20-7	m,p-Xylene	1.6		345.40	PPBV
OFA-4-40	6/7/95	Ambient Air	95-47-6	o-Xylene	0.54		345.40	PPBV
OFA-4-40	6/7/95	Ambient Air	108-88-3	Toluene	1.4		48.53	PPBV
OFA-4-40	6/7/95	Ambient Air	NA	Unknown cycloalkane	6.5	JN	ND	PPBV
OFA-4-40	6/7/95	Ambient Air	NA	Unknown cycloalkane	9.9	JN	ND	PPBV
OFA-4-40	6/7/95	Ambient Air	NA	Unknown hydrocarbon	4.9	JN	ND	PPBV
OFA-4-40	6/7/95	Ambient Air	NA	Unknown hydrocarbon	6.1	JN	ND	PPBV
OFA-4-40	6/7/95	Ambient Air	NA	Unknown hydrocarbon	4.9	JN	ND	PPBV
OFA-4-40	6/7/95	Ambient Air	NA	Unknown hydrocarbon	18	JN	ND	PPBV
OFA-4-40	6/7/95	Ambient Air	NA	Unknown hydrocarbon	6.0	JN	ND	PPBV
OFA-4-40	6/7/95	Ambient Air	NA	Unknown hydrocarbon	8.0	JN	ND	PPBV
OFA-4-40	6/7/95	Ambient Air	NA	Unknown hydrocarbon	15	JN	ND	PPBV
OFA-4-40	6/7/95	Ambient Air	NA	Unknown hydrocarbon	5.2	JN	ND	PPBV
OFA-4-60	6/7/95	Ambient Air	71-43-2	Benzene	0.85		0.04	PPBV
OFA-4-60	6/7/95	Ambient Air	74-87-3	Chloromethane	0.68		0.67	PPBV
OFA-4-60	6/7/95	Ambient Air	75-71-8	Freon 12	0.55		16.18	PPBV
OFA-4-60	6/7/95	Ambient Air	1330-20-7	m,p-Xylene	0.66		345.40	PPBV
OFA-4-60	6/7/95	Ambient Air	108-88-3	Toluene	1.5		48.53	PPBV
OFA-4-60	6/7/95	Ambient Air	NA	Unknown cycloalkane	11	JN	ND	PPBV
OFA-4-60	6/7/95	Ambient Air	NA	Unknown cycloalkane	5.0	JN	ND	PPBV
OFA-4-60	6/7/95	Ambient Air	NA	Unknown hydrocarbon	6.4	JN	ND	PPBV
ONA-4	6/7/95	Ambient Air	71-43-2	Benzene	0.28		0.04	PPBV
ONA-4	6/7/95	Ambient Air	74-87-3	Chloromethane	0.63		0.67	PPBV
ONA-4	6/7/95	Ambient Air	L90	Chlorotoluene	0.25		166.10	PPBV

COMPARATIVE AMBIENT AIR STUDY: COMPOUNDS DETECTED

LOCATION	SAMPLE DATE	Media	CAS ID	PARAMETER	RESULT	Q	Screening Value'	UNITS
ONA-4	6/7/95	Ambient Air	75-69-4	Freon 11	0.25		56.95	PPBV
ONA-4	6/7/95	Ambient Air	75-71-8	Freon 12	0.49		16.18	PPBV
ONA-4	6/7/95	Ambient Air	1330-20-7	m,p-Xylene	0.46		345.40	PPBV
ONA-4	6/7/95	Ambient Air	108-88-3	Toluene	0.82		48.53	PPBV
ONA-4	6/7/95	Ambient Air	NA	Unknown alkene	7.7	JN	ND	PPBV
ONA-4	6/7/95	Ambient Air	NA	Unknown aromatic	2.9	JN	ND	PPBV
ONA-4	6/7/95	Ambient Air	NA	Unknown hydrocarbon	2.6	JN	ND	PPBV
ONA-4	6/7/95	Ambient Air	NA	Unknown hydrocarbon	6.4	JN	ND	PPBV
ONA-4	6/7/95	Ambient Air	NA	Unknown hydrocarbon	3.7	JN	ND	PPBV
ONA-4	6/7/95	Ambient Air	NA	Unknown hydrocarbon	6.2	JN	ND	PPBV
ONA-4	6/7/95	Ambient Air	NA	Unknown hydrocarbon	7.2	JN	ND	PPBV
ONA-4	6/7/95	Ambient Air	NA	Unknown hydrocarbon	8.1	JN	ND	PPBV
ONA-4	6/7/95	Ambient Air	NA	Unknown hydrocarbon	7.0	JN	ND	PPBV
SK-4-39	6/7/95	Skirt Air	71-43-2	Benzene	0.69		0.04	PPBV
SK-4-39	6/7/95	Skirt Air	74-87-3	Chloromethane	0.62		0.67	PPBV
SK-4-39	6/7/95	Skirt Air	75-71-8	Freon 12	0.55		16.18	PPBV
SK-4-39	6/7/95	Skirt Air	1330-20-7	m,p-Xylene	0.46		345.40	PPBV
SK-4-39	6/7/95	Skirt Air	108-88-3	Toluene	1.1		48.53	PPBV
SK-4-39	6/7/95	Skirt Air	NA	Unknown hydrocarbon	4.1	JN	ND	PPBV
SK-4-39	6/7/95	Skirt Air	NA	Unknown hydrocarbon	4.7	JN	ND	PPBV
SK-4-54	6/7/95	Skirt Air	71-43-2	Benzene	0.44		0.04	PPBV
SK-4-54	6/7/95	Skirt Air	75-71-8	Freon 12	0.64		16.18	PPBV
SK-4-54	6/7/95	Skirt Air	1330-20-7	m,p-Xylene	0.53		345.40	PPBV
SK-4-54	6/7/95	Skirt Air	100-42-5	Styrene	1.5		107.32	PPBV
SK-4-54	6/7/95	Skirt Air	108-88-3	Toluene	0.96		48.53	PPBV
SK-4-60	6/7/95	Skirt Air	71-43-2	Benzene	0.52		0.04	PPBV
SK-4-60	6/7/95	Skirt Air	74-87-3	Chloromethane	1.2		0.67	PPBV
SK-4-60	6/7/95	Skirt Air	100-41-4	Ethyl benzene	0.39		105.28	PPBV
SK-4-60	6/7/95	Skirt Air	75-71-8	Freon 12	0.56		16.18	PPBV
SK-4-60	6/7/95	Skirt Air	1330-20-7	m,p-Xylene	1.3		345.40	PPBV
SK-4-60	6/7/95	Skirt Air	95-47-6	o-Xylene	0.49		345.40	PPBV
SK-4-60	6/7/95	Skirt Air	108-88-3	Toluene	0.97		48.53	PPBV
SK-4-60	6/7/95	Skirt Air	NA	Unknown alkene	54	JN	ND	PPBV
SK-4-60	6/7/95	Skirt Air	NA	Unknown cycloalkane	36	JN	ND	PPBV
SK-4-60	6/7/95	Skirt Air	NA	Unknown hydrocarbon	31	JN	ND	PPBV
SK-4-60	6/7/95	Skirt Air	NA	Unknown hydrocarbon	26	JN	ND	PPBV
SK-4-63	6/7/95	Skirt Air	95-63-6	1,2,4-Trimethylbenzene	3.2		85.43	PPBV
SK-4-63	6/7/95	Skirt Air	108-67-8	1,3,5-Trimethylbenzene	0.88		85.43	PPBV
SK-4-63	6/7/95	Skirt Air	71-43-2	Benzene	1.1		0.04	PPBV
SK-4-63	6/7/95	Skirt Air	74-87-3	Chloromethane	1.2		0.67	PPBV
SK-4-63	6/7/95	Skirt Air	100-41-4	Ethyl benzene	0.71		105.28	PPBV
SK-4-63	6/7/95	Skirt Air	75-71-8	Freon 12	0.51		16.18	PPBV
SK-4-63	6/7/95	Skirt Air	1330-20-7	m,p-Xylene	2.5		345.40	PPBV
SK-4-63	6/7/95	Skirt Air	95-47-6	o-Xylene	0.96		345.40	PPBV
SK-4-63	6/7/95	Skirt Air	108-88-3	Toluene	3.4		48.53	PPBV
SK-4-63	6/7/95	Skirt Air	NA	Unknown alkene	29	JN	ND	PPBV
SK-4-63	6/7/95	Skirt Air	NA	Unknown benzene	23	JN	ND	PPBV
SK-4-63	6/7/95	Skirt Air	NA	Unknown branched alkane	140	JN	ND	PPBV
SK-4-63	6/7/95	Skirt Air	NA	Unknown branched alkane	31	JN	ND	PPBV
SK-4-63	6/7/95	Skirt Air	NA	Unknown branched alkane	280	JN	ND	PPBV
SK-4-63	6/7/95	Skirt Air	NA	Unknown branched alkane	89	JN	ND	PPBV
SK-4-63	6/7/95	Skirt Air	NA	Unknown cycloalkane	47	JN	ND	PPBV
SK-4-63	6/7/95	Skirt Air	NA	Unknown hydrocarbon	42	JN	ND	PPBV
SK-4-63	6/7/95	Skirt Air	NA	Unknown hydrocarbon	62	JN	ND	PPBV
SK-4-63	6/7/95	Skirt Air	NA	Unknown substituted benzene	23	JN	ND	PPBV
SVP-4-39	6/7/95	Soil Gas	NA	Unknown hydrocarbon	180	JN	ND	PPBV
SVP-4-39	6/7/95	Soil Gas	NA	Unknown hydrocarbon	160	JN	ND	PPBV
SVP-4-54	6/7/95	Soil Gas	107-06-2	1,2-Dichloroethane	1.2		0.02	PPBV
SVP-4-54	6/7/95	Soil Gas	75-09-2	Methylene chloride	0.62	B	1.53	PPBV
SVP-4-54	6/7/95	Soil Gas	108-88-3	Toluene	0.48		48.53	PPBV

COMPARATIVE AMBIENT AIR STUDY: COMPOUNDS DETECTED

LOCATION	SAMPLE DATE	Media	CAS ID	PARAMETER	RESULT	Q	Screening Value[a]	UNITS
SVP-4-54	6/7/95	Soil Gas	NA	Unknown hydrocarbon	24	JN	ND	PPBV
SVP-4-54	6/7/95	Soil Gas	NA	Unknown substituted alkene	25	JN	ND	PPBV
SVP-4-60	6/7/95	Soil Gas	71-43-2	Benzene	0.53		0.09	PPBV
SVP-4-60	6/7/95	Soil Gas	1330-20-7	m,p-Xylene	1		ND	PPBV
SVP-4-60	6/7/95	Soil Gas	108-88-3	Toluene	0.92		48.53	PPBV
SVP-4-63	6/7/95	Soil Gas	107-06-2	1,2-Dichloroethane	1.6		0.02	PPBV
SVP-4-63	6/7/95	Soil Gas	108-67-8	1,3,5-Trimethylbenzene	4.3		ND	PPBV
SVP-4-63	6/7/95	Soil Gas	71-43-2	Benzene	9.4		0.09	PPBV
SVP-4-63	6/7/95	Soil Gas	100-41-4	Ethyl benzene	1.8		105.28	PPBV
SVP-4-63	6/7/95	Soil Gas	1330-20-7	m,p-Xylene	2.4		ND	PPBV
SVP-4-63	6/7/95	Soil Gas	95-47-6	o-Xylene	2.6		ND	PPBV
SVP-4-63	6/7/95	Soil Gas	NA	THC*	18000	JN	ND	PPBV
SVP-4-63	6/7/95	Soil Gas	108-88-3	Toluene	3.3		48.53	PPBV
OFA-5-10	6/14/95	Ambient Air	74-87-3	Chloromethane	0.96		0.67	PPBV
OFA-5-10	6/14/95	Ambient Air	75-71-8	Freon 12	0.92		16.18	PPBV
OFA-5-10	6/14/95	Ambient Air	100-42-5	Styrene	1		107.32	PPBV
OFA-5-30	6/14/95	Ambient Air	74-87-3	Chloromethane	0.54		0.67	PPBV
OFA-5-30	6/14/95	Ambient Air	75-71-8	Freon 12	0.64		16.18	PPBV
OFA-5-30	6/14/95	Ambient Air	100-42-5	Styrene	1.1		107.32	PPBV
OFA-5-30	6/14/95	Ambient Air	108-88-3	Toluene	0.49		48.53	PPBV
OFA-5-30	6/14/95	Ambient Air	NA	Unknown branched hydrocarbon	6.4	JN	ND	PPBV
OFA-5-30	6/14/95	Ambient Air	NA	Unknown cyclic	4.3	JN	ND	PPBV
OFA-5-50	6/14/95	Ambient Air	71-43-2	Benzene	0.52		0.04	PPBV
OFA-5-50	6/14/95	Ambient Air	74-87-3	Chloromethane	0.67		0.67	PPBV
OFA-5-50	6/14/95	Ambient Air	100-41-4	Ethyl benzene	1.1		105.28	PPBV
OFA-5-50	6/14/95	Ambient Air	75-71-8	Freon 12	0.63		16.18	PPBV
OFA-5-50	6/14/95	Ambient Air	1330-20-7	m,p-Xylene	4.2		345.40	PPBV
OFA-5-50	6/14/95	Ambient Air	95-47-6	o-Xylene	1		345.40	PPBV
OFA-5-50	6/14/95	Ambient Air	100-42-5	Styrene	0.41		107.32	PPBV
OFA-5-50	6/14/95	Ambient Air	108-88-3	Toluene	0.95		48.53	PPBV
OFA-5-50	6/14/95	Ambient Air	NA	Unknown cyclic	6.4	JN	ND	PPBV
OFA-5-50	6/14/95	Ambient Air	NA	Unknown hydrocarbon	4.5	JN	ND	PPBV
ONA-5	6/14/95	Ambient Air	74-87-3	Chloromethane	1.1		0.67	PPBV
ONA-5	6/14/95	Ambient Air	75-71-8	Freon 12	0.76		16.18	PPBV
ONA-5	6/14/95	Ambient Air	100-42-5	Styrene	1.2		107.32	PPBV
ONA-5	6/14/95	Ambient Air	108-88-3	Toluene	0.45		48.53	PPBV
ONA-55	6/14/95	Ambient Air	74-87-3	Chloromethane	0.57		0.67	PPBV
ONA-55	6/14/95	Ambient Air	75-71-8	Freon 12	0.67		16.18	PPBV
ONA-55	6/14/95	Ambient Air	100-42-5	Styrene	1.3		107.32	PPBV
ONA-55	6/14/95	Ambient Air	108-88-3	Toluene	0.46		48.53	PPBV
ONA-55	6/14/95	Ambient Air	NA	Unknown hydrocarbon	4	JN	ND	PPBV
SK-5-39	6/14/95	Skirt Air	74-87-3	Chloromethane	0.5		0.67	PPBV
SK-5-39	6/14/95	Skirt Air	75-69-4	Freon 11	0.27	J	56.95	PPBV
SK-5-39	6/14/95	Skirt Air	75-71-8	Freon 12	0.69		16.18	PPBV
SK-5-39	6/14/95	Skirt Air	59849-54-6	N-Propyl S-butyl disulfide	8.3	JN	667.04	PPBV
SK-5-39	6/14/95	Skirt Air	100-42-5	Styrene	1.1		107.32	PPBV
SK-5-39	6/14/95	Skirt Air	108-88-3	Toluene	0.42		48.53	PPBV
SK-5-39	6/14/95	Skirt Air	NA	Unknown amine	10	JN	ND	PPBV
SK-5-39	6/14/95	Skirt Air	NA	Unknown branched hydrocarbon	36	JN	ND	PPBV
SK-5-39	6/14/95	Skirt Air	NA	Unknown branched hydrocarbon	36	JN	ND	PPBV
SK-5-39	6/14/95	Skirt Air	NA	Unknown cyclic	11	JN	ND	PPBV
SK-5-39	6/14/95	Skirt Air	NA	Unknown disulfide	14	JN	ND	PPBV
SK-5-39	6/14/95	Skirt Air	NA	Unknown disulfide	13	JN	ND	PPBV
SK-5-39	6/14/95	Skirt Air	NA	Unknown hydrocarbon	21	JN	ND	PPBV
SK-5-39	6/14/95	Skirt Air	NA	Unknown hydrocarbon	15	JN	ND	PPBV
SK-5-39	6/14/95	Skirt Air	NA	Unknown hydrocarbon	9.1	JN	ND	PPBV
SK-5-54	6/14/95	Skirt Air	74-87-3	Chloromethane	0.87		0.67	PPBV
SK-5-54	6/14/95	Skirt Air	75-71-8	Freon 12	0.58		16.18	PPBV
SK-5-54	6/14/95	Skirt Air	100-42-5	Styrene	0.62		107.32	PPBV
SK-5-54	6/14/95	Skirt Air	108-88-3	Toluene	0.55		48.53	PPBV

COMPARATIVE AMBIENT AIR STUDY: COMPOUNDS DETECTED

LOCATION	SAMPLE DATE	Media	CAS ID	PARAMETER	RESULT	Q	Screening Value[a]	UNITS
SK-5-54	6/14/95	Skirt Air	NA	Unknown cyclic	6.0	JN	ND	PPBV
SK-5-54	6/14/95	Skirt Air	NA	Unknown cyclic	6.1	JN	ND	PPBV
SK-5-54	6/14/95	Skirt Air	NA	Unknown cyclic	4.8	JN	ND	PPBV
SK-5-54	6/14/95	Skirt Air	NA	Unknown hydrocarbon	8.4	JN	ND	PPBV
SK-5-60	6/14/95	Skirt Air	71-43-2	Benzene	0.45		0.04	PPBV
SK-5-60	6/14/95	Skirt Air	74-87-3	Chloromethane	0.78		0.67	PPBV
SK-5-60	6/14/95	Skirt Air	75-69-4	Freon 11	0.39		56.95	PPBV
SK-5-60	6/14/95	Skirt Air	75-71-8	Freon 12	0.61		16.18	PPBV
SK-5-60	6/14/95	Skirt Air	100-42-5	Styrene	0.44		107.32	PPBV
SK-5-60	6/14/95	Skirt Air	NA	Unknown cyclic	5.5	JN	ND	PPBV
SK-5-60	6/14/95	Skirt Air	NA	Unknown hydrocarbon	3.5	JN	ND	PPBV
SK-5-60	6/14/95	Skirt Air	NA	Unknown hydrocarbon	4.8	JN	ND	PPBV
SK-5-63	6/14/95	Skirt Air	71-43-2	Benzene	0.43		0.04	PPBV
SK-5-63	6/14/95	Skirt Air	74-87-3	Chloromethane	0.55		0.67	PPBV
SK-5-63	6/14/95	Skirt Air	75-71-8	Freon 12	0.61		16.18	PPBV
SK-5-63	6/14/95	Skirt Air	1330-20-7	m,p-Xylene	0.52		345.40	PPBV
SK-5-63	6/14/95	Skirt Air	100-42-5	Styrene	0.72		107.32	PPBV
SK-5-63	6/14/95	Skirt Air	108-88-3	Toluene	0.79		48.53	PPBV
SK-5-63	6/14/95	Skirt Air	NA	Unknown hydrocarbon	6.4	JN	ND	PPBV
SVP-5-39	6/14/95	Soil Gas	106-99-0	1,3-Butadiene	61	JN	0.002	PPBV
SVP-5-39	6/14/95	Soil Gas	NA	Unknown cyclic	41	JN	ND	PPBV
SVP-5-39	6/14/95	Soil Gas	NA	Unknown hydrocarbon	57	JN	ND	PPBV
SVP-5-39	6/14/95	Soil Gas	NA	Unknown hydrocarbon	210	JN	ND	PPBV
SVP-5-39	6/14/95	Soil Gas	NA	Unknown hydrocarbon	53	JN	ND	PPBV
SVP-5-39	6/14/95	Soil Gas	NA	Unknown ketone	34	JN	ND	PPBV
SVP-5-54	6/14/95	Soil Gas	107-06-2	1,2-Dichloroethane	0.41		0.02	PPBV
SVP-5-54	6/14/95	Soil Gas	NA	Unknown amine	10	JN	ND	PPBV
SVP-5-54	6/14/95	Soil Gas	NA	Unknown branched hydrocarbon	6.3	JN	ND	PPBV
SVP-5-54	6/14/95	Soil Gas	NA	Unknown cyclic	6.6	JN	ND	PPBV
SVP-5-54	6/14/95	Soil Gas	NA	Unknown cyclic	4.7	JN	ND	PPBV
SVP-5-54	6/14/95	Soil Gas	NA	Unknown cyclic	4.2	JN	ND	PPBV
SVP-5-54	6/14/95	Soil Gas	NA	Unknown cyclic	11	JN	ND	PPBV
SVP-5-54	6/14/95	Soil Gas	NA	Unknown cyclic	4.8	JN	ND	PPBV
SVP-5-54	6/14/95	Soil Gas	NA	Unknown hydrocarbon	5.7	JN	ND	PPBV
SVP-5-54	6/14/95	Soil Gas	NA	Unknown hydrocarbon	5.4	JN	ND	PPBV
SVP-5-54	6/14/95	Soil Gas	NA	Unknown hydrocarbon	9.5	JN	ND	PPBV
SVP-5-63	6/14/95	Soil Gas	75-34-3	1,1-Dichloroethane	4.3		39.53	PPBV
SVP-5-63	6/14/95	Soil Gas	95-63-6	1,2,4-Trimethylbenzene	1.5		ND	PPBV
SVP-5-63	6/14/95	Soil Gas	107-06-2	1,2-Dichloroethane	2.2		0.02	PPBV
SVP-5-63	6/14/95	Soil Gas	108-67-8	1,3,5-Trimethylbenzene	3.9		ND	PPBV
SVP-5-63	6/14/95	Soil Gas	71-43-2	Benzene	10		0.09	PPBV
SVP-5-63	6/14/95	Soil Gas	100-41-4	Ethyl benzene	1.4		105.28	PPBV
SVP-5-63	6/14/95	Soil Gas	76-14-2	Freon 114	1.2		ND	PPBV
SVP-5-63	6/14/95	Soil Gas	1330-20-7	m,p-Xylene	1.7		ND	PPBV
SVP-5-63	6/14/95	Soil Gas	95-47-6	o-Xylene	5.1		ND	PPBV
SVP-5-63	6/14/95	Soil Gas	NA	THC*	16000	JN	ND	PPBV
SVP-5-63	6/14/95	Soil Gas	108-88-3	Toluene	2.6		48.53	PPBV
OFA-6-240	6/16/95	Ambient Air	2114-00-3	2-Bromo-1-phenyl-1-propanone	4.2	JN	ND	PPBV
OFA-6-240	6/16/95	Ambient Air	75-71-8	Freon 12	0.64		16.18	PPBV
OFA-6-240	6/16/95	Ambient Air	NA	Unknown alkene	4.2	JN	ND	PPBV
OFA-6-240	6/16/95	Ambient Air	NA	Unknown alkene	23	JN	ND	PPBV
OFA-6-240	6/16/95	Ambient Air	NA	Unknown cyclic hydrocarbon	5.3	JN	ND	PPBV
OFA-6-240	6/16/95	Ambient Air	NA	Unknown hydrocarbon	6.4	JN	ND	PPBV
OFA-6-260	6/16/95	Ambient Air	74-87-3	Chloromethane	0.72		0.67	PPBV
OFA-6-260	6/16/95	Ambient Air	75-71-8	Freon 12	0.61		16.18	PPBV
OFA-6-260	6/16/95	Ambient Air	NA	Unknown hydrocarbon	6.3	JN	ND	PPBV
OFA-6-260	6/16/95	Ambient Air	NA	Unknown hydrocarbon	7.9	JN	ND	PPBV
OFA-6-260	6/16/95	Ambient Air	NA	Unknown hydrocarbon	5.3	JN	ND	PPBV
OFA-6-280	6/16/95	Ambient Air	95-63-6	1,2,4-Trimethylbenzene	0.36		85.43	PPBV
OFA-6-280	6/16/95	Ambient Air	115-11-7	2-Methyl-1-propene	12	JN	ND	PPBV

COMPARATIVE AMBIENT AIR STUDY: COMPOUNDS DETECTED

LOCATION	SAMPLE DATE	Media	CAS ID	PARAMETER	RESULT	Q	Screening Value[a]	UNITS
OFA-6-280	6/16/95	Ambient Air	74-87-3	Chloromethane	0.42		0.67	PPBV
OFA-6-280	6/16/95	Ambient Air	100-41-4	Ethyl benzene	2.4		105.28	PPBV
OFA-6-280	6/16/95	Ambient Air	75-71-8	Freon 12	0.57		16.18	PPBV
OFA-6-280	6/16/95	Ambient Air	1330-20-7	m,p-Xylene	4.5		345.40	PPBV
OFA-6-280	6/16/95	Ambient Air	95-47-6	o-Xylene	1.4		345.40	PPBV
OFA-6-280	6/16/95	Ambient Air	108-88-3	Toluene	2.5		48.53	PPBV
OFA-6-280	6/16/95	Ambient Air	NA	Unknown alkene	6.1	JN	ND	PPBV
OFA-6-280	6/16/95	Ambient Air	NA	Unknown cyclic hydrocarbon	6.2	JN	ND	PPBV
OFA-6-280	6/16/95	Ambient Air	NA	Unknown cyclic hydrocarbon	3.6	JN	ND	PPBV
OFA-6-280	6/16/95	Ambient Air	NA	Unknown hydrocarbon	17	JN	ND	PPBV
ONA-6	6/16/95	Ambient Air	75-71-8	Freon 12	0.56		16.18	PPBV
ONA-6	6/16/95	Ambient Air	NA	Unknown alkene	5.4	JN	ND	PPBV
ONA-6	6/16/95	Ambient Air	NA	Unknown alkene	4.0	JN	ND	PPBV
ONA-6	6/16/95	Ambient Air	NA	Unknown alkene	5.2	JN	ND	PPBV
ONA-6	6/16/95	Ambient Air	NA	Unknown cyclic hydrocarbon	4.1	JN	ND	PPBV
SK-6-39	6/16/95	Skirt Air	75-71-8	Freon 12	0.63		16.18	PPBV
SK-6-39	6/16/95	Skirt Air	NA	Unknown amine	6.1	JN	ND	PPBV
SK-6-39	6/16/95	Skirt Air	NA	Unknown cyclic hydrocarbon	7.1	JN	ND	PPBV
SK-6-54	6/16/95	Skirt Air	142-08-5	2 (1H)-Pyridinone	11	JN	ND	PPBV
SK-6-54	6/16/95	Skirt Air	71-43-2	Benzene	0.51		0.04	PPBV
SK-6-54	6/16/95	Skirt Air	75-71-8	Freon 12	0.59		16.18	PPBV
SK-6-54	6/16/95	Skirt Air	127-18-4	Tetrachloroethene	0.86		0.16	PPBV
SK-6-54	6/16/95	Skirt Air	108-88-3	Toluene	0.67		48.53	PPBV
SK-6-54	6/16/95	Skirt Air	NA	Unknown cyclic hydrocarbon	9.4	JN	ND	PPBV
SK-6-54	6/16/95	Skirt Air	NA	Unknown hydrocarbon	4.5	JN	ND	PPBV
SK-6-54	6/16/95	Skirt Air	NA	Unknown ketone	19	JN	ND	PPBV
SK-6-540	6/16/95	Skirt Air	71-43-2	Benzene	0.6		0.04	PPBV
SK-6-540	6/16/95	Skirt Air	127-18-4	Tetrachloroethene	0.93		0.16	PPBV
SK-6-540	6/16/95	Skirt Air	108-88-3	Toluene	0.69		48.53	PPBV
SK-6-540	6/16/95	Skirt Air	NA	Unknown alkene	7.2	JN	ND	PPBV
SK-6-540	6/16/95	Skirt Air	NA	Unknown alkanoic acid	6.0	JN	ND	PPBV
SK-6-540	6/16/95	Skirt Air	NA	Unknown cyclic hydrocarbon	5.0	JN	ND	PPBV
SK-6-540	6/16/95	Skirt Air	NA	Unknown cyclic hydrocarbon	4.8	JN	ND	PPBV
SK-6-60	6/16/95	Skirt Air	627-19-0	1-Pentyne	6.3	JN	ND	PPBV
SK-6-60	6/16/95	Skirt Air	75-69-4	Freon 11	0.45		56.95	PPBV
SK-6-60	6/16/95	Skirt Air	75-71-8	Freon 12	0.7		16.18	PPBV
SK-6-60	6/16/95	Skirt Air	108-88-3	Toluene	0.39		48.53	PPBV
SK-6-60	6/16/95	Skirt Air	NA	Unknown alkene	10	JN	ND	PPBV
SK-6-60	6/16/95	Skirt Air	NA	Unknown branched hydrocarbon	11	JN	ND	PPBV
SK-6-60	6/16/95	Skirt Air	NA	Unknown cyclic hydrocarbon	6.8	JN	ND	PPBV
SK-6-60	6/16/95	Skirt Air	NA	Unknown cyclic hydrocarbon	19	JN	ND	PPBV
SK-6-60	6/16/95	Skirt Air	NA	Unknown cyclic hydrocarbon	11	JN	ND	PPBV
SK-6-60	6/16/95	Skirt Air	NA	Unknown cyclic hydrocarbon	16	JN	ND	PPBV
SK-6-60	6/16/95	Skirt Air	NA	Unknown hydrocarbon	21	JN	ND	PPBV
SK-6-60	6/16/95	Skirt Air	NA	Unknown hydrocarbon	5.6	JN	ND	PPBV
SK-6-60	6/16/95	Skirt Air	NA	Unknown hydrocarbon	6.1	JN	ND	PPBV
SK-6-63	6/16/95	Skirt Air	75-71-8	Freon 12	0.63		16.18	PPBV
SK-6-63	6/16/95	Skirt Air	1330-20-7	m,p-Xylene	0.43		345.40	PPBV
SK-6-63	6/16/95	Skirt Air	108-88-3	Toluene	0.63		48.53	PPBV
SK-6-63	6/16/95	Skirt Air	NA	Unknown cyclic hydrocarbon	4.7	JN	ND	PPBV
SK-6-63	6/16/95	Skirt Air	NA	Unknown cyclic hydrocarbon	4.5	JN	ND	PPBV
SVP-6-54	6/16/95	Soil Gas	95-63-6	1,2,4-Trimethylbenzene	0.5		ND	PPBV
SVP-6-54	6/16/95	Soil Gas	5497-67-6	2,2-Dimethyl-4-pentenal	4.0	JN	ND	PPBV
SVP-6-54	6/16/95	Soil Gas	NA	Unknown alkanoic acid	6.5	JN	ND	PPBV
SVP-6-54	6/16/95	Soil Gas	NA	Unknown cyclic hydrocarbon	260	JN	ND	PPBV
SVP-6-54	6/16/95	Soil Gas	NA	Unknown cyclic hydrocarbon	6.4	JN	ND	PPBV
SVP-6-63	6/16/95	Soil Gas	107-06-2	1,2-Dichloroethane	2.1		0.02	PPBV
SVP-6-63	6/16/95	Soil Gas	71-43-2	Benzene	9.3		0.09	PPBV
SVP-6-63	6/16/95	Soil Gas	76-14-2	Freon 114	0.97		ND	PPBV
SVP-6-63	6/16/95	Soil Gas	1330-20-7	m,p-Xylene	1.4		ND	PPBV

COMPARATIVE AMBIENT AIR STUDY: COMPOUNDS DETECTED

LOCATION	SAMPLE DATE	Media	CAS ID	PARAMETER	RESULT	Q	Screening Value*	UNITS
SVP-6-63	6/16/95	Soil Gas	95-47-6	o-Xylene	3.8		ND	PPBV
SVP-6-63	6/16/95	Soil Gas	NA	THC*	19000	JN	ND	PPBV
SVP-6-63	6/16/95	Soil Gas	108-88-3	Toluene	2.4		48.53	PPBV

ND - No Data
Shading indicates exceedance of the screening value.

*Minimum screening value from Table 4-4. ASILs are not used, however, in comparisons to soil gas data since ASILs are applicable only to outdoor air.

TABLE 5-15

THE RESULTS OF THE "BOOTSTRAP" ANOVA FOR BENZENE, CHLOROMETHANE, AND TICS USING 0 AND 0.15 PPBV AS THE MINIMUM CONCENTRATION

Chemical	Alternative Hypothesis	Minimum (ppbv)	Significance Level
Benzene			
	skirt > offsite	0.00	0.0213
	onsite > offsite	0.00	0.1882
	skirt > onsite	0.00	0.2635
	skirt > offsite	0.15	0.0129
	onsite > offsite	0.15	0.1608
	skirt > onsite	0.15	0.2484
Chloromethane			
	skirt > offsite	0.00	0.9802
	onsite > offsite	0.00	0.6954
	skirt > onsite	0.00	0.8504
	skirt > offsite	0.15	0.9787
	onsite > offsite	0.15	0.6907
	skirt > onsite	0.15	0.8480
TICs			
	skirt>offsite	0.00	0.7590
	onsite>offsite	0.00	0.9284
	skirt>onsite	0.00	0.1617
	skirt>offsite	0.15	0.7590
	onsite>offsite	0.15	0.9285
	skirt>onsite	0.15	0.1617

Shading indicates the existence of a statistically significant difference in concentration. Areas not shaded represent cases with no significant difference in concentration.

TABLE 5-16

THE RESULTS OF THE "BOOTSTRAP" WILCOXON RANK SUM TEST FOR EACH SAMPLING EVENT FOR BENZENE, CHLOROMETHANE, AND TICS USING 0 AND 0.15 PPBV AS THE MINIMUM CONCENTRATION

Chemical	Minimum (ppbv)	Skirt vs. Offsite Significance Level for each Sampling Event					
		1	2	3	4	5	6
Benzene							
	0.00	0.128	0.319	0.057	0.343	0.621	0.383
	0.15	0.075	0.261	0.057	0.343	0.658	0.402
Chloromethane							
	0.00	0.029	0.114	0.500	0.264	0.571	0.141
	0.15	0.029	0.114	0.500	0.271	0.571	0.146
TICs							
	0.00	0.057	0.686	0.314	0.557	0.114	0.800
	0.15	0.057	0.686	0.314	0.557	0.114	0.800

Shading indicates the existence of a statistically significant difference in concentration (at the 90% or higher confidence level). Areas that are not shaded represent events determined to have no significant difference.

TABLE 5-17

ESTIMATED MEDIAN DIFFERENCE BETWEEN SKIRT AND OFFSITE AIR CONCENTRATION (PPBV) FOR EACH SAMPLING EVENT FOR BENZENE, CHLOROMETHANE, AND TICS USING 0 AND 0.15 PPBV AS THE MINIMUM CONCENTRATION

Chemical	Minimum (ppbv)	Median Difference for each Sampling Event (skirt - offsite air concentration)					
·		1	2	3	4	5	6
Benzene							
	0.00	0.248	0.080	0.323	0.125	-0.025	0.069
	0.15	0.248	0.096	0.323	0.125	-0.034	0.034
Chloromethane							
	0.00	-0.560	-0.050	-0.035	0.295	-0.40	0.069
	0.15	-0.519	-0.050	-0.035	0.295	-0.040	-0.137
TICs							
	0.00	33.8	-5.5	96.2	-2.6	14.0	-9.8
	0.15	33.8	-5.5	96.2	-2.6	14.0	-9.8

Shaded areas represent the estimated differences in concentration between skirt air and offsite air for those events determined to have significant differences in concentration.

Significant differences were noted only for the 1st and 3rd events (for benzene) and 1st event (for chloromethane and TICs). No significant difference was noted for other events (See Table 5-18).

TABLE 5-18

BENZENE IN SKIRT AIR VS BACKGROUND

	Background Samples			Skirt Air							
				Lot 39		Lot 54		Lot 60		Lot 63	
Sampling Event	Off-Site Sample	Benzene, ppb-v	Value Used[a]	Benzene, ppb-v	Value Used[a]	Benzene, ppb-v	Value Used[a]	Benzene, ppb-v	Value Used[a]	Benzene, ppb-v	Value Used[a]
1	OFA-1-210	<.22	0.11	<.42	0.21	0.47	0.47	<.27	0.135	0.28	0.28
	OFA-1-230	<.22	0.11								
	OFA-1-240	0.24	0.24								
	OFA-1-250	0.21	0.21								
2	OFA-2-40	0.21	0.21	0.49	0.49	0.38	0.38	<.4	0.2	0.59	0.59
	OFA-2-60	0.22	0.22								
	OFA-2-80	0.56	0.56								
3	OFA-3-130	0.42	0.42	0.46	0.46	0.26	0.26	0.71	0.71	0.93	0.93
	OFA-3-150	0.26	0.26								
	OFA-3-170	0.25	0.25								
4	OFA-4-20	0.67	0.67	0.69	0.69	0.44	0.44	0.52	0.52	1.1	1.1
	OFA-4-40	0.46	0.46								
	OFA-4-60	0.85	0.85								
5	OFA-5-10	<.39	0.195	<.39	0.195	<.39	0.195	0.45	0.45	0.43	0.43
	OFA-5-30	<.39	0.195								
	OFA-5-50	0.52	0.52								
6	OFA-6-240	<.39	0.195	<.38	0.19	0.51	0.51	<.38	0.19	<.39	0.195
	OFA-6-260	<.38	0.19								
	OFA-6-280	<.38	0.19								
	UCL_{95}				0.54		0.48		0.56		0.88
	X_{90}		0.58								

UCL_{95} - 95% Upper Confidence Limit for the Mean
UCL_{95} = mean + tS/SQRT(n), where:
t = t parameter, based on a one-sided [] of 0.05 and (n-1) degress of freedom
S = standard deviation
n = number of samples (6)

X_{90} = 90th Percentile
X_{90} = mean + $Z_{90}S$, where
Z_{90} = Z parameter from the normal distribution for a one-sided upper 90% confidence limit
S = standard deviation

[a] - Used one-half the detection limit for ND values.
Shading indicates exceedance of the X_{90} (90th Percentile) background value.
Source: Ecology (1992b) - *Statistical Guidance for Ecology Site Managers.*

RATIO OF SCREENING VALUE TO RESULT FOR ALL SOIL GAS EXCEEDANCES OF A SCREENING VALUE

Sample ID	Date	Media	Compounds Detected	Result	Q	Screening Value*	Units	Ratio of Results to Screening Values
122	6/14/95	Soil Gas	1,3-Butadiene	61	JN	0.002	PPBV	25,000
SVP-1-54	3/24/94	Soil Gas	CHLOROFORM	16		0.022	ppbV	1,000
SV.45	3/25/94	Soil Gas	2-PROPENENITRILE	8.9		0.016	ppbV	500
44	3/24/94	Soil Gas	2-PROPENENITRILE	8.3		0.016	ppbV	500
SV-36	5/30/95	Soil Gas	1,2-Dichloroethane	4.4		0.02	PPBV	200
SV-31	9/23/94	SOIL GAS	Benzene	15		0.09	ppbv	167
121	3/24/94	Soil Gas	BENZENE	14		0.09	ppbV	143
123	5/30/95	Soil Gas	Benzene	12		0.09	PPBV	125
48	6/6/95	Soil Gas	Benzene	12		0.09	PPBV	125
SVP2-39	3/9/95	SOIL VAPOR	Benzene	11		0.09	ppbv	111
SVP-36	6/14/95	Soil Gas	Benzene	10		0.09	PPBV	111
SVP-1-63	6/7/95	Soil Gas	Benzene	9.4		0.09	PPBV	100
SVP-1-39	6/16/95	Soil Gas	Benzene	9.3		0.09	PPBV	100
SVP-1-60	6/6/95	Soil Gas	1,2-Dichloroethane	2.3		0.02	PPBV	100
121	9/23/94	SOIL GAS	Benzene	8.9		0.09	ppbv	100
SVP-36	6/14/95	Soil Gas	1,2-Dichloroethane	2.2		0.02	PPBV	100
54	6/16/95	Soil Gas	1,2-Dichloroethane	2.1		0.02	PPBV	100
122	3/24/94	Soil Gas	CHLOROFORM	1.8		0.022	ppbV	100
SV-42	9/23/94	SOIL GAS	Benzene	7.3		0.09	ppbv	100
SVP-3-54	9/23/94	SOIL GAS	Chloroform	1.5		0.02	ppbv	100
SVP2-39	5/30/95	Soil Gas	1,2-Dichloroethane	1.6		0.02	PPBV	100
SV-22	6/7/95	Soil Gas	1,2-Dichloroethane	1.6		0.02	PPBV	100
SV-42	6/7/95	Soil Gas	1,2-Dichloroethane	1.2		0.02	PPBV	50
123	9/23/94	SOIL GAS	Tetrachloroethene	22		0.65	ppbv	33
63	9/23/94	SOIL GAS	Benzene	3.2	J	0.09	ppbv	33
SV-10	9/23/94	SOIL GAS	Benzene	2.3		0.09	ppbv	25
SVP-1-63	9/23/94	SOIL GAS	Benzene	2.2		0.09	ppbv	25
SVP-3-63	6/6/95	Soil Gas	1,2-Dichloroethane	0.55		0.02	PPBV	25
SVP-5-63	9/23/94	SOIL GAS	Benzene	1.8		0.09	ppbv	20
SVP-4-63	9/23/94	SOIL GAS	Benzene	1.8		0.09	ppbv	20
SVP-6-63	6/14/95	Soil Gas	1,2-Dichloroethane	0.41		0.02	PPBV	16.7
54	9/23/94	SOIL GAS	Benzene	1.6		0.09	ppbv	16.7
39	9/23/94	SOIL GAS	Benzene	1.3		0.09	ppbv	14.3
60	3/24/94	Soil Gas	ACETALDEHYDE	8.4		0.631	ppbV	12.5
61	9/23/94	SOIL GAS	Benzene	1.2		0.09	ppbv	12.5
136	9/23/94	SOIL GAS	Benzene	1.1		0.09	ppbv	11.1
122	9/23/94	SOIL GAS	Benzene	1.1		0.09	ppbv	11.1
125	3/25/94	Soil Gas	ACETALDEHYDE	7		0.631	ppbV	11.1
119	3/17/95	SOIL VAPOR	Tetrachloroethene	6.9		0.65	ppbv	11.1
65	3/25/94	Soil Gas	ACETALDEHYDE	6.5		0.631	ppbV	10
55	9/23/94	SOIL GAS	Benzene	0.86		0.09	ppbv	10
46	3/24/94	Soil Gas	TETRACHLOROETHENE	5.5		0.65	ppbV	10
47	9/23/94	SOIL GAS	Benzene	0.75		0.09	ppbv	10
51	9/23/94	SOIL GAS	Tetrachloroethene	5.1		0.65	ppbv	10
121	9/23/94	SOIL GAS	Benzene	0.69	J	0.09	ppbv	10
48	6/6/95	Soil Gas	Benzene	0.62		0.09	PPBV	5
SVP-3-60	5/30/95	Soil Gas	Methylene Chloride	10		1.53	PPBV	5
SVP-4-60	9/23/94	SOIL GAS	Tetrachloroethene	4		0.65	ppbv	5
SVP2-63	5/30/95	Soil Gas	Methylene Chloride	8.8		1.53	PPBV	5
NEW SVP-10	6/7/95	Soil Gas	Benzene	0.53		0.09	PPBV	5
SV.45	3/9/95	SOIL VAPOR	Benzene	0.48	J	0.09	ppbv	5
SV-32	5/30/95	Soil Gas	Methylene Chloride	7.4		1.53	PPBV	5
SV-9	3/25/94	Soil Gas	TETRACHLOROETHENE	2.4		0.65	ppbV	3
SV-15	9/23/94	SOIL GAS	Trichloroethene	1		0.27	ppbv	3
SV-9	6/1/95	Soil Gas	Benzene	0.26		0.09	PPBV	2
SV-49	3/17/95	SOIL VAPOR	Freon 12	42		16.18	ppbv	2

RATIO OF SCREENING VALUE TO RESULT FOR ALL SOIL GAS EXCEEDANCES OF A SCREENING VALUE

Sample ID	Date	Media	Compounds Detected	Result	Q	Screening Value[a]	Units	Ratio of Results to Screening Values
SVP-5-39	9/23/94	SOIL GAS	Tetrachloroethene	1.4		0.65	ppbv	2
SVP-1-63	5/30/95	Soil Gas	Trichloroethene	0.57		0.27	PPBV	2
SVP-3-63	9/23/94	SOIL GAS	Chloromethane	1.4		0.67	ppbv	2
SVP-5-63	9/23/94	SOIL GAS	Chloromethane	1.2		0.67	ppbv	2
SVP-6-63	3/9/95	SOIL VAPOR	Toluene	67	J	48.53	ppbv	1.4
SVP-1-54	3/24/94	Soil Gas	CHLOROMETHANE	0.87		0.673	ppbV	1.2
SVP-4-63	6/6/95	Soil Gas	Chloromethane	0.77		0.67	PPBV	1.1
SVP-4-54	9/23/94	SOIL GAS	Freon 12	18		16.18	ppbv	1.1
SVP-3-54	6/1/95	Soil Gas	Chloromethane	0.72		0.67	PPBV	1.1
SVP-5-54	6/1/95	Soil Gas	Tetrachloroethene	0.68		0.65	PPBV	1.1

[a]From Table 4-4. Excludes ASIL values which are for outdoor air only.

TABLE 6-1

SUMMARY OF IDENTIFICATION AND SCREENING OF REMEDIATION TECHNOLOGIES

Technology	Screening Comments	Retained? (Yes/No)
INSTITUTIONAL CONTROLS AND MONITORING		
Site Access Restrictions		
Fencing	Effective, easy to implement, low cost	Yes
Warning signs	Effective, easy to implement, low cost	Yes
Security patrols	Expensive and unnecessary	No
Land Use Restrictions		
Deed restrictions	Effective, easy to implement, low cost	Yes
Zoning	Feasible	Yes
Groundwater use restrictions	Effective, easy to implement, low cost	Yes
Alternate water supply	No current need (groundwater is not unacceptably impacted). In the event of a future problem with site groundwater, monitoring will allow remedial action before drinking water supplies are affected.	No
Monitoring	Required component of site remedy	Yes
CONTAINMENT		
Capping	Capping is proven, effective technology for providing reliable long-term containment and preventing or minimizing off-site migration of constituents of concern.	
Permeable soil cap	Effective; readily implemented; inexpensive	Yes
Pavement cap (asphalt/concrete)	Subject to cracking; not as reliable as other cap options of comparable cost	No
Low-permeability soil cap	Effective and implementable	Yes
FML cap	Effective and implementable	Yes
RCRA Subtitle C cap	Other cap options provide sufficient protection and are easier to implement for much less cost	No
Surface water controls Grading Stormwater drainage controls Vegetative cover	Useful component of cap remedy	Yes
Vertical barriers Slurry wall Grout wall Sheet pile wall	Groundwater is not unacceptably impacted; therefore, no need for groundwater containment at this site.	No
Horizontal barriers Grout injection	Groundwater is not unacceptably impacted; therefore, no need for groundwater containment at this site.	No

TABLE 6-1

SUMMARY OF IDENTIFICATION AND SCREENING OF REMEDIATION TECHNOLOGIES

Technology	Screening Comments	Retained? (Yes/No)
Hydraulic groundwater containment	Groundwater is not unacceptably impacted; therefore, no need for groundwater containment at this site.	No
WASTE/SOIL TREATMENT		
Reuse/recycling	No waste materials identified with the potential for reuse or recycling; usually not feasible for complex mixtures of heterogeneous waste and affected soil	No
Other waste/soil treatment	No need for waste treatment at this site.	No
GROUNDWATER TREATMENT	Groundwater is not unacceptably impacted; therefore, groundwater treatment is not needed.	No
LANDFILL GAS TREATMENT	Ambient air at the site is not unacceptably impacted; therefore, landfill gas treatment is not needed.	No
OFF-SITE DISPOSAL	Current disposal site is acceptable; therefore, no point in moving waste to another disposal location.	No
REMOVAL		
Excavation (soil/waste) Backhoe Loader Bulldozer Clamshell Dragline	No need for waste treatment or off-site disposal; therefore, no need for waste excavation. Excavation retained as it applies to regrading and capping the site.	No
Groundwater extraction	Groundwater is not unacceptably impacted; therefore, no need for groundwater extraction.	No
Landfill gas extraction	Ambient air at the site is not unacceptably impacted; therefore, no need for active landfill gas extraction.	No

TABLE 8-1

SUMMARY OF REMEDIATION ALTERNATIVE EVALUATION

Criteria [a]	Relative Value of Criterion [b]	Calculated Criteria Weights	Alternative Scores [c]			
			1 No Action	2 Institutional Controls	3 Permeable Soil Cap	4 Low-Permeability Cap
Long-Term Effectiveness and Reliability						
Effectiveness (50% of criterion)		50%	3	4	9	9.5
Reliability (50% of criterion)		50%	1	4	9	8.5
Overall criterion score	1	69%	2	4	9	9
Short-Term Effectiveness	0.2	14%	10	9	6	3
Reduction in Toxicity, Mobility, and Volume	0.05	3%	0	0	0	2
Implementability	0.2	14%	10	9	7	4
Net Benefit		100%	4.1	5.2	8.0	7.2
Incremental benefit			NA	1.1	2.8	-0.8
Cost (present value, millions)			$0	$1.00	$1.30	$2.66
Benefit : cost (i.e., cost-effectiveness)			NA	5.2	6.1	2.7
Incremental cost			NA	$1.00	$0.30	$1.36
Incremental benefit : incremental cost			NA	1.1	9.3	-0.6

[a] See text for criteria definitions.

[b] The numeric value of one scoring unit of the criterion relative to one scoring unit of the long-term effectiveness and reliability criterion.

[c] See text for score basis.

TABLE 8-2

SUMMARY OF ESTIMATED COSTS FOR REMEDIATION ALTERNATIVES

	Alternative	Estimated Costs (millions) [a]			
		Capital [b]	Land Use Cost [c]	O&M [d]	Total
1	No Action	$0	$0	$0	$0
2	Institutional Controls and Monitoring	$0.11	$0.76	$0.14	$1.00
3	Permeable Soil Cap	$0.78	$0.25	$0.28	$1.30
4	Low-Permeability Cap (FML)	$1.48	$0.62	$0.56	$2.66

[a] Costs are for early 1996. See Appendix G for cost breakdowns.

[b] Includes operating costs during remedial action.

[c] Cost attributable to lost land value and earning potential (Alt. 2),
or incremental development cost to provide equivalent land value and earning potential (Alts. 3 and 4).

[d] Long-term maintenance and monitoring for 20 years; net present value at 5% interest (net of inflation).

TABLE 8-3

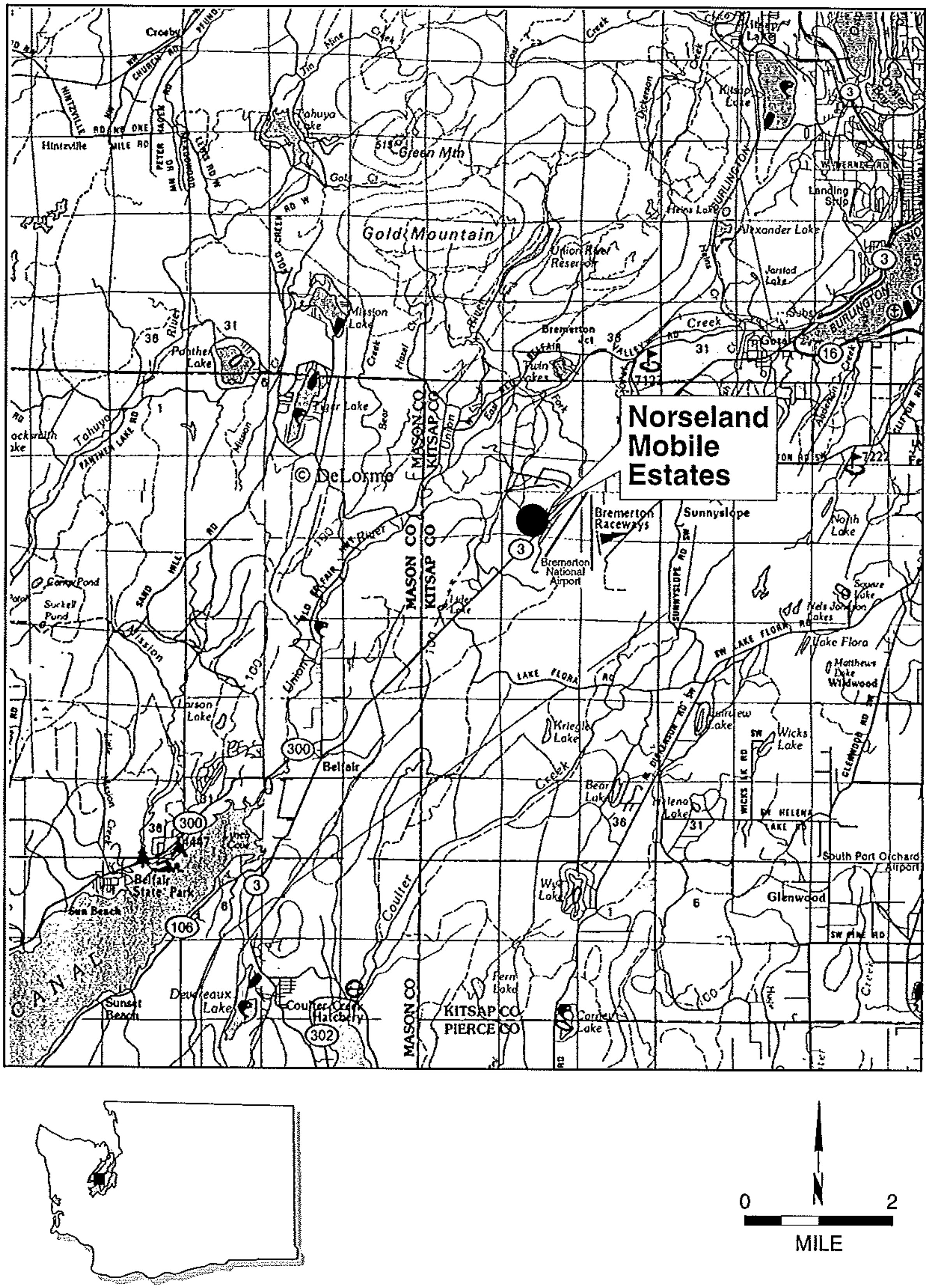
SUMMARY OF STOCHASTIC UNCERTAINTY ANALYSIS

	Alternative	Deterministic	Percentiles [b]					
		Value [a]	10%	25%	Median	MEAN	75%	90%
			Net Benefit (Overall Non-Cost Score)					
1	No Action	4.1	3.4	3.8	4.1	4.1	4.5	4.7
2	Institutional Controls and Monitoring	5.2	4.8	5.0	5.2	5.2	5.4	5.6
3	Permeable Soil Cap	8.0	7.8	7.9	8.0	8.0	8.1	8.3
4	Low-Permeability Cap (FML)	7.2	6.9	7.0	7.2	7.3	7.5	7.7
			Estimated Cost (millions)					
1	No Action	$0						
2	Institutional Controls and Monitoring	$1.00	$0.82	$0.91	$1.04	$1.06	$1.17	$1.32
3	Permeable Soil Cap	$1.30	$1.06	$1.18	$1.33	$1.36	$1.50	$1.68
4	Low-Permeability Cap (FML)	$2.66	$2.19	$2.41	$2.67	$2.72	$2.98	$3.33

[a] Deterministic values are approximately equal to stochastic modes (most likely values) for most probability distributions.

[b] Percentiles estimated by Monte Carlo simulation as described in text. Simulation output in Appendix H.

FIGURES



REFERENCES: USGS 7.5' Quadrangles
Wildcat Lake, WA
Burley, WA
Belfar, WA
Bremerton West, WA

FIGURE **1-1**
SITE LOCATION MAP
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 46253 DATE 9/27/95 DRAWN BY CB

Golder Associates

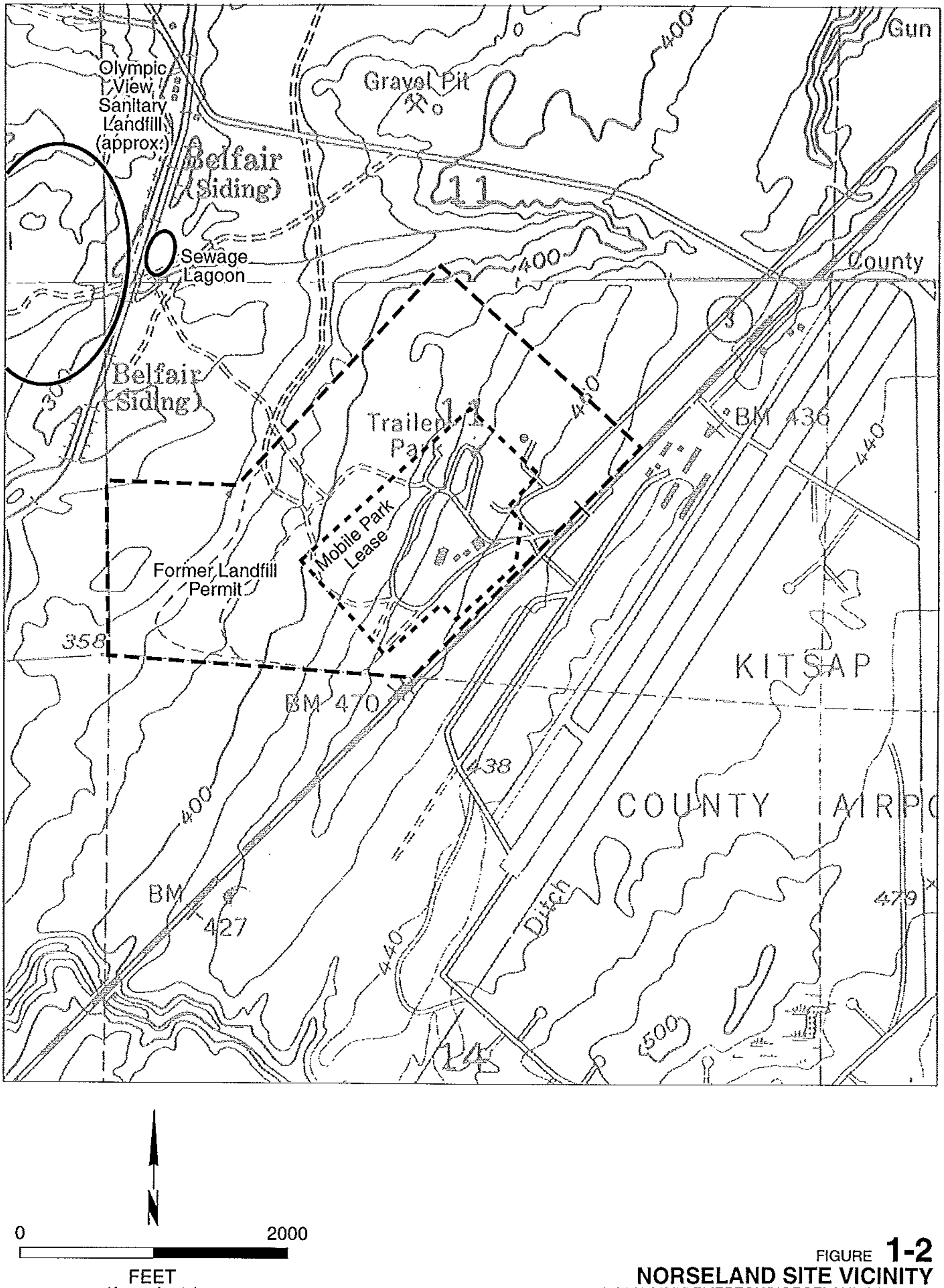


FIGURE **1-2**

NORSELAND SITE VICINITY

PORT OF BREMERTON/NORSELAND RI-FS/WA

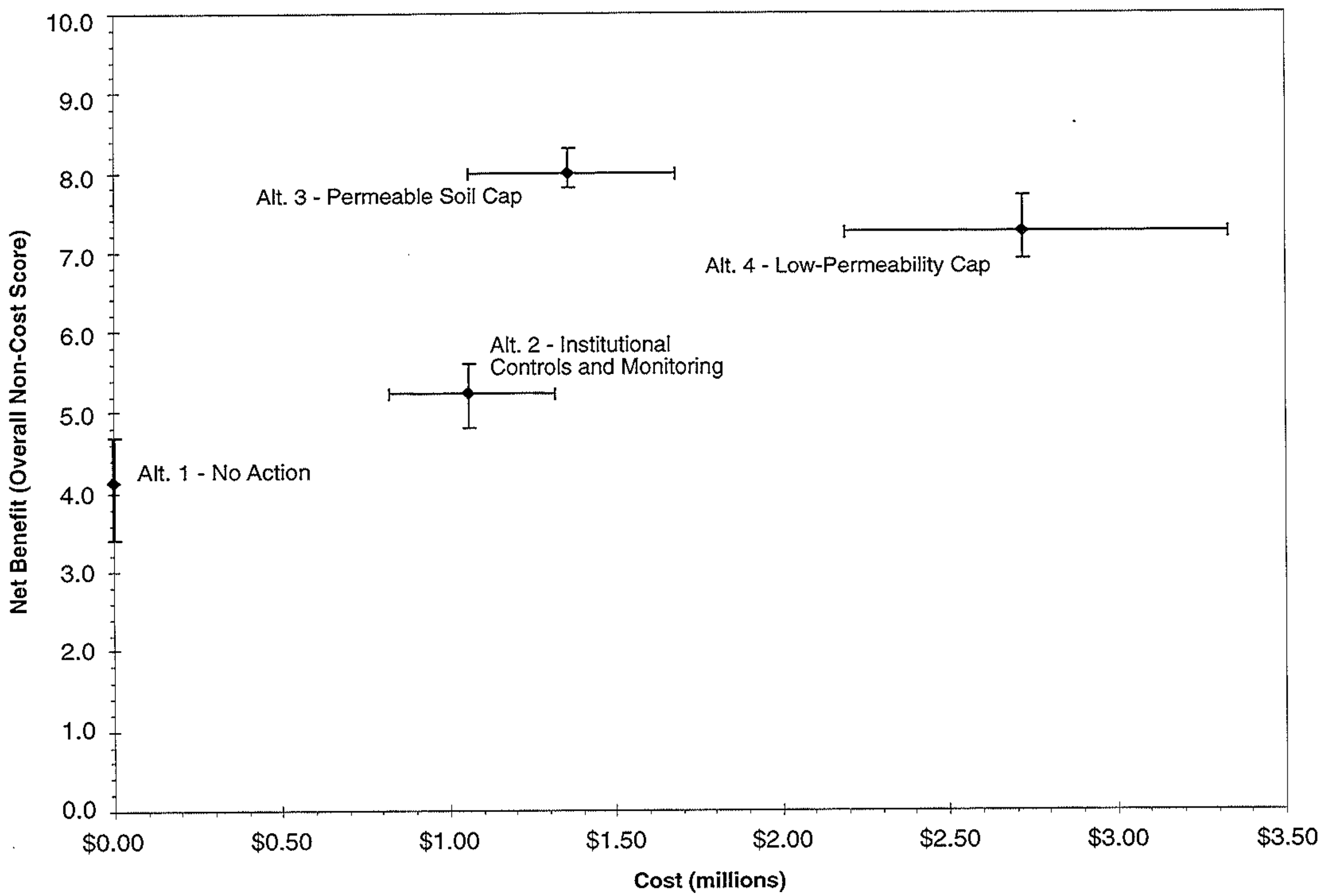


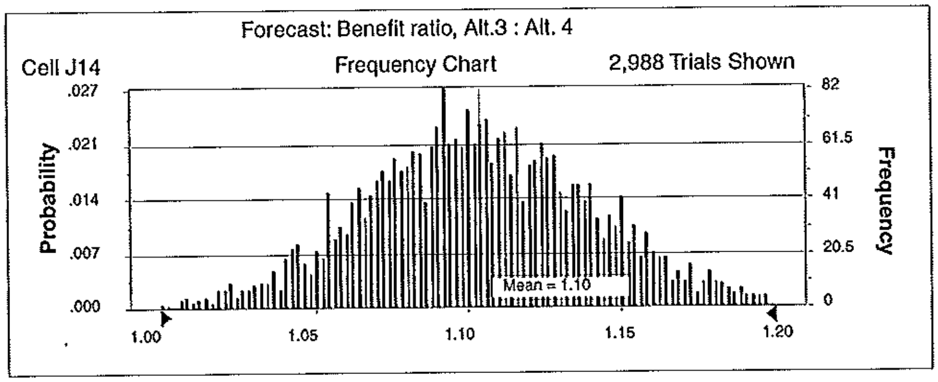
FIGURE **8-1**

COST VS. BENEFIT FOR ALTERNATIVES

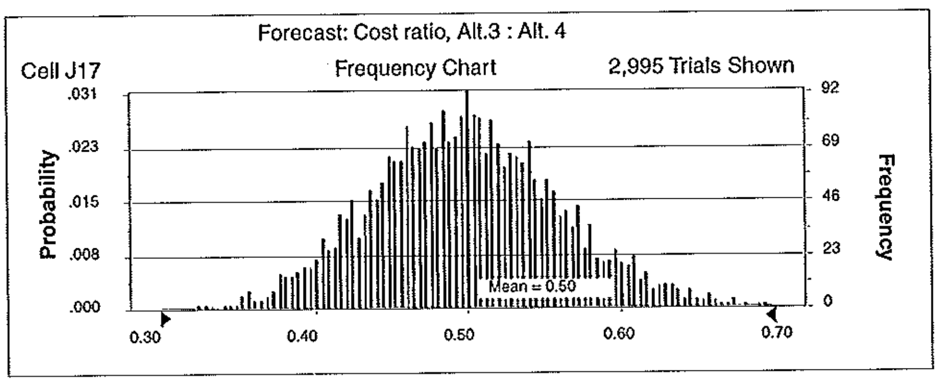
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 55881 DATE 2/13/96 DRAWN BY CB

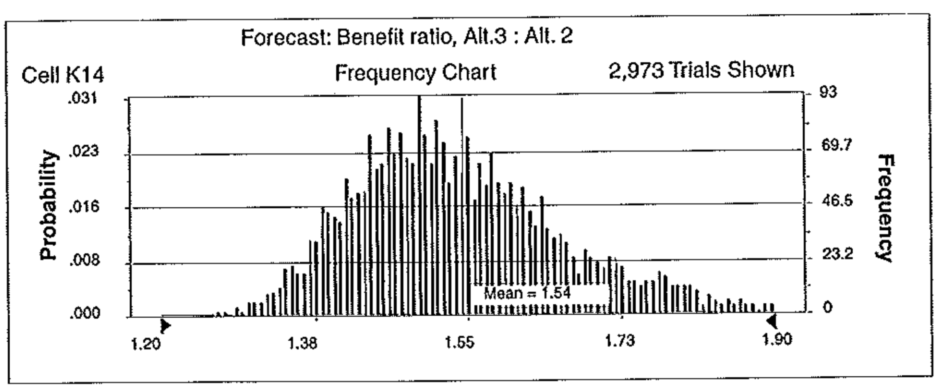
Golder Associates



Net Benefit Ratio
Alternative 3 (Permeable Soil Cap) : Alternative 4 (Low-Permeability Cap)



Cost Ratio
Alternative 3 (Permeable Soil Cap) : Alternative 4 (Low-Permeability Cap)



Net Benefit Ratio
Alternative 3 (Permeable Soil Cap) : Alternative 2 (Institutional Controls and Monitoring)

FIGURE **8-2**
NET BENEFIT AND COST RATIOS
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 55882 DATE 2/13/96 DRAWN BY CB

Golder Associates

APPENDIX A

NORSELAND SITE CONDITIONS QUESTIONNAIRE RESPONSE SUMMARY

Norseland Site Condition Questionnaire
Response Summary
Norseland Mobile Estates
November 2, 1994

Section I: Air Quality

Do you ever smell odors at the address given above?

Norseland Residents		Non-Norseland Respondants
Yes	50	11
No	28	2

Can you describe the odor?

Norseland Residents		Non-Norseland Respondants
Ammonia	2	1
Bleach-like	0	2
Burnt Plastic	0	1
Burnt Rubber	0	2
Chemical	3	1
Chlorine	2	0
Cow Manure	2	0
Earthy	1	0
Floral	1	0
Garbage	16	6
Moldy	5	1
Natural Gas	9	4
Oil Field	4	0
Oily or Gassy	14	1
Rotten Eggs	7	1
Sewer	4	3
Solvent-like	8	1
Sour	0	2
Sulfurous	9	2
Sweet	1	0

Response/Reaction to Perceived Odor

Norseland Residents		Non-Norseland Respondants
Acrid	2	0
Burning	0	2

Choking	4	3
Irritating	6	3
Headaches	8	1
Nauseating	11	4
Pungent/Putrid	14	4
Rancid	1	3
Sharp	3	1
Sickening	9	5
Suffocating	3	1
Unpleasant	20	6

Do you notice the odor more during a particular time of year?

Norseland Residents		Non-Norseland Respondants
Winter	26	11
Spring	21	9
Summer	15	5
Fall	29	10

Do you notice the odor more during a particular weather condition?

Norseland Residents		Non-Norseland Respondants
Windy	4	2
Rainy	13	1
Hot	3	2
Breezy	9	3
Foggy	28	8
Warm	6	4
Still	21	8
Clear	6	1

Wind	
NE	1
SW	1
Breeze	
S	2
SW	1
W	2
NW	1
NE	1

Is there a particular time of day when you most frequently notice the odor?

Norseland Residents		Non-Norseland Respondants
Early Morning	40	11
Mid Morning	13	8
Mid Day	3	2
Afternoon	3	2
Evening	9	2
Night	18	1

How frequently do you smell these odors?

Norseland Residents		Non-Norseland Respondants
Every day	1	2
Every few days	7	3
Every week	1	0
Several times a montl	18	6
Every few months	0	0
Infrequently	23	0

Do you notice different odors on different occasions?

Norseland Residents		Non-Norseland Respondants
Yes	10	1
No	36	10

Do you notice different odors at different places on the same occasion?

Norseland Residents		Non-Norseland Respondants
Yes	12	1
No	32	10

How long does the odor generally last?

Norseland Residents		Non-Norseland Respondants
Seconds	3	0
Minutes	25	0
Hours	10	8
Days	1	1
Varies	23	6

Where do you unsually notice the odor?

Norseland Residents		Non-Norseland Respondants
Indoors	11	4
Outdoors	48	11

How intense is the odor?

Norseland Residents		Non-Norseland Respondants
No perception	1	0
Very faint	16	0
Easily noticeable	20	7
Strong	20	7
Overpowering	13	6
Varies	25	1

Note: Those who answered question 1 "Do you smell odors," in the negative typically did not continue the questionnaire, therefore "No perception" is underrepresented.

Section II: Ground Stability (Norseland Only)

Has your sidewalk, driveway, yard, or the street in front of your house cracked or settled?

Yes	13
No	58

When did you first notice these cracks or settlements?

When first moved in	4
Last 6-8 months	1
Last year	2
Two years ago	1
Eight years ago	2
Several years ago	2

Have these cracks or settlements been increasing or changing in size or shape since first noticed?

Yes	6
No	8

Has your home needed re-leveling since you moved into Norseland Mobile Estates?

Yes	27
No	42

How often has your home been leveled?

Once per month	1
Once per quarter	0
Twice per year	1
Once per year	5
Every several years	9
Less often	21

Has a particular side or corner of your home required leveling more than the other sides?

Yes	17
No	23

Have you noticed any ground settlement, other than identified above, on or near your home?

Yes	10
No	56

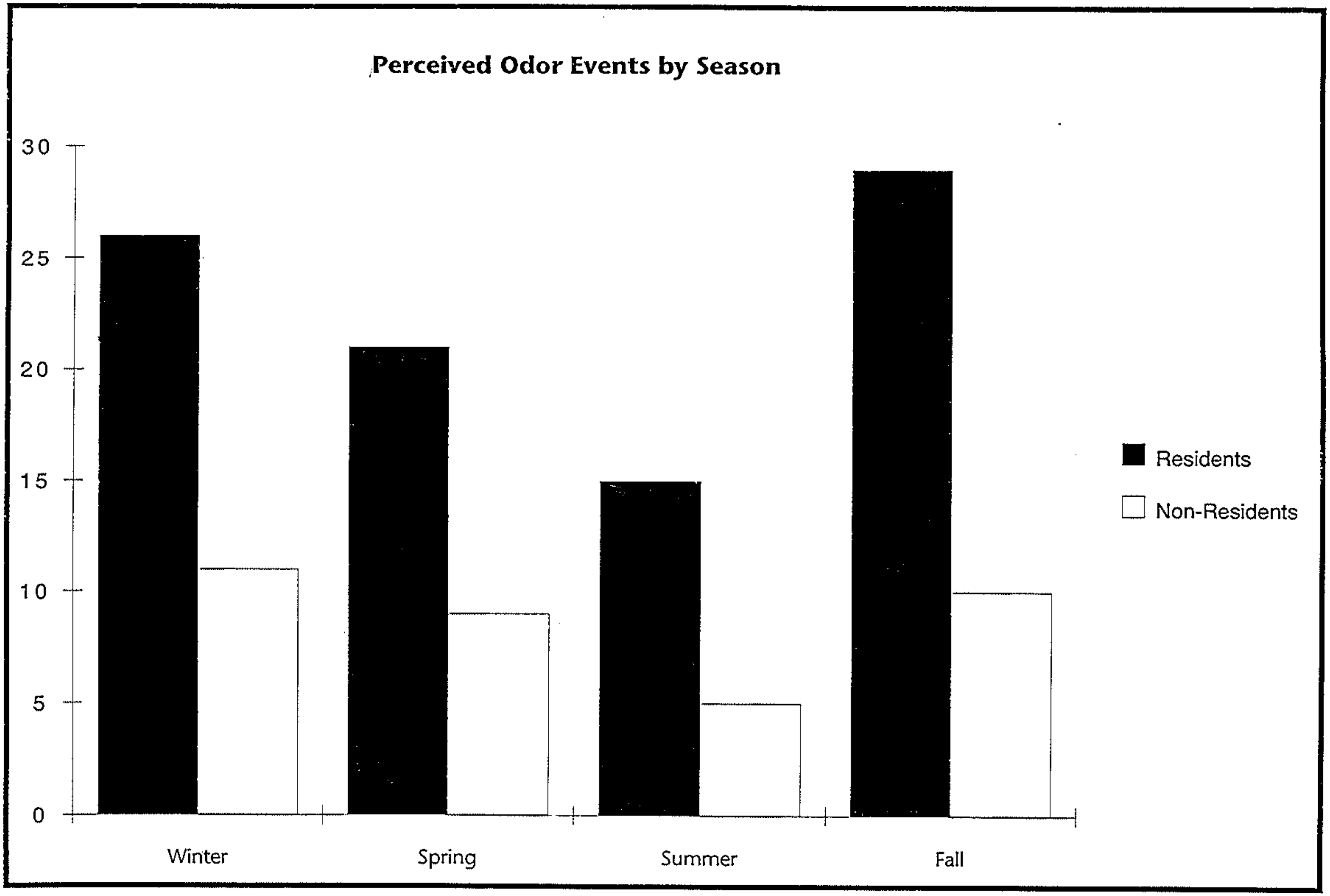
Section III: Sanitary Waste (Norseland Only)

Have you ever had any difficulties with your sewer or septic tank connection?

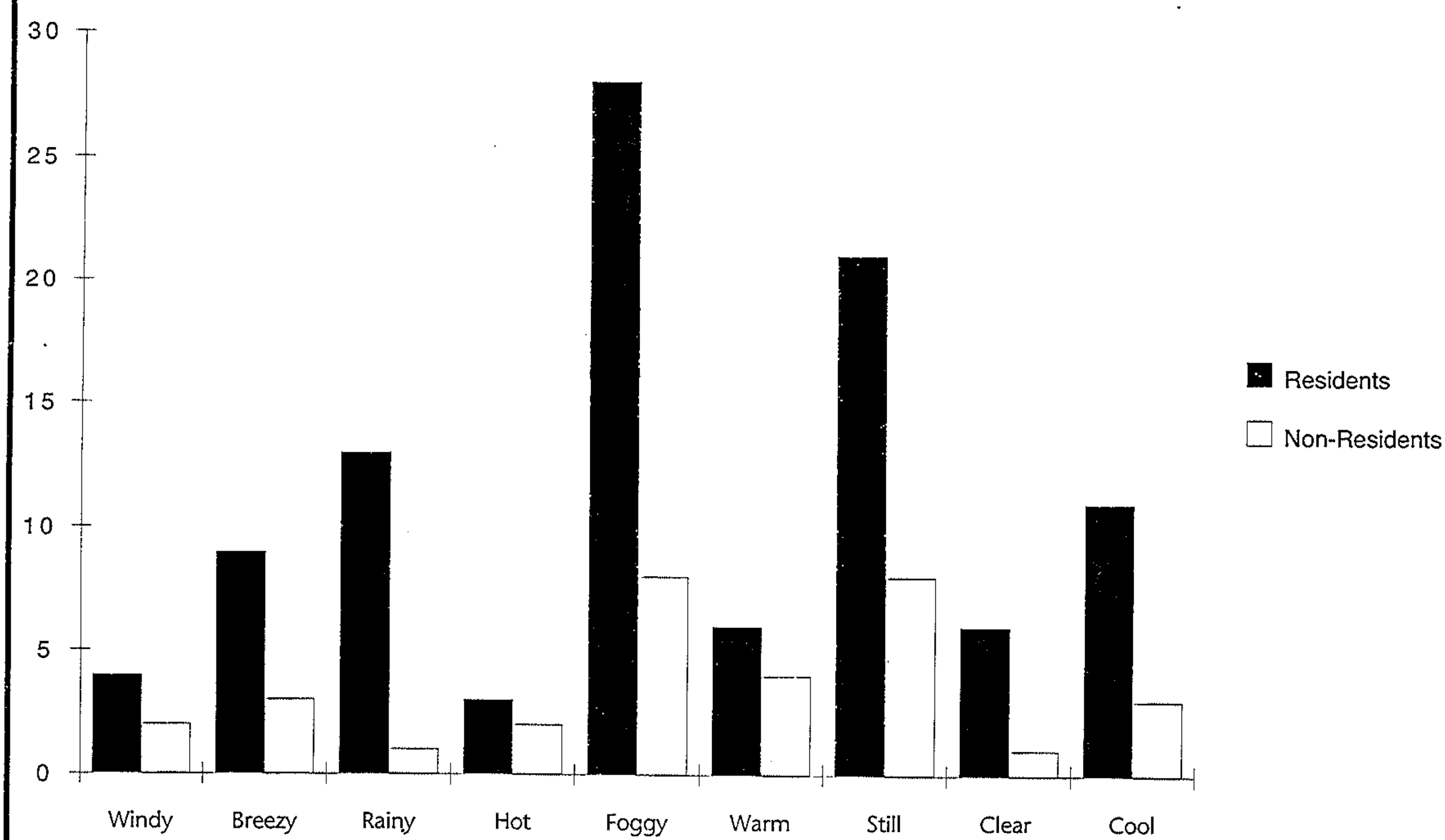
Yes	8
No	69

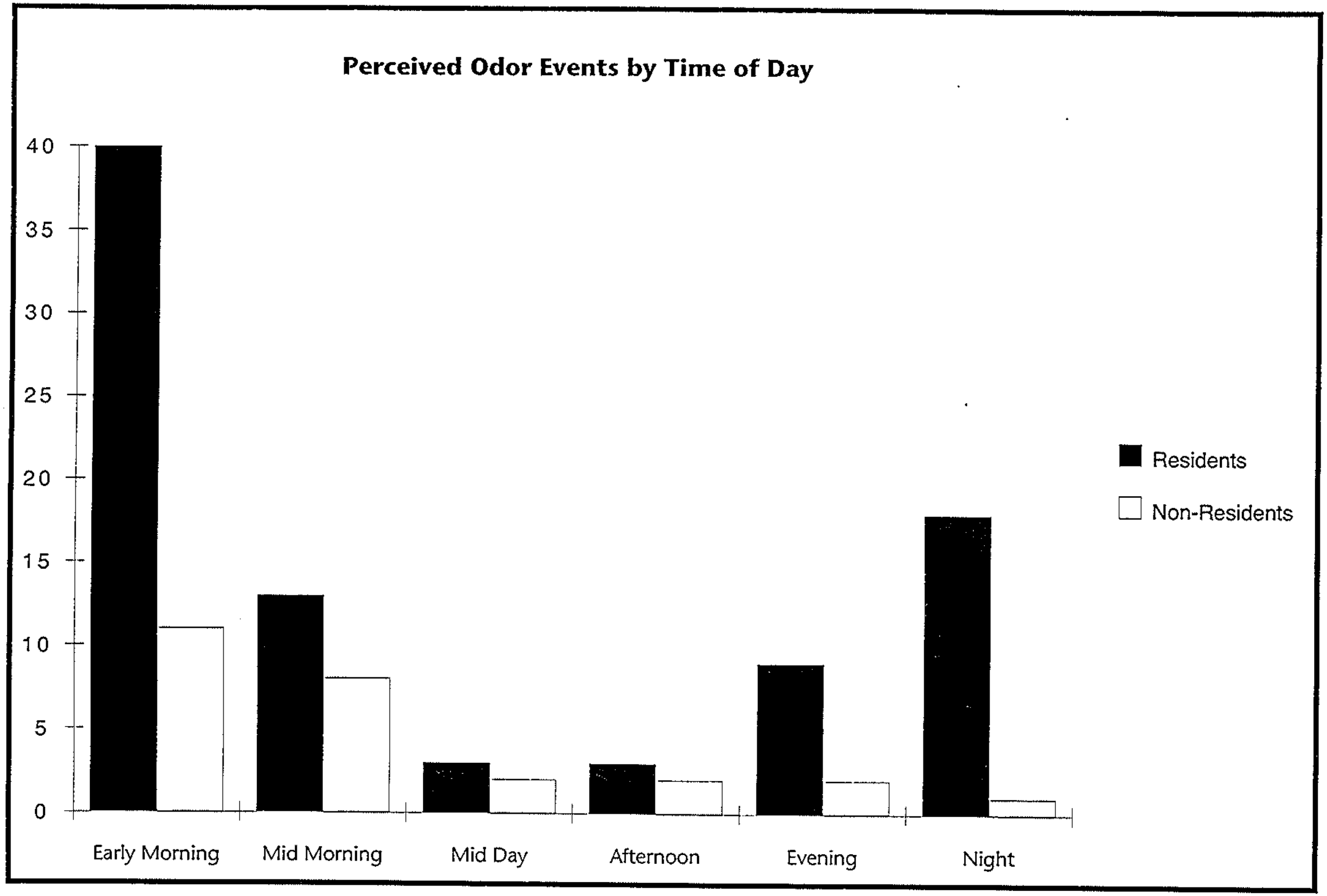
Do you know of any other difficulties with sewers or septic systems at Norseland Mobile Estates?

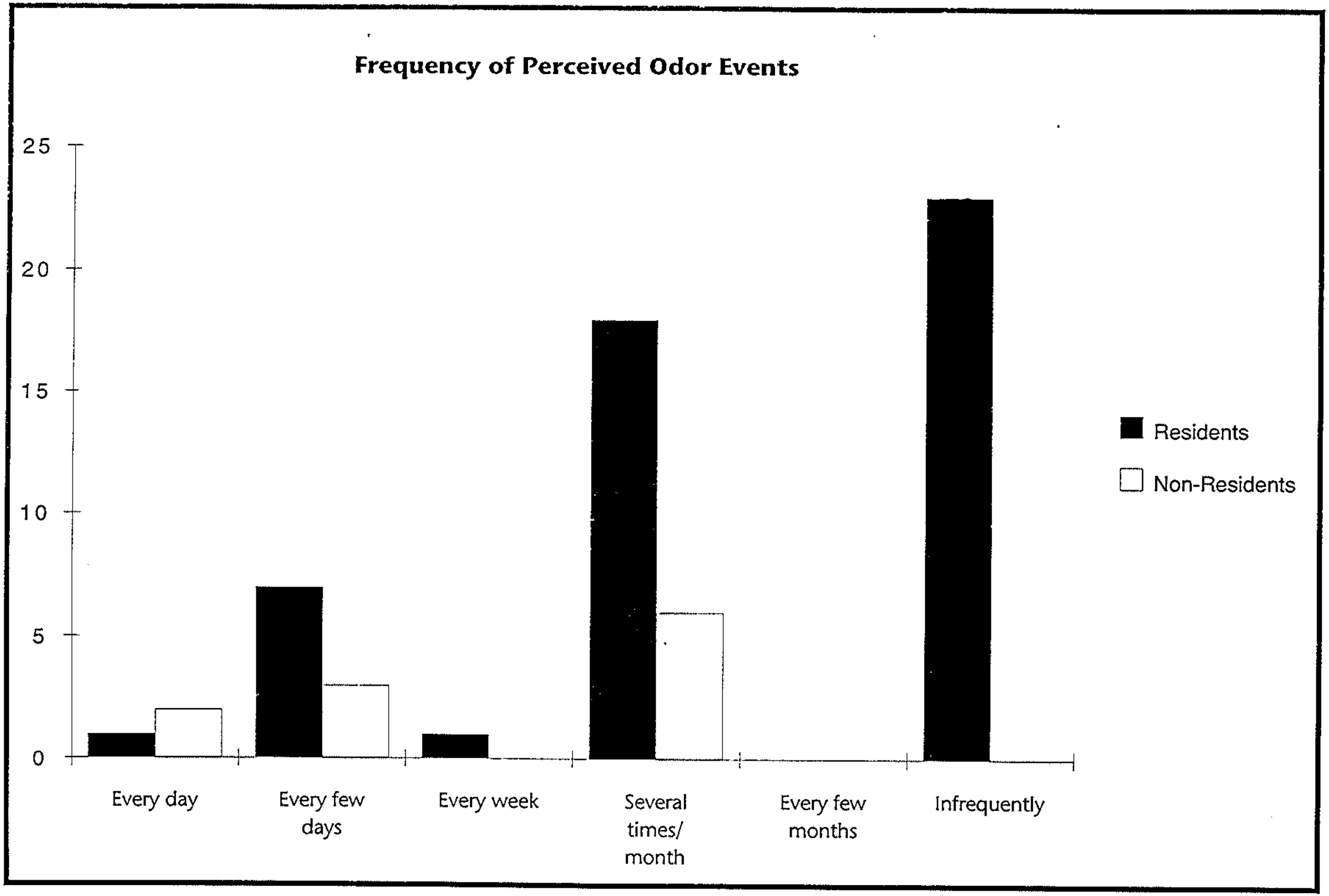
Yes	30
No	45


Perceived Odor Events by Season
30
25
20
15
10
5
0
Winter
Spring
Summer
Fall
Residents
Non-Residents

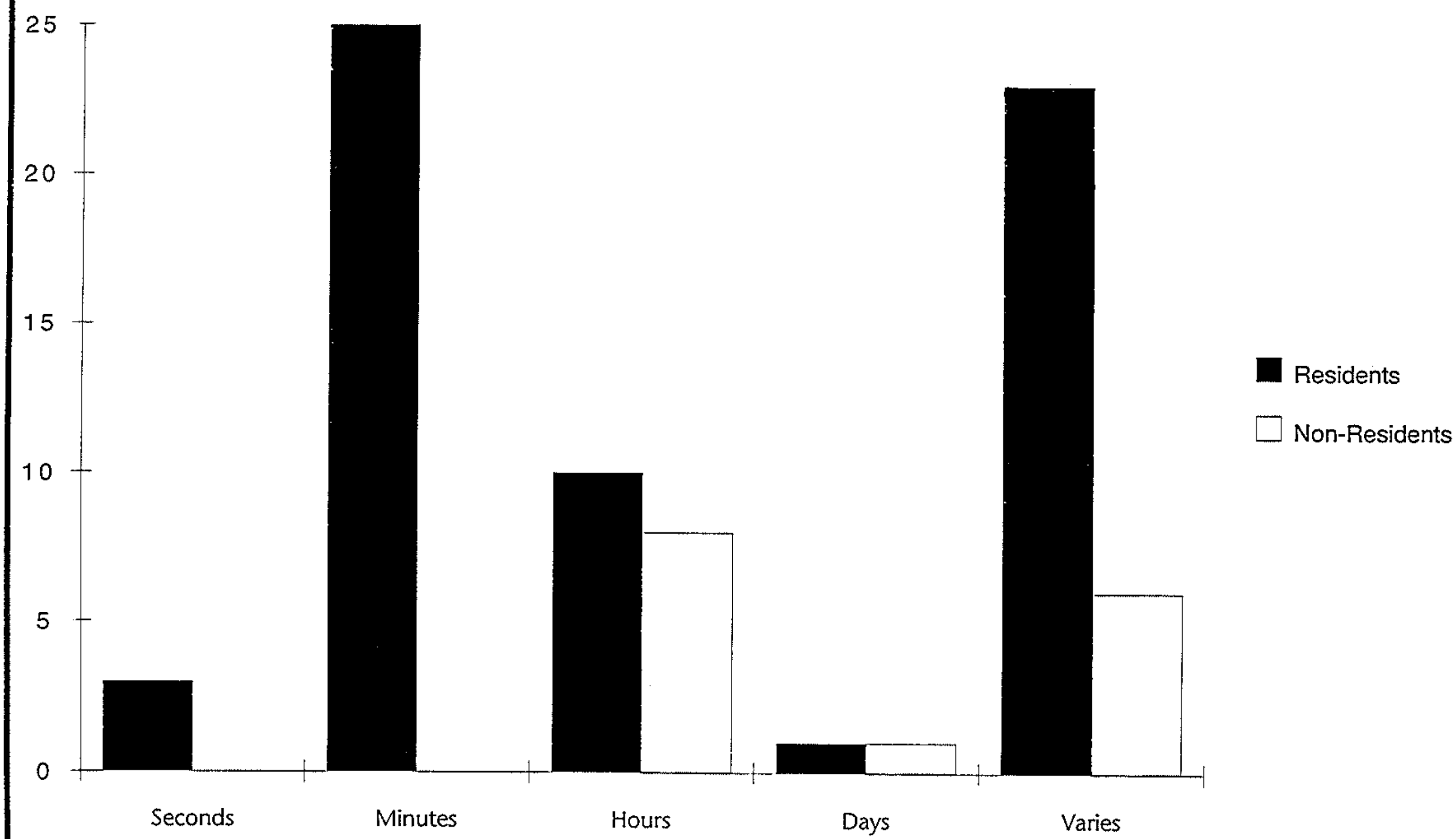
Perceived Odor Events by Weather Condition

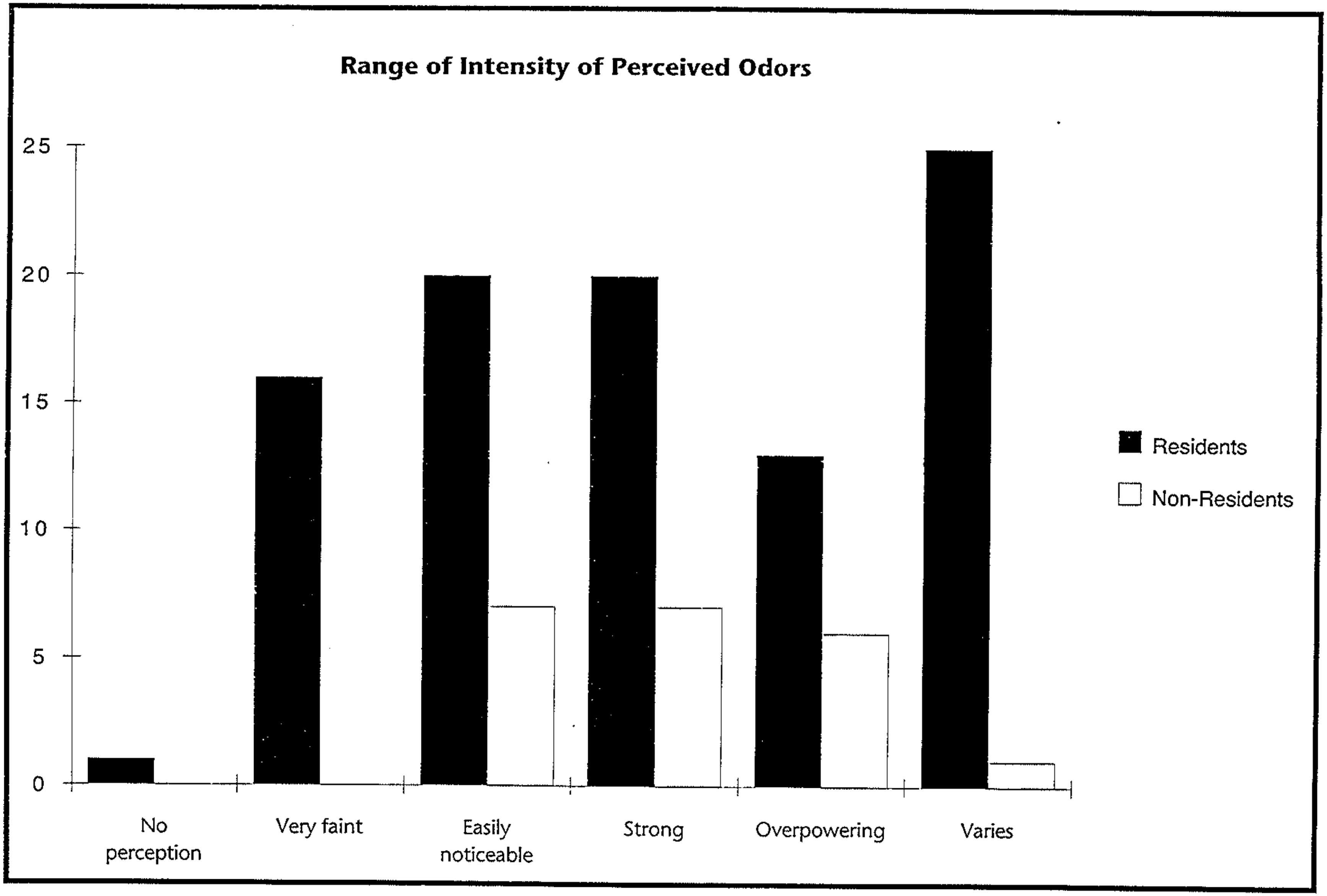


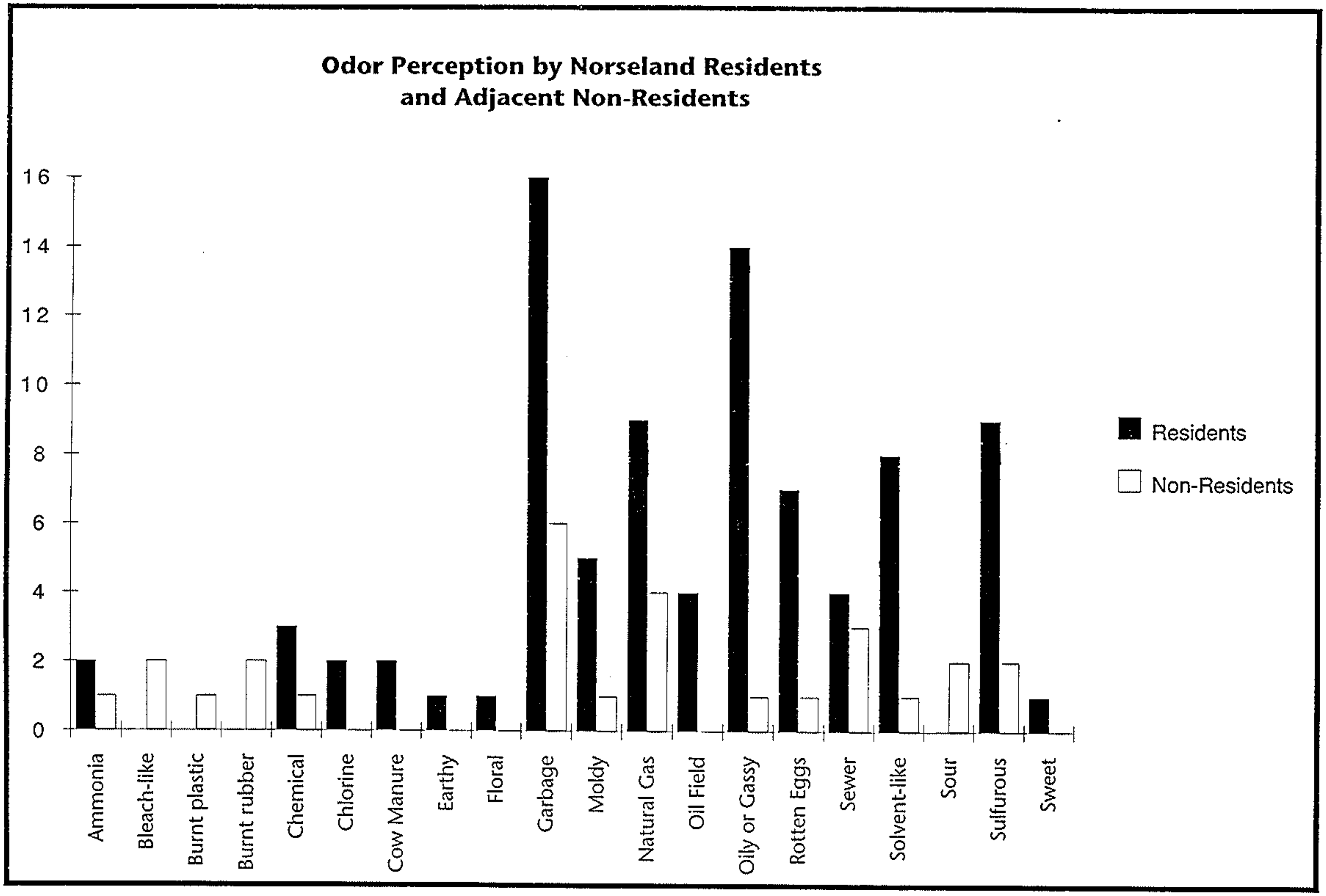

Perceived Odor Events by Time of Day
40
35
30
25
20
15
10
5
0
Early Morning
Mid Morning
Mid Day
Afternoon
Evening
Night
Residents
Non-Residents

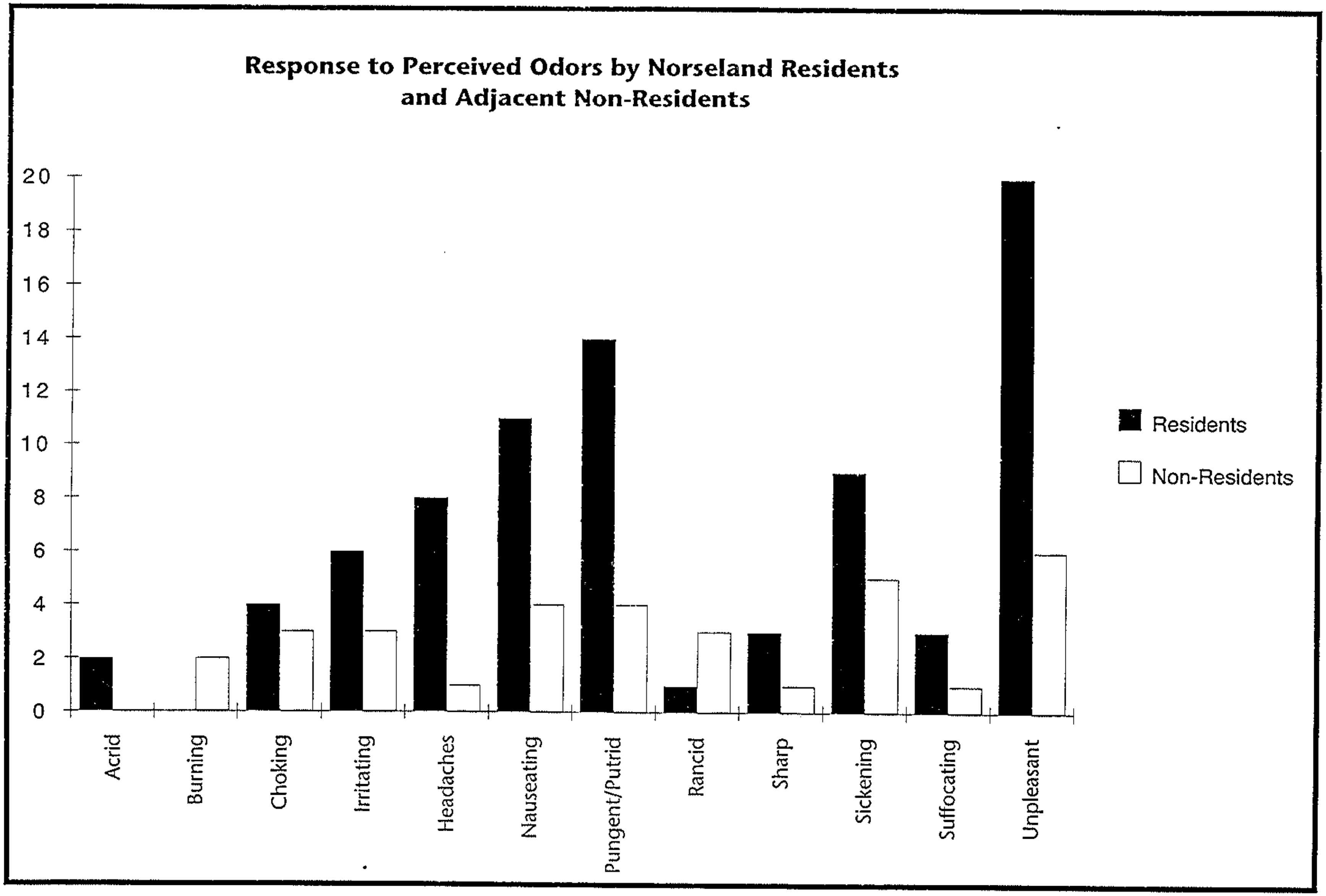

Frequency of Perceived Odor Events
25
20
15
10
5
0
Every day
Every few days
Every week
Several times/ month
Every few months
Infrequently
Residents
Non-Residents

Duration of Perceived Odor Events

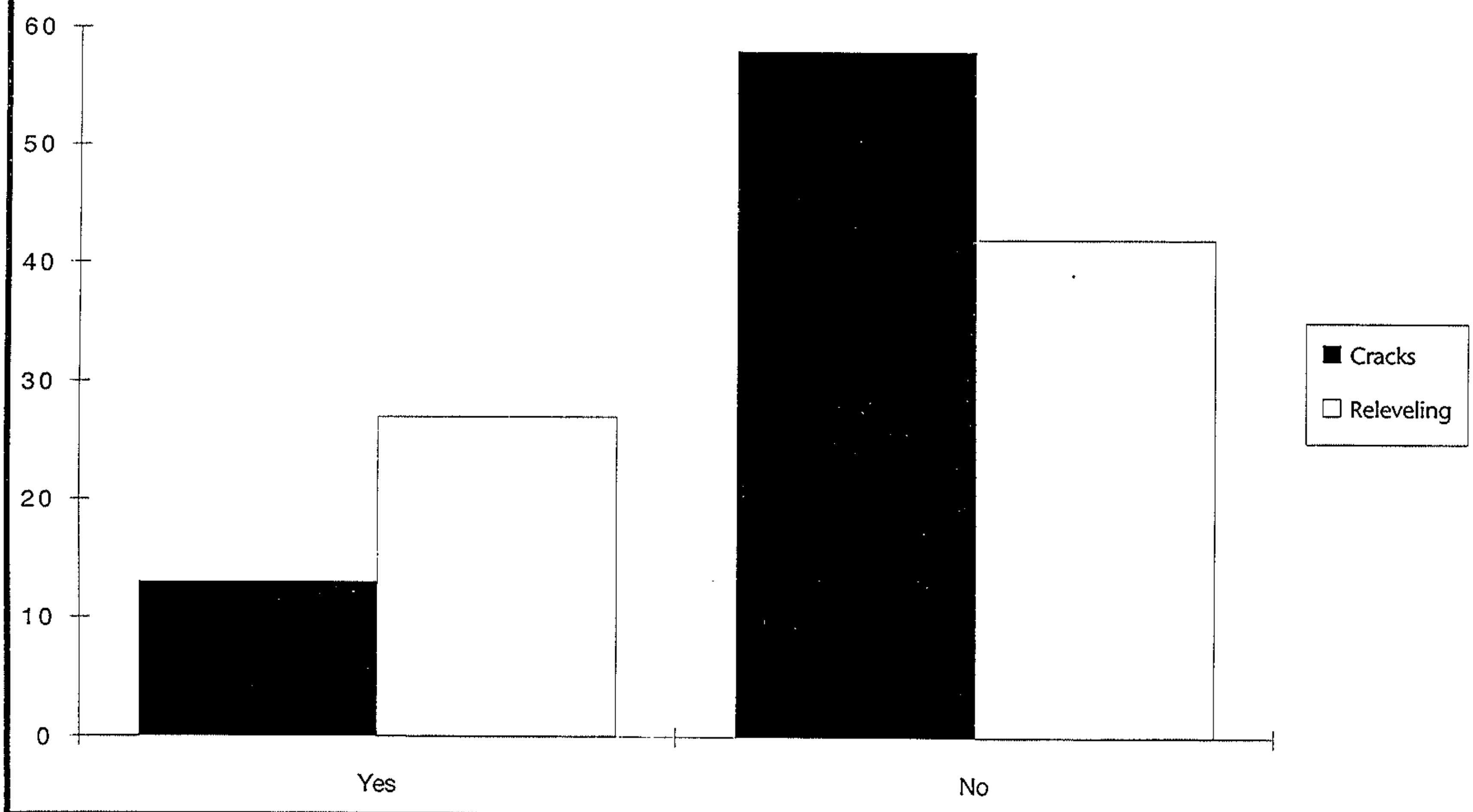


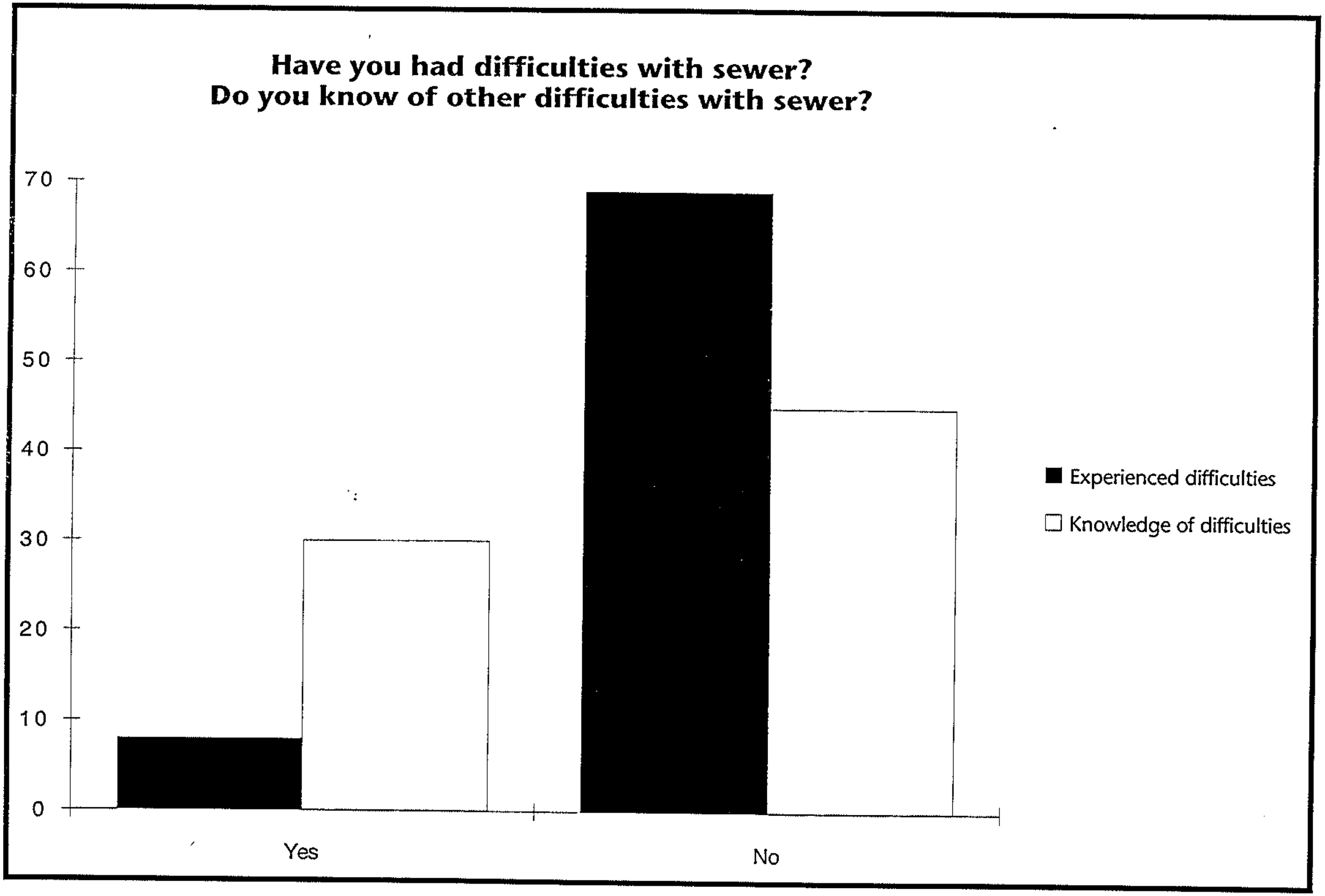

Range of Intensity of Perceived Odors
25
20
15
10
5
0
No perception
Very faint
Easily noticeable
Strong
Overpowering
Varies
Residents
Non-Residents


Odor Perception by Norseland Residents
and Adjacent Non-Residents
16
14
12
10
8
6
4
2
0
Ammonia
Bleach-like
Burnt plastic
Burnt rubber
Chemical
Chlorine
Cow Manure
Earthy
Floral
Garbage
Moldy
Natural Gas
Oil Field
Oily or Gassy
Rotten Eggs
Sewer
Solvent-like
Sour
Sulfurous
Sweet
Residents
Non-Residents


Response to Perceived Odors by Norseland Residents
and Adjacent Non-Residents
20
18
16
14
12
10
8
6
4
2
0
Acrid
Burning
Choking
Irritating
Headaches
Nauseating
Pungent/Putrid
Rancid
Sharp
Sickening
Suffocating
Unpleasant
Residents
Non-Residents

Has your sidewalk, etc., cracked or settled?
Has your home needed releveling?




Have you had difficulties with sewer?
Do you know of other difficulties with sewer?
70
60
50
40
30
20
10
0
Yes
No
Experienced difficulties
Knowledge of difficulties

APPENDIX B

SURVEY DATA

KITSAP COUNTY
DEPARTMENT OF PUBLIC WORKS
614 Division St., (MS-26), Port Orchard, WA 98366-4699

RANDY W. CASTEEL, P.E.
Director / County Engineer

RECEIVED
JUN 30 1994
Golder Associates

June 7, 1994

Golder Associates Inc.
4104-148th Avenue N.E.
Redmond, WA 98052

Re: Norsland Mobile Home Park
Attn: Mike Lubrecht

Dear Mike.

Following is a list of coordinates for the points identified by your maps at the Norsland Mobile Home Park. All coordinates are Washington State Plane, North Zone and elevations are NGVD 1929. The values, when possible, were obtained by direct differential GPS. Points unable to receive satellite transmissions were calculated by distance-distance intersection calculations from two GPS observed points nearby.

Point id	Northing	Easting	Elevation
SV-31	186215.741	1161459.088	454.621
SV-38	186154.130	1161594.761	454.092
SV-33	186224.964	1161651.449	454.603
SV-14	186553.033	1161685.984	440.930
SV-10	186651.105	1161691.248	438.774
GPR-10	186617.485	1161743.221	440.989
SV-11	186599.396	1161775.218	443.916
GPR-8	186760.728	1161882.373	444.604
SV-54	187066.922	1161967.178	444.294
SV-1	187027.106	1162003.524	449.837
SV-55	186927.000	1162002.477	450.668
SV-53	187123.273	1162052.428	447.961
TBM-1	187084.422	1162121.423	454.623
TBM-10	185564.570	1161142.300	440.773
SV-49	185760.521	1161177.349	436.288
SV-48	185882.747	1161055.324	417.778
TBM-19	185827.224	1161017.113	417.409
SV-47	185993.650	1161161.604	421.454

TBM-7	186121.666	1161083.826	415.279
SV-8	186320.156	1161075.984	410.546
SV-26	186280.003	1161182.867	413.340
SV-18	186370.399	1161210.102	412.918
TBM-17	186402.071	1161190.875	412.087
SV-19	186415.388	1161232.555	412.155
TBM-18	186470.532	1161106.216	408.778
SV-16	186505.684	1161235.984	413.415
SV-15	186557.567	1161259.126	412.931
TBM-16	186598.402	1161230.260	412.370
SV-7	186602.227	1161170.943	411.162
TBM-G2	186814.481	1161317.716	410.692
SV-4	186851.635	1161413.076	413.160
TBM-12	186976.560	1161363.276	408.158
TBM-13	186885.908	1161654.066	419.347
SV-5	186784.822	1161702.985	423.296
SV-6	186767.688	1161615.741	421.257
TBM-14	186697.062	1161596.274	421.651
SV-9	186690.956	1161472.700	417.064
SV-15	186564.362	1161541.418	425.744
TBM-15	186473.802	1161466.546	418.165
SV-21	186466.786	1161483.023	418.107
TBM-6	186469.396	1161690.378	444.512
SV-22	186409.017	1161709.025	446.333
SV-28	186336.415	1161707.562	453.420
SV-32	186289.651	1161575.955	453.778
SV-27	186305.646	1161428.220	445.858
SV-30	186273.973	1161328.969	445.067
SV-41	186128.098	1161289.974	441.539
SV-42	186020.666	1161439.579	446.963
TBM-9	185990.482	1161417.467	441.622
SV-44	185989.059	1161322.754	437.902
GRP-16	185788.154	1161331.536	440.740
GPR-14	185967.833	1161549.222	457.119
GPR-15	185781.981	1161441.345	461.446
GPR-12	186062.706	1161545.263	455.922
SV-43	186071.079	1161486.119	453.952
SV-37	186149.933	1161528.786	455.409
SV-36	186183.192	1161344.684	452.471
TBM-2	186985.635	1162217.840	466.359
SV-3	186829.849	1162115.790	466.393
TBM-4	186566.285	1162089.427	474.186
TBM-5	186746.425	1161989.820	455.344
SV-2	186887.895	1162260.002	472.333
GPR-7	186945.465	1162305.711	473.609

GPR-6	186310.921	1162024.443	475.627
TBM-7	186357.074	1161924.800	471.798
SV-24	186462.776	1162049.338	475.315
SV-12	186509.269	1161948.660	469.148
SV-23	186427.333	1161877.044	463.312
GPR-11	186419.306	1161826.543	458.384
SV-16	186462.894	1161775.503	451.142
SV-13	186284.624	1161851.505	472.226
SV-29	186184.412	1161767.125	466.291
SV-34	186158.637	1161754.873	466.119
SV-35	186202.995	1162021.983	472.875
SV-39	186174.139	1162065.178	466.637
GPR-3	186279.783	1162254.772	462.426
TBM-3	186367.013	1162281.464	467.846
GPR-5	186397.773	1162219.047	473.987
GPR-1	186154.732	1162220.467	459.278
SV-40	186103.100	1162149.800	462.495
TBM-G1	185935.967	1162030.860	465.153
TBM-8	185870.151	1161718.682	474.671
TBM-11	185441.324	1161327.208	462.424
SV-46	185788.258	1161881.879	
GPR-1	185795.752	1161917.201	
TBM-20	186121.666	1161083.826	415.497
SV-45	185926.979	1161572.888	

Should you need any other assistance or have any questions please feel free to call myself or Jeff at Public Works.

Sincerely,

John D. James, PLS
Survey and Mapping

cc: Jeff Frettingham

APPENDIX D

TEST PIT LOGS AND PHOTOS

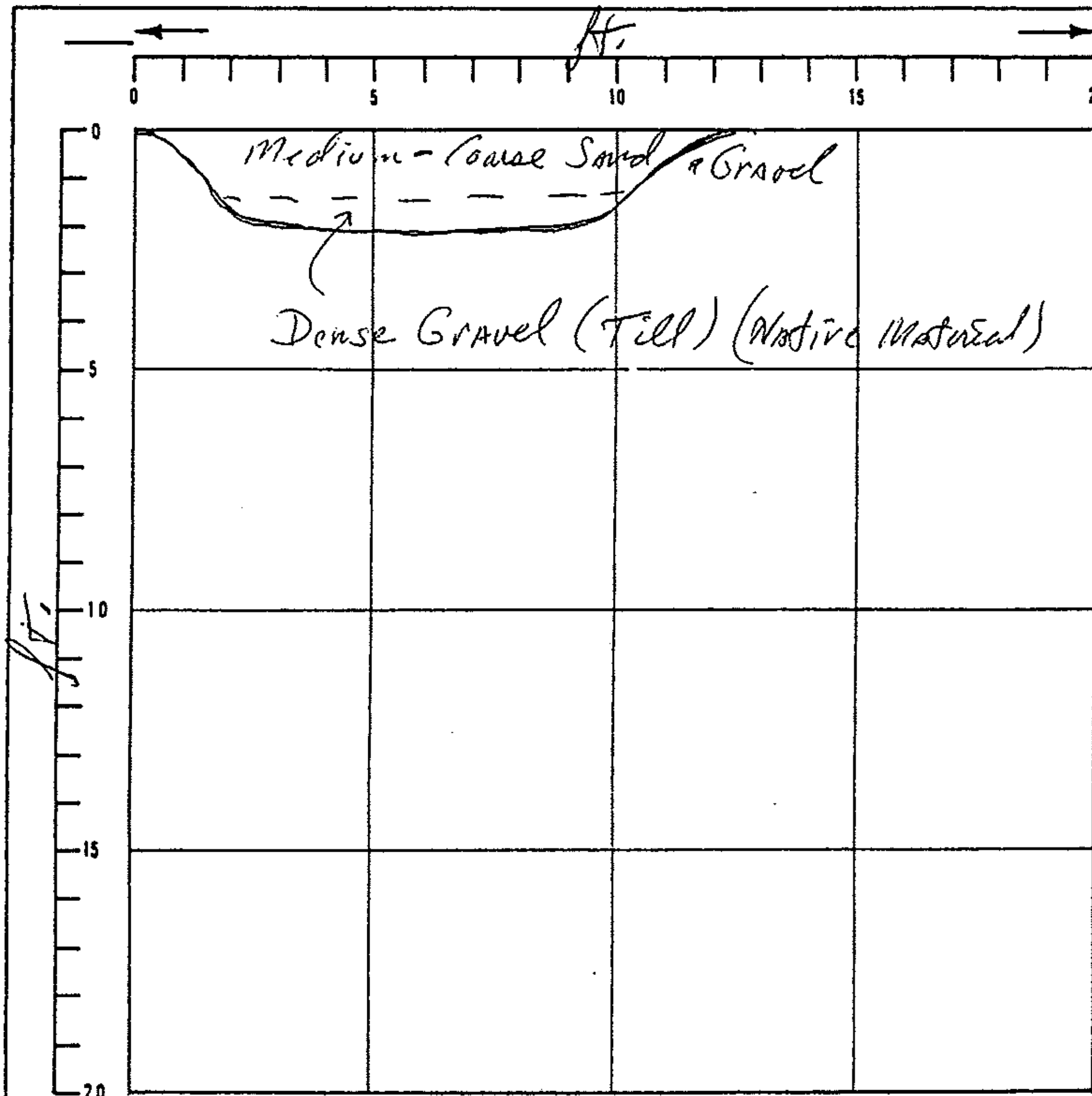
26C

Golder Associates

933-1280.1602

FIELD TEST PIT LOG

TEMP ___ F.	WEATHER	ENGINEER: DJM & Mike Lubrecht	OPERATOR: Geoff Yates	TEST PIT: TP-1	
EQUIPMENT		CONTRACTOR: Yates		DATE: 7/13/94	
LOCATION: Noseland		ELEVATION	DATUM	JOB	



SAMPLES	
NO	DEPTH

SAMPLE DESCRIPTIONS AND EXCAVATION NOTES

TIME	DEPTH OF HOLE	DEPTH TO W/L

SPECIAL NOTES:

OVA = 0 ppm (above background)
H_2S = 0 ppm
O_2 = 21%
LEL = 0%
Alpha = 0 cpm
Beta & Gamma = 20-40 cpm

933-1280.1602

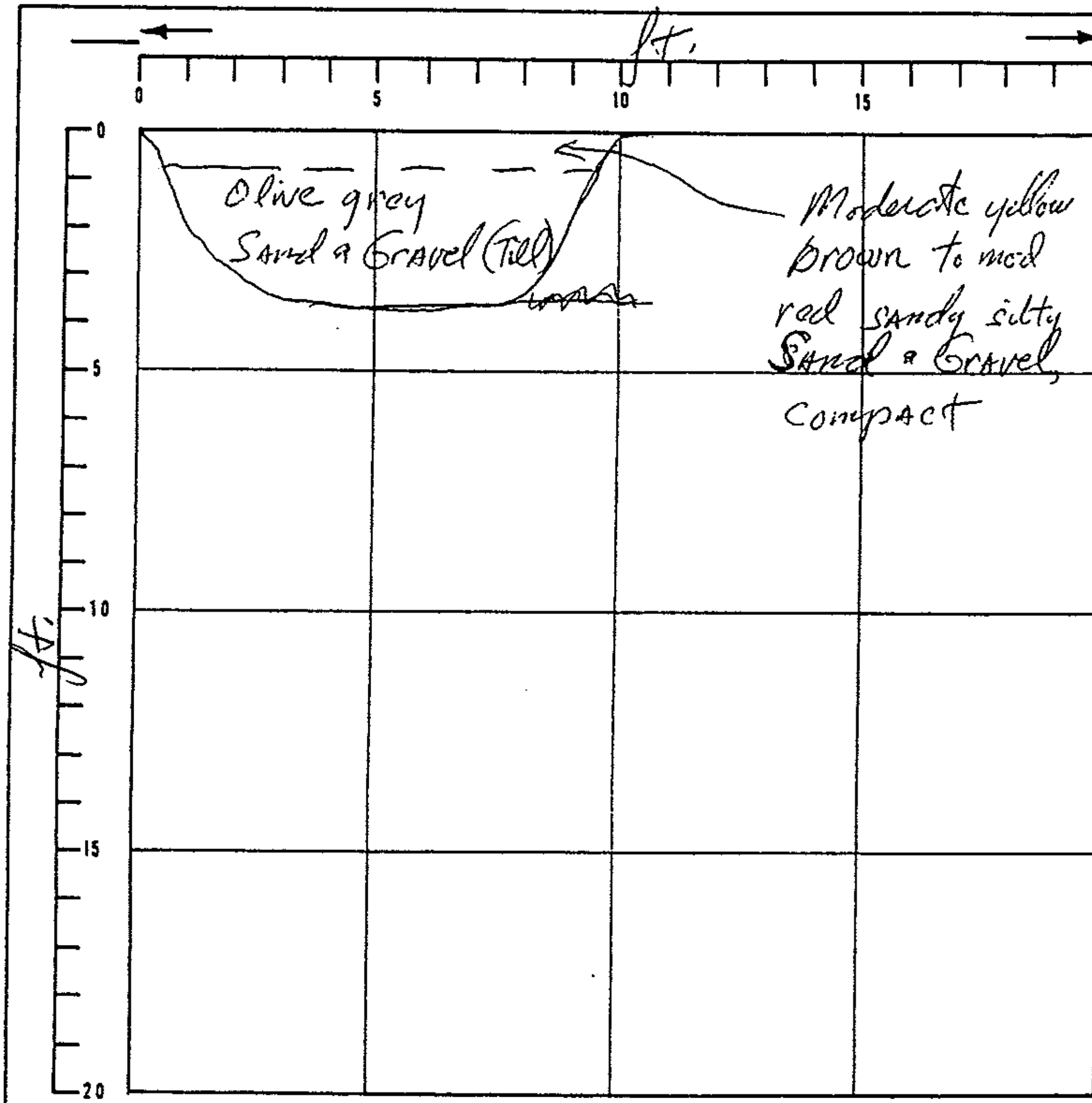
Golder Associates

FIELD TEST PIT LOG

TEMP ___ F. WEATHER ___ ENGINEER DTM & Mike Lubrecht OPERATOR Geoff Yates TEST PIT TP-2

EQUIPMENT ___ CONTRACTOR ___ DATE 7/13/94

LOCATION Norseland ELEVATION ___ DATUM ___ JOB ___



SAMPLES	
NO	DEPTH

SAMPLE DESCRIPTIONS AND EXCAVATION NOTES

TIME	DEPTH OF HOLE	DEPTH TO W/L

SPECIAL NOTES:

OVA = 0 ppm (above background)
H_2S = 0 ppm
O_2 = 21 %
LEL = 0 %
Alpha = 0 cpm
Beta & Gamma = 20-40 cpm

933-1280.1602

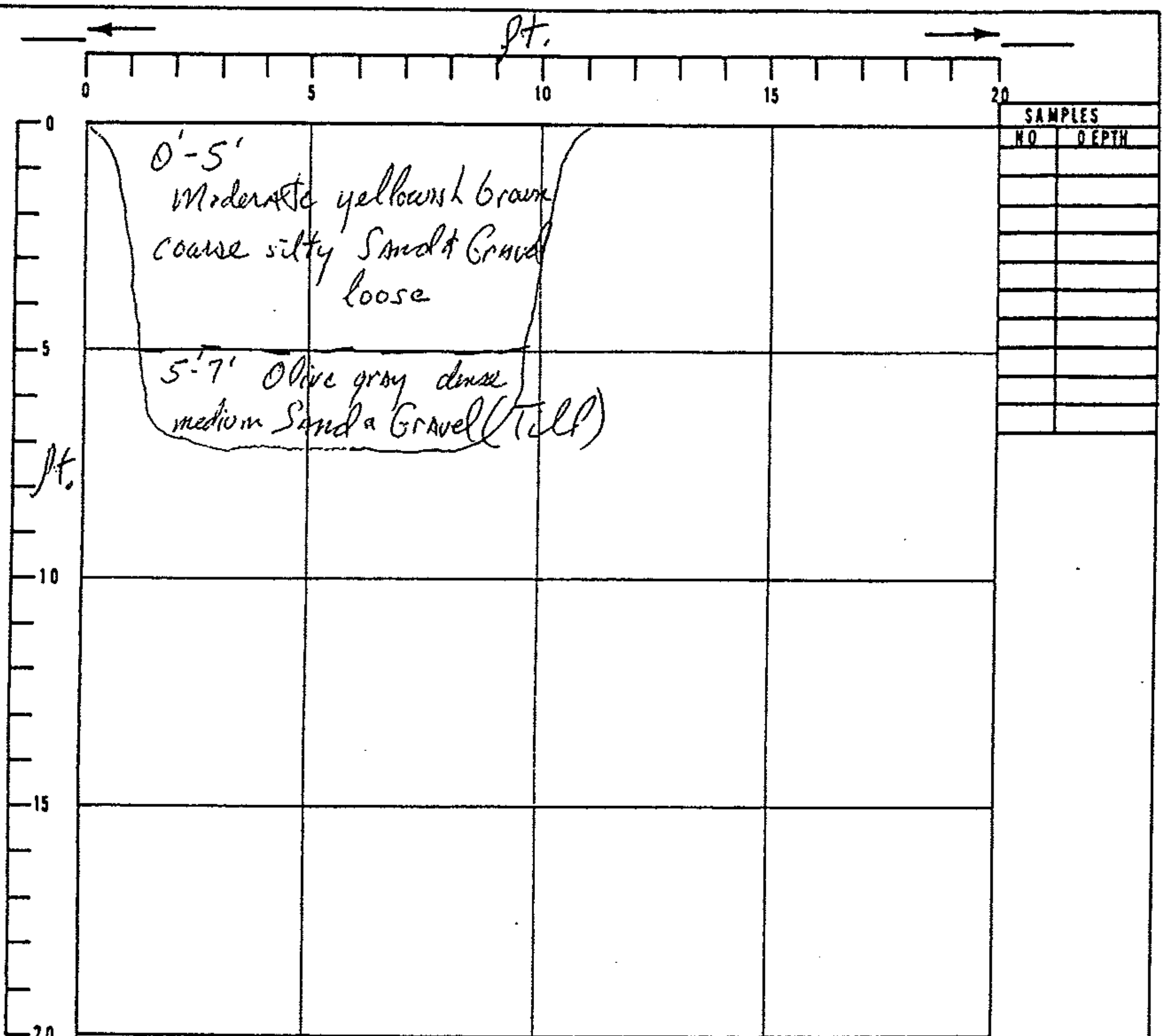
Golder Associates

FIELD TEST PIT LOG

TEMP __ F. WEATHER ______ ENGINEER DJM & Mike Lobrecht OPERATOR Geoff Yates TEST PIT TP-3

EQUIPMENT ______ CONTRACTOR Yates DATE 7/13/94

LOCATION Norseland ELEVATION ______ DATUM ______ JOB ______



SAMPLES	
NO	DEPTH

SAMPLE DESCRIPTIONS AND EXCAVATION NOTES

TIME	DEPTH OF HOLE	DEPTH TO W/L

SPECIAL NOTES:

OVA = 0 ppm above background

H_2S = 0 ppm

O_2 = 21 %

LEL = 0 %

Alpha = 0 cpm (0-5 feet)
= 1 cpm (5-7 feet)

Beta & Gamma = 20-40 cpm (0-5')
= 20-60 cpm (5-7')

933-~~1602~~ 1280.1602

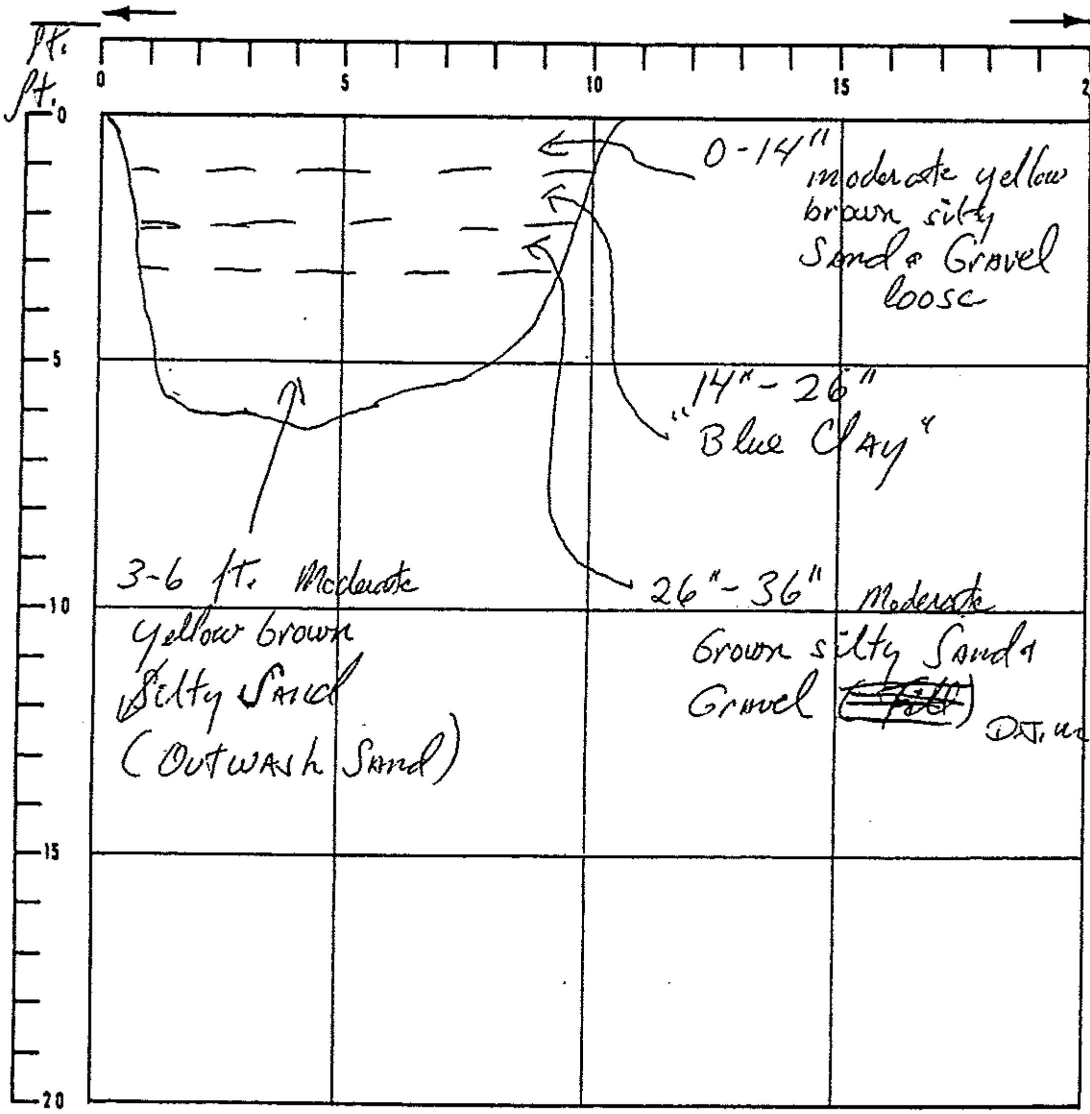
Golder Associates

FIELD TEST PIT LOG

TEMP ___ F. WEATHER ___ ENGINEER DJM & Mike Lubrecht OPERATOR Geoff Yates TEST PIT TP-4

EQUIPMENT ___ CONTRACTOR Yates DATE 7/13/94

LOCATION Nooseland ELEVATION ___ DATUM ___ JOB ___



SAMPLES	
NO	DEPTH

SAMPLE DESCRIPTIONS AND EXCAVATION NOTES

Surface

OVA = 1-2 ppm
O_2 = 20.9 %
H_2S = 0 ppm
LEL = 0 %
Alpha = < 10 cpm
Beta/Gamma = 20-40 cpm

TIME	DEPTH OF HOLE	DEPTH TO W/L

SPECIAL NOTES:

14"-26" and below

OVA = 0-6 ppm
H_2S = 0 ppm
O_2 = 20.9 %
Alpha = < 10 cpm (0-3 cpm)
Beta/Gamma = 30-50 cpm

933-1280.1602

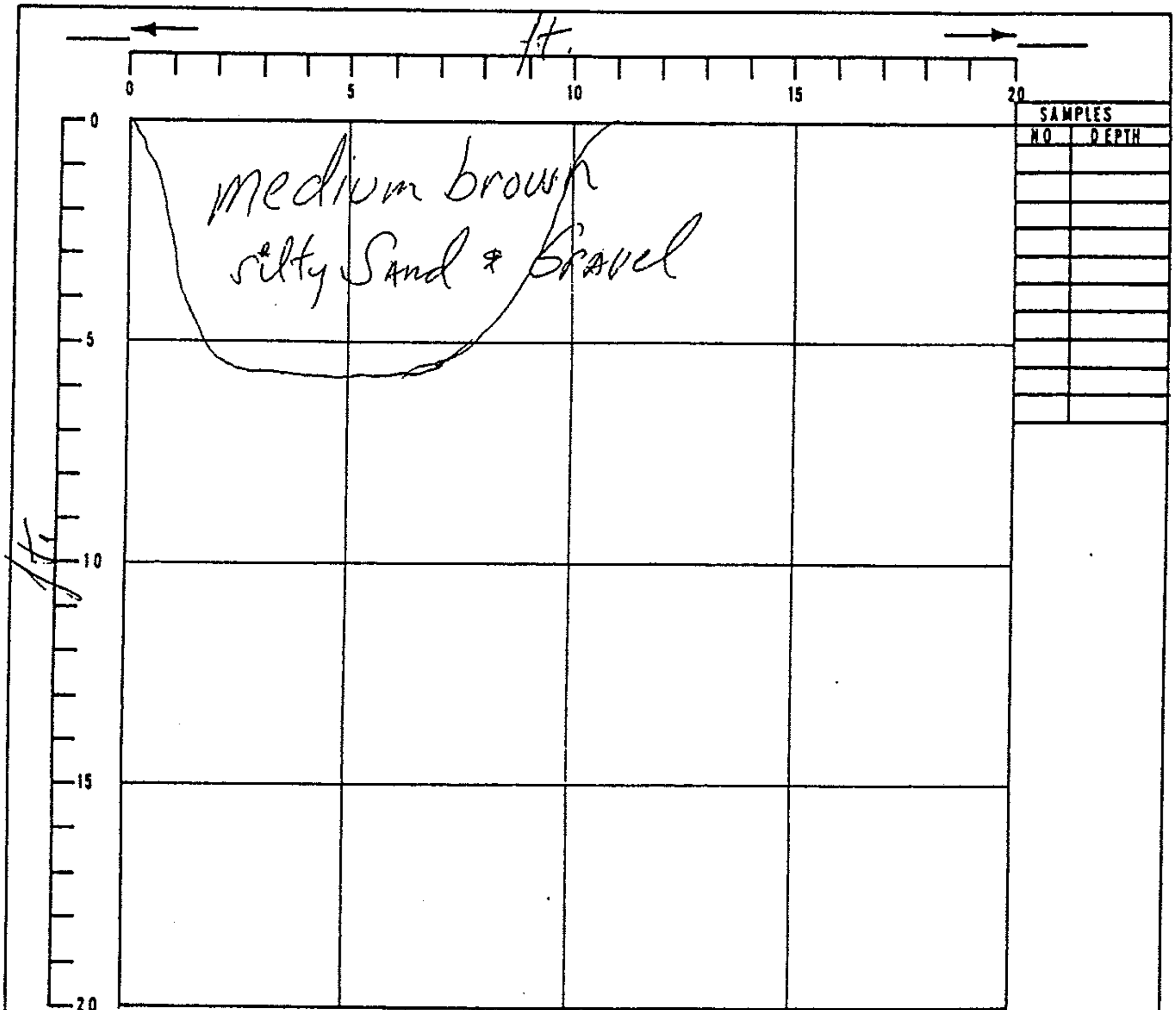
Golder Associates

FIELD TEST PIT LOG

TEMP ___ F. WEATHER ______ ENGINEER DM. & Mike Lubrecht OPERATOR Geoff Yates TEST PIT TP-5

EQUIPMENT ______ CONTRACTOR Yates DATE 7/13/94

LOCATION Norsaland ELEVATION ______ DATUM ______ JOB ______



SAMPLE DESCRIPTIONS AND EXCAVATION NOTES
OVA drifting due to exhaust. Recalibrated and zeroed the instrument for background

TIME	DEPTH OF HOLE	DEPTH TO W/L

SPECIAL NOTES: All Depths

OVA = 8 ppm
H_2S = 0 ppm
O_2 = 21%
LEL = 0%
Alpha = 1 to 0 cpm (<1 cpm)
Beta/Gamma = 20-30 cpm

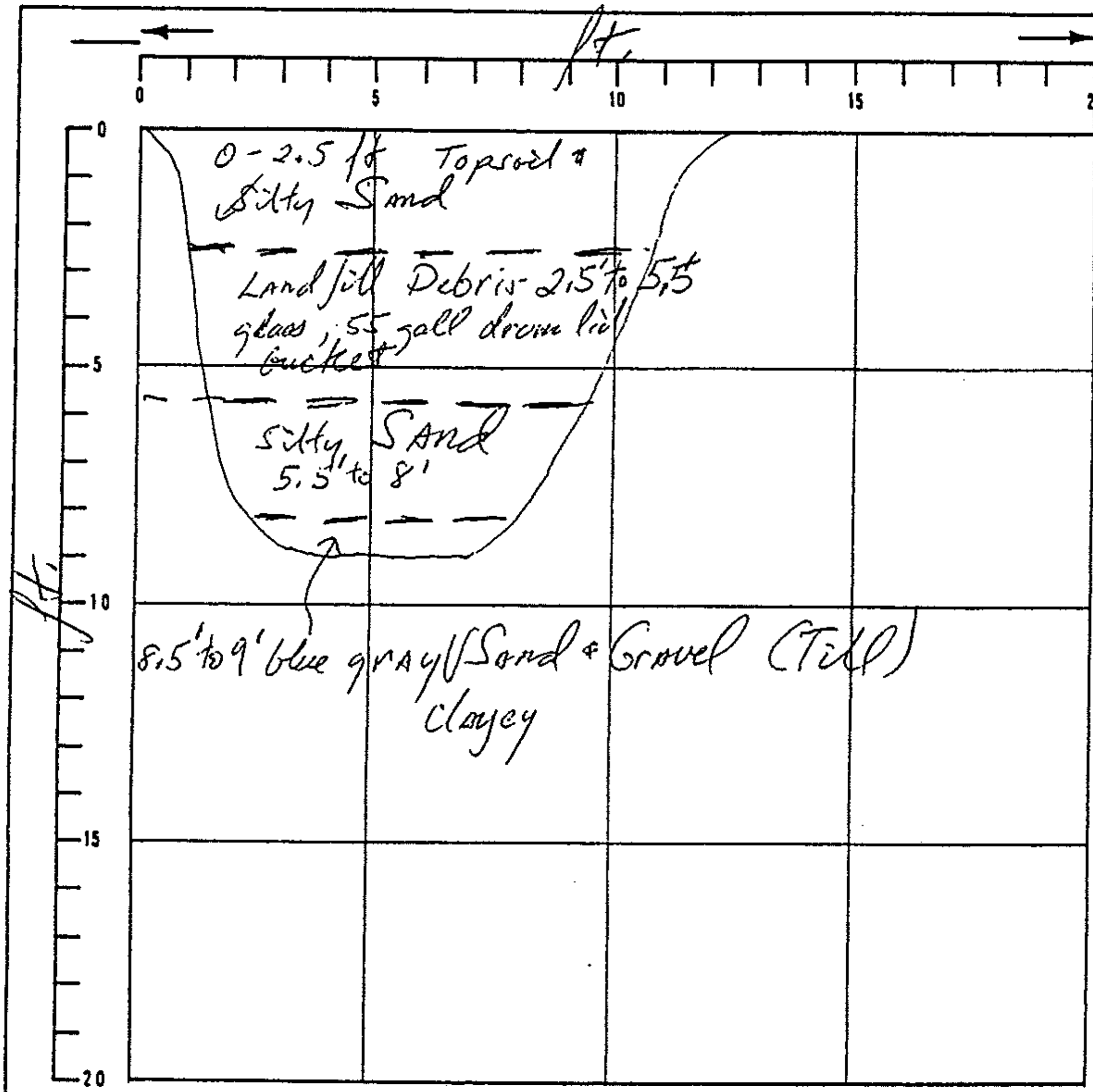
Golder Associates

FIELD TEST PIT LOG

TEMP ___ F. WEATHER ___ ENGINEER DTM & Mike Lubrecht OPERATOR Geoff Yates TEST PIT TP-6

EQUIPMENT ___ CONTRACTOR Yates DATE 7/13/94

LOCATION Horseland ELEVATION ___ DATUM ___ JOB ___



SAMPLES	
NO	DEPTH

SAMPLE DESCRIPTIONS AND EXCAVATION NOTES

Top 2.5 ft

OVA = 2ppm

H_2S = 0ppm

LEL = 2%

Alpha = 0 cpm

Beta/Gamma = 20-30 cpm

TIME	DEPTH OF HOLE	DEPTH TO W/L

Recalibrated OVA

SPECIAL NOTES: Rest of Pit

OVA = 0 ppm

Alpha = 0 cpm

Beta/Gamma = 20-30 cpm

933-1280.1602

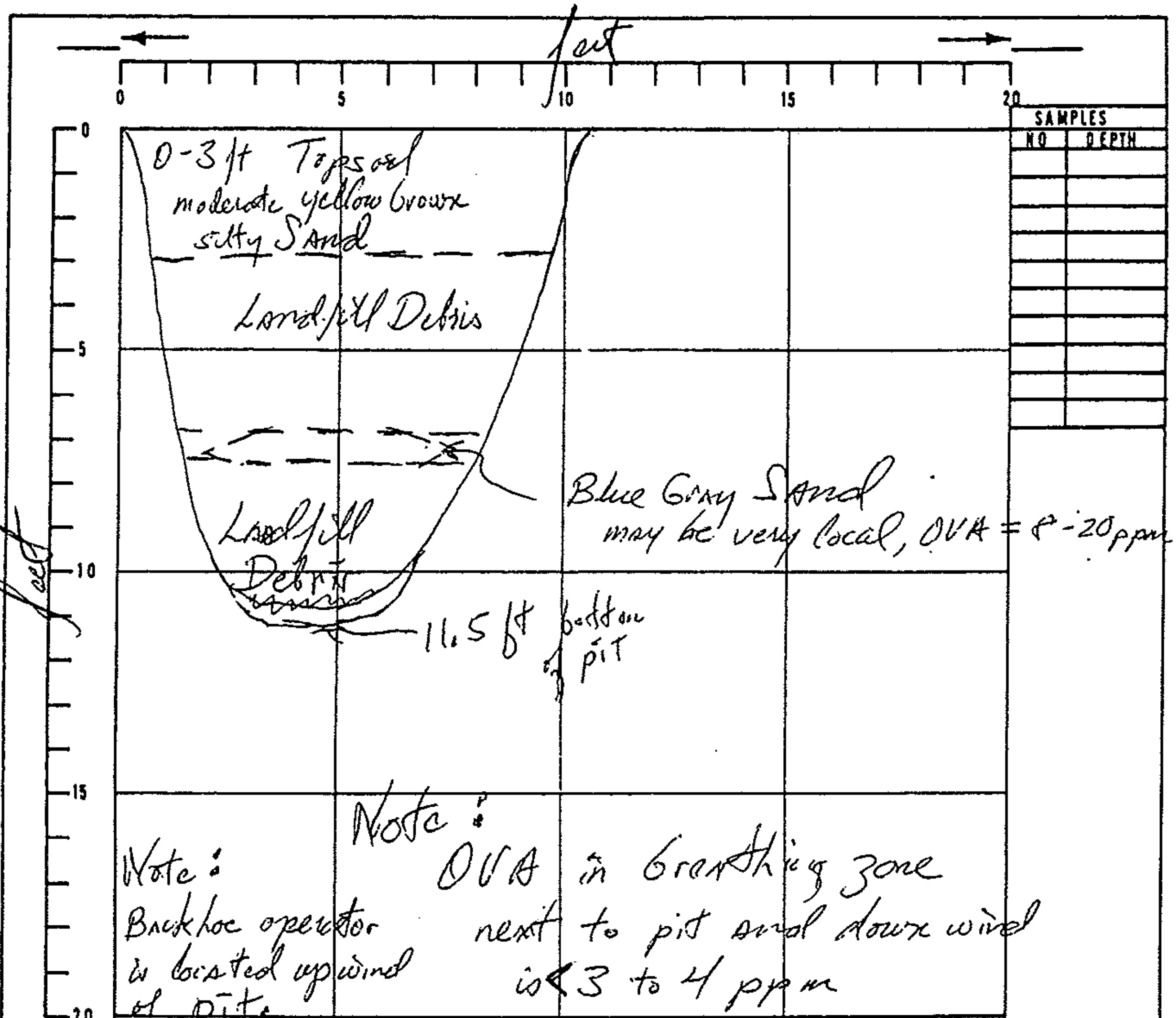
Golder Associates

FIELD TEST PIT LOG

TEMP ___ F. WEATHER ___ ENGINEER DOM & Mike Lobrecht OPERATOR Geoff Yates TEST PIT TP-7

EQUIPMENT ___ CONTRACTOR Yates DATE 7/13/94

LOCATION Norcoland ELEVATION ___ DATUM ___ JOB ___



SAMPLES NO	DEPTH

SAMPLE DESCRIPTIONS AND EXCAVATION NOTES

TIME	DEPTH OF HOLE	DEPTH TO W/L

SPECIAL NOTES: Debris

OVA = 100 - 150 ppm

H_2S = 0 ppm

O_2 = 21 %

LEL = 0 %

Alpha = 0 cpm

Beta/Gamma = 20-30 cpm

933-1280.1602

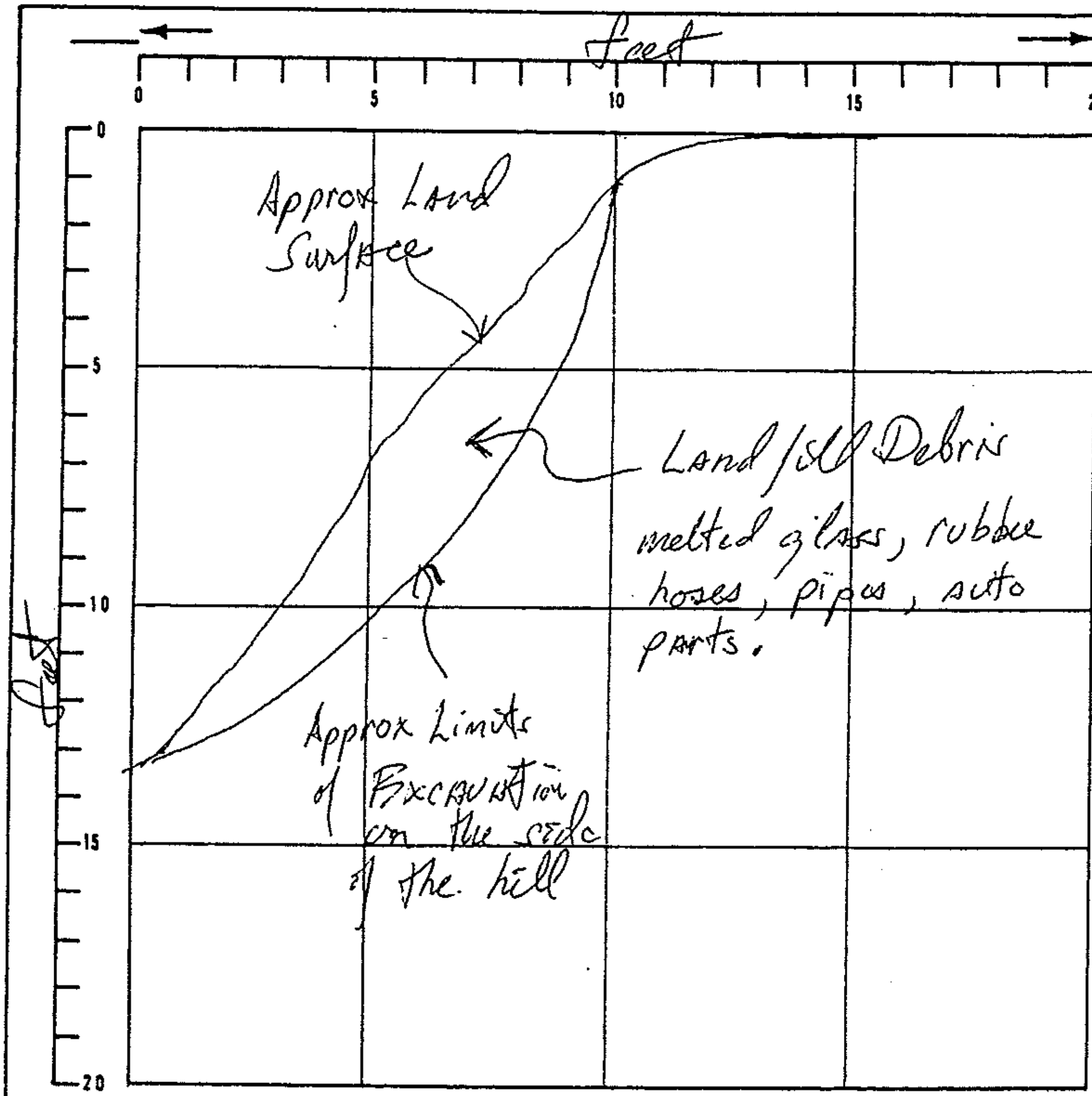
Golder Associates

FIELD TEST PIT LOG

TEMP ___ F. WEATHER ______ ENGINEER D. Jilk & Mike Lubrecht OPERATOR Geoff Yates TEST PIT TP-8

EQUIPMENT ______ CONTRACTOR Yates DATE ______

LOCATION Norseland ELEVATION ______ DATUM ______ JOB ______



SAMPLES NO	DEPTH

SAMPLE DESCRIPTIONS AND EXCAVATION NOTES

TIME	DEPTH OF HOLE	DEPTH TO W/L

SPECIAL NOTES:

OVA = 0-1 ppm

H_2S = ~~[illegible]~~ Not Measured

O_2 = ~~[illegible]~~ Not Measured

Alpha = 0 cpm

Beta/Gamma = 20-30 cpm

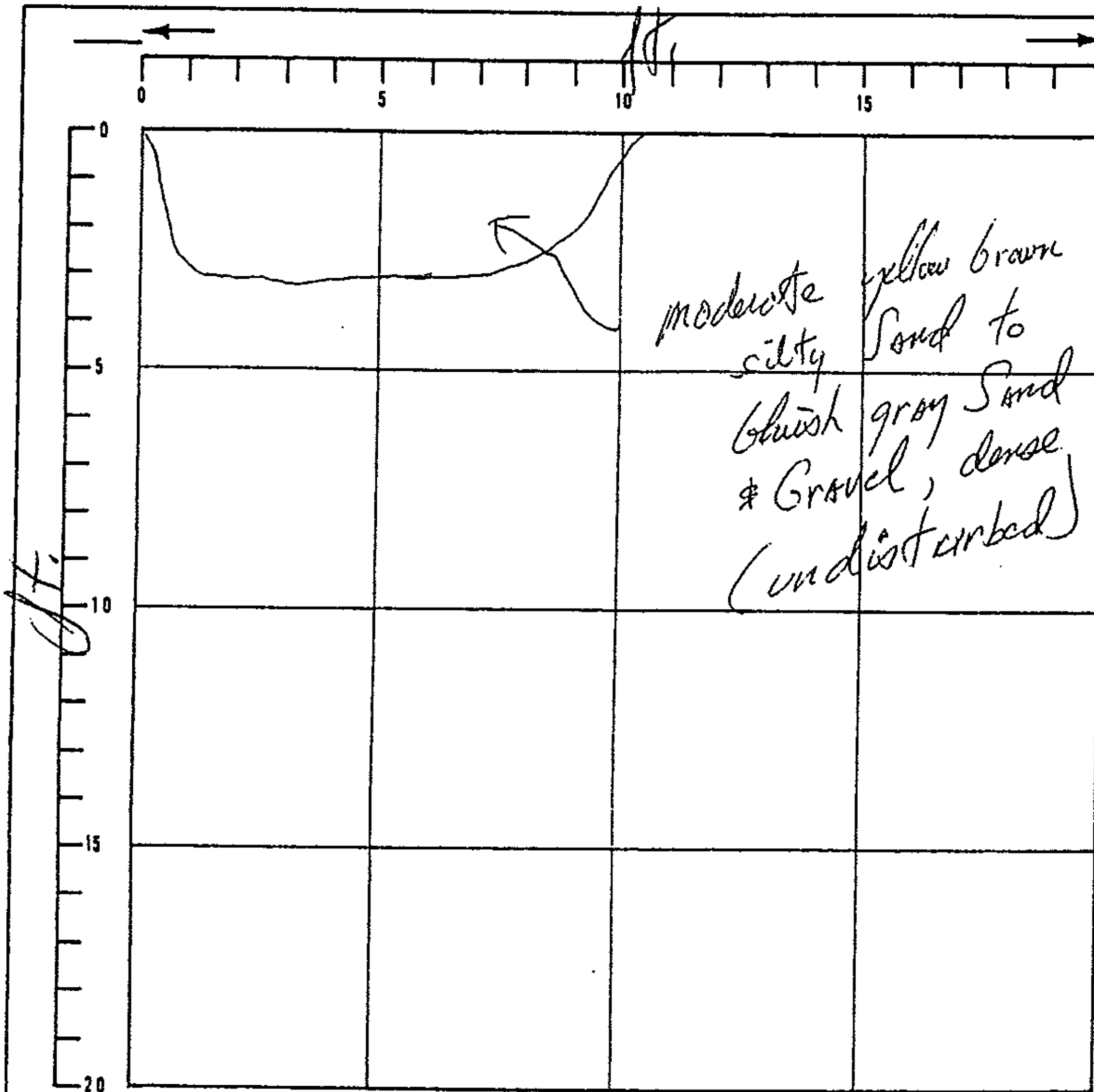
Golder Associates

FIELD TEST PIT LOG

TEMP ___ F. WEATHER ______ ENGINEER DCM & Mike Lubrecht OPERATOR Geoff Yates TEST PIT TP-9

EQUIPMENT ______ CONTRACTOR Yates DATE 7/13/94

LOCATION Norseland ELEVATION ______ DATUM ______ JOB ______



SAMPLES	
NO	DEPTH

SAMPLE DESCRIPTIONS AND EXCAVATION NOTES

TIME	DEPTH OF HOLE	DEPTH TO W/L

SPECIAL NOTES:

OVA = 0ppm
Alpha = 0 cpm
Beta / Gamma = 20-30 cpm

933-1280.1602

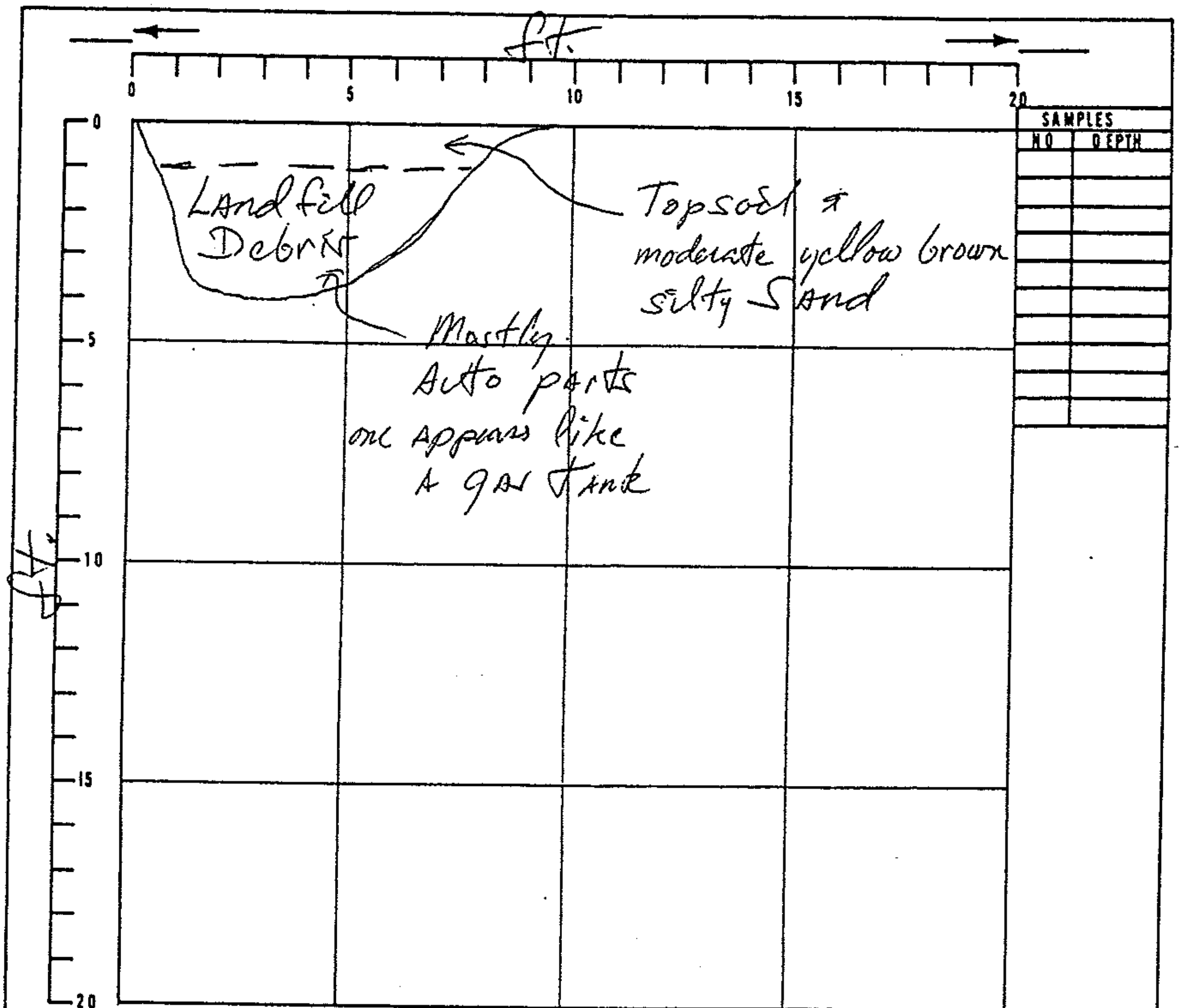
Golder Associates

FIELD TEST PIT LOG

TEMP ___ F. WEATHER ___ ENGINEER RJM & Mike Lubrecht OPERATOR Geoff Yates TEST PIT TP-10

EQUIPMENT ___ CONTRACTOR Yates DATE 7/13/94

LOCATION Nosseland ELEVATION ___ DATUM ___ JOB ___



SAMPLE DESCRIPTIONS AND EXCAVATION NOTES

TIME	DEPTH OF HOLE	DEPTH TO W/L

SPECIAL NOTES: Note:

No instrument readings! A hornets nest was encountered and was immediately backfilled.

953-1280.1602

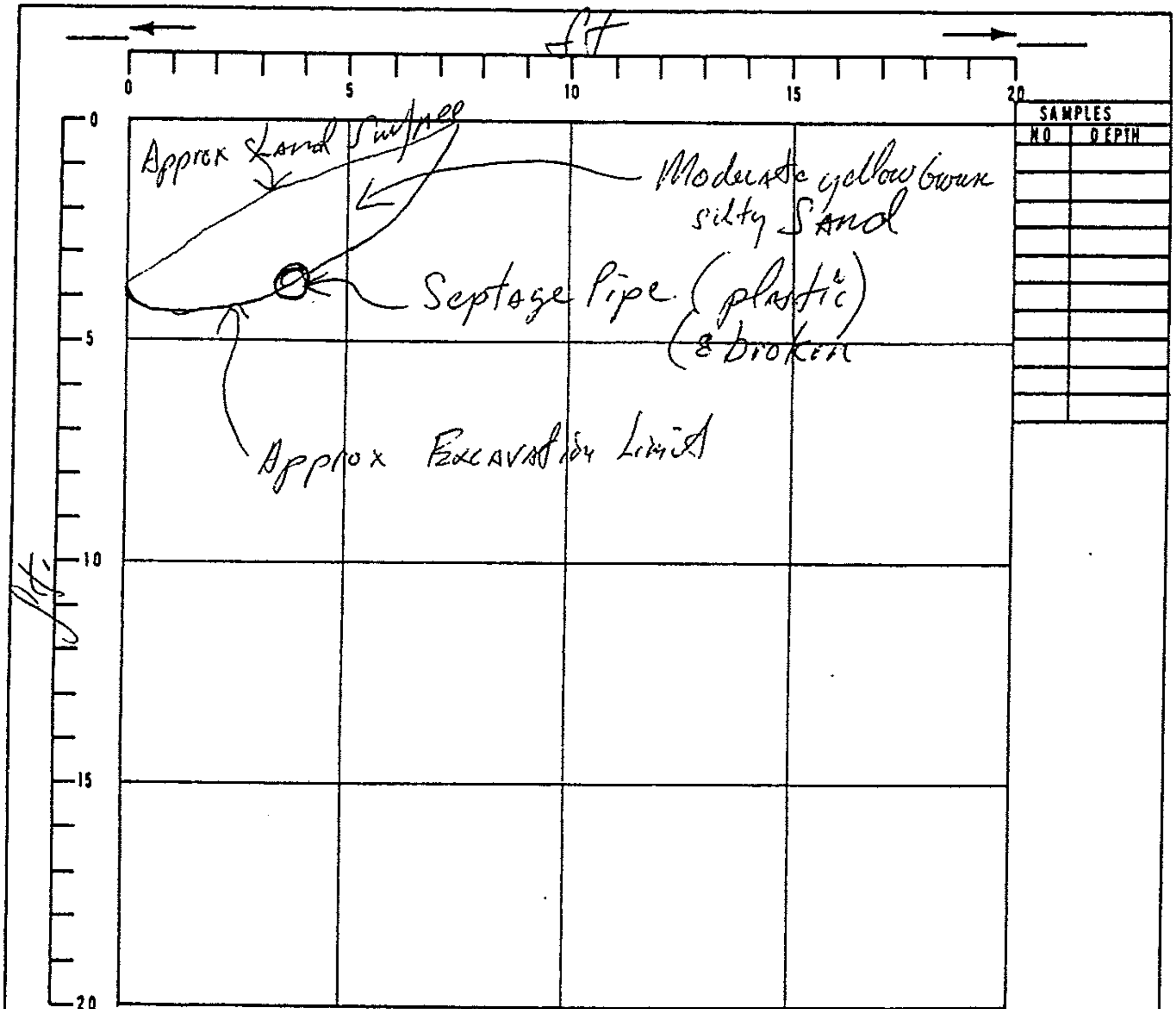
Golder Associates

FIELD TEST PIT LOG

TEMP ___ F. WEATHER ___ ENGINEER D. J. Mc. & Mike Lobrecht OPERATOR Geoff Yates TEST PIT TP-11

EQUIPMENT ___ CONTRACTOR Yates DATE 7/13/94

LOCATION Norseland ELEVATION ___ DATUM ___ JOB ___



SAMPLES	
NO	DEPTH

SAMPLE DESCRIPTIONS AND EXCAVATION NOTES

TIME	DEPTH OF HOLE	DEPTH TO W/L

SPECIAL NOTES:

OVA = No Readings

Alpha = 0-1 cpm

Beta/Gamma = 20-30

NORSELAND SITE

TP-1 7/13/94

TP-2 7/13/94

NORSELAND SITE

TP-5 7/13/94

TP-3 7/13/94

NORSELAND SITE

TP-5 7/13/94

TP-6 7/13/94

NORSELAND SITE

TP-6 7/13/94

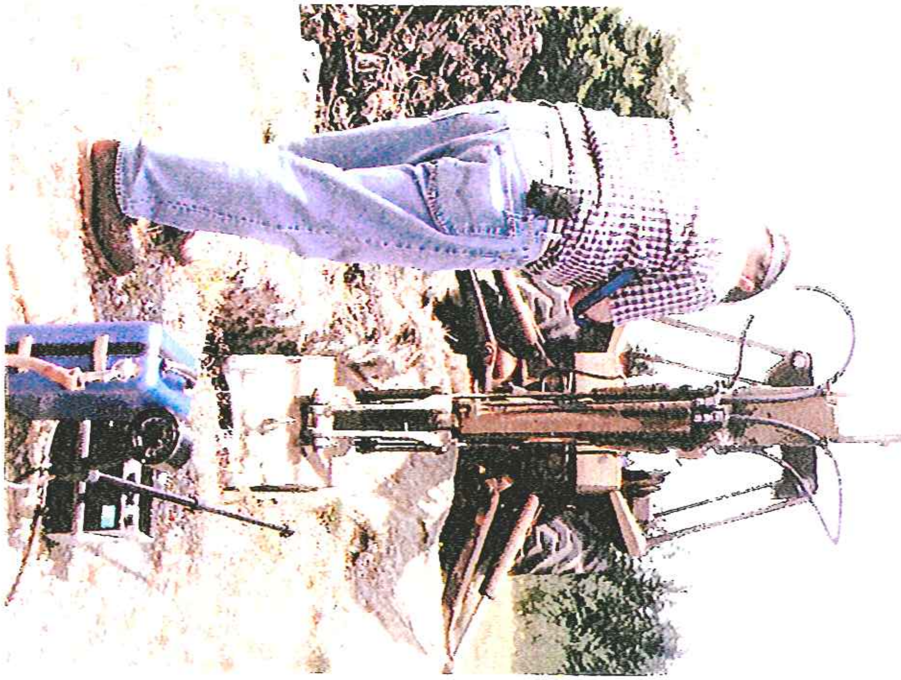
TP-7 7/13/94

NORSELAND SITE

TP-7 7/13/94

TP-7 7/13/94

NORSELAND SITE

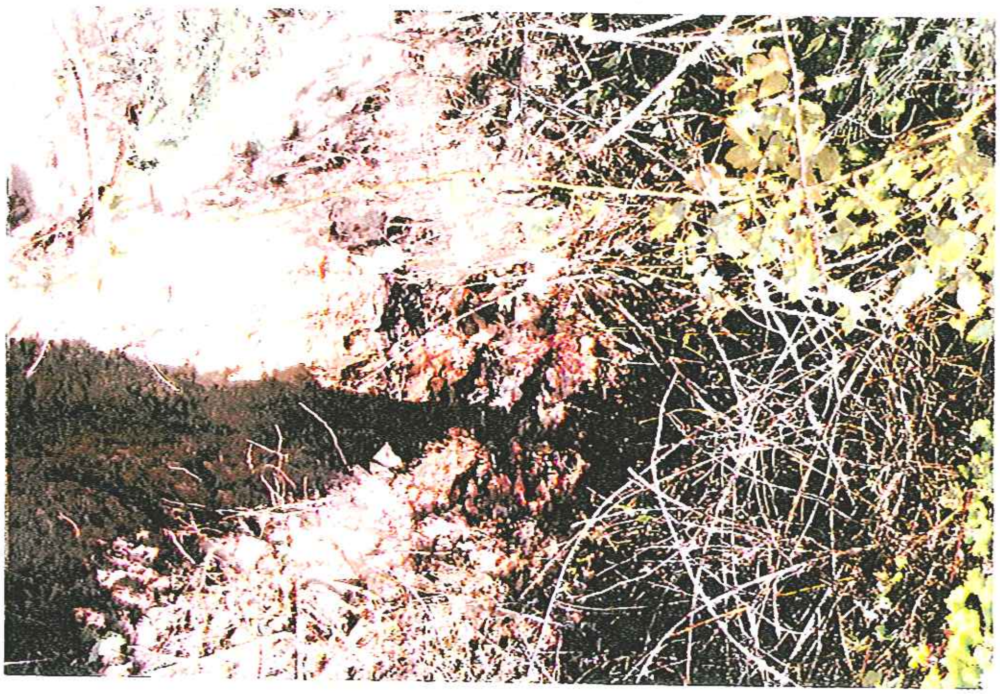


TP-7 7/13/94

TP-7 7/13/94

NORSELAND SITE

TP-8 7/13/94



TP-8 7/13/94

NORSELAND SITE

TP-8 7/13/94

TP-8 7/13/94

NORSELAND SITE

TP-8 7/13/94

TP-9 7/13/94

NORSELAND SITE

TP-10 7/13/94

TP-10 7/13/94

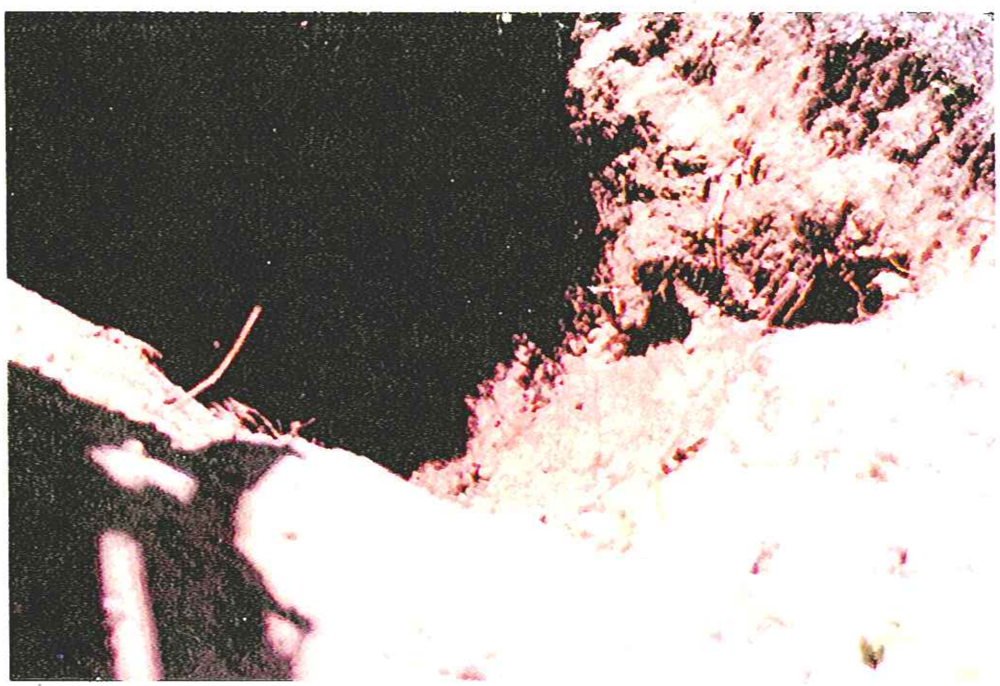
NORSELAND SITE

TP-10 7/13/94

TP-10 7/13/94

NORSELAND SITE

TP-10 7/13/94



TP-10 7/13/94

APPENDIX E

SUMMARY OF ODOR EVENT OBSERVATIONS

TABLE 1. NORSELAND RI/FS SITE - ONSITE ODOR EVENTS - GOLDER OBSERVATIONS -WINTER 1995

EVENT	DATE	DAY	TIME	LOCATION	TYPE of ODOR	STRENGTH	EXTENT	DURATION	GOLDER STAFF ONSITE	NOTES	OVSL WIND DIR/SPEED	OVSL BP/BP TREND	AWOS WIND DIR/SPEED	AWOS BP/BP TREND
1	09-Dec-94	Friday	10:50	Lot 15 and Golder Office	[Sulfur - "Mercaptan-like"]	[5]	[North half of site]	<10 min.	Higgins		185/0.8 (11:00)	29.86/R (11:00)	180/04 (10:55)	30.31/R (10:55)
2	12-Dec-94	Monday	11:15	"several locations"/ Lot 122	[Sulfur - "Mercaptan-like"]	1-2	[South half of site]	<10 min.	Higgins/Beck		237/1.5 (11:00)	29.58/R (11:00)	010/04 (11:15)	30.00/S (11:15)
3	13-Dec-94	Tuesday	6:20	Golder Office	[Sulfur - "Mercaptan-like"]	6	NR	10 min	Higgins/Beck		323/0 (06:30)	29.61/S (06:30)	000/0 (06:15)	30.08/S (06:15)
4	13-Dec-94	Tuesday	8:00	Lots 140 and 146	[Sulfur - "Mercaptan-like"]	3	[Lots 142/144]	[10 min]	Higgins/Beck		323/0 (08:00)	29.62/R (08:00)	000/0 (07:55)	30.09/S (07:55)
5	14-Dec-94	Wednesday	7:20	Golder Office	[Sulfur - "Mercaptan-like"]	3	NR	NR	Beck		253/0 (07:30)	29.40/F (07:30)	000/0 (07:15)	29.86/F (07:15)
6	14-Dec-94	Wednesday	8:10	Lot 66	[Sulfur - "Mercaptan-like"]	3	NR	Intermittent	Beck		253/0 (08:00)	29.40/F (08:00)	000/0 (08:00)	29.86/F (08:00)
7	22-Dec-94	Thursday	7:30	Lot 140	[Sulfur - "Mercaptan-like"]	1-2	[Limited to street adjacent to Lot 140]	[Intermittent]	Stapp		ND	ND	230/06 (07:35)	30.09/S (07:35)
	22-Dec-94	Thursday	8:00 to 8:55 (n)	Golder Office	[Sulfur - "Mercaptan-like"]	8	[Site wide, by AA-1, AA 2 and AA-3]	[5 - 10 min]	Stapp		ND	ND	220/03 (07:55)	30.07/F (07:55)
	22-Dec-94	Thursday	8:00 to 8:55	AA-1	[Sulfur - "Mercaptan-like"]	5-6	NR	[@ 2 min]	Stapp		ND	ND	220/03 (07:55)	30.07/F (07:55)
	22-Dec-94	Thursday	8:00 to 8:55	AA-2	[Sulfur - "Mercaptan-like"]	6-7	NR	[@ 2 min]	Stapp		ND	ND	220/03 (07:55)	30.07/F (07:55)
	22-Dec-94	Thursday	8:00 to 8:55	AA-3	[Sulfur - "Mercaptan-like"]	2-3	NR	[@ 2 min]	Stapp		ND	ND	220/03 (07:55)	30.07/F (07:55)
8	06-Jan-95	Friday	5:20	Office	[Sulfur - "Mercaptan-like"]	1	NR	NR	Beck		062/0.5 (05:30)	29.42/R (05:30)	000/0 (05:15)	29.89/S (05:15)
9	12-Jan-95	Thursday	16:15	Lot 140	[Sulfur - "Mercaptan-like"]	1-2	NR	NR	Manchester		146/0.3 (16:00)	29.24/R (16:00)	120/05 (16:15)	29.68/R (16:15)
10	17-Jan-95	Tuesday	10:30	AA-1	[Sulfur - "Mercaptan-like"]	2	NR	NR	Manchester		225/3.3 (10:30)	29.52/F (10:30)	180/07 (10:35)	29.96/F (10:35)
11	19-Jan-95	Thursday	6:50	Lot 44	[Sulfur - "Mercaptan-like"]	2	On Lower Lofall	Fleeting	Stapp		060/1.4 (07:00)	29.75/S (07:00)	ND	ND
12	25-Jan-95	Wednesday	8:45	Inside Golder Office	[Sulfur - "Mercaptan-like"]	3	[10 sf]	3 - 5 min	Beck		051/2.1 (08:30)	29.30/R (08:30)	ND	ND
13	26-Jan-95	Thursday	11:15	AA-2	[Sulfur - "Mercaptan-like"]	2-3	localized	few minutes	Higgins		247/1 (11:00)	29.46/R (11:00)	000/0 (11:15)	ND
	26-Jan-95	Thursday	11:20	Lots 140 to 146 and 86	[Sulfur - "Mercaptan-like"]	2-3 [5]	[South half of site]	15 min	Higgins	Odor moved to Lot 86 then to Airport	260/0.6 (11:30)	29.46/R (11:30)	000/0 (11:15)	ND
14	27-Jan-95	Friday	10:15	Lots 140 to 146 and 86	[Sulfur - "Mercaptan-like"]	5	[South half of site]	15 min	Higgins	Odor moved to Lot 86 then to Airport	046/0.5 (10:00)	29.69/R (10:00)	200/03 (10:15)	30.15/R (10:15)
15	3-Feb-95	Friday	9:15	Golder Office	[Sulfur - "Mercaptan-like"]	1-2	[very localized]	1 min	Higgins/Burgess		035/2.1 (09:00)	29.88/R (09:00)	030/05 (09:15)	30.35/R (09:15)
16	06-Feb-95	Monday	6:15	Golder Office	Sulfide, similar to Kraft Process smell	2-3	Localized to parking area around office.	5 min	Beck		064/3 (06:00)	29.80/R (06:00)	040/04 (06:15)	30.25/R (06:15)
	06-Feb-95	Monday	6:20	Lot 140	Sulfide, similar to Kraft Process smell	2	Localized	5 min	Beck		086/4.7 (06:30)	29.81/R (06:30)	040/04 (06:15)	30.25/R (06:15)
	06-Feb-95	Monday	6:25	AA-2	Sulfide, similar to Kraft Process smell	2	From AA-1 to AA-2.	5 min	Beck	Odor event localized to area from office to AA-2, not detected in other locations.	086/4.7 (06:30)	29.81/R (06:30)	040/04 (06:15)	30.25/R (06:15)
17	07-Feb-95	Tuesday	6:00	AA-1	[Sulfur - "Mercaptan-like"]	2	NR	5 min	Beck		109/0.6 (06:00)	29.80/F (06:00)	000/0 (05:55)	30.25/F (05:55)
17	07-Feb-95	Tuesday	6:40	RV Road	[Sulfur - "Mercaptan-like"]	1	NR	10 min	Beck		276/1.3 (07:00)	29.77/F (07:00)	000/0 (06:35)	30.23/F (06:35)
18	10-Feb-95	Friday	8:15	Lot 146	[Sulfur - "Mercaptan-like"]	Slight [1-2]	[From Lot 146 to AA-1]	[< 2 min]	Higgins		226/0.4 (08:00)	29.75/S (08:00)	000/0 (08:15)	30.23/S (08:15)

TABLE 1. NORSELAND RI/FS SITE - ONSITE ODOR EVENTS - GOLDER OBSERVATIONS -WINTER 1995

EVENT	DATE	DAY	TIME	LOCATION	TYPE of ODOR	STRENGTH	EXTENT	DURATION	GOLDER STAFF ONSITE	NOTES	OVSL WIND DIR/SPEED	OVSL BP/BP TREND	AWOS WIND DIR/SPEED	AWOS BP/BP TREND
	10-Feb-95	Friday	8:15	AA-1	[Sulfur - "Mercaptan-like"]	Slight [1-2]	[From Lot 146 to AA-1]	[< 2 min]	Higgins		226/0.4 (08:00)	29.75/S (08:00)	000/0 (08:15)	30.23/S (08:15)
19	21-Feb-95	Tuesday	15:00	AA-3 and Lot 44	[Sulfur - "Mercaptan-like"]	1	[@50 sf]	[Intermittent]	Stapp/Lubrecht		267/2.6 (15:00)	29.85/R (15:00)	270/04 (14:55)	30.26/S (14:55)
	21-Feb-95	Tuesday	15:30	AA-1, AA-2 and AA-3	[Sulfur - "Mercaptan-like"]	1	NR	[Not sustained]	Stapp/Lubrecht		294/2.9 (15:30)	29.86/R (15:30)	240/03 (15:35)	30.28/S (15:35)
20	22-Feb-95	Wednesday	6:30	Skirt of Lot 134	"Chlorine-like"	1-2	Ground level near skirt and under home	Not Sustained	Stapp	Resident could not confirm	159/0.7 06:30	29.82/F (06:30)	000/0 (06:35)	30.30/S (06:35)
21	22-Feb-95	Wednesday	8:05	AA-2	[Sulfur - "Mercaptan-like"]	1	NR	Not Sustained	Stapp		212/0.8 (08:00)	29.82/F (08:00)	000/0 (07:55)	30.29/S (07:55)
22	09-Mar-95	Thursday	11:05	Lot 88	[Sulfur - "Mercaptan-like"]	3-4	100 yds	[15 min]	Stapp/Higgins	Sampled area	223/1.9 (11:00)	28.65/F (11:00)	000/0 (10:55)	29.06/F (10:55)
	09-Mar-95	Thursday	11:13	Intersection of Lower Lofall and Matteson	[Sulfur - "Mercaptan-like"]	4-5	NR	NR	Stapp/Higgins	Sampled area	223/1.9 (11:00)	28.65/F (11:00)	270/04 (11:15)	29.05/F (11:15)
23	13-Mar-95	Monday	5:55	Golder Office	[Sulfur - "Mercaptan-like"]	[3]	NR	< 5 min	Higgins		205/1.2 (06:00)	29.31/F (06:00)	000/0 (04:55)	29.75/S (04:55)
24	14-Mar-95	Tuesday	9:45	Lot 140 Breezeway	[Sulfur - "Mercaptan-like"]	[1-2]	Localized	[< 2 min]	Higgins		247/1.5 (09:30)	29.30/R (09:30)	170/03 (09:35)	29.73/R (09:35)
25	17-Mar-95	Friday	9:55	AA-3	[Sulfur - "Mercaptan-like"]	1-5	[100 ft north to south]	41 min	Stapp	Sampled Area - odor confirmed by residents	267/2.1 (10:00)	29.55/S (10:00)	000/0 (09:55)	29.97/F (09:55)
	17-Mar-95	Friday	10:05	Golder Office	[Sulfur - "Mercaptan-like"]	4-5	[50 sf]	42 min	Stapp	Sampled Area - odor confirmed by residents	267/2.1 (10:00)	29.55/S (10:00)	000/0 (09:55)	29.97/F (09:55)
26	20-Mar-95	Monday	7:45	North end of site [Golder office and Lots 15-35]	[Sulfur - "Mercaptan-like"]	[3]	North half of site	[< 2 min]	Higgins		240/4.0 (07:30)	28.91/S (07:30)	200/05 (07:35)	29.36/S (07:35)

a - The subsequent 3 weather observations were as follows: 08:15 = 000/0, 30.07/F; 08:35 = 220/04, 30.06/F; 08:55 = 250/04, 30.06/F

F - Falling barometric pressure (BP, in Hg), evaluated by trends in BP for several hours before and after subject BP.

R - Rising barometric pressure, evaluated by trends in BP for several hours before and after subject BP.

S - Stable barometric pressure, evaluated by trends in BP for several hours before and after subject BP.

NA - Not Applicable

ND - No Data

NR - Not reported

Notes: 1) Bracketed information indicates that the information is based on subject GAI personnel memory, but not specified in the field logbook.
2) All wind directions are given in true north. (AWOS recorded message is in magnetic north).
3) AWOS wind speed is given in knots, OVSL wind speed are in mph.
4) All barometric pressure readings to hundreds of an inch mercury.

TABLE 2. NORSELAND RI/FS - ONSITE ODOR EVENTS - RESIDENT OBSERVATIONS - WINTER 1995

DATE	DAY	TIME OF ODOR	LOCATION	TYPE OF ODOR	STRENGTH	EXTENT	DURATION	RESIDENT	NOTES	OVSL WIND DIR/SPEED	OVSL BP/BP TREND	AWOS WIND DIR/SPEED	AWOS BP/BP TREND
7-Dec-94	Wednesday	07:45	NR	NR	NR	NR	NR	J. Frettingham	Said that it was a good day to check for odors (foggy conditions) and that there was an odor in AM	274/0.9 (07:30)	29.74/R (07:30)	220/4 (07:35)	30.22/R (07:35)
7-Dec-94	Wednesday	10:04	Lot 146	Natural Gas	6-8	NR	NR	NR	35o F	146/1.7 (10:00)	29.83/R (10:00)	000/0 (09:55)	30.30/R (09:55)
9-Dec-94	Friday	16:30	Lot 22	Rank Odor	NR	NR	NR	NR		129/0.1 (16:30)	29.78/F (16:30)	000/0 (16:15)	30.23/F (16:15)
13-Dec-94	Tuesday	3:00	Lot 140	NR	Bad	NR	3 hrs	D. Loftus		280/0 (03:00)	29.60/R (03:00)	000/0 (02:55)	30.08/R (02:55)
13-Dec-94	Tuesday	7:40	Lot 134	NR	NR	NR	Few minutes	L. Harbin		321/0 (07:30)	29.61/R (07:30)	000/0 (07:35)	30.09/R (07:35)
13-Dec-94	Tuesday	7:55	Lot 146	NR	NR	NR	5 min	NR		323/0 (08:00)	29.62/F (08:00)	000/0 (07:55)	30.09/S (07:55)
13-Dec-94	Tuesday	20:50	Lot 22	Rotten potatoes or sewage	10	Outside home	Few hours	P. Barone	Odor did not get into house	258/0 (21:00)	29.56/F (21:00)	260/03 (20:55)	30.02/F (20:55)
14-Dec-94	Wednesday	8:10	Lot 51	NR	NR	NR	NR	K. Tingelsted	Mr. Tingelsted said that there are no odor problems at site, just the occasional smell from the dump.	253/0 (08:00)	29.40/F (08:00)	000/0 (07:55)	29.86/F (07:55)
14-Dec-94	Wednesday	8:40	Lot 140	NR	NR	NR	NR	D. Loftus	Odor in backyard, but it comes and goes, B. Beck did not smell odor.	253/0 (08:30)	29.39/F (08:30)	000/0 (08:35)	29.86/F (08:35)
14-Dec-94	Wednesday	13:01	Lot 135	Gas, propane - nauseating smell	8-9	Around Lot 135	NR	K. Bowers	Foggy, raining, cold	216/0.6 (13:00)	29.35/F (13:00)	000/0 (12:55)	29.80/F (12:55)
15-Dec-94	Thursday	NR	NR	NR	NR	NR	NR	John Berchind (Port	Odor present	No Time Specified	No Time Specified	No Time Specified	No Time Specified
15-Dec-94	Thursday	Afternoon	Lot 135	Natural gas	NR	NR	NR	NR		No Time Specified	No Time Specified	No Time Specified	No Time Specified
16-Dec-94	Friday	20:40	Lot 140	NR	6	NR	1.5 hours	D. Loftus		279/1.63 (20:30)	29.38/S (20:30)	290/04 (20:35)	29.80/F (20:35)
16-Dec-94	Friday	22:08	Lot 37	Sewer odor	5	NR	NR	P. Johnson		199/0.5 (22:00)	29.36/F (22:00)	000/0 (21:55)	29.78/F (21:55)
22-Dec-94	Thursday	03:00 to 05:00	Lot 140	gas-like	Strong	[Limited to street adjacent to Lot 140]	2 hrs	D. Loftus	Confined to porch	ND	ND	000/0 - 210/3 (02:55 - 04:55)	30.08 - 30.12/R (02:55 - 04:55)
22-Dec-94	Thursday	05:10	Lot 107	Burning garbage odor	Very strong	NR	NR	NR	Call placed at app. 09:42	ND	ND	000/0 (05:15)	30.11/S (05:15)
22-Dec-94	Thursday	8:30	Lot 140	NR	NR	NR	NR	D. Loftus		ND	ND	220/04 (08:35)	30.06/F (08:35)
22-Dec-94	Thursday	09:01	Lot 140	Gas odor	NR	Front porch of Lot 140	NR	D. Loftus	Confined to front porch, Foggy	ND	ND	250/4 (08:55)	30.06/F (08:55)
22-Dec-94	Thursday	09:09	Lot 65	NR	4	NR	20 min	S. Johnston		ND	ND	250/4 (08:55)	30.06/F (08:55)
23-Dec-94	Friday	12:32	Lot 65	NR	Light, not strong odor	NR	NR	NR		ND	ND	000/0 (12:35)	29.70/F (12:35)
23-Dec-94	Friday	13:00	Lot 78	Putrid odor	Heavy	NR	30 min	NR	Strongest in backyard	ND	ND	000/0 (12:55)	29.69/F (12:55)
23-Dec-94	Friday	13:45	NR	Bad odor	Bad	NR	NR	NR		ND	ND	000/0 (13:35)	29.67/F (13:35)
23-Dec-94	Friday	13:59	Lot 136	NR	NR	NR	NR	NR	Several people complaining of odor today.	ND	ND	000/0 (13:55)	29.67/F (13:55)
23-Dec-94	Friday	14:10	Lot 44	NR	Strong	Highway to manager's office	NR	B Stone		ND	ND	000/0 (14:15)	29.67/F (14:15)
24-Dec-94	Saturday	07:36	Lot 140	NR	Strong	Inside house	NR	D Loftus	Odor inside house today and yesterday.	ND	ND	180/4 (07:35)	29.63/R (07:35)

TABLE 2. NORSELAND RI/FS - ONSITE ODOR EVENTS - RESIDENT OBSERVATIONS - WINTER 1995

DATE	DAY	TIME OF ODOR	LOCATION	TYPE OF ODOR	STRENGTH	EXTENT	DURATION	RESIDENT	NOTES	OVSL WIND DIR/SPEED	OVSL BP/BP TREND	AWOS WIND DIR/SPEED	AWOS BP/BP TREND
31-Dec-94	Saturday	20:00	Lot 140	Chemical, gaseous, or rotten	NR	NR	NR	D. Loftus		ND	ND	000/0 (19:55)	30.22/F (19:55)
3-Jan-95	Tuesday	9:10	Lot 105	NR	NR	NR	NR	P. O'Brady	No odors for a few days	NA	NA	NA	NA
3-Jan-95	Tuesday	Throughout day	Lot 140	Chemical, gaseous, or rotten	1-5	Inside house and in backyard	Few to 20 minutes	D. Loftus	Reported to B. Beck, not called in	NA	NA	NA	NA
04-Jan-95	Wednesday	01:05	Lot 56	Ammonia / [crushed dandelions]	8	Localized to kitchen sink	30 min	R. Williams	Also said that same odor occurs in master bathroom, Golder rep could not smell odor during event.	040/2.1 (01:00)	29.46/F (01:00)	000/0 (00.55)	29.96/S (00:55)
04-Jan-95	Wednesday	7:35	Lot 146	NR	NR	NR	NR	NR	No odors for several days	NA	NA	NA	NA
04-Jan-95	Wednesday	NR	Lot 140	Chemical, gaseous, or rotten	4-5	NR	NR	D. Loftus	Odors occured throughout last week of December, reported to B. Beck, not called in.	NA	NA	NA	NA
5-Jan-95	Thursday	6:15	Lot 105	NR	NR	NR	NR	P. O'Brady	No odors for a few days	NA	NA	NA	NA
06-Jan-95	Friday	05:20	Lot 44	Indescribable, decay odor	6	Western side of house	10 min	B. Stone	Odor was gone by the time Golder personnel arrived, Sulfur odor at office (I) confirmed by B. Beck.	042/0.5 (05:00)	29.42/R (05:00)	000/0 (05:15)	29.89/R (05:15)
07-Jan-95	Saturday	16:00 - 17:00	Lot 56	NR	NR	NR	1 hr	R. Williams	Call placed at 16:56	068/1.5 (16:00)	29.07/R (16:00)	000/0 (15:55)	29.50/R (15:55)
08-Jan-95	Sunday	07:26	Lot 140	NR	NR	NR	Off and on in AM	D. Loftus	Odor began at 07:26; call placed at 11:10	056/2.8 (07:30)	28.96/R (07:30)	020/3 (07:55)	29.40/R (07:55)
09-Jan-95	Monday	AM	Lot 140	NR	Slight	NR	NR	D. Loftus	Call placed at 12:48, Raining	Gen = 200/1.5 (AM)	Gen = R (AM)	Gen = 000/0 (AM)	Gen = R (AM)
12-Jan-95	Thursday	11:15	Lot 140	NR	Faint	In backyard	NR	D. Loftus		282/1.3 (11:00)	29.20/R (11:00)	000/0 (11:15)	29.66/R (11:15)
12-Jan-95	Thursday	11:30	Lot 135	NR	Bad	NR	NR	K. Bowers	Log indicates Lot 134 but indicates that Ms Bowers called, assuming that Lot no. is wrong.	200/1.3 (11:30)	29.19/S (11:30)	000/0 (11:15)	29.66/R (11:15)
12-Jan-95	Thursday	16:10	Lot 140	NR	Slight	NR	NR	D. Loftus		146/0.3 (16:00)	29.24/R (16:00)	000/0 (15:55)	29.67/R (15:55)
13-Jan-95	Friday	08:00	Lot 140	NR	Slight	NR	NR	D. Loftus		165/2.4 (08:00)	29.13/F (08:00)	350/3 (07:55)	29.56/F (07:55)
17-Jan-95	Tuesday	15:00	Lot 56	Chlorox odor	NR	In house	25 min	R. Williams	Wife cannot stay in home because of odor reaction.	214/6.3 (15:00)	29.43/F (15:00)	200/07 (14:55)	29.85/F (14:55)
23-Jan-95	Monday	8:25	Lot 140	NR	NR	NR	NR	D. Loftus	No odors, but occasional light and fleeting odors have occured over past 2 weeks.	NA	NA	NA	NA
23-Jan-95	Monday	18:45	Lot 56	[crushed dandelions]	NR	In house and carport	25 min	R. Williams	Wife cannot stay in home because of odor reaction.	053/3.1 (18:30)	29.46/F (18:30)	AWOS down	AWOS down
25-Jan-95	Wednesday	16:30	Lot 86	NR	Slight	NR	NR	NR		121/0.7 (16:30)	29.26/F (16:30)	000/0 (18:35)	AWOS down
25-Jan-95	Wednesday	16:25	Lot 140	NR	2	NR	1 hour	D. Loftus	Call placed at 17:25	121/0.7 (16:30)	29.26/F (16:30)	000/0 (18:35)	AWOS down

TABLE 2. NORSELAND RI/FS - ONSITE ODOR EVENTS - RESIDENT OBSERVATIONS - WINTER 1995

DATE	DAY	TIME OF ODOR	LOCATION	TYPE OF ODOR'	STRENGTH	EXTENT	DURATION	RESIDENT	NOTES	OVSL WIND DIR/SPEED	OVSL BP/BP TREND	AWOS WIND DIR/SPEED	AWOS BP/BP TREND
26-Jan-95	Thursday	11:02	Lot 140	Sulfur odor	Strong	NR	NR	D. Loftus		247/1 (11:00)	29.46/R (11:00)	AWOS down	AWOS down
26-Jan-95	Thursday	11:03	Lot 86	NR	NR	NR	NR	NR	Smelly, neighbors also smelled	247/1 (11:00)	29.46/R (11:00)	AWOS down	AWOS down
26-Jan-95	Thursday	11:10	Lot 15	NR	NR	NR	NR	NR	Odor is out	247/1 (11:00)	29.46/R (11:00)	AWOS down	AWOS down
26-Jan-95	Thursday	11:30	Port of Bremerton	NR	Major event	At airport	NR	K. Attebury (Port of		260/0.6 (11:30)	29.46/R (11:30)	AWOS down	AWOS down
26-Jan-95	Thursday	13:35	Lot 140	NR	NR	Inside house	NR	D. Loftus		230/1.5 (13:30)	29.46/R (13:30)	000/0 (13:35)	29.88/R (13:35)
26-Jan-95	Thursday	19:02	Lot 140	NR	Slight	NR	NR	D. Loftus	Light rain	210/1 (19:00)	29.51/R (19:00)	260/3 (18:55)	29.96/R (18:55)
26-Jan-95	Thursday	19:03	Lot 65	NR	8	NR	NR	NR	Strongest odor in a while.	210/1 (19:00)	29.51/R (19:00)	260/3 (18:55)	29.96/R (18:55)
26-Jan-95	Thursday	19:20	Lot 146	NR	Not as bad as in AM	NR	NR	NR	Referenced AM call not reported	210/1 (19.00)	29.51/R (19:00)	260/3 (18:55)	29.96/R (18:55)
27-Jan-95	Friday	10:30	Lot 140	NR	NR	On porch and in yard	NR	D. Loftus	Mr. Loftus reported as having a headache.	225/1 (10:30)	29.70/R (10:30)	260/3 (10:35)	30.15/R (10:35)
27-Jan-95	Friday	10:43	Lot 140	NR	Increased since 10:30	Odor in house	NR	D. Loftus		225/1 (10:30)	29.70/R (10:30)	260/3 (10:35)	30.15/R (10:35)
27-Jan-95	Friday	10:46	erton National Ai	NR	NR	Odor at Airport	NR	C. Klein (Port of Br		225/1 (10:30)	29.70/R (10:30)	260/3 (10:35)	30.15/R (10:35)
28-Jan-95	Saturday	15:09	Lot 140	NR	Faint	On porch and in home	NR	D. Loftus		262/2.6 (15:00)	29.58/F (15:00)	000/0 (14:55)	30.03/F (14:55)
28-Jan-95	Saturday	15:53	Lot 140	NR	Increased since 15:09	[On porch and in home]	NR	D. Loftus		312/2.5 (16:00)	29.58/F (16:00)	000/0 (15:55)	30.03/F (15:55)
28-Jan-95	Saturday	17:18	Lot 140	Sulfur odor	NR	On Rte 3 approximately 1/2 mil	NR	D. Loftus		047/1.7 (17:00)	29.58/F (17:00)	000/0 (17:15)	30.02/F (17:15)
28-Jan-95	Saturday	PM	Lot 140	NR	NR	NR	NR	D. Loftus	Call placed at 00:30 Sunday, said that odor was out all night, on and off.	Gen = 60 - 210/0.1-1.4 (PM)	Gen = F (PM)	Gen = 000/0 (PM)	Gen = F (PM)
29-Jan-95	Sunday	19:17	Lot 140	NR	NR	NR	NR	D. Loftus		290/3.8 (19:00)	29.67/R (19:00)	000/0 (19:15)	30.12/R (19:15)
29-Jan-95	Sunday	20:10	Lot 146	NR	4	NR	NR	NR	Light fog	124/1.8 (20:00)	29.66/F (20:00)	000/0 (19:55)	30.10/F (19:55)
02-Feb-95	Thursday	09:32	Lot 140	NR	Slight	NR	NR	D. Loftus		071/0.7 (09:30)	29.87/S (09:30)	000/0 (09:35)	30.34/S (09:35)
02-Feb-95	Thursday	09:53	Lot 140	NR	Faint	NR	NR	D. Loftus		213/1.1 (10:00)	29.89/S (10:00)	000/0 (09:55)	30.34/S (09:55)
03-Feb-95	Friday	02:30 to 05:30	Lot 140	NR	NR	NR	3 hrs (off and on)	D. Loftus		100 - 200/0.6 - 1 (02:30 - 05:30)	29.78 - 29.79/R (02:30 - 05:30)	000/0 (02:30-05:30)	30.23 - 30.26/R (02:30-05:30)
05-Feb-95	Sunday	11:15	Lot 15	NR	NR	NR	NR	NR		254/1 (11:00)	29.75/R (11:00)	000/0 (11:15)	30.19/R (11:15)
8-Feb-95	Wednesday	10:40	Lot 64	NR	NR	NR	NR	Mr. Clark	Mr Clark told B. Beck that he occasionally gets a weak (2) odor at home that smells like a "shade tree garage".	NA	NA	NA	NA
09-Feb-95	Thursday	05:10	Lot 44	Not identifiable	NR	Southwest side of house	NR	NR	Some kind of smell	190/0.4 (05:00)	29.75/F (05:00)	000/0 (05:15)	30.24/F (05:15)
10-Feb-95	Friday	08:20	Lot 146	NR	Slight	NR	NR	NR	Its out a little.	226/0.7 (08:00)	29.74/R (08:00)	000/0 (08:15)	30.23/S (08:15)
10-Feb-95	Friday	15:00	Lot 109	Gasoline	9	In house and in house at Lot 108.	4 hours	D. Christian	Reported on 2/13/95, not called in, he also said that he occasionally smells ammonia odors at home.	225/5.7 (15:00)	29.73/F (15:00)	180/06 (14:55)	30.17/F (14:55)

TABLE 2. NORSELAND RI/FS - ONSITE ODOR EVENTS - RESIDENT OBSERVATIONS - WINTER 1995

DATE	DAY	TIME OF ODOR	LOCATION	TYPE OF ODOR	STRENGTH	EXTENT	DURATION	RESIDENT	NOTES	OVSL WIND DIR/SPEED	OVSL BP/BP TREND	AWOS WIND DIR/SPEED	AWOS BP/BP TREND
11-Feb-95	Saturday	5:00	Lot 105	9	NR	NR	NR	P. O'Brady	Reported on 2/13/95, not called in.	158/2 (05:00)	29.49/F (05:00)	010/03 (04:55)	29.95/F (04:55)
11-Feb-95	Saturday	05:05	Lot 140	NR	Strong	Backyard	NR	D. Loftus	Worst odor in a couple of weeks, drizzle with fog in the valley northeast of Lot 140	158/2 (05:00)	29.49/F (05:00)	010/03 (04:55)	29.95/F (04:55)
13-Feb-95	Monday	10:05	Lot 134	Petroleum Odor	Strong	NR	NR	Harbin		087/2.4 (10:00)	29.30/R (10:00)	000/0 (09:55)	29.80/R (09:55)
13-Feb-95	Monday	12:30	Lot 138	NR	NR	NR	NR	NR	Told B. Beck that he has not smelled odor for approximately 6 days.	NA	NA	NA	NA
13-Feb-95	Monday	12:45	Lot 64	NR	NR	NR	NR	Mr. Clark	Mr. Clark told B Beck that he has not smelled odor for past few days.	NA	NA	NA	NA
15-Feb-95	Wednesday	12:30	Lot 134	NR	NR	NR	NR	Harbin	No recent odors	NA	NA	NA	NA
18-Feb-95	Saturday	11:40	Lot 86	NR	NR	NR	NR	S. Walter		180/3.3 (11:30)	29.60/F (11:30)	170/06 (11:35)	30.04/F (11:35)
18-Feb-95	Saturday	NR	Lot 92	NR	NR	NR	App. 1 hour	NR	Reported to T. Stapp on 2/20/95.	No time specified	No time specified	No time specified	No time specified
20-Feb-95	Monday	8:45	Lots 51 and 60	NR	NR	NR	NR	NR	Owners said that they have not smelled odor in recent memory.	NA	NA	NA	NA
21-Feb-95	Tuesday	PM	RV Road	NR	Not consistent or sustained	NR	Not sustained	J. Frettingham	Reported to T. Stapp on 2/22/95.	Gen = variable from east to southwest (19:00 - 24:00)	Gen Trend = Stable	PM = 000/0	30.26 - 30.28/R (18:55-24:00)
22-Feb-95	Wednesday	6:30	Lot 134	Sweet chemical	Low and intermittent	NR	NR	Harbin	T. Stapp smelled a chlorine odor at skirt of Lot 134.	159/.7 (06:30)	29.82/F (06:30)	000/0 (14:35)	30.30/S (14:35)
22-Feb-95	Wednesday	8:05	Lot 51	NR	NR	NR	NR	[K. Tingelsted]	Owner could not smell odor	211/0.7 (08:00)	29.82/s (08:00)	000/0 (07:55)	30.29/F (07:55)
23-Feb-95	Thursday	09:45	Lot 140	Unusual, maybe cleaning solvent	NR	NR	NR	D. Loftus		214/2.5 (09:30)	29.65/S (09:30)	000/0 (19:35)	30.11/S (09:35)
23-Feb-95	Thursday	10:15	Lot 86	Unusual odor	NR	Skirt of Lot 86	NR	NR	M. Higgins identified as cat urine, confirmed by owner on following day.	200/1.7 (10:00)	29.65/S (10:00)	000/0 (10:15)	30.11/S (10:15)
25-Feb-95	Saturday	NR	Lot 140	Sulfur-like odor	Strong	NR	NR	D. Loftus		No Time Specified	No Time Specified	No Time Specified	No Time Specified
25-Feb-95	Saturday	NR	Lot 134	Odor	Strong	NR	NR	Harbin		No Time Specified	No Time Specified	No Time Specified	No Time Specified
27-Feb-95	Monday	16:45	Lot 135	Rotten Smell	NR	NR	NR	K. Bowers	Smell not confirmed by M. Higgins	038/10 (16:30)	29.84/F (16:30)	020/14 (16:35)	30.29/F (16:35)
05-Mar-95	Sunday	08:05	Lot 140	NR	NR	NR	NR	D. Loftus		143/1.3 (08:00)	29.48/R (08:00)	000/0 (07:55)	29.95/R (07:55)
05-Mar-95	Sunday	20:12	Lot 140	Sulfur	2-3	Backyard	4 hours	D. Loftus	Mr. Loftus identified a 2-3 odor as slight and rising to a 7-8 from 23:00 to midnight.	233/0.6 (20:00)	29.60/S (20:00)	000/0 (20:15)	30.07/R (20:15)
05-Mar-95	Sunday	21:00	Lot 107	Burning sewage	6	Driveway and parking lot	NR	L. Jensen	Reported to B. Beck, not called in	187/0.9 (21:00)	29.60/S (21:00)	000/0 (20:55)	30.08/R (20:55)

TABLE 2. NORSELAND RI/FS - ONSITE ODOR EVENTS - RESIDENT OBSERVATIONS - WINTER 1995

DATE	DAY	TIME OF ODOR	LOCATION	TYPE OF ODOR	STRENGTH	EXTENT	DURATION	RESIDENT	NOTES	OVSL WIND DIR/SPEED	OVSL BP/BP TREND	AWOS WIND DIR/SPEED	AWOS BP/BP TREND
6-Mar-95	Monday	15:03	Lot 105	NR	NR	NR	NR	P. O'Brady	Told B. Beck that he smelled no odors on 3/5/95 (unit is near Lot 107, see odor event listed above.)	182/3.1 (15:00)	29.72/F (15:00)	NA	NA
07-Mar-95	Tuesday	08:20	Lot 140	Odor out	Faint	Backyard	30 min	D. Loftus	Call placed at 08:50	225/0.8 (08:00)	29.64/S (08:00)	000/0 (08:15)	30.12/F (08:15)
07-Mar-95	Tuesday	09:10	NR	NR	6	NR	NR	J. Holmes	Smelled that smell, not as strong as in past	262/1.0 (09:00)	29.66/R (09:00)	010/05 (09:15)	30.13/S (09:15)
07-Mar-95	Tuesday	09:32	Lot 140	NR	2-3	Backyard	1 - 2 min	D Loftus		270/1.6 (09:30)	29.66/R (09:30)	020/05 (09:35)	30.12/S (09:35)
07-Mar-95	Tuesday	NR	Lot 44	Gasoline	NR	Filled livingroom	NR	B. Stone	Ms. Stone told B. Beck that she was not sure if it happened on 3/7/95 or 2/28/95, not called in. She said she told M. Lubrecht.	No Time Specified	No Time Specified	No Time Specified	No Time Specified
09-Mar-95	Thursday	11:09	Lot 86	NR	NR	Between Lots 86 and 100	NR	S. Walter		223/1.9 (11:00)	28.65/F (11:00)	270/04 (11:15)	29.05/F (11:15)
09-Mar-95	Thursday	11:18	Lot 22	Foul odor	Strong	NR	NR	NR		223/1.9 (11:00)	28.65/F (11:00)	270/04 (11:15)	29.05/F (11:15)
09-Mar-95	Thursday	12:14	Lot 140	NR	NR	NR	3 min	D. Loftus	Smell is on and off	254/2.2 (12:00)	28.64/F (12:00)	210/03 (12:15)	29.05/F (12:15)
10-Mar-95	Friday	10:32	Lot 140	Sulfur w/garbage odor	Very strong	In carport and front yard	NR	D. Loftus	Faint smell on street	224/2.4 (10:30)	28.94/S (10:30)	140/03 (10:35)	29.37/S (10:35)
10-Mar-95	Friday	11:45	Lot 140	Sulfur w/garbage odor	Very strong	In carport and front yard	NR	D. Loftus	63 minutes since the last call.	194/1.0 (11:30)	28.92/F (11:30)	290/04 (11:35)	29.33/F (11:35)
10-Mar-95	Friday	12:30	Lot 140	Sulfur w/garbage odor	Very strong	In carport and front yard	NR	D. Loftus	118 minutes since the last call.	293/3.5 (12:30)	28.87/F (12:30)	300/05 (12:15)	29.29/F (12:15)
10-Mar-95	Friday	18:20	Lot 136	NR	NR	In area around house	NR	I. Dunn	Daughter smelled as leaving house.	130/1.4 (18:30)	28.72/F	000/0 (18:15)	29.13/F (18:15)
10-Mar-95	Friday	18:26	Lot 140	Sulfur-like odor	Not strong	On street	NR	D. Loftus	Smelled while walking dog. Light rain with no apparent wind observed.	130/1.4 (18:30)	28.72/F (18:30)	000/0 (18:15)	29.13/F (18:15)
10-Mar-95	Friday	18:50	Lot 146	Gasoline type	5	Front yard	NR	NR	"Stinky, stinky, stinky, guys"	151/0.7 (19:00)	28.71/F (19:00)	000/0 (18:55)	29.13/F (18:55)
11-Mar-95	Saturday	5:30	Lot 44	Putrid, rotten	3-4, defined as light	Front yard	NR	B. Stone	Reported to B. Beck, not called in.	202/5.4 (05:30)	28.90/R (05:30)	180/08 (05:35)	29.33/R (05:35)
12-Mar-95	Sunday	19:09	[Lot 140]	Sulfur-like	Faint	NR	1 hour	[D. Loftus]		056/1.0 (19:00)	29.45/S (19:00)	000/0 (19:15)	29.90/S (19:15)
12-Mar-95	Sunday	22:05	Lot 146	NR	1-2	NR	Not long	NR		066/1.7 (22:00)	29.39/F (22:00)	000/0 (21:55)	29.83/F (21:55)
12-Mar-95	Sunday	22:35	Lot 15	NR	NR	NR	NR	NR	Not confirmed by M. Higgins.	074/0.4 (22:30)	29.38/F (22:30)	000/0 (22:35)	29.82/F (22:35)
13-Mar-95	Monday	03:58	Lot 140	NR	NR	NR	Off and on	D Loftus		184/1.4 (04:00)	29.30/F (04:00)	000/0 (03:55)	29.75/F (03:55)
14-Mar-95	Tuesday	9:45	Lot 140	NR	NR	NR	NR	D. Loftus	Odor present in breezeway, confirmed by M. Higgins.	247/1.5 (09:30)	29.30/R (09:30)	170/03 (09:55)	29.73/R (09:55)
17-Mar-95	Friday	10:02	Lot 86	NR	NR	NR	NR	NR	Smells out here	267/2.1 (10:00)	29.55/R (10:00)	000/0 (09:55)	29.97/F (09:55)
17-Mar-95	Friday	10:15	Lot 63	NR	NR	NR	NR	NR	Told T. Stapp that he could not smell odor.	267/2.1 (10:00)	29.55/R (10:00)	000/0 (10:15)	29.97/F (10:15)

TABLE 2. NORSELAND RI/FS - ONSITE ODOR EVENTS - RESIDENT OBSERVATIONS - WINTER 1995

DATE	DAY	TIME OF ODOR	LOCATION	TYPE OF ODOR	STRENGTH	EXTENT	DURATION	RESIDENT	NOTES	OVSL WIND DIR/SPEED	OVSL BP/BP TREND	AWOS WIND DIR/SPEED	AWOS BP/BP TREND
17-Mar-95	Friday	10:18	Lot 44	NR	Slight	Porch	NR	B. Stone	Told T. Stapp that odor was strong at 09:30, not called in.	216/1.7 (10:30)	29.55/R (10:30)	000/0 (10:15)	29.97/F (10:15)
17-Mar-95	Friday	10:19	Lot 140	NR	Not real strong	NR	45 min	D Loftus		216/1.7 (10:30)	29.55/R (10:30)	000/0 (10:15)	29.97/F (10:15)
17-Mar-95	Friday	10:20	Lot 15	NR	NR	NR	NR	NR	Odor episode just now	216/1.7 (10:30)	29.55/R (10:30)	000/0 (10:15)	29.97/F (10:15)
17-Mar-95	Friday	10:30	Lot 42	NR	Slight	NR	NR	NR	Told T. Stapp that he could smell odor and that he only smells odors app. 5 days a year.	216/1.7 (10:30)	29.55/R (10:30)	000/0 (10:15)	29.97/F (10:15)
17-Mar-95	Friday	10:36	NR	NR	NR	NR	NR	NR	An unidentified area worker told T. Stapp that he could not smell odor.	216/1.7 (10:30)	29.55/R (10:30)	240/03 (10:35)	29.95/F (10:35)
17-Mar-95	Friday	10:45	Lot 103	Sour oil field	10	NR	NR	NR	Owner told T. Stapp, not called in.	216/1.7 (10:30)	29.55/R (10:30)	240/03 (10:35)	29.95/F (10:35)
18-Mar-95	Saturday	06:27	Lot 134	NR	Pretty bad	NR	NR	Harbin	Raining and no wind	252/0.6 (06:30)	29.38/S (06:30)	250/04 (06:15)	29.82/S (06:15)
18-Mar-95	Saturday	11:40	Lot 44	NR	Very strong	NR	NR	B. Stone	Ms. Stone said that the wind was at 9 mph	216/9.2 (11:30)	29.45/R (11:30)	190/13, w/gusts = 16 (11:35)	29.87/F (11:35)
19-Mar-95	Sunday	05:45 to 06:30	Lot 140	Sulfur odor	Strong	NR	45 min	D. Loftus		199/7.7 (06:00)	29.67/R (06:00)	170/10, w/gusts = 15 (05:35)	30.13/R (05:35)
19-Mar-95	Sunday	06:19	Lot 135	Rotten, gas-like odor	NR	NR	NR	K. Bowers	Upset stomach	196/6.0 (06:30)	29.67/S (06:30)	170/07 (06:15)	30.13/R (06:15)
19-Mar-95	Sunday	07:10	Lot 140	Garbage odor	Strong	NR	NR	D. Loftus		208/5.0 (07:00)	29.68/R (07:00)	170/07 (06:55)	30.15/R (06:55)
19-Mar-95	Sunday	09:30	Lot 146	NR	Slight	NR	NR	NR	Light rain	208/5.9 (09:30)	29.70/R (09:30)	170/09 (09:35)	30.12/F (09:35)

F - Falling barometric pressure (BP, in Hg), evaluated by trends in BP for several hours before and after subject BP.
R - Rising barometric pressure, evaluated by trends in BP for several hours before and after subject BP.
S - Stable barometric pressure, evaluated by trends in BP for several hours before and after subject BP.
NA - Not Applicable
ND - Not Determined
NR - Not Reported

Notes: 1) Bracketed information indicates that the information is based on subject GAI personnel memory, but not specified in the field logbook
2) All wind directions are given in true north, (AWOS recorded message is in magnetic north).
3) All wind speeds are given in knots.
4) All barometric pressure readings to hundreds of an inch mercury.

APPENDIX F

BORING LOGS AND WELL CONSTRUCTION DIAGRAMS

RECORD OF BOREHOLE MW-1 (Initial)

PROJECT: KPAT/Norseland RI/FS/WA

PROJECT NUMBER: 933 1280.2003

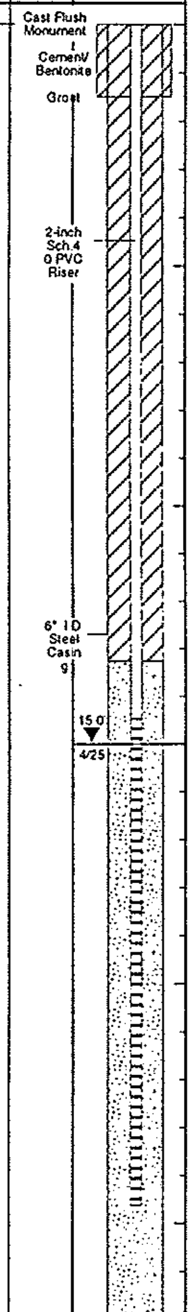
SHEET 1 **OF** 1

DATUM: See MW-1 (Final)

BORING LOCATION: See MW-1 (Final)

BORING DATE: 4/25/94

DEPTH FEET	BORING METHOD	SOIL PROFILE – DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES – NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer, 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp – W – Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
0	6" Hollow Stem Auger	Sandy SILT to silty SAND, little gravel	SM									
5						1		50				
1						2		50				
0						3		37-50				15.0' 4/25
1						4		16				
						5						
5												
2												



DRILL RIG: CME-75/2

DRILLING CONTRACTOR: Cascade Drilling

DRILLER: Rodney

LOGGED: G. Moon

CHECKED: MDL

DATE: 10/6/95

Golder Associates

PROJECT: Kent/Norseland RI/FS/WA

RECORD OF BOREHOLE
MW-1 (Final)

SHEET 1 OF 3

DATUM: Top of PVC = 465.93

PROJECT NUMBER: 933-1280.2003 **BORING LOCATION** N:185934.8024 E: 1162032.1717 **BORING DATE:** 5/25/94

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT, PERCENT Wp—W—Wl	PIEZOMETER GRAPHIC / WATER LEVEL
0	6-inch HSA	0-27.0' Redrill previous borehole [See log of MW-1 (Initial)]										
10												
20												

DRILL RIG: CME 75

DRILLING CONTRACTOR: Cascade Drilling

DRILLER: Steve Hughes

LOGGED: M. Lubrecht

CHECKED:

DATE: 10/6/95

Golder Associates

RECORD OF BOREHOLE
MW-1 (Final)

PROJECT: Kent/Norseland RI/FS/WA

SHEET 2 OF 3

DATUM: Top of PVC = 465.93

PROJECT NUMBER: 933-1280.2003

BORING LOCATION N:185934.8024 E: 1162032.1717

BORING DATE: 5/25/94

DEPTH FEET	BORING METHOD	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer, 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. / WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
20	6-inch HSA	0-27.0' Redrill previous borehole										
		Silty Clay										Chips
30					30.0	1	SS	50/1"				
		Silty Sand and Gravel										
					35.0					2%		
					36.0	2	SS	50/5"		100%		
					36.4							
40												10-20 Sand

DRILL RIG: CME 75

DRILLING CONTRACTOR: Cascade Drilling

DRILLER: Steve Hughes

LOGGED: M. Lubrecht

CHECKED:

DATE: 10/6/95

Golder Associates

PROJECT: Kent/Norseland RI/FS/WA

RECORD OF BOREHOLE MW-1 (Final)

DATUM: Top of PVC = 465.93

PROJECT NUMBER: 933-1280.2003

BORING LOCATION N:185934.8024 E: 1162032.1717

BORING DATE: 5/25/94

DEPTH FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. (0 10 20 30 40 50); WATER CONTENT,PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
40	6-inch HSA	Sand, little Gravel	SW									
					41.0	3	SS	50/3"				
					41.2							
					45.0	4	SS	26/50-4"				
					45.8							
												49.0
					49.5	5	SS	50/5"				
50		End of Hole 50.0'										
60												

DRILL RIG: CME 75

DRILLING CONTRACTOR: Cascade Drilling

DRILLER: Steve Hughes

LOGGED: M. Lubrecht

CHECKED:

DATE: 10/6/95

Golder Associates

RECORD OF BOREHOLE MW-2

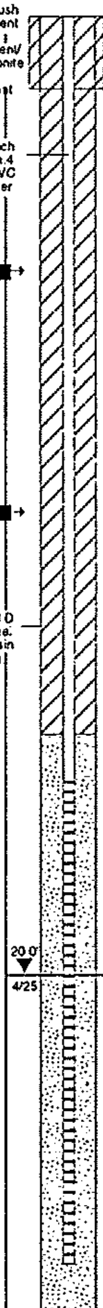
PROJECT: KPAT/Norseland RI/FS/WA

SHEET 1 **OF** 1

DATUM: NA

PROJECT NUMBER: 933 1280.2003 **BORING LOCATION:** NA **BORING DATE:** 4/25/94

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer, 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp —o W— Wl	PIEZOMETER GRAPHIC / WATER LEVEL
0	6" Hollow Stem Auger	Fine to medium SAND with trace silt	SM									
5						1	SS	31-34-37	71		■→	
1		GRAVEL and fine to medium SAND with trace silt	G W			2	SS	10-27-50	70		■→	
0						3	SS	50				
1						4	SS	32				20.0' ▼ 4/25
		Gravelly, fine to medium SAND with trace silt	SW			5	SS	37-54				
5						6	SS	50				
2												



DRILL RIG: CME-75/2

DRILLING CONTRACTOR: Cascade Drilling

DRILLER: Rodney

LOGGED: G. Moon

CHECKED: MDL

DATE: 10/6/95

Golder Associates

PROJECT: Kent/Norseland RI/FS/WA

RECORD OF BOREHOLE MW-2B

SHEET 1 OF 3

DATUM: Top of PVC = 412.43

PROJECT NUMBER: 933-1280.2003

BORING LOCATION N:186813.9571 E: 1161320.1851

BORING DATE: 5/25/94

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
0	6-inch HSA	0-18.0' Moderate yellowish brown, medium to coarse SAND and GRAVEL, compact to dense	GW									Above ground completion with 6" pad
												Concrete
10												
												Bentonite chips (Hydrated)
		Grades to fine to medium SAND			18.0	1	SS	50/6"		100		
					18.5	2	SS	50/6"		100		
					19.0	3	SS	37-50/6"		100		
20					20.0							

DRILL RIG: CME 75

DRILLING CONTRACTOR: Cascade Drilling

DRILLER: Steve Hughes

LOGGED: M. Lubrecht

CHECKED:

DATE: 10/6/95

Golder Associates

PROJECT: Kent/Norseland RI/FS/WA

RECORD OF BOREHOLE MW-2B

DATUM: Top of PVC = 412.43

PROJECT NUMBER: 933-1280.2008

BORING LOCATION N:186813.9571 E: 1161320.1851

BORING DATE: 5/25/94

DEPTH FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
20	6-inch HSA	Medium to coarse SAND and GRAVEL	GW		20.0	4	SS	28-50/4"				
		Pale yellowish brown, silty, medium to coarse SAND and fine to medium GRAVEL, some clay			20.8	5	SS	30-50/4"				
30		Medium yellowish brown, fine to coarse SAND and GRAVEL			30.0	6	SS	32-50/4"				
					30.8							
					35.0	7	SS	30-50/4"		100		
40												

DRILL RIG: CME 75

DRILLING CONTRACTOR: Cascade Drilling

DRILLER: Steve Hughes

LOGGED: M. Lubrecht

CHECKED:

DATE: 10/6/95

Golder Associates

PROJECT: Kent/Norseland RI/FS/WA

RECORD OF BOREHOLE MW-2B

SHEET 3 **OF** 3

DATUM: Top of PVC = 412.43

PROJECT NUMBER: 933-1280.2003 **BORING LOCATION** N:186813.9571 E: 1161320.1851 **BORING DATE:** 5/25/94

DEPTH FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
40	6-inch HSA	Pale yellowish brown to dark olive gray, fine to medium SAND	GW		40.0	8	SS	32-50/5"				Bentonite Chips
			SW		41.0							
					45.0	9	SS	21-50/3"				
												10-20 silica sand
50		Pale yellowish brown to dusky yellowish brown, very fine to coarse SAND, little silt, little gravel			50.0	10	SS	26-50-				
					55.0	11	SS	18-50-				▼
60		End of Hole - 60.0'										

DRILL RIG: CME 75 Hi Torque

DRILLING CONTRACTOR: Cascade Drilling

DRILLER: Steve Hughes

LOGGED: M. Lubrecht

CHECKED:

DATE: 10/6/95

Golder Associates

PROJECT: KPAT/Norseland RI/FS/WA

RECORD OF BOREHOLE MW-3

SHEET 1 OF 2

DATUM: Top of PVC = 411.04

PROJECT NUMBER: 933 1280.2003 **BORING LOCATION** N:186334.0813 E: 1161065.8648 **BORING DATE:** 4/25/94

DEPTH FEET	BORING METHOD	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer, 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. / WATER CONTENT, PERCENT (Wp—W—Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
0	6" Hollow Stem Auger	Silty, gravelly fine to medium SAND	SM									Cast Flush Monument; Cement/ Bentonite Grout
5						1	SS	50				2-inch Sch.40 PVC Riser
1						2	SS	50				
												6" I.D. Steel Casing
0						3	SS	30-26-30	56			
		Silty, fine to medium SAND and GRAVEL	SM									
1						4						
5						5	SS	50				
2						6	SS	18-27-30	57			
		Log continued on next page										

Log continued on next page

DRILL RIG: CME-75/2

DRILLING CONTRACTOR: Cascade Drilling

DRILLER: Rodney

LOGGED: G. Moon

CHECKED: MDL

DATE: 10/6/95

Golder Associates

PROJECT: KPAT/Norseland RI/FS/WA

RECORD OF BOREHOLE MW-3

DATUM: Top of PVC = 411.04

PROJECT NUMBER: 933 1280.2003 BORING LOCATION N:186334.0813 E: 1161065.8648 BORING DATE: 4/25/94

DEPTH FEET	BORING METHOD	DESCRIPTION	USCS	ELEV. / DEPTH	NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer, 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. / WATER CONTENT, PERCENT	PIEZOMETER GRAPHIC / WATER LEVEL
3	6" Hollow Stem Auger	Silty, fine to medium SAND and GRAVEL	SM								
0					7	SS	36-35-37	72			
3		Fine to medium SAND with trace silt	SW		8	SS	34				
					9	SS	55				6" I.D. Steel Casing
5					10	SS	20-50				
											48.5 4/25
4					11		6-10-50	60			
0					12	SS	100				
4											

DRILL RIG: CME-75/2

DRILLING CONTRACTOR: Cascade Drilling

DRILLER: Rodney

LOGGED: G. Moon

CHECKED: MDL

DATE: 10/6/95

Golder Associates

APPENDIX G

COST ESTIMATES

TABLE OF CONTENTS

LIST OF TABLES

TABLE G-1

QUANTITIES AND STANDARD FACTORS

Item	Unit Cost [a]	Units	Std. Dev. [b]	Source/Comments
QUANTITIES:				
Cap area	11.3	ac	2.3	Figure 7-1
Institutional controls area	14.8	ac		Cap/waste area plus 50-ft buffer
Total fill volume, including cap	150,000		30,000	Estimated from approx. topography and cap grading
Permeable soil cap volume (topsoil, 0.5 ft thick)	9,000	yd^3		Fill soil below topsoil covered in fill-and-grade volume
Fill-and-grade volume for permeable cap	141,000			
FML cap volume	46,000			2.5 ft thick (see Table G-3)
Fill-and-grade volume for FML cap	104,000			
Utility disconnection trenching	1,800	lf		
BASIC FACTORS:				
Interest rate (net of inflation)	5%			EPA value; for present value calculations
Post-closure care period	20	yr		MFS post-closure care period
Present value factor for specified interest and time	12.462			Calculated
Contractor overhead & profit	15%		3%	Mid-range value for site remediation
Engineering, construction management, and CQA	20%		3%	Includes required MTCA design and completion reports
Contingency	20%			Appropriate for FS

[a] For probabilistic uncertainty analysis, specified cost used as mean value of lognormal distribution.

[b] Standard deviation of unit cost assumed for probabilistic uncertainty analysis.

TABLE G-2

UNIT COSTS

Item	Unit Cost [a]	Units	Std. Dev. [b]	Source/Comments
SITE WORK (labor, materials and equipment) and MATERIALS (in place):				Not including contractor overhead & profit, engineering, construction management, CQA, or contingency
Seeding	$0.05	ft^2	$0.015	Means 1995, 029-308-200
Trenching for utility disconnection	$5	lf	$1.50	Means 1995, 022-254-500
Gas collection trench	$20	lf	$6.00	Estimate, 10 ft deep, gravel with PVC collection pipe
Fencing	$13	lf	$3.90	Means 1995, 028-300-200
Topsoil, purchased	$15	yd^3	$4.50	Estimate
Topsoil, site source	$4	yd^3	$1.20	2 x Means 1995 022-242-6040
Topsoil, combined	$10	yd^3		Assume admix: 1/2 purchased and 1/2 site source
Cap fill soil	$4	yd^3	$1.20	Site source; 2 x Means 1995 022-242-6040
Grading and fill (beneath cap)	$2.50	yd^3	$0.75	Means 1995 022-242-6040 plus compaction
Low-permeability soil, 10^{-6} cm/sec	$15	yd^3		Estimate for purchased / off-site source
Pea gravel (vapor layer)	$10	yd^3	$3.00	Estimate for purchased / off-site source
FML (50 mil)	$0.45	ft^2	$0.14	Estimate
Geotextile	$0.15	ft^2	$0.05	Estimate
INSTITUTIONAL CONTROLS, MAINTENANCE, AND MONITORING				
Lost land value	$15,000	acre		Stochastic uniform distribution $10 K - $20 K
Lost land use value, annual	$3,400	acre-yr	$680	$110,000 / year for 32 acres per Port of Bremerton
Lost land use value, 30-yr present value	$52,266			
Implement institutional controls	$25,000	LS	$7,500	Allowance
Fence maintenance, annual	$0.50	lf-yr	$0.15	Allowance
Fence maintenance, present value	$6.20	lf		Calculated using time and interest above
Soil cap maintenance, annual	$1,000	ac-yr	$300	Allowance
Soil cap maintenance, present value	$12,000	acre		Calculated using time and interest above
FML cap maintenance, annual	$2,500	ac-yr	$750	Allowance
FML cap maintenance, present value	$31,000	acre		Calculated using time and interest above
Landfill gas monitoring, semi-annual	$10,000	yr	$3,000	Monitoring 2 times/yr; 4 air samples
Landfill gas monitoring, present value	$43,000			Present value of 5-yr cash flow for monitoring program
Alt. 4 landfill gas monitoring, semi-annual	$12,000	yr	$3,600	Monitoring 2 times/yr; 6 air samples
Alt. 4 landfill gas monitoring, present value	$52,000			Present value of 5-yr cash flow for monitoring program
Groundwater monitoring, semi-annual	$12,000	yr	$3,600	Monitoring 2 times/yr; 4 wells
Groundwater monitoring, present value	$52,000			Present value of 5-yr cash flow for monitoring program

[a] For probabilistic uncertainty analysis, specified cost used as mean value of lognormal distribution.

[b] Standard deviation of unit cost assumed for probabilistic uncertainty analysis.

TABLE G-3

CAP UNIT COSTS

Item	Quantity	Units	Unit Cost
Costs do not include contractor overhead and profit, engineering, construction management, CQA, or contingency			
Permeable Soil Cap:			
Topsoil	0.5	ft/ft^2	$0.18
Seed topsoil	1	ft^2	$0.05
Clean fill soil	1.5	ft/ft^2	*
Soil Cap Unit Cost		ft^2	$0.23
		ac	$10,000
* Clean fill cost covered in separate fill-and-grade cost item in Table G-5			
Low-Permeability Soil Cap			
Topsoil	0.5	ft/ft^2	$0.18
Seed topsoil	1	ft^2	$0.05
10^{-6} Soil	2	ft/ft^2	$1.11
Geotextile	1	ft^2	$0.15
Gravel (vapor collection)	0.5	ft/ft^2	$0.19
Low-Permeability Soil Cap Unit Cost		ft^2	$1.68
		ac	$73,000
Low-Permeability FML Cap			
Topsoil	0.5	ft/ft^2	$0.18
Seed topsoil	1	ft^2	$0.05
Clean fill soil	1.5	ft/ft^2	$0.22
FML, 50 mil	1	ft^2	$0.45
Geotextile	1	ft^2	$0.15
Gravel (vapor collection)	0.5	ft/ft^2	$0.19
FML Cap Unit Cost		ft^2	$1.24
		ac	$54,000

TABLE G-4

ESTIMATED COST FOR ALTERNATIVE 2: Institutional Controls and Monitoring

Item	Quantity	Units	Unit Cost	Cost[a]	Notes
CAPITAL COSTS					
Implement institutional controls				$25,000	
Perimeter fencing	3,300	lf	$13	$42,900	
Subtotal				$67,900	
Contractor overhead and profit			15%	$10,000	
Engineering and construction surveillance			20%	$14,000	Includes CQA
Contingency			20%	$14,000	
Subtotal				$105,900	
Lost land value	11.3	acres	$15,000	$169,500	Not available for beneficial use
Lost land use	11.3	acres	$52,266	$590,610	Present value
TOTAL CAPITAL COSTS				$866,010	
POST-CLOSURE CARE COSTS					Present value (see Table G-2)
Fence maintenance	3,300	lf	$6.20	$20,000	
Landfill gas monitoring				$43,000	
Groundwater monitoring				$52,000	
Subtotal:				$115,000	
Contingency			20%	$23,000	
NET PRESENT VALUE COST FOR POST-CLOSURE CARE[b]				$138,000	
TOTAL ALTERNATIVE COST (NET PRESENT VALUE)[c]				$1,004,010	

[a] Costs are for early 1996.

[b] Maintenance and monitoring for 20 years; interest (discount) rate of 5 percent (net of inflation).

[c] The sum of capital and operating costs and the net present value of the post-closure care costs.

TABLE G-5

ESTIMATED COST FOR ALTERNATIVE 3: Permeable Soil Cap

Item	Quantity	Units	Unit Cost	Cost[a]	Notes
CAPITAL COSTS					
Implement institutional controls				$25,000	
Trenching for utility disconnection	1,800	lf	$5	$9,000	
Fill and grade	141,000	yd^3	$2.50	$353,000	Includes cap fill soil
Permeable soil cap	11.3	acres	$10,000	$113,000	Topsoil and seeding
Subtotal				$500,000	
Contractor overhead and profit			15%	$75,000	
Engineering and construction surveillance			20%	$100,000	Includes CQA
Contingency			20%	$100,000	
Subtotal				$775,000	
Cost to allow land use	11.3	acres		$250,000	Incremental design and construction costs
Lost land value				$0	Available for beneficial use
Lost land use				$0	Available for beneficial use
TOTAL CAPITAL COSTS				**$1,025,000**	
POST-CLOSURE CARE COSTS					Present value (see Table G-2)
Cap maintenance and monitoring	11.3	ac	$12,000	$136,000	
Landfill gas monitoring				$43,000	
Groundwater monitoring				$52,000	
Subtotal:				$231,000	
Contingency			20%	$46,000	
NET PRESENT VALUE COST FOR POST-CLOSURE CARE[b]				**$277,000**	
TOTAL ALTERNATIVE COST (NET PRESENT VALUE)[c]				**$1,302,000**	

[a] Costs are for early 1996.

[b] Maintenance and monitoring for 20 years; interest (discount) rate of 5 percent (net of inflation).

[c] The sum of capital and operating costs and the net present value of the post-closure care costs.

TABLE G-6

ESTIMATED COST FOR ALTERNATIVE 4: Low-Permeability Cap (FML)

Item	Quantity	Units	Unit Cost	Cost[a]	Notes
CAPITAL COSTS					
Implement institutional controls				$25,000	
Trenching for utility disconnection	1,800	lf	$5	$9,000	
Fill and grade	104,000	yd^3	$2.50	$260,000	
FML cap	11.3	acres	$54,000	$610,000	
Gas collection trench	1,000	lf	$20	$20,000	Eastern cap edge
Fencing	2,400	lf	$13	$31,000	Around gas collection trench and vents
Subtotal				$955,000	
Contractor overhead and profit			15%	$143,000	
Engineering and construction surveillance			20%	$191,000	Includes CQA
Contingency			20%	$191,000	
Subtotal				$1,480,000	
Cost to allow land use	11.3	acres		$620,000	Incremental design and construction costs
Lost land value				$0	Available for beneficial use
Lost land use				$0	Available for beneficial use
TOTAL CAPITAL COSTS				**$2,100,000**	
POST-CLOSURE CARE COSTS					Present value (see Table G-2)
Cap maintenance and monitoring	11.3	ac	$31,000	$350,000	
Fence maintenance	2,400	lf	$6.20	$15,000	
Landfill gas monitoring				$52,000	
Groundwater monitoring				$52,000	
Subtotal:				$469,000	
Contingency			20%	$94,000	
NET PRESENT VALUE COST FOR POST-CLOSURE CARE[b]				**$563,000**	
TOTAL ALTERNATIVE COST (NET PRESENT VALUE)[c]				**$2,663,000**	

[a] Costs are for early 1996.

[b] Maintenance and monitoring for 20 years; interest (discount) rate of 5 percent (net of inflation).

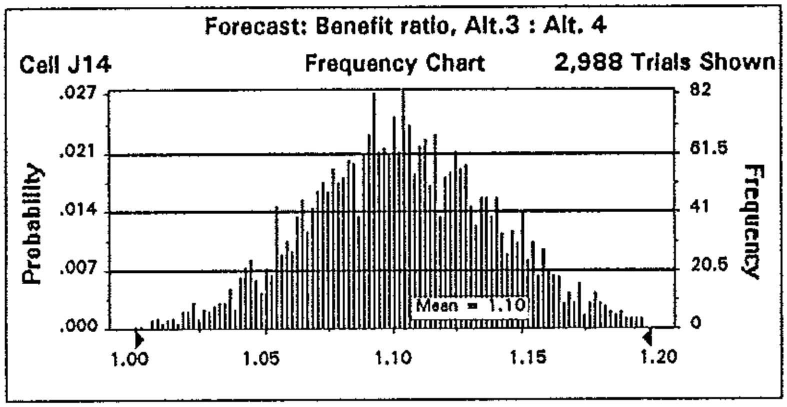
[c] The sum of capital and operating costs and the net present value of the post-closure care costs.

APPENDIX H

PROBABILISTIC UNCERTAINTY ANALYSIS

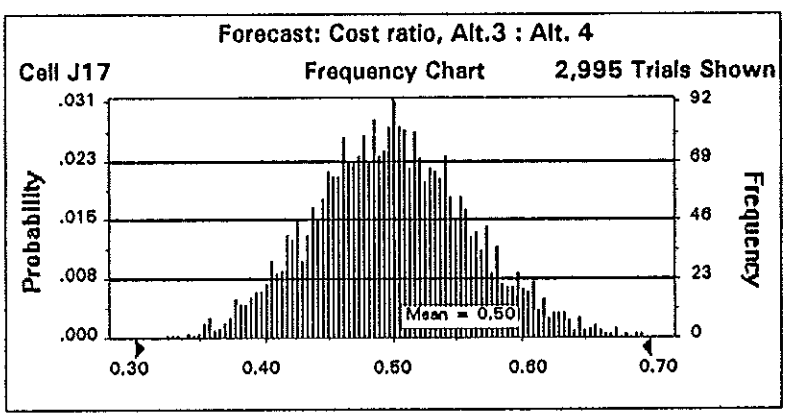
APPENDIX H
Probabilistic Uncertainty Analysis
3,000 trials
Latin Hypercube Sampling; Sample Size = 100

Forecast: Benefit ratio, Alt.3 : Alt. 4



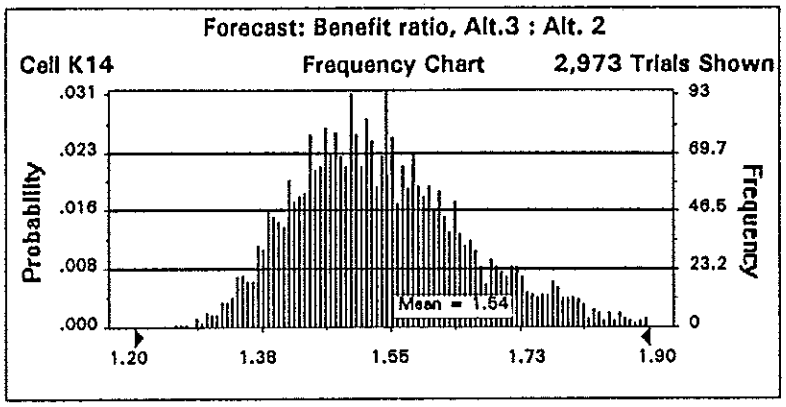
Percentile	Value
0%	0.99
10%	1.06
25%	1.08
50%	1.10
75%	1.13
90%	1.15
100%	1.22

Forecast: Cost ratio, Alt.3 : Alt. 4



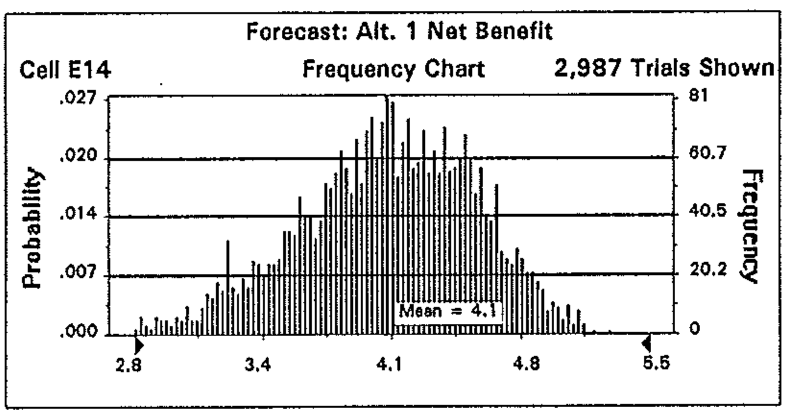
Percentile	Value
0%	0.29
10%	0.42
25%	0.46
50%	0.50
75%	0.54
90%	0.58
100%	0.74

Forecast: Benefit ratio, Alt.3 : Alt. 2



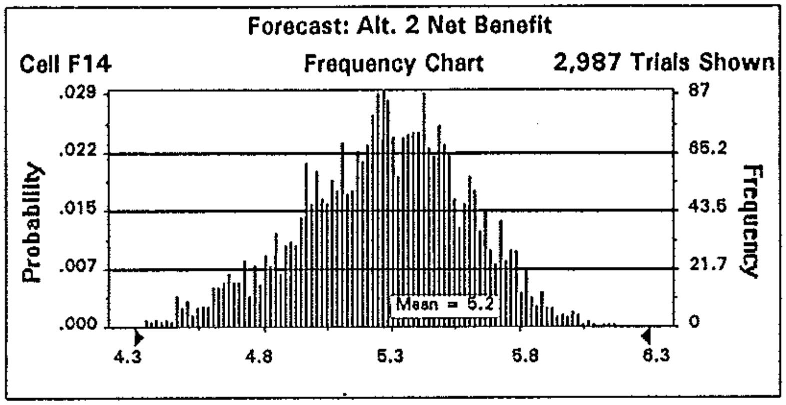
Percentile	Value
0%	1.26
10%	1.40
25%	1.45
50%	1.53
75%	1.61
90%	1.71
100%	2.16

Forecast: Alt. 1 Net Benefit



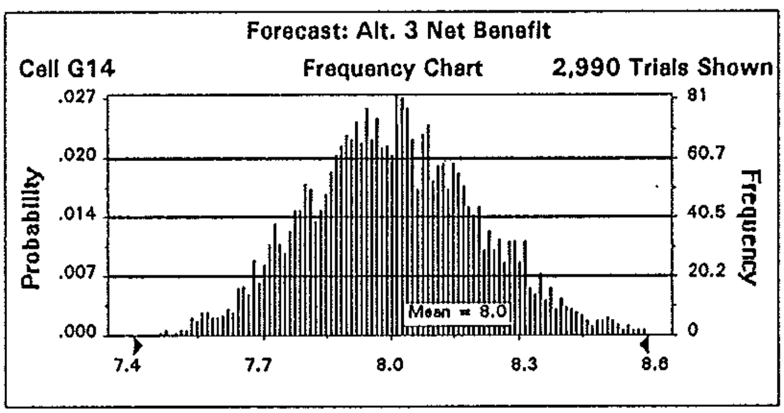
Percentile	Value
0%	2.5
10%	3.4
25%	3.8
50%	4.1
75%	4.5
90%	4.7
100%	5.3

Forecast: Alt. 2 Net Benefit



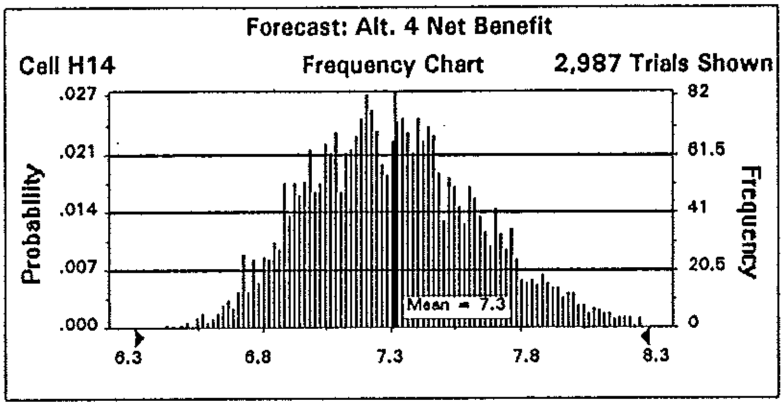
Percentile	Value
0%	4.1
10%	4.8
25%	5.0
50%	5.2
75%	5.4
90%	5.6
100%	6.1

Forecast: Alt. 3 Net Benefit



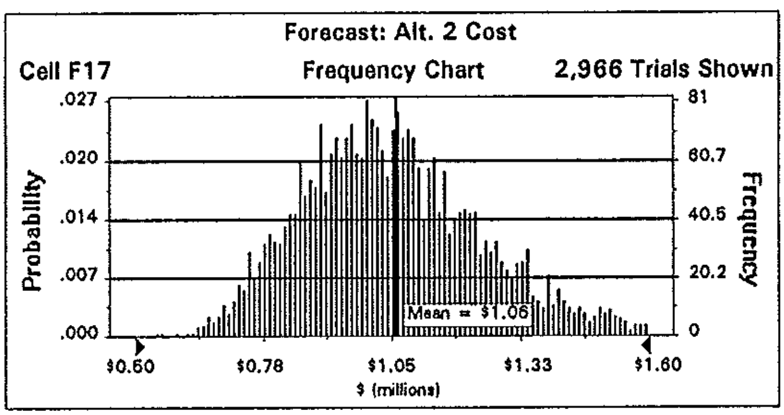
Percentile	Value
0%	7.5
10%	7.8
25%	7.9
50%	8.0
75%	8.1
90%	8.3
100%	8.9

Forecast: Alt. 4 Net Benefit



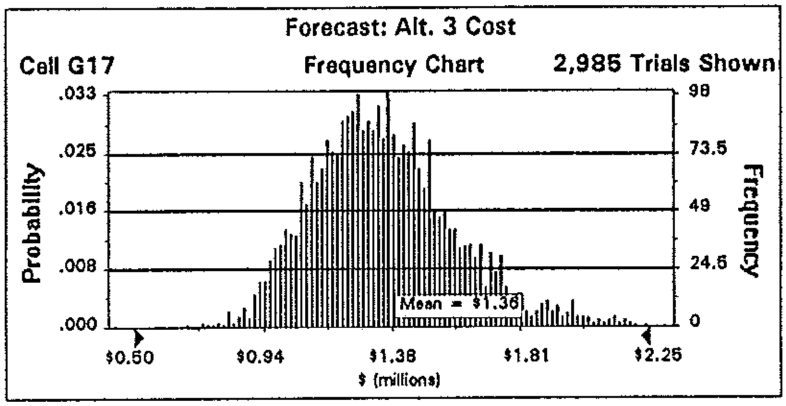
Percentile	Value
0%	6.4
10%	6.9
25%	7.0
50%	7.2
75%	7.5
90%	7.7
100%	8.4

Forecast: Alt. 2 Cost



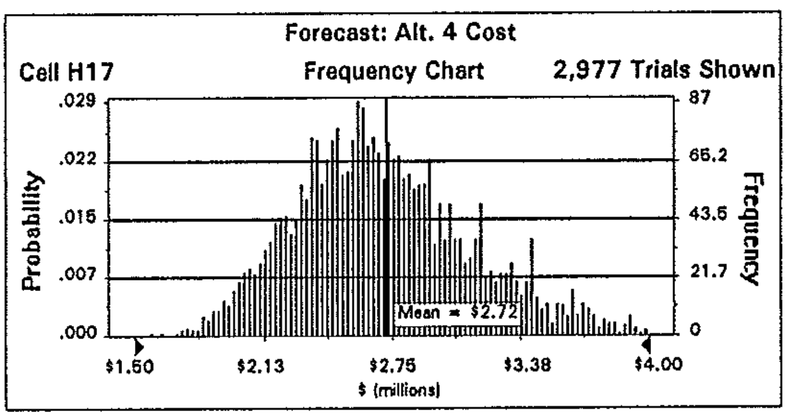
Percentile	$ (millions)
0%	$0.55
10%	$0.82
25%	$0.91
50%	$1.04
75%	$1.17
90%	$1.32
100%	$1.92

Forecast: Alt. 3 Cost



Percentile	$ (millions)
0%	$0.69
10%	$1.06
25%	$1.18
50%	$1.33
75%	$1.50
90%	$1.68
100%	$2.70

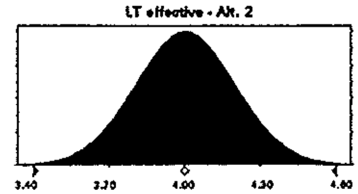
Forecast: Alt. 4 Cost



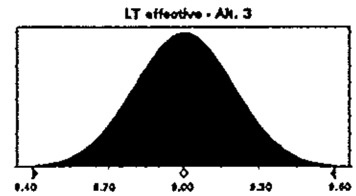
Percentile	$ (millions)
0%	$1.60
10%	$2.19
25%	$2.41
50%	$2.67
75%	$2.98
90%	$3.33
100%	$4.76

Assumptions

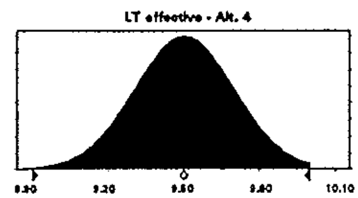
Assumption: LT effective - Alt. 2
Normal distribution with parameters:
Mean 4.00
Standard Dev. 0.20
Mean value in simulation was 4.00



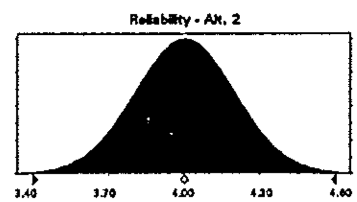
Assumption: LT effective - Alt. 3
Normal distribution with parameters:
Mean 9.00
Standard Dev. 0.20
Mean value in simulation was 9.00



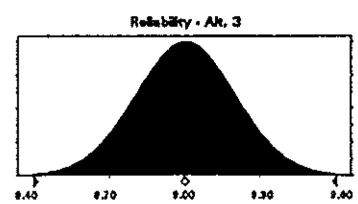
Assumption: LT effective - Alt. 4
Normal distribution with parameters:
Mean 9.50
Standard Dev. 0.20
Mean value in simulation was 9.50



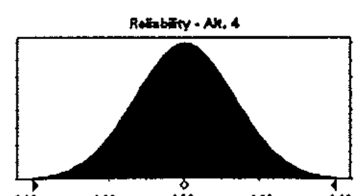
Assumption: Reliability - Alt. 2
Normal distribution with parameters:
Mean 4.00
Standard Dev. 0.20
Mean value in simulation was 4.00



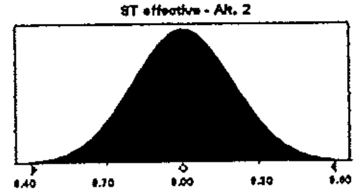
Assumption: Reliability - Alt. 3
Normal distribution with parameters:
Mean 9.00
Standard Dev. 0.20
Mean value in simulation was 9.00



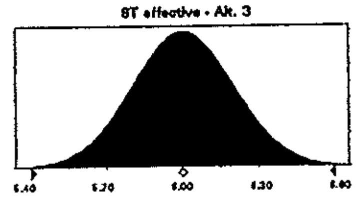
Assumption: Reliability - Alt. 4
Normal distribution with parameters:
Mean 8.50
Standard Dev. 0.20
Mean value in simulation was 8.50



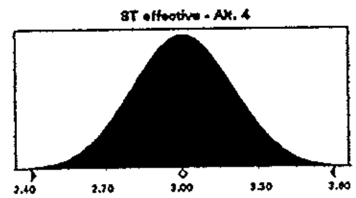
Assumption: ST effective - Alt. 2
Normal distribution with parameters:
Mean 9.00
Standard Dev. 0.20
Mean value in simulation was 9.00



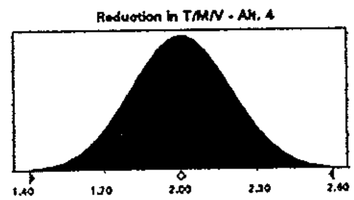
Assumption: ST effective - Alt. 3
Normal distribution with parameters:
Mean 6.00
Standard Dev. 0.20
Mean value in simulation was 6.00



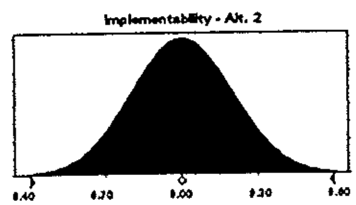
Assumption: ST effective - Alt. 4
Normal distribution with parameters:
Mean 3.00
Standard Dev. 0.20
Mean value in simulation was 3.00



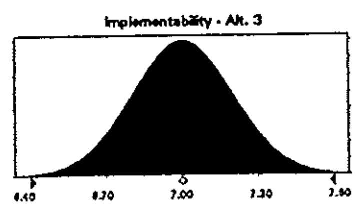
Assumption: Reduction in T/M/V - Alt. 4
Normal distribution with parameters:
Mean 2.00
Standard Dev. 0.20
Mean value in simulation was 2.00



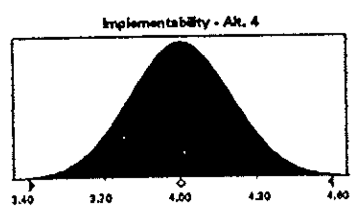
Assumption: Implementability - Alt. 2
Normal distribution with parameters:
Mean 9.00
Standard Dev. 0.20
Mean value in simulation was 9.00



Assumption: Implementability - Alt. 3
Normal distribution with parameters:
Mean 7.00
Standard Dev. 0.20
Mean value in simulation was 7.00



Assumption: Implementability - Alt. 4
Normal distribution with parameters:
Mean 4.00
Standard Dev. 0.20
Mean value in simulation was 4.00

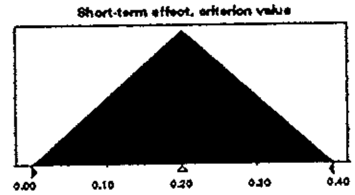


Assumption: Short-term effect. criterion value

Triangular distribution with parameters:

Minimum	0.00
Likeliest	0.20
Maximum	0.40

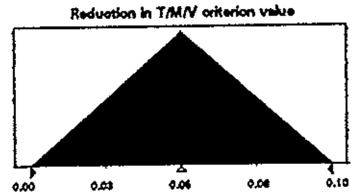
Mean value in simulation was 0.20



Assumption: Reduction in T/M/V criterion value

Triangular distribution with parameters:

Minimum	0.00
Likeliest	0.05
Maximum	0.10

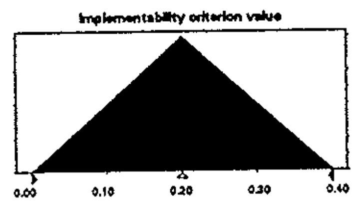


Assumption: Implementability criterion value

Triangular distribution with parameters:

Minimum	0.00
Likeliest	0.20
Maximum	0.40

Mean value in simulation was 0.20



Assumption: Cap area (acres)

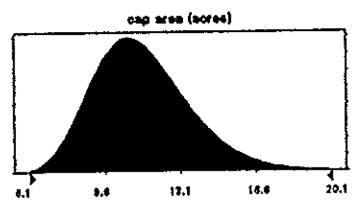
Lognormal distribution with parameters:

Mean	11.3
Standard Dev.	2.3

Mean value in simulation was 11.3

Correlated with:

Fill volume including cap	0.75

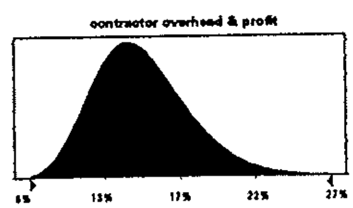


Assumption: Contractor overhead & profit

Lognormal distribution with parameters:

Mean	15%
Standard Dev.	3%

Mean value in simulation was 15%

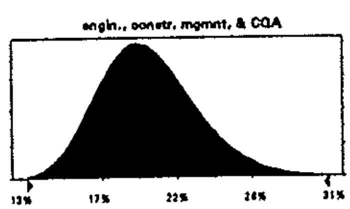


Assumption: Engineering, construction management, & CQA

Lognormal distribution with parameters:

Mean	20%
Standard Dev.	3%

Mean value in simulation was 20%



Assumption: Fill volume including cap (cy)

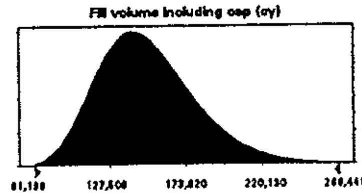
Lognormal distribution with parameters:

Mean	150,000
Standard Dev.	30,000

Mean value in simulation was 150,000

Correlated with:

Cap area	0.75

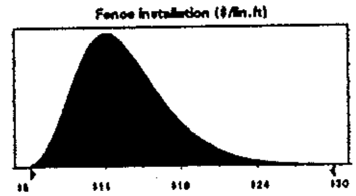


Assumption: Fence installation ($/lin.ft)

Lognormal distribution with parameters:

Mean	$13
Standard Dev.	$4

Mean value in simulation was $13

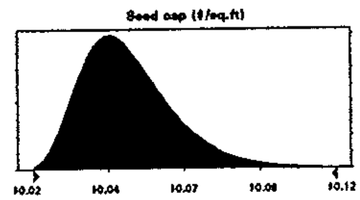


Assumption: Seed cap ($/sq.ft)

Lognormal distribution with parameters:

Mean	$0.05
Standard Dev.	$0.02

Mean value in simulation was $0.05

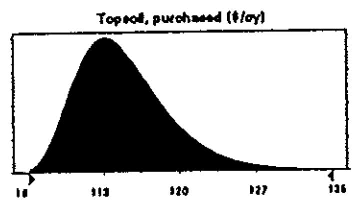


Assumption: Topsoil, purchased ($/cy)

Lognormal distribution with parameters:

Mean	$15
Standard Dev.	$5

Mean value in simulation was $15

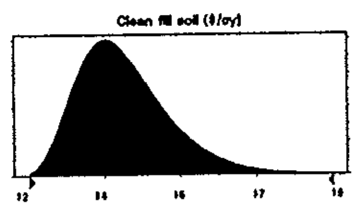


Assumption: Clean fill soil ($/cy)

Lognormal distribution with parameters:

Mean	$4
Standard Dev.	$1

Mean value in simulation was $4

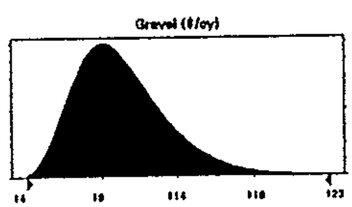


Assumption: Gravel ($/cy)

Lognormal distribution with parameters:

Mean	$10
Standard Dev.	$3

Mean value in simulation was $10

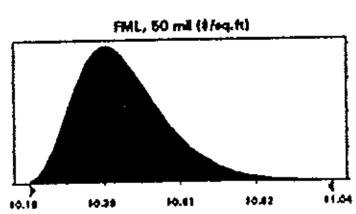


Assumption: FML, 50 mil ($/sq.ft)

Lognormal distribution with parameters:

Mean	$0.45
Standard Dev.	$0.14

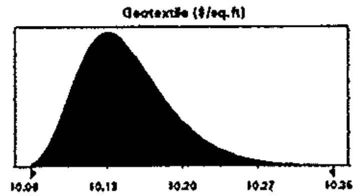
Mean value in simulation was $0.45



Assumption: Geotextile ($/sq.ft)
Lognormal distribution with parameters:

Mean	$0.15
Standard Dev.	$0.05

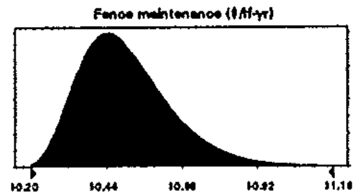
Mean value in simulation was $0.15



Assumption: Fence maintenance ($/lf-yr)
Lognormal distribution with parameters:

Mean	$0.50
Standard Dev.	$0.15

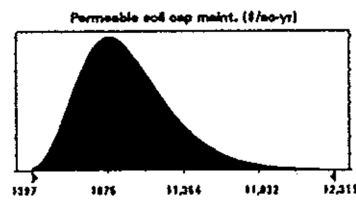
Mean value in simulation was $0.50



Assumption: Permeable soil cap maintenance ($/ac-yr)
Lognormal distribution with parameters:

Mean	$1,000
Standard Dev.	$300

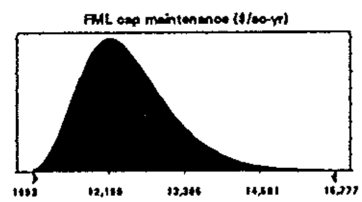
Mean value in simulation was $1,000



Assumption: FML cap maintenance ($/ac-yr)
Lognormal distribution with parameters:

Mean	$2,500
Standard Dev.	$750

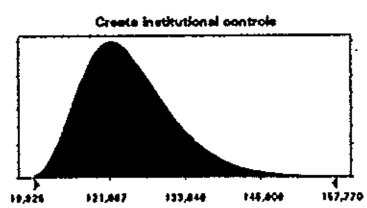
Mean value in simulation was $2,501



Assumption: Create institutional controls
Lognormal distribution with parameters:

Mean	$25,000
Standard Dev.	$7,500

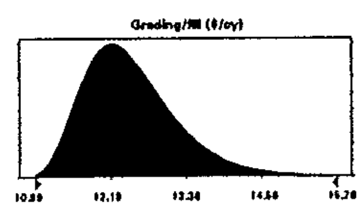
Mean value in simulation was $25,006



Assumption: Grading/fill ($/cy)
Lognormal distribution with parameters:

Mean	$2.50
Standard Dev.	$0.75

Mean value in simulation was $2.50

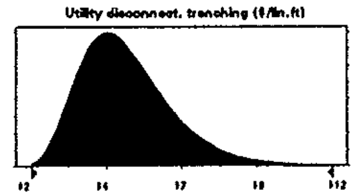


Assumption: Utility disconnection trenching ($/lin.ft)

Lognormal distribution with parameters:

Mean	$5
Standard Dev.	$2

Mean value in simulation was $5

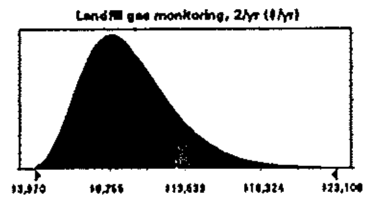


Assumption: Landfill gas monitoring, 2/yr ($/yr)

Lognormal distribution with parameters:

Mean	$10,000
Standard Dev.	$3,000

Mean value in simulation was $10,003

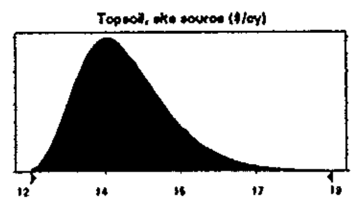


Assumption: Topsoil, site source ($/cy)

Lognormal distribution with parameters:

Mean	$4
Standard Dev.	$1

Mean value in simulation was $4

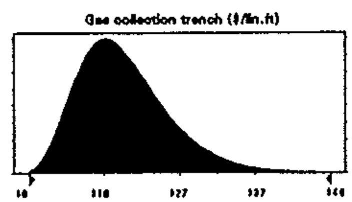


Assumption: Gas collection trench ($/lin.ft)

Lognormal distribution with parameters:

Mean	$20
Standard Dev.	$6

Mean value in simulation was $20

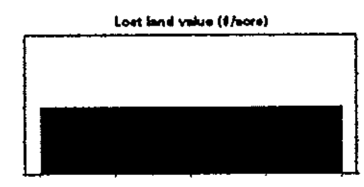


Assumption: Lost land value ($/acre)

Uniform distribution with parameters:

Minimum	$10,000
Maximum	$20,000

Mean value in simulation was $15,000

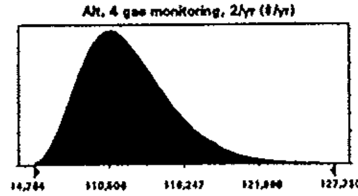


Assumption: Alt. 4 gas monitoring, 2/yr ($/yr)

Lognormal distribution with parameters:

Mean	$12,000
Standard Dev.	$3,600

Mean value in simulation was $12,010

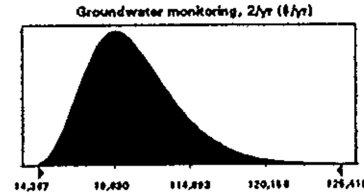


Assumption: Groundwater monitoring, 2/yr ($/yr)

Lognormal distribution with parameters:

Mean	$11,000
Standard Dev.	$3,300

Mean value in simulation was $10,994

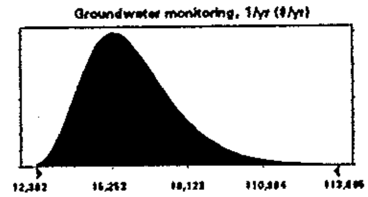


Assumption: Groundwater monitoring, 1/yr ($/yr)

Lognormal distribution with parameters:

Mean	$6,000
Standard Dev.	$1,800

Mean value in simulation was $5,997

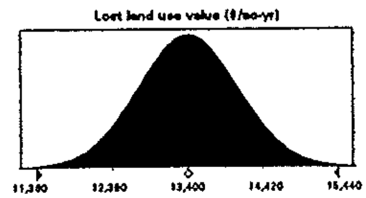


Assumption: Lost land earning potential ($/ac-yr)

Normal distribution with parameters:

Mean	$3,400
Standard Dev.	$680

Mean value in simulation was $3,400

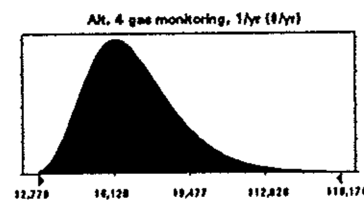


Assumption: Alt. 4 gas monitoring, 1/yr ($/yr)

Lognormal distribution with parameters:

Mean	$7,000
Standard Dev.	$2,100

Mean value in simulation was $7,002

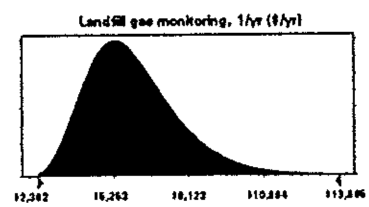


Assumption: Landfill gas monitoring, 1/yr ($/yr)

Lognormal distribution with parameters:

Mean	$6,000
Standard Dev.	$1,800

Mean value in simulation was $6,006

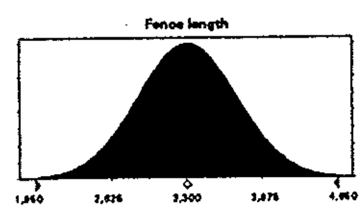


Assumption: Fence length

Normal distribution with parameters:

Mean	3,300
Standard Dev.	450

Mean value in simulation was 3,300

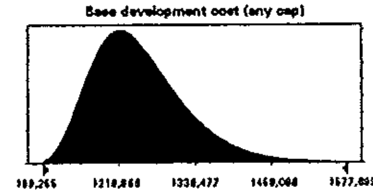


Assumption: Base development cost (any cap)

Lognormal distribution with parameters:

Mean	$250,000
Standard Dev.	$75,000

Mean value in simulation was $250,283

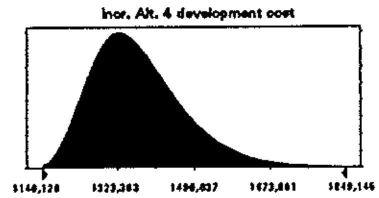


Assumption: Incremental Alt. 4 development cost

Lognormal distribution with parameters:

Mean	$370,000
Standard Dev.	$110,000

Mean value in simulation was $370,121



End of Assumptions

APPENDIX I

AMBIENT AIR SAMPLING
TECHNICAL PROCEDURES (TPs)

STANDARD OPERATING PROCEDURES (SOPs)

QA AUDIT REPORTS (SIRs)

AMBIENT AIR SAMPLING TECHNICAL PROCEDURES
(TP-1.2-25)

INFORMATION ONLY

Golder Associates

Technical Procedure

Number: TP-1.2-25

Title: AMBIENT AIR/SOIL VAPOR SAMPLING FOR CHEMICAL ANALYSES

Prepared by	Approved by	Approved by	Effective Date	Rev. Level
[signature] 2-28-95	[signature] 2-24-95	[signature] 2-28-95	2-28-95	0
[signature] 3-9-95	[signature] 3-9-95	[signature] 3-9-95	3-10-95	1

Record of Revisions

TP-1.2-25	Revision 1
Section	Description of Change
3.5	Clarified flow rate as constant
3.6	Added definition for "semi-quantitative"
7.2.1	Reworded for clarity
7.2.2	Clarified calibration requirements and sampling steps, added bullet for soil gas
7.2.3	Reworded for clarity
7.3.2	Reworded for clarity

1. PURPOSE

This technical procedure establishes a uniform methodology for collecting ambient air and soil vapor samples for chemical analysis that are representative of ambient air quality or soil vapor.

2. APPLICABILITY

This technical procedure is applicable to all Golder Associates personnel engaged in the collection of air or soil vapor samples for purposes of chemical analysis.

3. DEFINITIONS

3.1 SUMMA Canister

A summa canister is a stainless steel sampling device which has had its internal surface specially passivated using a "SUMMA" process, a surface that is inert resisting both surface adsorption and chemical reaction. Evacuated canisters are used too draw in the air sample and retain it prior to analysis.

3.2 Tedlar Bag

A Tedlar bag is a dedicated sampling bag which is constructed of Tedlar film, a chemically inert fluorocarbon polymer with characteristic low permeability.

3.3 Lung Sampler

A lung sampler is a rigid air sample box which allows the direct filling of an air sample bag using negative pressure provided by a personnel sampling or hand-pump. The air sample enters to the bag directly, without passing through the pump. This eliminates the risk of contaminating the pump or sample. All surfaces in contact with the sample are constructed of stainless steel or Teflon.

3.4 Sorbent Tube

A sorbent tube is applicable to a wide range of chemical classes and consists of a glass tube containing two layers of solid adsorbent material chosen to capture analytes of interest. When air is actively pulled through the tube, airborne chemicals are trapped by the first adsorbent layer with the second layers serving as a backup layer and indicator of sample breakthrough.

3.5 Personal Air Sampling Pump

A personal air sampling pump is a low-flow air sampling pump which is designed to capture air or soil vapor samples at a constant flow rate which is set and calibrated by the user.

3.6 Semi-Quantitative

A semi-quantitative measurement is a measurement obtained as an estimated value rather 1
than a quantitative value. Documented calibration is not required for equipment used for semi-quantitative measurements.

4. REFERENCES

4.1 EPA (1988), *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*, EPA 600 4-89-017, June 1988, US EPA, Atmospheric Research and Exposure Assessment Laboratory, Research Triangle Park, North Carolina.

4.2 EPA (1991) *Canister-Based Method for Monitoring Toxic VOCs in Ambient Air*, EPA 600 J-92 263, US EPA, Atmospheric Research and Exposure Assessment Laboratory, Research Triangle Park, North Carolina.

4.2 EPA (1992), *Test Methods for Evaluating Solid Waste, Chemical/Physical Methods, Third Edition*, SW-846, U.S. EPA, Office of Solid Waste, Washington, D.C.

4.4 NIOSH (1994), *NIOSH Manual of Analytical Methods*, 4th Edition, August 1994, US Department of Health and Human Services, Pubic Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Division of Physical Sciences and Engineering, Cincinnati, Ohio.

4.5 ASTM (1994), *1994 Annual Book of Standards*, Method D-3416, "Analysis of Atmospheric Gases", 1994, American Society of Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania.

4.6 GAI (1995), P-12.0-1, *Calibration and Maintenance of Measuring and Test Equipment*, Golder Associates, Inc.

4.7 GAI (1995), TP-1.2-23, *Chain of Custody*, Golder Associates, Inc.

5. DISCUSSION

Ambient air and /or soil vapor samples shall be collected in quantities and types as directed by the Project Manager and project work documents. All instruments used for quantitative field analyses shall be calibrated in accordance with Golder Associates Procedure P-12.0-1, "Calibration and Maintenance of Measuring and Test Equipment." All non-dedicated sampling equipment shall be decontaminated before and after each use. Samples shall be collected in properly prepared containers of the appropriate size and type (see Table 1). All samples shall be appropriately labelled and sealed (see TP-1.2-23, Exhibit A). Samples shall be stored and transported in coolers or shipping containers as appropriate for the sample type and anticipated analysis. Chain of custody shall be maintained in accordance with procedure TP-1.2-23, "Chain of Custody."

6. RESPONSIBILITIES

6.1 Field Personnel

Field personnel are responsible for sample collection, sample custody in the field, preservation, field testing, total and accurate completion of data sheets, sample shipment and delivery of data to the Project Manager and designated Project Document Custodian, all as described in this technical procedure.

6.2 Task Leader

The Task Leader is responsible for supervising field personnel. Supervision includes ensuring that samples are collected, documented, preserved, field analyzed, handled and shipped to the appropriate laboratory as specified in project work documents and this technical procedure.

6.3 Project Manager

The Project Manager has overall management responsibilities for the project, is responsible for designing the sampling program, for arranging the logistics of the program, and for providing any required clarifications in the use of this procedure. The Project Manager may assume the responsibilities of the Task Leader on smaller projects.

6.4 Document Custodian

The Document Custodian is responsible for maintaining project files and filing project documents, project correspondence, sample integrity data sheets, chain of custody forms, field report forms, generated data and other associated and pertinent project information.

7. PROCEDURE

7.1 General Considerations

7.1.2 Sample Quantities, Types, and Documentation

Samples shall be collected in quantities and types as directed by the Project Manager or as specified in the project work documents. Samples shall be transferred to the analytical laboratory under formal chain of custody, which shall be documented (TP-1.2-23, Exhibit C) and maintained in accordance with procedure TP-1.2-23, "Chain of Custody".

7.1.3 Sample Containers

Table 1 provides a summary of the sampling technique, sample container types, and detection limit goals for the most common chemical analyses on air or soil vapor samples. All sample containers must be properly cleaned and prepared as appropriate for the method of analysis. All samples shall be labelled and sealed (see Section 7.4) and immediately placed in shipping containers or coolers with securely closed lids for storage and transport. Samples must be received by the analytical laboratory in sufficient time to conduct the requested analyses within the specified holding time or as soon as possible.

7.1.4 Acceptable Materials

Acceptable materials that may contact any air or soil vapor sample are stainless steel and fluorocarbon resin (Teflon, PTFE, FEP, or PFA). Glass is an acceptable material for contacting samples but it is not recommended for sample storage and transport.

7.1.5 Sample Acquisition

Ambient air or soil vapor samples shall be collected with the use of an evacuated canister, lung sampler, or absorbent tube.

7.2 <u>Collection of Samples for Specified Chemical Analyses</u>

7.2.1 <u>Sulfide</u>

- Sulfide samples are taken using a Tedlar® bag and lung sampler. A clean tedlar bag and a new section of Teflon® tubing are connected to the bag and the sample source via the sampling port in the lung sampler. A pump is then connected to the pumping port of the lung sampler, the sampler lid closed and the pumping action producing a relative negative pressure around the bag allows the bag to fill with sample. 1

- Be sure to stop pumping when a vacuum has been created, excessive pressure can cause the bag to fail. Cap the sampling port and break the vacuum by forcing the lid open or by bleeding in air by opening the pump port connection or vent. Close the bag valve and disconnect the tubing from the bag.

- Sulfide samples have a recommended maximum holding time (MHT) of 24 hours when sampled in a Tedlar bag. Because of the short MHT, ship samples immediately and notify the laboratory the day the sample are shipped so that analysis can be conducted shortly after sample receipt. Samples analyzed within two times the MHT (48 hrs.) will be qualified as estimated but useable for decision making purposes.

- Store and transport the Tedlar® bags at approximately 25 °C in a rigid insulated shipping container. Tedlar bag samples may be shipped by air freight, only if pressurized.

7.2.2 Aldehydes/Ketones and Aliphatic Amines

Aldehyde/ketone sampling is performed with a XAD-2 cartridge. Amine sampling is performed with a silica gel cartridge. Sampling may be performed by using a separate pump for each tube, or by using a manifold or "T" with two or more tubes connected to a single pump.

- Calibrate the rotameter on each pump weekly with the sample collection setup in the sampling line. Adjust the manifold/"T" (if used) such that the flow is equal through each absorbent tube. The calibration shall be performed using either an NIST traceable bubble meter or digital flow meter, or a rotameter which has itself been calibrated to an NIST traceable bubble meter or digital flow meter within the past six months.

- Break off the tips (both ends) of an XAD-2 absorbent tube and a silica gel adsorbent tube. Examine both ends of each tube to verify that the tube has in fact been opened.

1

- Prior to sampling insert a "blank" sample collection setup in the sample line and verify that the rotameter reading on the pump is the same as the reading at the known (calibrated) flow rate.

- Begin sampling by drawing air through the adsorbent tubes at the calibrated rate (200-500 ml/min). The total volume of air drawn through each tube should be 20 to 30 liters.

- During soil vapor sampling verify that the sampling rate is not affected by any additional pressure drop by noting the rotameter reading on the pump. Record the exact rotameter reading on the pump if different than that observed during calibration.

- Disconnect and seal the adsorbent tubes at the conclusion of the sampling period.

- Reintroduce the blank sample collection setup to the sampling line and verify that the calibrated flow rate has been maintained for the duration of the sampling period. Record the exact reading on the rotameter if different than that observed during calibration.

- The XAD-2 and silica gel cartridges can be stored together. Label each tube with the sample location and store in a labeled padded envelope. The samples should be stored at approximately 25 °C from the time of collection. Ship the cartridges at ambient temperature in an insulated shipping container to the laboratory performing the analysis.

7.2.3 <u>Volatile Organic Compounds and Fixed Gases</u>

Volatile organic compounds (VOCs) and fixed gases will be sampled using a single SUMMA® passivated stainless steel canister. Canisters are evacuated and blank certified by the laboratory.

- Soil vapor or ambient air grab samples are taken by slowly opening the valve of
  the canister, which may connected to a sample location via a length of Teflon® 1
  tubing.

- When the sample canister has reached equilibrium pressure, the vacuum hissing will stop and the valve is closed.

- Fix sample identification to the canister and record the canister sample ID and prepare for shipment to the laboratory.

- Special storage requirements are not required other than keeping the sample containers at ambient temperature by storing out of direct sunlight.

7.3 <u>Field Analyses</u>

7.3.1 Calibration of Instruments

All instruments used for quantitative field analyses shall be calibrated in accordance with procedure P-12.0-1, "Calibration and Maintenance of Measuring and Test Equipment." Only equipment with a calibration tag showing a recall date later than the anticipated date of use shall be taken to the field. Each instrument should be accompanied by a copy of the manufacturer's operation manual.

7.3.2 Meteorologic Conditions

Temperature, windspeed/direction and barometric pressure conditions shall be recorded for
each sample location as a semi-quantitative measurement of local conditions. General 1
meteorologic conditions such as precipitation, fog, etc. shall also be noted.

7.4 Documentation

Documentation for air or soil vapor sampling includes labelling sample containers; completing sample Chain of Custody Records; securing individual samples or shipping containers with chain of custody seals; and documenting conditions and observations in the field log.

7.4.1 Sample Labels

Samples shall be immediately labelled. Labels shall be water proof. Information shall be recorded on each label with indelible ink. All blanks shall be filled in (N/A if not applicable). Sample designations will be as specified in the project work documents or by the Project Manager.

7.4.2 Chain of Custody Records

Chain-of-Custody Records will be used to record the custody and transfer of samples in accordance with procedure TP-1.2-23, "Chain of Custody." These forms shall be filled in completely (N/A if not applicable). Tamper-proof Seals (TP-1.2-23, Exhibit A) shall be placed on either sample bottles or shipping containers. The seal number shall be recorded on the Chain of Custody Form. The original form must accompany the samples to the analytical laboratory to be completed and returned to Golder for filing by the Document Custodian. A copy of the Chain of Custody Record documenting the transfer of samples from the field shall be submitted to the Document Custodian for filing.

7.5 Field Log Book

All observations, including meteorologic conditions, and observations of other persons onsite shall be recorded in the field log book for each sample where applicable.

8. QUALITY ASSURANCE/QUALITY CONTROL

8.1 Duplicate Sample Analysis

Sample precision will be monitored by collecting blind duplicate samples at a frequency of 10% of the total number of samples. Duplicate sample locations will be selected at random from an on-site ambient air sampling location (not a background location). Samples in duplicate will not be taken at soil vapor locations.

8.2 Equipment/Field Blanks

One equipment/field blank will be sampled by pumping ambient air (upwind from any known sources) through the sampling train for each set of parameters. An equipment/field blank can be taken at either the beginning or end of the field sampling program.

TABLE 1

PARAMETER	REFERENCE	SAMPLING TECHNIQUE	DETECTION LIMIT GOALS[a]	COMMENTS
SULFUR CMPDS H2S - HYDROGEN SULFIDE (CH3)2S - DIMETHYL SULFIDE (CH3)2S2 - DIMETHYLDISULFIDE CH4S - METHYL MERCAPTAN	EPA 15/16	TEDLAR BAG, LUNG SAMPLER EVACUATED WITH PERSONAL SAMPLING PUMP	50 ppm$_v$ 50 ppm$_v$ 50 ppm$_v$ 50 ppm$_v$	1 LITER SAMPLE
VOCS	EPA TO14	SUMMA CANISTER, EVACUATED	0.5 ppb$_v$	6 L SAMPLE
FIXED GASES CO2 - CARBON DIOXIDE CO - CARBON MONOXIDE CH4 - METHANE N2 - NITROGEN O2 - OXYGEN TNMHC - TOTAL NON-METHANE HCS	ASTM D1946	SUMMA CANISTER, EVACUATED	0.001% 0.001% 0.001% 0.001% 0.010% 0.010%	SUB SAMPLE OF VOC SUMMA CANISTER
ALDEHYDES/KETONES CH20 - FORMALDEHYDE CH3CHO - ACETALDEHYDE CH2=CHCHO - ACROLEIN	EPA T011 OR NIOSH 2539	XAD-2 CALIBRATED PERSONAL SAMPLING PUMP	0.1mg/m^3	20 - 30 LITER SAMPLE AT LESS THAN 1 LITER PER MINUTE
ALIPHATIC AMINES (C2H5)2NH - DIETHYLAMINE (CH3)2NH - DIMETHYL AMINE C4H9NH - N BUTYL AMINE	NOISH 2010	SILICA GEL, CALIBRATED PERSONAL SAMPLE PUMP	1mg/m^3	20 - 30 LITER SAMPLE

[a]Detection limits are goals. Actual achieved detection limits will be dependent on the media interferences/matrix.

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STANDARD OPERATING PROCEDURES (SOPs) FOR DECIDING TO SAMPLE AN ODOR EVENT

NORSELAND MOBILE ESTATES

Revised Ambient Air SOP

The following procedures outline daily ambient air monitoring activities for Golder field representatives at the Norseland Mobile Estates site. The outline is arranged chronologically and is flexible.

1. Upon arrival on site, check for phone messages. Record weather conditions in log and document barometer reading in the daily barometric pressure log. If there are any messages documenting odors when Golder was not onsite, make sure to contact the caller for a debriefing of the event.
2. The six ambient air monitoring stations are numbered AA-1 (Lot 134), AA-2 (Lot 66), AA-3 (Lot 60), and the perimeter samples (AA-4 through AA-6). All sample containers (i.e., Tedlar® bag, SUMMA® canister, XAD-2 and silica cartridges) should be marked accordingly. The field duplicate should be numbered AA-7 and collected concurrently with sample AA-1, AA-2 or AA-3.

Sampling equipment for each station should consist of the following:

a) Sulfide lung sampler, SUMMA® canister and low-flow air pump.
b) Attach the hoses to the upper portion of the 4 foot steel rod, set in ground while sampling. Do not attach the XAD-2 or silica tubes to the hoses until the onset of an odor event.
c) The sampling ports on the lung sampler and SUMMA® canister must be covered with parafilm tape to ensure that the samplers are not tampered with if left unattended. If there are scattered showers during sampling, position the ends of all sample ports to ensure that water intrusion is eliminated. If it is raining steadily or forecast indicates adverse conditions do not set up the sample stations.
d) Set barrier tape around sampling site.

Equipment may be set up at air monitoring stations daily or may be secured in the Golder vehicle, ready for immediate deployment for sampling. Equipment may be borrowed from other Golder Associates offices for use on this project, provided calibration is current during the period of use. Calibration documentation for borrowed equipment shall be maintained in project records.

After setting up the stations, conduct the first walk-through inspection of the site, using the site map to ensure that all locations are reviewed. We screen for odors by smelling the ambient air. Characterize detected odors as smelling like rotten cabbage, manufactured natural gas, rotten eggs (H2S), solvents or anything else that could describe the odor, or as reported by a resident. If odor is detected, rate on a scale of 1 to 10; 1 being barely detectable and variable, 5 being detectable, constant and unmistakable,

and 10 being overpowering. Record all observations, including the numerical odor rating in the field log book. The inspection can be done on foot or from a vehicle.

Note that the permanent soil vapor probe on Lot 123 is in the occupant's backyard. If you need to sample it during the early morning hours, make sure to enter the premises on the LEFT side, the side opposite of the carport. If you walk near the carport a security light will turn on and wake the owners. Use a flashlight when entering private lots in the dark and wear a white Golder hat for identification purposes.

After the Norseland site walk-through inspection, drive to the Kitsap County Sanitary Landfill (KCSL) to check for odors at the two off-site perimeter sampling locations, see the attached KCSL map. If there are detectable odors at both locations, return to the Norseland site office and call Lee Wilson (KCSL General Manager) to gain access to the site. Lee must be contacted prior to entering the landfill. He will arrange for an escort to accompany us from the entrance gate. We can contact Lee at his home, on his mobile phone, or at the landfill from as early as 05:00, he usually arrives at the landfill from 06:00 to 08:00. His phone numbers are available at the Golder field office. There are KCSL staff onsite and available as escorts as early as 05:00. Alternately, a sample can be collected at the end of the county road adjacent to the landfill entrance road. This location is approximately 100 yds from the proposed onsite landfill location.

The site walk-through and KCSL inspections should be conducted once every hour, or as close to that as possible in order to provide a comprehensive baseline of Norseland site ambient air conditions. As many inspections as practicable should be completed between the hours of 6:00 a.m. and 11:00 a.m. KCSL inspections may be less frequent if primary activities (such as sampling) at the Norseland Site preclude KCSL visits.

If odors are detected at sampling locations AA-1 through AA-3 (Lower Lofall Lane), go back to sample location AA-1 and check to ensure that the odor remains. If it does, begin sampling as detailed below. However, if after collecting samples at AA-1, the odor has dissipated at sampling locations AA-2 and AA-3, then discontinue sampling (false start) and contact the project manager for disposition of sample AA-1.

Sample ambient air as follows:

1. Snap both ends off the glass XAD-2 and silica tubes (needle nose pliers work well) making sure not to crack the tube, just snap off the fluted end. Inspect the ends of the tubes to verify that both ends have in fact been opened. Inspect the parafilm guards to ensure that the samplers have not been tampered with, remove them and set the sampling tubes into the appropriate hoses for the aldehydes/ketones (XAD-2) and aliphatic amines (silica). If the sampling equipment has been tampered with, replace it and document the event in the site log book.
2. Turn the pump on. Make sure to run it for at least enough time to sample 20 liters of air. This is calculated by:

$$T = \frac{DV}{FR}$$

where: FR = flow rate of pump (L/minute)
DV = desired volume (minimum 20 liters)
T = Total sampling time (minutes)

3. Check the flow rate and calculate the sampling time required for at least 20 liters for each pump (flow rate is checked every week and logged - located in the site office).
4. Collect both grab samples (i.e., sulfide lung sampler and SUMMA® VOC sampler) according to the directions in TP-1.2-25, "Ambient Air/Soil Vapor Sampling for Chemical Analysis." The samples and sampling devices should be collected and transported to the site office after sampling is completed. Store samples according to the directions in TP-1.2-25.

Collect the remaining samples as follows:

a) The perimeter ambient air samples should be collected first, AA-4 through AA-6 following the same sampling procedures outlined for samples AA-1 through AA-3.
b) Set up permanent soil vapor probes, sample locations SVP-1 through SVP-4, according to the directions in TP-1.2-25.
c) Collect a field blank sample as specified in TP-1.2-25.
d) After all the samples are collected, return to site office and store samples according to the directions in TP-1.2-25. Complete chain-of-custody forms before shipping but after checking out the KCSL sites (see e. below). All samples should be sent out the same day for overnight delivery to the appropriate analytical labs. There is a Federal Express office at Olympic View Industrial Park which may be used to ship the samples.
e) Travel to the KCSL sites with three sampling stations in your vehicle (AA-8 through AA-10), if the same odors are detected at the two perimeter sampling locations simultaneously, then collect ambient samples from the three locations, as outlined above. These three samples can also be collected separately, that is they can be sampled even if there are no odors at the Norseland site. However if the KCSL site is sampled independently from the Norseland site, a field duplicate and field blank must also be collected at KCSL.

1. INTRODUCTION

This procedure is intended for use by Golder Associates personnel assigned to acquire ambient air samples at the Norseland Mobile Estates site, or other locations associated with the Remedial Investigation / Feasibility Study being performed at the Norseland site. Ambient air monitoring is one of several tasks required under the Phase I RI/FS Work Plan adopted under the Consent Decree and Agreed Order for the Norseland site.

The Work Plan requires that ambient air sampling be performed at a series of fixed, pre-selected stations at six locations within the Norseland site. Additional sampling has also been approved to permit the capture of three ambient air samples at fixed locations near the Kitsap County Sanitary Landfill (KCSL), located to the west of the Norseland site in the Olympic View Industrial Park. These fixed stations are intended to provide data regarding the concentration and variability of captured organic and inorganic compounds across an extended transect of the Norseland site and the KCSL site. The procedures to be followed for ambient air sampling for a significant odor event are described in Appendix C of the Work Plan.

The procedures included in this addendum are intended for use in capturing localized odor events at the Norseland or KCSL sites. These procedures are intended as a supplement to the primary sampling activity required by the Work Plan and specified in Appendix C. The procedures described herein provide the ability to obtain ambient air samples at any outdoor location at the Norseland site or in the vicinity of KCSL. Further, the procedures permit identification of odor events for sampling purposes by either Golder personnel or Norseland residents.

2. REFERENCES

Department of Ecology Draft, Phase I Remedial Investigation/Feasibility Study Work Plan, Norseland Mobile Estates, Kitsap County, Washington, October 13, 1993 [*Work Plan*]

Technical Procedure, TP - 1.2 - 25, Ambient Air/Soil Vapor Sampling for Chemical Analyses.

3. METHOD

The following subsections describe the method for observing localized odors, selecting a suitable odor event for sampling, acquiring a sample, and performing required Quality Assurance, pursuant to the Quality Assurance Plan, Attachment A of the Work Plan.

3.1. Observation Procedure

3.1.1. Golder-Initiated Observations

A protocol has been established in the Ambient Air SOP in Appendix C for performing regular site excursions to investigate for odors at the Norseland site and in the vicinity of KCSL. The same procedures apply to this addendum. A summary of the required activities and documentation responsibilities follows:

- Site excursions should be conducted on an hourly basis or as close to that as possible between 0600 and 1100.
- Site excursions may be conducted either on foot or in a vehicle, as part of the protocol for the significant odor event investigation described in Appendix C. If vehicular excursions are performed, the investigator will make sure that the vehicle windows are down and will make all reasonable effort to obtain exposure to outside air. If an odor is detected at any location within the Norseland site or the vicinity of

KCSL, the investigator will park in a safe manner and exit the vehicle to continue the investigation. For any odor, the investigator will spend a minimum of two to three minutes observing and documenting the atmospheric conditions.

- All odor events will be appropriately logged in the field book, with minimum notations including time of day, wind velocity, general meteorological conditions (e.g., rain, fog, clear), a description of the odor, and odor intensity.
- If an odor is detected by the field investigator at an intensity of "3," or more, as defined in the Ambient Air SOP, the investigator will prepare to collect an ambient air sample as described in TP-1.2-25. An intensity of "3," is further described as being readily noticeable and continuously observable for a period of at least 3 minutes. All types of odors, without restriction, (e.g., sweet, sour, "landfill") will be recorded.

3.1.2. Resident-Initiated Observations

In addition to odors that are identified by Golder personnel for potential sample acquistion, field investigators will also respond to communications from Norseland residents that an odor event is underway. These communications may include telephone calls, telephone messages, or direct communication.

Upon notification that an odor event is occuring, the investigator will respond as quickly as practicable to the location of the event to meet with the resident. The investigator will log the following resident observations:

- Time odor was noticed
- Location where odor was first noticed
- Description of odor
- Intensity of odor when first noticed
- Current intensity of odor

If the current intensity of the odor is "3," or above, the investigator will prepare to collect a sample of outdoor ambient air. Prior to beginning sample collection, the investigator will query the resident if the odor is still present. If the intensity is still at "3" or above, the sample collection will be initiated as described in TP - 1.2 - 25.

3.2. Sampling Procedure

The procedure for acquiring, managing, and shipping ambient air samples is provided in the Ambient Air SOP and in the Technical Procedure TP - 1.2 - 25. The following additions and modifications to the Appendix C operating procedure will be followed for monitoring and sampling single-location odor events.

3.2.1. Definition of Terms

Sample An air (or soil vapor) sample at a given location includes the following subsamples, as described in the Work Plan, Quality Assurance Plan (QAP) [Attachment A to the Work Plan], and Technical Procedure TP - 1.2 - 25. The specific target analytes and analytical methods are provided in the QAP.

- One, six-liter evacuated Summa canister for collection of volatile organic compounds,
- One, one-liter Tedlar bag, filled using a lung sampler or equivalent, for collection of sulfur compounds,

- One XAD-2 adsorption tube for collection of aldehydes and ketone, collected using a calibrated personal sampling pump,
- One silica gel tube for collection of aliphatic amines, collected using a T-connection to the personal sampling pump.

Discrete Odor Event A discrete odor event is one that does not appear to be connected to a previously-identified event or one that manifests significantly increased intensity from previous recent observations. This distinction is made on the basis of temporal separation, meterological conditions, and odor type and intensity.

Example A: Resident X calls, observing an event in progress. The investigator responds and collects a sample in accordance with the established selection criteria. A few hours later Resident Y calls, reporting the same odor type and intensity. Weather conditions have not changed. This event is assumed to relate to the previously sampled one, and is not sampled.

Example B: Resident X calls, observing an event in progress at intensity "3." This meets selection criteria and is sampled. One half hour following collection of the sample, the investigator notes (or is informed by residents) that the odor has increased to "7" or above. This is considered a significant increase and a sample is collected.

Example C: Resident X calls, observing an event in progress which is sampled. Two days later, Resident X calls again, reporting a similar event. This is a discrete event and is sampled.

Example D: Resident X calls, observing an event in progress of type "L." A sample is acquired. Later that day, Resident Y calls, observing an event in progress of type "S." This is a discrete event and another sample is acquired.

3.2.2. Site Conditions Documentation

For any discrete sampling event, either resident or investigator initiated, that does not occur at a previously-established sample location (e.g., AA-1), the investigator will remain with the sampling equipment and will request that the resident also standby during the sampling. The investigator will regularly query and document the resident's observations of the event in progress. If the sampling is initiated by the Golder investigator, he or she will attempt to solicit and document input from nearby residents regarding their perception of the event in progress. During the sample acquistion, the investigator will also monitor and regularly record wind velocity.

For events initiated in response to a resident report, the investigator will also document his or her own observations of the odor event, including type and intensity, however, he or she should not discuss his personnal observations with the resident, in order to avoid introducing potential bias into the resident's observations.

3.2.3. Number of Samples

Ambient Air

One ambient air sample will be collected for each discrete odor event that meets the criteria established above, up to a total of six events.

Soil Vapor

One soil vapor sample will be collected from each of the four permanent soil vapor probes for each discrete, sampled odor event, up to a total of one per day. Since soil vapor is influenced only slightly by ambient air conditions (particularly under stable air conditions), one sample per day is assumed to be sufficient to characterize subsurface conditions even if multiple odor events are noted in a given day.

Quality Assurance samples

One ambient air duplicate sample will be collected for each of the first two discrete, sampled events. If analytical data does not indicate detections for non-VOCs, then one Summa canister will be collected as a duplicate and analyzed by method TO-14 for VOCs for each of the remaining four planned sampling events.

The analytical laboratory will analyze one method blank for each of the analytical methods for each batch of samples sent, or one per ten samples, whichever is most frequent.

3.2.4 Sample Analysis

Samples will be analyzed for specific target analytes, using the analytical methods specified in the Work Plan, QAP, and TP - 1.2 - 25.

QA AUDIT REPORTS (SIRs)

933-1280

28J

SURVEILLANCE INSPECTION REPORT

SIR

Page 1 of 4

No.: 070

Inspected Activity or Test: Ambient Air Monitoring, Task 7

Job Number: 933-1280.950

Personnel Contacted: Mike Higgins, Bill Beck

Reference Requirements: Work Plan for Phase I RI/FS - Norseland Mobile Estates + Dated Feb. 1995

Insp. Date: 3-1-95 Start Time: 10:15 End Time: 12:15

Equipment Condition/Calibration Status: See attached

Observation and Comments (Use Extra Sheets as Required): See attached

NCIR Reference (if any): NCIR No. 068

Action Items Requiring Correction (Use Extra Sheets as Required): See attached

Inspector: [signature] Date: 3-2-95

Closed By QA Manager: [signature] Date: 3-14-95

Action Item Closure Date: 3-14-95

Comments: Note: Use of parafilm to be confirmed in follow-up surveillance inspection.

GOLDER ASSOCIATES INC.

Equipment Condition/Calibration Status:

Equipment observed:

Personal Sampling Pumps
SKC Vac-U-Chamber ("lung sampler")
Rotameter
Compass
Wind speed indicator
Barometer

Condition:
All equipment appeared to be in good condition, with the exception of one pump (Golder ID Sea 0226, field number 13) which was not in good working order, but was not being used for any quantitative activities. (Reference action item 1.)

Calibration Status:
One personal sampling pump (Golder ID Sea 0226) and the compass (Sea 0052) were observed to be labeled with Golder IDs, indicating that they were obtained from the Golder equipment inventory. The additonal pumps were apparently on loan from another Golder office and were not labeled. The rotameter was labeled with "Seattle Chem Lab". The Vac-U-Chamber and the wind speed indicator are new and have not been entered into Golder's equipment inventory. The barometer is a personally owned piece of equipment.

Wind speed indicator - No calibration information available, no calibration sticker.

Barometer - Personally owned equipment, no calibration information available, no calibration sticker.

(Note that project personnel indicate that, although it is unclear in the SOP, the wind speed and barometer readings taken at the site are intended as gross indicators, not as quantitative data. Meteorological data obtained from both the Bremerton National Airport and the Olympic View Landfill will be used to characterize weather conditions, when necessary.)

Personal sampling pumps (field numbered 1 through 12) - Calibrated on site on a weekly basis using a rotameter (see below), calibration documented in the "Weekly Personal Pump Calibration Log." No calibration stickers observed on the pumps, no Golder IDs.

Rotameter - No calibration sticker. Per field personnel, rotameter has been calibrated.

(Reference NCIR No. 068 regarding equipment calibration practices.)

Note that no sampling was performed during the audit, and field personnel indicate that none has been performed since the ambient air monitoring task began. Therefore, the ambient air sampling equipment has not yet been utilized for data collection activities.

Observations and Comments:

A site walk-through was observed. It was indicated by field personnel that this activity usually consists of a combination of driving and walking with a stop at each station for observation. No odors were detected during the walk-through.

Field logs indicate that walk-through inspections are being conducted as close to hourly as possible. It should be noted that the "Revised Ambient Air SOP", dated 1/9/95, states that the outline is flexible (reference first paragraph). Field personnel also indicate that at least six walk-throughs are performed daily, in any case.

Weather conditions as indicated by the Bremerton National Airport are consistently recorded in the field log at the beginning of each day. Barometric pressure measured by an on-site barometer has also been recorded in the "Barometric Pressure Log" (reference NCIR No. 068). Wind speed is also measured and recorded in the field log during walk-throughs using a handheld wind speed indicator (reference NCIR No. 068).

It was noted that air monitoring stations AA-1, AA-2, and AA-3 (stations within the residential area) had been set up with SUMMA canisters and pumps with the necessary tubing attached. The set up, however, was not as indicated in the SOP (See action item 2). The stations did not contain 5 gallon carboy-type lung samplers, tubing was not taped or clamped as indicated in the SOP, and SUMMA canisters were not covered with parafilm. Parafilm was available at the site and was to be added immediately. Field personnel indicate that the 5 gallon carboy-type lung samplers have been replaced with a more efficient recently purchased SKC Vac-U-Chamber. It is to be used at all stations, however, and cannot be included in each station set up. The Vac-U-Chamber, along with additional SUMMA canisters, tedlar bags, XAD-2 tubes, silica tubes, and additional tubing are maintained in the van, available for immediate use. The Vac-U-Chamber was observed to be prepared for collection of 2 samples in tedlar bags (presumably, one duplicate).

Perimeter stations AA-4 and AA-5 had not been set up at the time of the walk-through. No equipment had been placed at these stations. (See action item 3.)

The SOP is unclear regarding the required frequency of visits to the Kitsap County Sanitary Landfill (KCSL), but implies that KCSL visits should occur after each site walk-through. The KCSL was not visited during the observed walk-through (See action item 4). Field personnel indicate that the KCSL is visited at least 3 times per day, and had already been visited twice that morning. One more visit was planned.

No single-location or site-wide odor events were identified during the audit, so no sampling was required. Since no sampling was performed during the site visit, TP-1.2-25, "Ambient Air/Soil Vapor Sampling for Chemical Analyses," was not implemented, with the exception of preparation in anticipation of sampling.

A controlled copy of the current Work Plan with all applicable attachments was available at the work site. Field personnel were very cooperative and informative.

Action Items:

1. Personal sampling pump number 13 (Golder ID Sea 0226) is not operating appropriately, and is not being used for any quantitative activities. In accordance with P-12.0-1, "Calibration and Maintenance of Measuring and Test Equipment," section 6.2, it should be returned to the Equipment Manager for maintenance purposes or removal from service. (Action: Higgins)

2. The "Revised Ambient Air SOP," dated 1/9/95, contained in Appendix C to the QA Plan includes a description of the ambient air monitoring station set up. Stations AA-1, AA-2, and AA-3 were observed to be include only SUMMA canisters, personal sampling pumps, and tubing. Five gallon carboy-type lung samplers had not been placed at the stations, tubing was not taped or clamped, and SUMMA canisters were not covered with parafilm. Parafilm was available at the site and was to be added immediately. Station set up as noted in the SOP should be updated to reflect actual practice, if appropriate to the activity, or practices should be adjusted to comply with the SOP. (Action: Higgins, Morell)

3. The SOP referenced above includes the perimeter stations (AA-4, AA-5, AA-6) as requiring set up. AA-4 and AA-5 had not been set up at the time of the audit. The SOP should be updated to reflect actual practice, if appropriate to the activity, or practices should be adjusted to comply with the SOP. (Action: Higgins, Morell)

4. The SOP is not clear regarding the required frequency of visits to the KCSL, but states "After the Norseland site walk-through, drive to the Kitsap County Sanitary Landfill (KCSL) to check for odors..." The KSLC should apparently be visited after every walk-through. Field personnel, however, indicate that the KSLC is visited a minimum of 3 times daily. The SOP should be updated to clarify the intended frequency of visits to the KSCL, or actual frequency should be increased to comply with the apparent intent of the SOP. (Action: Higgins, Morell)

Ref SIR-010

NORSELAND MOBILE ESTATES

Revised Ambient Air SOP

The following procedures outline daily ambient air monitoring activities for Golder field representatives at the Norseland Mobile Estates site. The outline is arranged chronologically and is flexible.

1. Upon arrival on site, check for phone messages. Record weather conditions in log and document barometer reading in the daily barometric pressure log. If there are any messages documenting odors when Golder was not onsite, make sure to contact the caller for a debriefing of the event.
2. The six ambient air monitoring stations are numbered AA-1 (Lot 134), AA-2 (Lot 66), AA-3 (Lot 60), and the perimeter samples (AA-4 through AA-6). All sample containers (i.e., Tedlar® bag, SUMMA® canister, XAD-2 and silica cartridges) should be marked accordingly. The field duplicate should be numbered AA-7 and collected concurrently with sample AA-1, AA-2 or AA-3.

Sampling equipment for each station should consist of the following:

a) Sulfide lung sampler, SUMMA® canister and low-flow air pump.
b) Attach the hoses to the upper portion of the 4 foot steel rod, set in ground while sampling. Do not attach the XAD-2 or silica tubes to the hoses until the onset of an odor event.
c) The sampling ports on the lung sampler and SUMMA® canister must be covered with parafilm tape to ensure that the samplers are not tampered with if left unattended. If there are scattered showers during sampling, position the ends of all sample ports to ensure that water intrusion is eliminated. If it is raining steadily or forecast indicates adverse conditions do not set up the sample stations.
d) Set barrier tape around sampling site.

Equipment may be set up at air monitoring stations daily or may be secured in the Golder vehicle, ready for immediate deployment for sampling. Equipment may be borrowed from other Golder Associates offices for use on this project, provided calibration is current during the period of use. Calibration documentation for borrowed equipment shall be maintained in project records.

After setting up the stations, conduct the first walk-through inspection of the site, using the site map to ensure that all locations are reviewed. We screen for odors by smelling the ambient air. Characterize detected odors as smelling like rotten cabbage, manufactured natural gas, rotten eggs (H2S), solvents or anything else that could describe the odor, or as reported by a resident. If odor is detected, rate on a scale of 1 to 10; 1 being barely detectable and variable, 5 being detectable, constant and unmistakable,

and 10 being overpowering. Record all observations, including the numerical odor rating in the field log book. The inspection can be done on foot or from a vehicle.

Note that the permanent soil vapor probe on Lot 123 is in the occupant's backyard. If you need to sample it during the early morning hours, make sure to enter the premises on the LEFT side, the side opposite of the carport. If you walk near the carport a security light will turn on and wake the owners. Use a flashlight when entering private lots in the dark and wear a white Golder hat for identification purposes.

After the Norseland site walk-through inspection, drive to the Kitsap County Sanitary Landfill (KCSL) to check for odors at the two off-site perimeter sampling locations, see the attached KCSL map. If there are detectable odors at both locations, return to the Norseland site office and call Lee Wilson (KCSL General Manager) to gain access to the site. Lee must be contacted prior to entering the landfill. He will arrange for an escort to accompany us from the entrance gate. We can contact Lee at his home, on his mobile phone, or at the landfill from as early as 05:00, he usually arrives at the landfill from 06:00 to 08:00. His phone numbers are available at the Golder field office. There are KCSL staff onsite and available as escorts as early as 05:00. Alternately, a sample can be collected at the end of the county road adjacent to the landfill entrance road. This location is approximately 100 yds from the proposed onsite landfill location.

The site walk-through and KCSL inspections should be conducted once every hour, or as close to that as possible in order to provide a comprehensive baseline of Norseland site ambient air conditions. As many inspections as practicable should be completed between the hours of 6:00 a.m. and 11:00 a.m. KCSL inspections may be less frequent if primary activities (such as sampling) at the Norseland Site preclude KCSL visits. ✓

If odors are detected at sampling locations AA-1 through AA-3 (Lower Lofall Lane), go back to sample location AA-1 and check to ensure that the odor remains. If it does, begin sampling as detailed below. However, if after collecting samples at AA-1, the odor has dissipated at sampling locations AA-2 and AA-3, then discontinue sampling (false start) and contact the project manager for disposition of sample AA-1.

Sample ambient air as follows:

1. Snap both ends off the glass XAD-2 and silica tubes (needle nose pliers work well) making sure not to crack the tube, just snap off the fluted end. Inspect the ends of the tubes to verify that both ends have in fact been opened. Inspect the parafilm guards to ensure that the samplers have not been tampered with, remove them and set the sampling tubes into the appropriate hoses for the aldehydes/ketones (XAD-2) and aliphatic amines (silica). If the sampling equipment has been tampered with, replace it and document the event in the site log book.
2. Turn the pump on. Make sure to run it for at least enough time to sample 20 liters of air. This is calculated by:

Golder Associates

NONCONFORMANCE/INCIDENT REPORT

Project Client/Title: Kitsap Co. / Norseland

Project/Task No.: 933-1280

Stop Work? ☐ YES ☒ NO

☒ NONCONFORMANCE
☐ SIGNIFICANT
☐ INCIDENT

NCIR NO.: 068

DATE: 3-2-95

REPORTED BY: M. Gorman
ref SIR 070

CONDITION

Description of Condition: (location, time/date of occurrence?)

see attached

ACCEPT: QA Mgr./Date M. Gorman 3-7-95

Disposition to Correct Condition:

see attached

Proj. Mgr./Date D. Morell 3/8/95 Other ______

CORRECTIVE ACTION

Cause of Condition:

see attached

ACCEPT: QA Mgr./Date M. Gorman 3-7-95

Corrective Action Required:

see attached

*Note: labelling of equipment located in the field to be confirmed during follow up surveillance inspection.

Estimated Completion Date: 3-9-95

Proj. Mgr./Date D. Morell 3/8/95 Other ______

Client Notified by: D. Morell Date 3-7-95

Client Representative Notified Jeff Frettingham

Disposition Complete: QA Mgr./Date * M. Gorman 3-15-95

Corrective Action Complete: QA Mgr./Date M. Gorman 3-15-95

IP3 0024/47764

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NCIR No. 068

Description of Condition:

The "Quality Assurance Project Plan for Phase 1 Remedial Investigation/Feasibility Study - Norseland Mobile Estates," section 4.8, requires that measuring and test equipment be controlled in accordance with P-12.0-1, "Calibration and Maintenance of Measuring and Test Equipment."

The following measuring and test equipment was on site and available for use, but was not labeled or controlled per P-12.0-1. It should be noted that at the time of the systems audit (ref. SIR 070), no sampling had taken place under the ambient air monitoring task, and no ambient air sample data had been obtained using this sampling equipment.

1. Personal Sampling Pumps - Twelve personal sampling pumps have apparently been borrowed from another Golder office for use on this project. No provision is made in the QAPP for use of borrowed equipment. Although the pumps are calibrated weekly on site in anticipation of use, they are not entered into Golder's calibration system, and there are no calibration stickers on the pumps to indicate calibration status to the user.

2. Rotameter - A rotameter is used on site to calibrate the pumps noted above. It is labeled "Seattle Chem Lab," is not entered into Golder's calibration system, and has not been labeled with a calibration sticker to indicate calibration status to the user. Field personnel indicate that the rotameter has been calibrated.

3. Wind Speed Indicator - A wind speed indicator has been purchased and is in use on site to record wind speed in the field log during site walk-throughs. It has not been entered into Golder's calibration system.

4. Barometer - A personally owned barometer is used on site to log barometric pressure in the "Barometric Pressure Log". It has not been entered into Golder's calibration system.

Note that project personnel indicate that, although unclear in the project plans and procedures, the wind speed and barometer readings taken at the site are intended as indicators, not as quantitative data. Quantitative data is obtained from the Bremerton National Airport and the Kitsap County Sanitary Landfill.

Disposition to Correct Condition:

1. Include provisions in the plans/procedures for use of equipment borrowed from other Golder Associates offices. Current calibration shall be maintained during the period of use of the equipment, and calibration documentation shall be maintained in the project records.

2. Enter the rotometer into the equipment inventory/calibration system and label accordingly. Confirm that current calibration documentation is available in accordance with P-12.0-1.

3. and 4. The project plans/procedures will be updated as necessary to clarify the purpose of the wind speed and barometer readings, and to specify equipment calibration/identification requirements.

Cause of Condition:

Conditions of the project required unanticipated use of equipment borrowed from another Golder Associates office which was not addressed in project plans. Other items were issues of clarification in written plans/procedures.

Corrective Action Required:

Project plans/procedures will be updated as necessary to allow the use of borrowed equipment, to specify the calibration requirements for borrowed equipment, and to clarify the purpose of wind speed and barometer information. The rotometer will be entered into the calibration system in accordance with P-12.0-1 and labelled accordingly. All measuring and test equipment used on this project will be controlled as required by P-12.0-1 or project-specific documents.

No sampling has been performed under the ambient air monitoring task using the equipment identified in this NCIR, and, therefore, no ambient air sample data is in question at this time.

Project No.______ REF NCIR 068
Book No.______ TITLE NORSELAND EQUIPMENT CALIB.

From Page No.__

12-21-~~95~~94

Rotometer Calibration:

→ Using Bubble Meter prepared for calibration by measurement with 250 ml volumetric "A" flask.

① Bubble meter: 4 ft glass tube × 1 inch ID, with stoppers @ each end. A beginning level of water was added to ~~the~~ tube and marked. The 250 ml volumetric "A" flask was filled with H_2O and added to tube and marked. This set of marks indicates a calibrated volume of 250 ml.
The volumetric (250 ml) "A" flask was again filled with H_2O and added to the existing H_2O and again the tube was marked. This mark indicates a calibrated volume of 500 ml.

② Vacuum: A latex rubber hose is attached to the upper end of the 1" ID glass tube and connected to a flow restricter valve and then to a pump.

③ Indicator: Soap solution in a beaker is applied to the other end of the 1" ID glass tube as needed to track flow up the length of the tube, when a bubble is formed

④ Rotometer: Connected by latex rubber hose to bottom end of bubble meter. An appropriate restriction is applied to get flow reading 250 ml/min on the Rotometer by existing marks. Soap solution is applied and timed against the meter volumetric marks as follows:

Rotometer:	250 ml/min	500 ml/min
Timed Bubble:	63 sec	58 sec.
Calculated:	262.5 ml/min	483.3 ml/min
Error:	5%	3%

To Page No.____

Witnessed & Understood by me, [initials] 12-21-94

Date 12/21/94

Invented by

Date

Recorded by

NORSELAND MOBILE ESTATES

Revised Ambient Air SOP

The following procedures outline daily ambient air monitoring activities for Golder field representatives at the Norseland Mobile Estates site. The outline is arranged chronologically and is flexible.

1. Upon arrival on site, check for phone messages. Record weather conditions in log and document barometer reading in the daily barometric pressure log. If there are any messages documenting odors when Golder was not onsite, make sure to contact the caller for a debriefing of the event.
2. The six ambient air monitoring stations are numbered AA-1 (Lot 134), AA-2 (Lot 66), AA-3 (Lot 60), and the perimeter samples (AA-4 through AA-6). All sample containers (i.e., Tedlar® bag, SUMMA® canister, XAD-2 and silica cartridges) should be marked accordingly. The field duplicate should be numbered AA-7 and collected concurrently with sample AA-1, AA-2 or AA-3.

Sampling equipment for each station should consist of the following:

a) Sulfide lung sampler, SUMMA® canister and low-flow air pump.
b) Attach the hoses to the upper portion of the 4 foot steel rod, set in ground while sampling. Do not attach the XAD-2 or silica tubes to the hoses until the onset of an odor event.
c) The sampling ports on the lung sampler and SUMMA® canister must be covered with parafilm tape to ensure that the samplers are not tampered with if left unattended. If there are scattered showers during sampling, position the ends of all sample ports to ensure that water intrusion is eliminated. If it is raining steadily or forecast indicates adverse conditions do not set up the sample stations.
d) Set barrier tape around sampling site.

Equipment may be set up at air monitoring stations daily or may be secured in the Golder vehicle, ready for immediate deployment for sampling. Equipment may be borrowed from other Golder Associates offices for use on this project, provided calibration is current during the period of use. Calibration documentation for borrowed equipment shall be maintained in project records. ✓

After setting up the stations, conduct the first walk-through inspection of the site, using the site map to ensure that all locations are reviewed. We screen for odors by smelling the ambient air. Characterize detected odors as smelling like rotten cabbage, manufactured natural gas, rotten eggs (H2S), solvents or anything else that could describe the odor, or as reported by a resident. If odor is detected, rate on a scale of 1 to 10; 1 being barely detectable and variable, 5 being detectable, constant and unmistakable,

3.5 Personal Air Sampling Pump

A personal air sampling pump is a low-flow air sampling pump which is designed to capture air or soil vapor samples at a constant flow rate which is set and calibrated by the user.

3.6 Semi-Quantitative

A semi-quantitative measurement is a measurement obtained as an estimated value rather than a quantitative value. Documented calibration is not required for equipment used for semi-quantitative measurements. 1

4. REFERENCES

4.1 EPA (1988), *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*, EPA 600 4-89-017, June 1988, US EPA, Atmospheric Research and Exposure Assessment Laboratory, Research Triangle Park, North Carolina.

4.2 EPA (1991) *Canister-Based Method for Monitoring Toxic VOCs in Ambient Air*, EPA 600 J-92 263, US EPA, Atmospheric Research and Exposure Assessment Laboratory, Research Triangle Park, North Carolina.

4.2 EPA (1992), *Test Methods for Evaluating Solid Waste, Chemical/PhysicalMethods, Third Edition*, SW-846, U.S. EPA, Office of Solid Waste, Washington, D.C.

4.4 NIOSH (1994), *NIOSH Manual of Analytical Methods*, 4th Edition, August 1994, US Department of Health and Human Services, Pubic Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Division of Physical Sciences and Engineering, Cincinnati, Ohio.

4.5 ASTM (1994), *1994 Annual Book of Standards*, Method D-3416, "Analysis of Atmospheric Gases", 1994, American Society of Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania.

4.6 GAI (1995), P-12.0-1, *Calibration and Maintenance of Measuring and Test Equipment*, Golder Associates, Inc.

4.7 GAI (1995), TP-1.2-23, *Chain of Custody*, Golder Associates, Inc.

5. DISCUSSION

Ambient air and /or soil vapor samples shall be collected in quantities and types as directed by the Project Manager and project work documents. All instruments used for quantitative field analyses shall be calibrated in accordance with Golder Associates Procedure P-12.0-1, "Calibration and Maintenance of Measuring and Test Equipment." All non-dedicated

- The XAD-2 and silica gel cartridges can be stored together. Label each tube with the sample location and store in a labeled padded envelope. The samples should be stored at approximately 25 °C from the time of collection. Ship the cartridges at ambient temperature in an insulated shipping container to the laboratory performing the analysis.

7.2.3 Volatile Organic Compounds and Fixed Gases

Volatile organic compounds (VOCs) and fixed gases will be sampled using a single SUMMA® passivated stainless steel canister. Canisters are evacuated and blank certified by the laboratory.

- Soil vapor or ambient air grab samples are taken by slowly opening the valve of the canister, which may connected to a sample location via a length of Teflon® tubing. 1

- When the sample canister has reached equilibrium pressure, the vacuum hissing will stop and the valve is closed.

- Fix sample identification to the canister and record the canister sample ID and prepare for shipment to the laboratory.

- Special storage requirements are not required other than keeping the sample containers at ambient temperature by storing out of direct sunlight.

7.3 Field Analyses

7.3.1 Calibration of Instruments

All instruments used for quantitative field analyses shall be calibrated in accordance with procedure P-12.0-1, "Calibration and Maintenance of Measuring and Test Equipment." Only equipment with a calibration tag showing a recall date later than the anticipated date of use shall be taken to the field. Each instrument should be accompanied by a copy of the manufacturer's operation manual.

7.3.2 Meteorologic Conditions

Temperature, windspeed/direction and barometric pressure conditions shall be recorded for each sample location as a semi-quantitative measurement of local conditions. General meteorologic conditions such as precipitation, fog, etc. shall also be noted. 1

933-1280

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SURVEILLANCE INSPECTION REPORT

SIR

No.: 071

Inspected Activity or Test: Follow up to SIR 070 and NCIR 068 — Ambient Air Task

Job Number: 933-1280 Norseland

Personnel Contacted: Tom Stepp, Mike Higgins

Reference Requirements: Appendix A dated March 14 "Ambient Air Sample Acquisition Procedure"

Insp. Date: 3-16-95 Start Time: 9:00 AM End Time: 11:00 AM

Equipment Condition/Calibration Status: see attached

Observation and Comments (Use Extra Sheets as Required): see attached

NCIR Reference (if any): na

Action Items Requiring Correction (Use Extra Sheets as Required): na

Inspector: [signature] Date: 3-16-95

Closed By QA Manager: [signature] Date: 3-16-95

Action Item Closure Date: na

Comments:

GOLDER ASSOCIATES INC.

Equipment Calibration/Calibration Status:

Seattle Office-owned equipment is labelled with Golder ID numbers and, as appropriate, calibration stickers indicating date last calibrated and date due for next calibration. Equipment calibration is current.

In addition to the rotameter referenced in NCIR 070, a digital flowmeter is now also available on site. Both meters are labelled (Golder ID numbers C0069 and C0072) and are tagged with calibration stickers as required. Calibration is current.

The twelve personal sampling pumps borrowed from another Golder office are labelled #1 through #12, and calibrated weekly. Sampling pump calibration is documented in a log which will be included in the project records when it is complete.

The equipment required for sampling under the ambient air task was observed to be maintained in the Golder vehicle, ready for sampling. Parafilm was observed on SUMMA canisters to allow them to be set out at each station, at the discretion of field personnel.

Observation and Comments:

One complete walk-through was observed during the follow-up audit. All stations were visited, including the Kitsap County Sanitary Landfill stations. No odors were apparent during the observed walk-through, and therefore, no sampling was performed. Wind direction and wind speed were recorded by field personnel at each station. A newly installed soil vapor probe was checked to confirm that it was still secure. The seal on the probe was intact.

All items noted for follow-up on NCIR 068 and SIR 070 were confirmed to be corrected as required.

A copy of the current instructions, Appendix C, "Ambient Air Sample Acquisition Procedure," dated March 14, 1995 was available on site. Previously issued controlled documents were removed from the site. Field personnel were cooperative and informative.

Action Items:

No action items are required as a result of this audit. No NCIRs were issued as a result of this audit.

APPENDIX J

STATISTICAL ANALYSIS OF BENZENE, CHLOROMETHANE AND TIC DATA FOR THE COMPARATIVE AMBIENT AIR INVESTIGATION

November 22, 1996

933-1280.2008
APPXJ.DOC

TABLE OF CONTENTS

J.1 INTRODUCTION

The results of the odor event sampling and the comparative ambient air sampling have shown that benzene and chloromethane are the most frequently detected compounds exceeding air criteria at Norseland. Evaluations conducted as part of the odor investigation suggested that the source of these compounds may be off-site; however, the data were ambiguous and inconclusive in this regard. In order to more fully evaluate the source(s) of these compounds at the site, the data for these constituents are analyzed statistically. This section describes the statistical analyses performed on the Norseland data. The statistical analysis is performed for benzene and chloromethane. Additionally, total TICs are also analyzed. TICs are included in the evaluation because they are pervasive at the site in soil gas, skirt air, and ambient air samples but cannot be evaluated from a health risk standpoint due to of a lack of toxicological data.

For each of these chemicals, the initial set of hypotheses is the null hypothesis, i.e. that there are no differences in the constituent concentrations measured in the skirt, onsite and offsite ambient air samples, and the alternative hypothesis or that there is a difference in the constituent concentrations between one or more of these locations. If there is a significant difference, additional tests are done to determine with which sampling events these differences occurred. Finally, the magnitude of the difference, if any, between the skirt and the ambient offsite air concentration of each chemical constituent is estimated. In Section J.2, the data set and pre-analysis data reduction are described. Section J.3 describes the statistical analysis techniques used and presents. The results of each statistical analyses.

J.2 DATA

As described in Section 2.6.3 of the RI/FS Report, there were six sampling events conducted in the comparative ambient air study. During each event, samples were taken for skirt air, onsite and offsite ambient air. There were 4 skirt locations, and three offsite and one onsite ambient air locations. During each sampling event, a field duplicate was taken at one location. Additionally, there were laboratory duplicates at each event. The results of the laboratory analyses of the samples for benzene, chloromethane and total TICs are shown in Table J-1.

The laboratory duplicates are subsamples of the same experimental unit and are a measure of the precision (repeatability) of the laboratory analyses. For each pair, the coefficient of variation (relative standard deviation, the ratio of the standard deviation to the average) was calculated. The results ranged from 2.2% to 58% and had a median value of 12%, for the 13 pairs of benzene, chloromethane and TICs with concentrations greater than the detection limit.

The field duplicates for the skirts were a second sample taken from the same probe. These duplicates are also subsamples of the same experimental unit and are a measure of the precision of the combination of laboratory analyses and field procedures. This precision estimate also contains any short term variability in the skirt concentrations. The coefficient of variation for the pairs with concentrations greater than the detection limit ranged from 1.4% to 44% with a median value of 17%. These values are similar to the results for the laboratory duplicates, which indicates that the variability in the subsamples are dominated by variability in the laboratory analyses rather than variability in field procedures or short term changes in the skirt concentrations.

The field duplicates for the onsite and offsite ambient air were samples taken using a separate air sampler that was near but not coexistent with another air sampler. These duplicates are replicates of the experimental unit, as compared to the other duplicates which were subsamples.

The duplicates which are subsamples of the same experimental unit are averaged for the statistical analyses. The duplicates which are replicates of the experimental unit are retained for the statistical analyses. Table J-2 shows the data, after these data reductions, that were used in the statistical analyses.

J.3 STATISTICAL ANALYSIS TECHNIQUES

Figures J-1, J-2, and J-3 show the results for the six events for benzene, chloromethane, and total TICs, respectively. The following observations can be made from these figures and Table J-2:

- results are not the same between sampling events;
- results are skewed to the right, there are a few relatively large concentrations at some of the sampling events;
- there are a different number of samples from each sampling location for each sampling event;
- there are a large number of sample results that are less than the detection limit;
- detection limits are not the same for all the samples results that are less than the detection limit.

These observations need to be considered when performing the statistical analyses.

J.3.1 ANOVA Test

A one way analysis of variance (ANOVA) with blocking is performed on the results of the six sampling events. The null hypothesis is that there is no difference between the skirt, onsite and offsite air concentration. The alternative hypothesis is there is at least one inequality. The blocks are the sampling events. The blocks are included in the analysis to account for the variability between sampling events, which can mask the difference between the skirt, onsite and/or offsite air concentration.

The ANOVA is performed within a linear regression framework. In this framework, one regression parameter estimates the difference between the skirt and offsite air concentrations. Another regression parameter estimates the difference between onsite and offsite concentrations. The difference between these two regression parameters estimates the difference between the skirt and onsite air concentrations. The actual hypotheses that are tested are whether the regression parameters are equal to or less than zero versus the alternative hypothesis that the regression parameters are greater than zero. That is, the alternative hypotheses are that skirt air concentration is greater than offsite air, onsite air concentration is greater than offsite air concentration, and skirt air concentration is greater than onsite air concentration.

The ANOVA is performed using the rank transformation of the results because of the skewed data and number of results that are less than the detection limit.

A "bootstrap" or resampling technique is used in the analyses because the results are reported as less than the detection limit and the different detection levels. When a result is reported as less than the detection limit, it is assumed that the result is between the detection limit and a minimum value. The ANOVA is repeated 1000 times, each time a new value is drawn for each of the results reported as less than the detection limit, from a uniform distribution between the results detection limit and the minimum value. Since each one of the 1000 ANOVAs has an equal chance of occurring, the significance level for the overall ANOVA is the average of the significance level for 1000 runs. The minimum value that should be used is also unknown. Therefore, two different analyses are performed, with the minimum set at different values: zero and 0.15. The two different analyses are run to determine if the results change if the minimum value is different.

The results of the ANOVA are shown in Table J-3. The purpose of this analysis was to determine whether or not there are significant differences in the constituent concentrations measured in the skirt, onsite and offsite ambient air samples. As seen in this table, the concentration of benzene in the skirt air is significantly greater than in the offsite air at between the 0.0213 (minimum concentration of 0 ppbv) and 0.0129 (minimum concentration of 0.15 ppbv). That is, there is between 97.9% and 98.7% confidence in rejecting the null hypothesis and accepting the alternative hypothesis. The other hypotheses for benzene are not significant at the 0.10 level (90% confidence level), indicating that the onsite air is not elevated over offsite air, nor is skirt air elevated over onsite air.

For chloromethane, the significance level of the skirt versus offsite air concentration hypothesis test is so small, that if the hypotheses had been reversed, there would be a significant difference. That is, the skirt air concentration of chloromethane is significantly less than the offsite air concentration at between the 97.9% and 98.0% confidence level. The other hypotheses for chloromethane are not significant at the 0.10 level (90% confidence level). In other words, skirt air chloromethane is not elevated over offsite air, onsite air is not elevated over offsite air, and skirt air is not elevated over onsite air. Also, the analysis actually indicates that offsite air is elevated over skirt air.

For TICs, all three hypotheses are not significant at the 0.10 level (90% confidence level). In other words, skirt air TICs are not elevated over off-site air, onsite air is not elevated over off-site air, and skirt air is not elevated over onsite air.

J.3.2 Wilcoxon Rank Sum Test

The Wilcoxon Rank Sum (WRS) Test is performed to test for differences in the skirt and offsite air concentrations for each sampling event, individually. The null hypothesis is the skirt and offsite air concentrations are the same. The alternative hypothesis for benzene and total TICs is that the skirt air concentrations is greater than the offsite air concentration. The alternative hypothesis for the chloromethane is that the skirt air concentration is less than the offsite air concentration. The alternative hypothesis was changed for the chloromethane because of the results of the ANOVA.

The magnitude of the difference between the skirt and offsite air concentrations of benzene, chloromethane and total TICs are estimated for each of the sampling events. When there are one or more results reported as less than the detection level for a sampling event, the "bootstrap" technique, described above, is used. Again, because of the skewed distributions and the results reported as less than the detection level, a nonparametric estimator is used. The estimate is the median of all the paired differences between skirt and offsite air concentrations. When there are results reported as less than the detection level, the "bootstrap" technique, described above, is used.

The results of the WRS test are shown in Table J-4. The purpose of this analysis is to determine during which individual sampling events significant differences occurred. Benzene concentration is significantly higher in the skirt air as compared to the offsite air for only the first and third sampling events, at the 0.10 level (90% confidence) when the 0.15 ppbv minimum is used. For the other events, the benzene level in the skirt air is not significantly elevated over the off-site air at the 90% confidence level. The confidence levels are lower for the WRS test, as compared to the ANOVA, because of the small sample sizes for each sampling event. Chloromethane concentration is significantly lower in the skirt air as compared to the offsite air for only the first sampling event ($p=0.029$). The TICs are significantly higher in the skirt air compared to the offsite air for only the first sampling event ($p=0.057$).

The estimates of the difference between the skirt and offsite air concentrations of benzene, chloromethane and TICs are shown in Table J-5. Benzene concentrations in the skirt air are greater than offsite by 0.248 ppbv and 0.323 ppbv during the first and third sampling event, where the difference between skirt and offsite air concentration is significant, according to the WRS test. As indicated above, skirt air benzene concentrations for sampling events other than the first and third event were not significantly elevated over offsite air. The chloromethane concentrations in the skirt air are less than the offsite air by between 0.519 and 0.560 ppbv during the first sampling event. The TICs concentration in skirt air is greater than the offsite air by 33.8 ppb-v during the first sampling event. The other estimates shown in Table 5-19 are not significantly different than zero.

Therefore, the results of this analysis have indicated that there was no significant difference noted between onsite air and offsite air benzene levels. Benzene in the skirt air was slightly higher in concentration than in the offsite air, but this difference occurred only during two of the six sampling events. For the other four events, there was no significant difference. When the difference was significant (first and third events), the magnitude of the difference between skirt air and offsite air was small - skirt air levels were estimated to be higher by about 0.2 to 0.3 ppbv.

J.3.3 Upper Confidence Level Test of Individual Skirts

Another way of evaluating these data is to look at the benzene levels at each individual skirt and compare them to background. In Table J-6, all of the benzene data from the comparative ambient air study are tabulated. Since the offsite samples were collected upwind of Norseland, these samples represent air not impacted by the site, and can be considered as background samples. Using guidance presented in Ecology (1992b), the skirt air data are compared to the background data to determine whether any of the skirts exhibit benzene levels above background. A 90th percentile concentration (.58 ppb-v) is used to represent benzene background at the site based on the offsite samples. 95% upper confidence limits (UCL_{95}) are used to represent the average benzene concentration at each skirt location. As seen in the table, the only location where the skirt air exceeds the background concentration is lot 63. This indicates that lot 63 is the only skirt where benzene levels exceeded the natural benzene concentration in ambient air during the ambient air study.

COMPARATIVE AMBIENT AIR RESULTS FOR BENZENE, CHLOROMETHANE AND TICs

Event	Location	Sample ID	Chloromethane (ppbv)	QA	Benzene (ppbv)	QA	Det limit	TICs (ppbv)	Duplicates
1	offsite	210	0.65		nd		0.22	66.9	
1	offsite	230	0.81		nd		0.22	57.6	
1	offsite	240	1.2		0.24		0.2	83.5	field
1	offsite	250	1.1		0.21		0.21	67.8	
1	skirt	39	nd		nd		0.42	76.1	
1	skirt	54	nd		0.47		0.43	101.1	
1	skirt	60	1.9	R	nd	R	0.27	107.3	
1	skirt	63	0.57		0.28		0.25	358	
1	skirt	63	0.71		0.67		0.5	262	laboratory
1	onsite	1	1.3		0.33		0.21	81.9	
2	offsite	40	1		0.21		0.2	95.5	
2	offsite	60	0.61		0.22		0.2	54.9	
2	offsite	80	0.6		0.56		0.4	150	
2	skirt	39	0.62		0.49		0.39	50.5	
2	skirt	54	0.46		0.38	J	0.4	53.2	
2	skirt	54	0.72		0.32		0.2	124.8	laboratory
2	skirt	60	0.53		nd		0.4	72.9	
2	skirt	63	0.58		0.59		0.4	215.7	
2	onsite	2	0.6		0.88		0.35	10.6	
2	onsite	22	0.58		1.1		0.35	295	
3	offsite	130	1.4		0.42		0.19	264.7	
3	offsite	150	0.66		0.26		0.19	16	
3	offsite	150	0.64		0.25		0.19	13.4	laboratory
3	offsite	170	0.72		0.25		0.19	15.4	
3	skirt	39	nd		0.46		0.38	98.6	
3	skirt	54	0.65		0.26		0.19	128.9	
3	skirt	60	0.73		0.71		0.38	95.5	
3	skirt	60	0.93		1		0.38	152.4	field
3	skirt	63	1.6		0.93		0.4	137.7	
3	onsite	3	0.77		0.26		0.19	28.6	
4	offsite	20	0.63		0.67		0.4	7.1	
4	offsite	40	0.9		0.46		0.21	84.5	
4	offsite	60	0.68		0.85		0.4	22.4	
4	offsite	200	0.33		0.25		0.2	430.7	field
4	skirt	39	0.62		0.69		0.4	8.8	
4	skirt	54	nd		0.44		0.41	nd	
4	skirt	60	1.2		0.52		0.39	147	
4	skirt	63	1.2		1.1		0.41	766	
4	onsite	4	0.63		0.28		0.2	51.8	
5	offsite	10	0.96		nd		0.39	nd	
5	offsite	30	0.54		nd		0.39	10.7	

COMPARATIVE AMBIENT AIR RESULTS FOR BENZENE, CHLOROMETHANE AND TICs

Event	Location	Sample ID	Chloromethane (ppbv)	QA	Benzene (ppbv)	QA	Det limit	TICs (ppbv)	Duplicates
5	offsite	50	0.67		0.52		0.39	10.9	
5	skirt	39	0.5		nd		0.39	173.4	
5	skirt	39	0.61		nd		0.2	172	laboratory
5	skirt	54	0.87		nd		0.39	25.3	
5	skirt	60	0.78		0.45		0.39	13.8	
5	skirt	63	0.55		0.43		0.39	6.4	
5	onsite	5	1.1		nd		0.39	nd	
5	onsite	55	0.57		nd		0.39	4	field
6	offsite	240	nd		nd		0.39	43.1	
6	offsite	260	0.72		nd		0.38	19.5	
6	offsite	280	0.42		nd		0.38	44.9	
6	offsite	280	0.36	J	nd		0.38	41.8	laboratory
6	skirt	39	nd		nd		0.38	12.2	
6	skirt	54	nd		0.51		0.39	43.9	
6	skirt	54	nd		0.5		0.39	23	field
6	skirt	60	nd		nd		0.38	112.8	
6	skirt	63	nd		nd		0.39	9.2	
6	onsite	6	nd		nd		0.39	18.7	

nd - Not Detected

TABLE J-2

AIR SAMPLE DATA USED IN STATISTICAL ANALYSES

Event	Location	Sample ID	Chloromethane (ppbv)	Benzene (ppbv)	TICs (ppbv)
1	offsite	210	0.65	<0.22	66.9
1	offsite	230	0.81	<0.22	57.6
1	offsite	240	1.2	0.24	83.5
1	offsite	250	1.1	0.21	67.8
1	skirt	39	<0.42	<0.42	76.1
1	skirt	54	<0.43	0.47	101.1
1	skirt	63	0.64	0.475	310
1	onsite	1	1.3	0.33	81.9
2	offsite	40	1	0.21	95.5
2	offsite	60	0.61	0.22	54.9
2	offsite	80	0.6	0.56	150
2	skirt	39	0.62	0.49	50.5
2	skirt	54	0.59	0.35	89
2	skirt	60	0.53	<0.4	72.9
2	skirt	63	0.58	0.59	215.7
2	onsite	2	0.6	0.88	10.6
2	onsite	22	0.58	1.1	295
3	offsite	130	1.4	0.42	264.7
3	offsite	150	0.65	0.255	14.7
3	offsite	170	0.72	0.25	15.4
3	skirt	39	<0.38	0.46	98.6
3	skirt	54	0.65	0.26	128.9
3	skirt	60	0.83	0.855	123.95
3	skirt	63	1.6	0.93	137.7
3	onsite	3	0.77	0.26	28.6
4	offsite	20	0.63	0.67	7.1
4	offsite	40	0.9	0.46	84.5
4	offsite	60	0.68	0.85	22.4
4	offsite	200	0.33	0.25	430.7
4	skirt	39	0.62	0.69	8.8
4	skirt	54	<0.41	0.44	nd
4	skirt	60	1.2	0.52	147
4	skirt	63	1.2	1.1	766
4	onsite	4	0.63	0.28	51.8
5	offsite	10	0.96	<0.39	nd
5	offsite	30	0.54	<0.39	10.7
5	offsite	50	0.67	0.52	10.9
5	skirt	39	0.555	<0.2	172.7
5	skirt	54	0.87	<0.39	25.3
5	skirt	60	0.78	0.45	13.8
5	skirt	63	0.55	0.43	6.4

TABLE J-2

AIR SAMPLE DATA USED IN STATISTICAL ANALYSES

Event	Location	Sample ID	Chloromethane (ppbv)	Benzene (ppbv)	TICs (ppbv)
5	onsite	5	1.1	<0.39	nd
5	onsite	55	0.57	<0.39	4
6	offsite	240	<0.39	<0.39	43.1
6	offsite	260	0.72	<0.38	19.5
6	offsite	280	0.39	<0.38	43.35
6	skirt	39	<0.38	<0.38	12.2
6	skirt	54	<0.39	0.505	33.45
6	skirt	60	<0.38	<0.38	112.8
6	skirt	63	<0.39	<0.39	9.2
6	onsite	6	<0.39	<0.39	18.7

TABLE J-3

THE RESULTS OF THE "BOOTSTRAP" ANOVA FOR BENZENE, CHLOROMETHANE, AND TICS USING 0 AND 0.15 PPBV AS THE MINIMUM CONCENTRATION

Chemical	Alternative Hypothesis	Minimum (ppbv)	Significance Level
Benzene			
	skirt > offsite	0.00	0.0213
	onsite > offsite	0.00	0.1882
	skirt > onsite	0.00	0.2635
	skirt > offsite	0.15	0.0129
	onsite > offsite	0.15	0.1608
	skirt > onsite	0.15	0.2484
Chloromethane			
	skirt > offsite	0.00	0.9802
	onsite > offsite	0.00	0.6954
	skirt > onsite	0.00	0.8504
	skirt > offsite	0.15	0.9787
	onsite > offsite	0.15	0.6907
	skirt > onsite	0.15	0.8480
TICs			
	skirt>offsite	0.00	0.7590
	onsite>offsite	0.00	0.9284
	skirt>onsite	0.00	0.1617
	skirt>offsite	0.15	0.7590
	onsite>offsite	0.15	0.9285
	skirt>onsite	0.15	0.1617

Shading indicates the existence of a statistically significant difference in concentration. Areas not shaded represent cases with no significant difference in concentration.

TABLE J-4

THE RESULTS OF THE "BOOTSTRAP" WILCOXON RANK SUM TEST FOR EACH SAMPLING EVENT FOR BENZENE, CHLOROMETHANE, AND TICS USING 0 AND 0.15 PPBV AS THE MINIMUM CONCENTRATION

Chemical	Minimum (ppbv)	Skirt vs. Offsite Significance Level for each Sampling Event					
		1	2	3	4	5	6
Benzene							
	0.00	0.128	0.319	0.057	0.343	0.621	0.383
	0.15	0.075	0.261	0.057	0.343	0.658	0.402
Chloromethane							
	0.00	0.029	0.114	0.500	0.264	0.571	0.141
	0.15	0.029	0.114	0.500	0.271	0.571	0.146
TICs							
	0.00	0.057	0.686	0.314	0.557	0.114	0.800
	0.15	0.057	0.686	0.314	0.557	0.114	0.800

Shading indicates the existence of a statistically significant difference in concentration (at the 90% or higher confidence level). Areas that are not shaded represent events determined to have no significant difference.

TABLE J-5

ESTIMATED MEDIAN DIFFERENCE BETWEEN SKIRT AND OFFSITE AIR CONCENTRATION (PPBV) FOR EACH SAMPLING EVENT FOR BENZENE, CHLOROMETHANE, AND TICS USING 0 AND 0.15 PPBV AS THE MINIMUM CONCENTRATION

Chemical	Minimum (ppbv)	Median Difference for each Sampling Event (skirt - offsite air concentration)					
		1	2	3	4	5	6
Benzene							
	0.00	0.248	0.080	0.323	0.125	-0.025	0.069
	0.15	0.248	0.096	0.323	0.125	-0.034	0.034
Chloromethane							
	0.00	-0.560	-0.050	-0.035	0.295	-0.40	0.069
	0.15	-0.519	-0.050	-0.035	0.295	-0.040	-0.137
TICs							
	0.00	33.8	-5.5	96.2	-2.6	14.0	-9.8
	0.15	33.8	-5.5	96.2	-2.6	14.0	-9.8

Shaded areas represent the estimated differences in concentration between skirt air and offsite air for those events determined to have significant differences in concentration.

Significant differences were noted only for the 1st and 3rd events (for benzene) and 1st event (for chloromethane and TICs). No significant difference was noted for other events (See Table 5-18).

TABLE J-6

BENZENE IN SKIRT AIR VS BACKGROUND

	Background Samples			Skirt Air							
				Lot 39		Lot 54		Lot 60		Lot 63	
Sampling Event	Off-Site Sample	Benzene, ppb-v	Value Used*	Benzene, ppb-v	Value Used*	Benzene, ppb-v	Value Used*	Benzene, ppb-v	Value Used*	Benzene, ppb-v	Value Used*
1	OFA-1-210	<.22	0.11	<.42	0.21	0.47	0.47	<.27	0.135	0.28	0.28
	OFA-1-230	<.22	0.11								
	OFA-1-240	0.24	0.24								
	OFA-1-250	0.21	0.21								
2	OFA-2-40	0.21	0.21	0.49	0.49	0.38	0.38	<.4	0.2	0.59	0.59
	OFA-2-60	0.22	0.22								
	OFA-2-80	0.56	0.56								
3	OFA-3-130	0.42	0.42	0.46	0.46	0.26	0.26	0.71	0.71	0.93	0.93
	OFA-3-150	0.26	0.26								
	OFA-3-170	0.25	0.25								
4	OFA-4-20	0.67	0.67	0.69	0.69	0.44	0.44	0.52	0.52	1.1	1.1
	OFA-4-40	0.46	0.46								
	OFA-4-60	0.85	0.85								
5	OFA-5-10	<.39	0.195	<.39	0.195	<.39	0.195	0.45	0.45	0.43	0.43
	OFA-5-30	<.39	0.195								
	OFA-5-50	0.52	0.52								
6	OFA-6-240	<.39	0.195	<.38	0.19	0.51	0.51	<.38	0.19	<.39	0.195
	OFA-6-260	<.38	0.19								
	OFA-6-280	<.38	0.19								
	UCL_{95}				0.54		0.48		0.56		0.88
	X_{90}		0.58								

UCL_{95} - 95% Upper Confidence Limit for the Mean
UCL_{95} = mean + tS/SQRT(n), where:
t = t parameter, based on a one-sided [] of 0.05 and (n-1) degress of freedom
S = standard deviation
n = number of samples (6)

X_{90} = 90th Percentile
X_{90} = mean + Z_{90}S, where
Z_{90} = Z parameter from the normal distribution for a one-sided upper 90% confidence limit
S = standard deviation

* - Used one-half the detection limit for ND values.
Shading indicates exceedance of the X_{90} (90th Percentile) background value.
Source: Ecology (1992b) - *Statistical Guidance for Ecology Site Managers.*

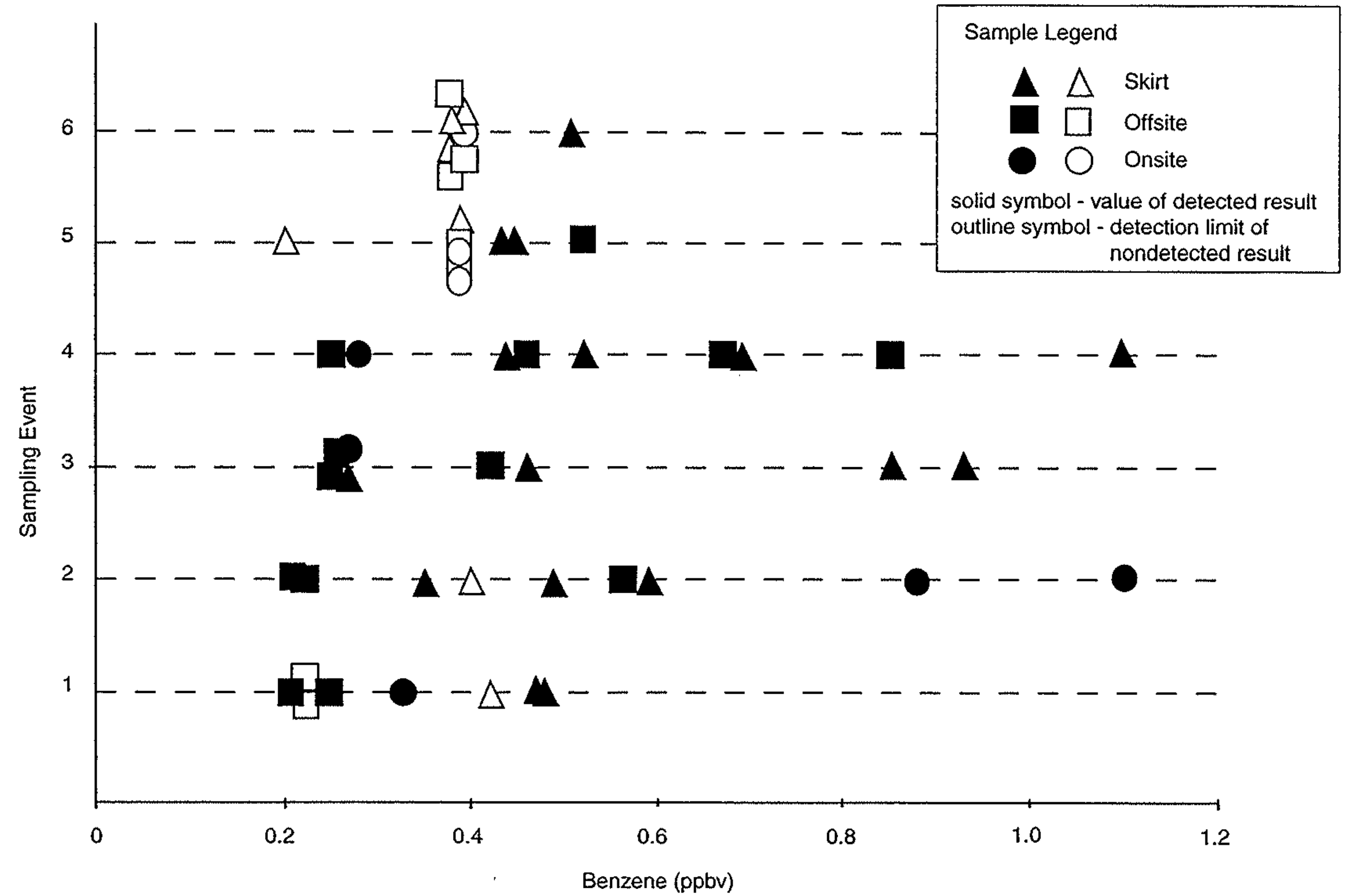


FIGURE **J-1**
BENZENE CONCENTRATION (ppbv) IN SKIRT, OFFSITE AND ONSITE AIR SAMPLES
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 67366 DATE 11/21/96 DRAWN BY TB

Golder Associates

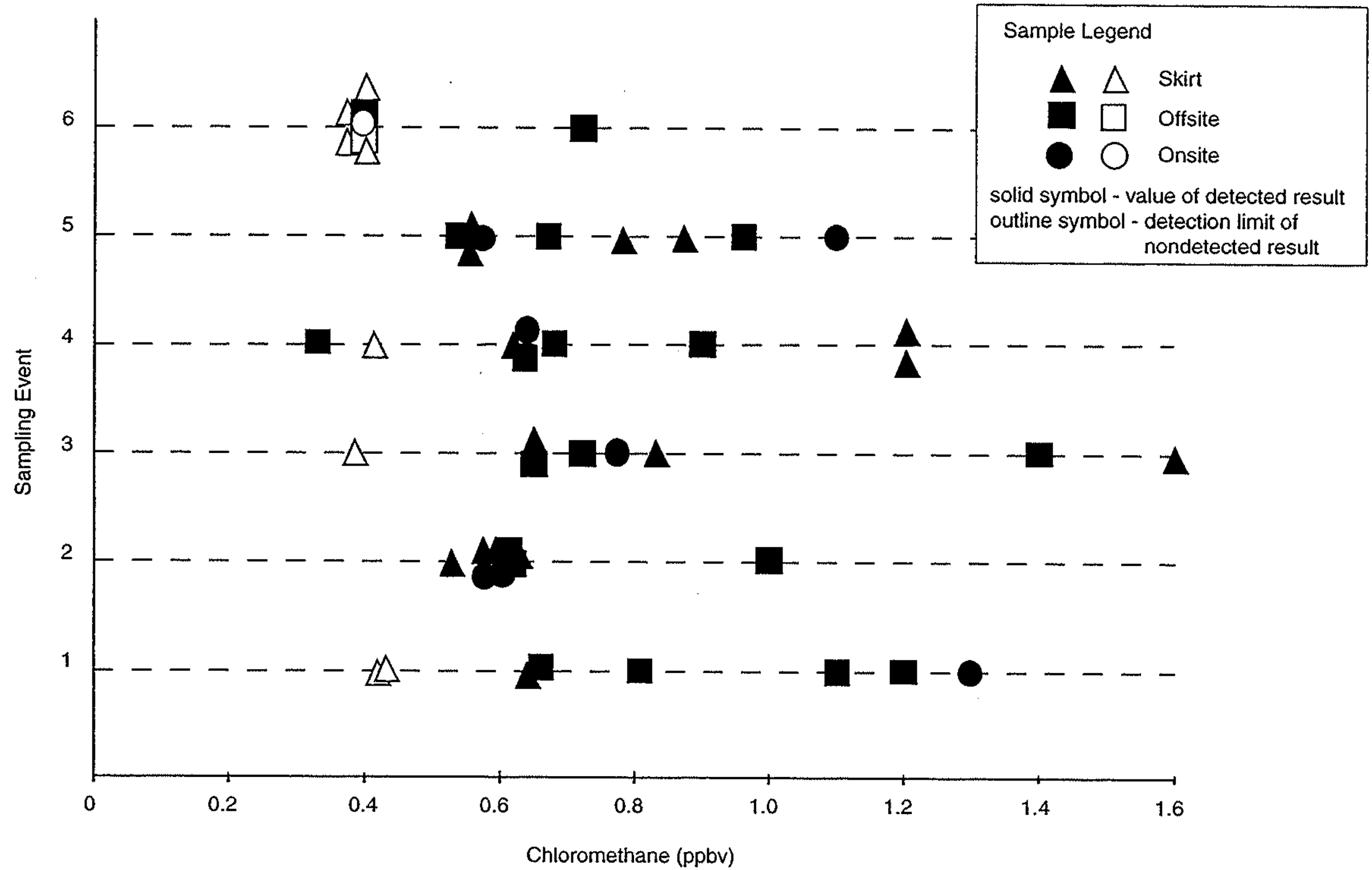


FIGURE **J-2**

CHLOROMETHANE CONCENTRATION (ppbv) IN SKIRT, OFFSITE AND ONSITE AIR SAMPLES

PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 67367 DATE 11/21/96 DRAWN BY TK

Golder Associates

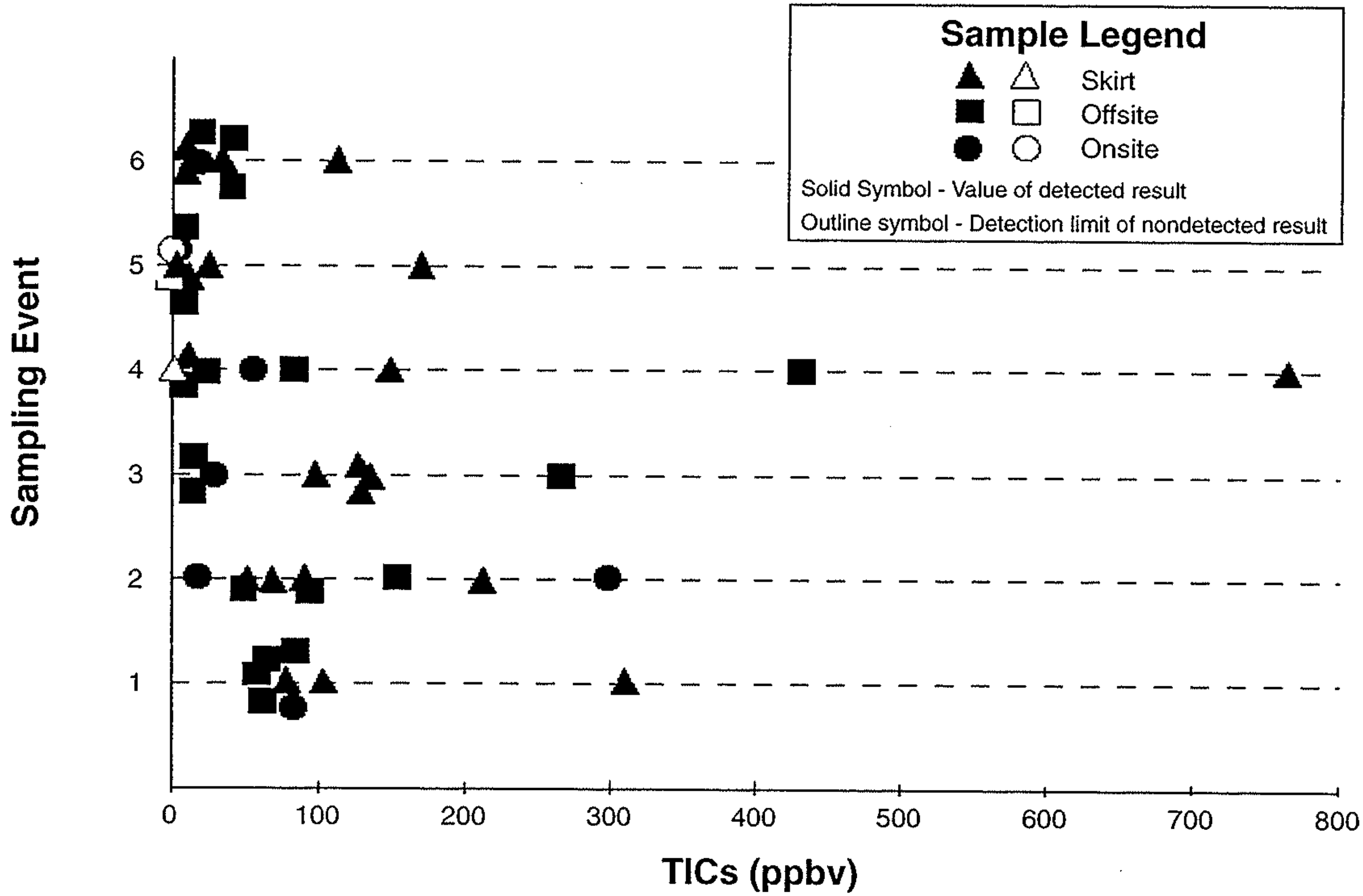


FIGURE **J-3**
TIC CONCENTRATIONS (ppb-v) IN SKIRT, OFFSITE AND ONSITE AIR SAMPLES
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933-1280.2003 DRAWING NO. 67368 DATE 11/21/96 DRAWN BY TK

Golder Associates

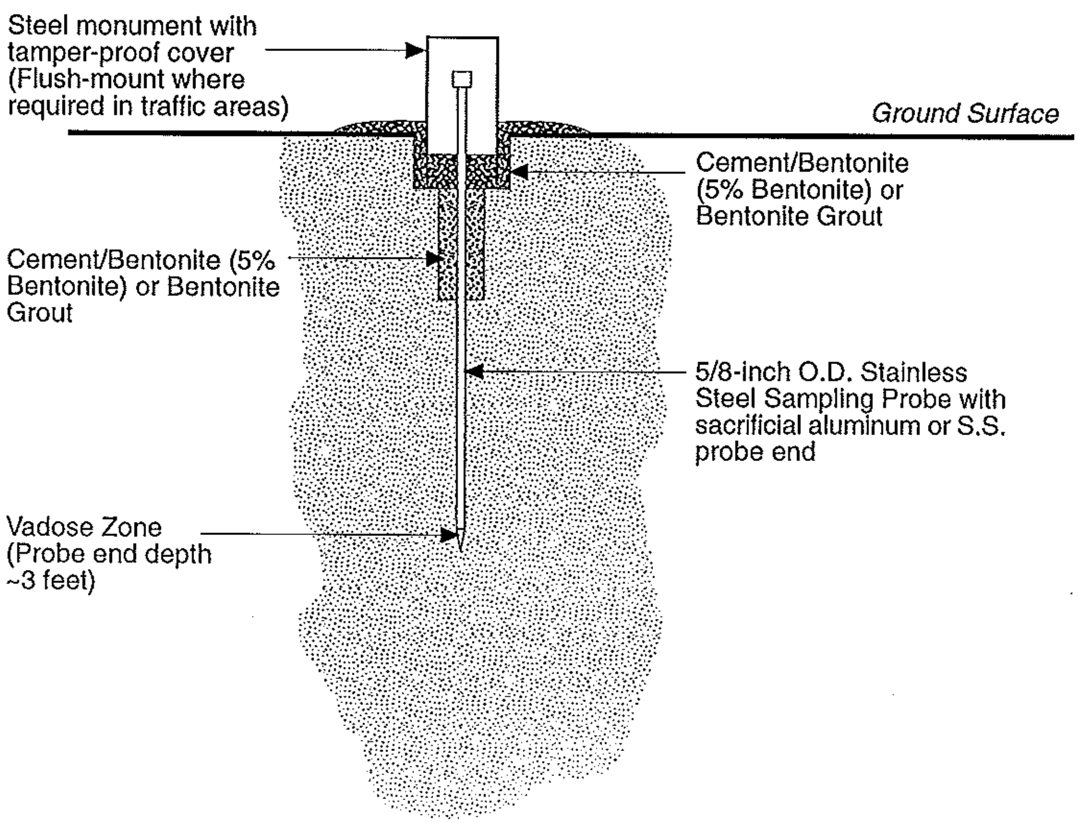


FIGURE **2-4**

SCHEMATIC DIAGRAM OF PERMANENT SOIL VAPOR PROBE INSTALLATION

PORT OF BREMERTON/NORSELAND RI-FS/WA

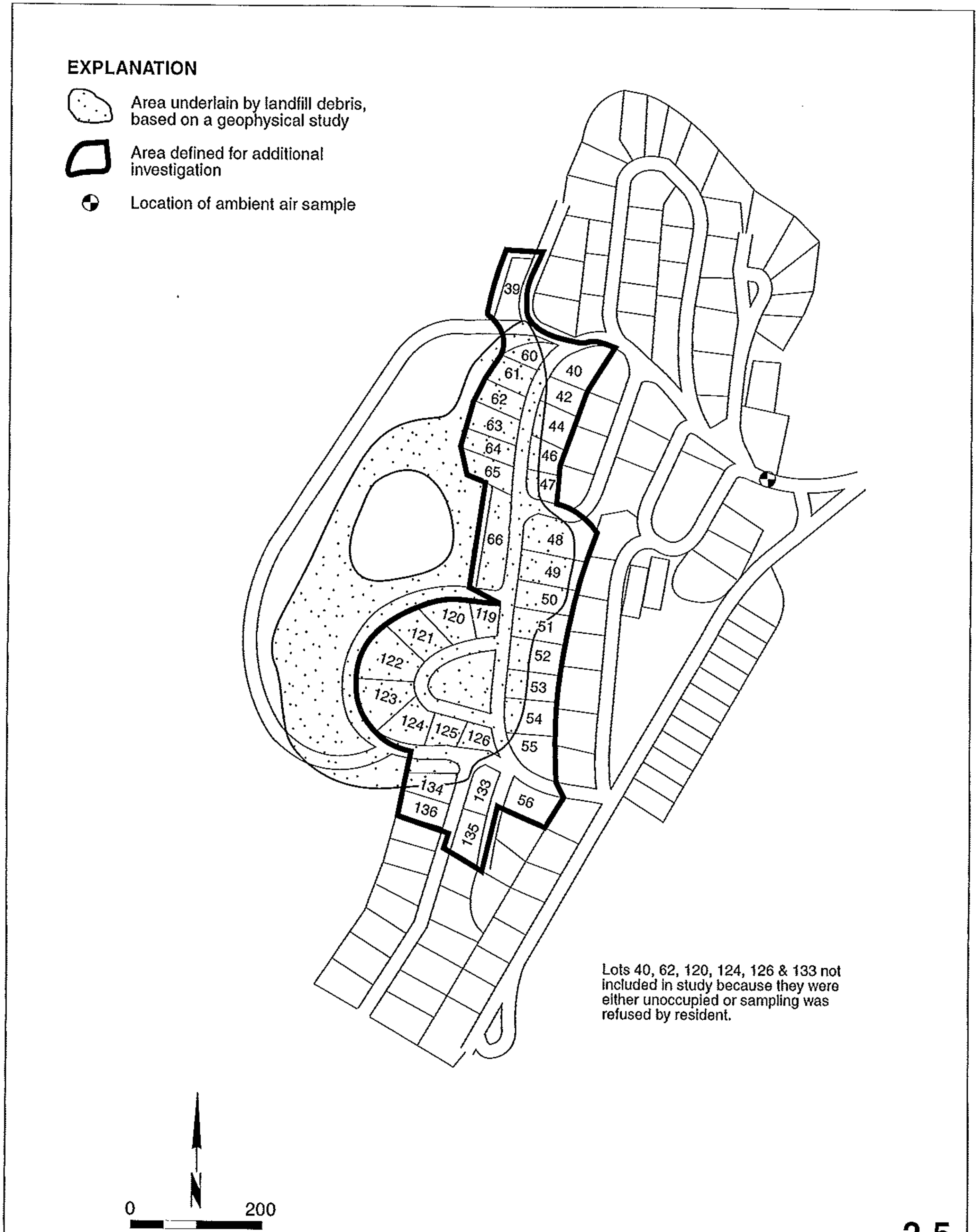
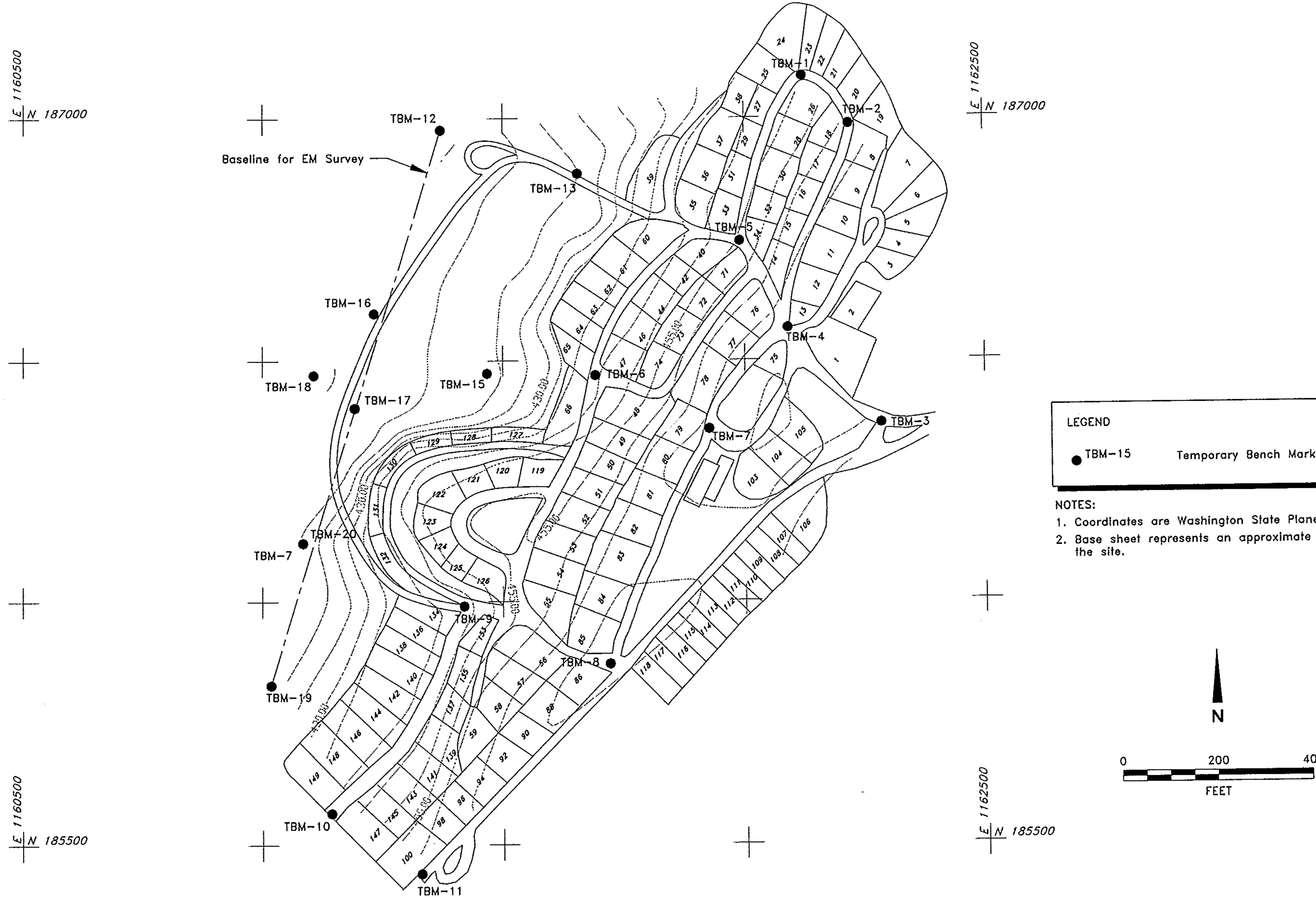


FIGURE **2-5**
STUDY AREA FOR SOIL VAPOR AND SKIRT SAMPLING STUDY
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 50178 DATE 10/17/95 DRAWN BY TK

Golder Associates



LEGEND

● TBM-15 Temporary Bench Mark

NOTES:

1. Coordinates are Washington State Plane North Zone.
2. Base sheet represents an approximate rendering of the site.

FIGURE **2-1**

SITE BASE MAP

PORT OF BREMERTON/NORSELAND RI-FS/WA

Golder Associates

C:\ADCADD\CIVIL\P\9331280\2003\51489 10-16-95 16:17 xrf: NONE

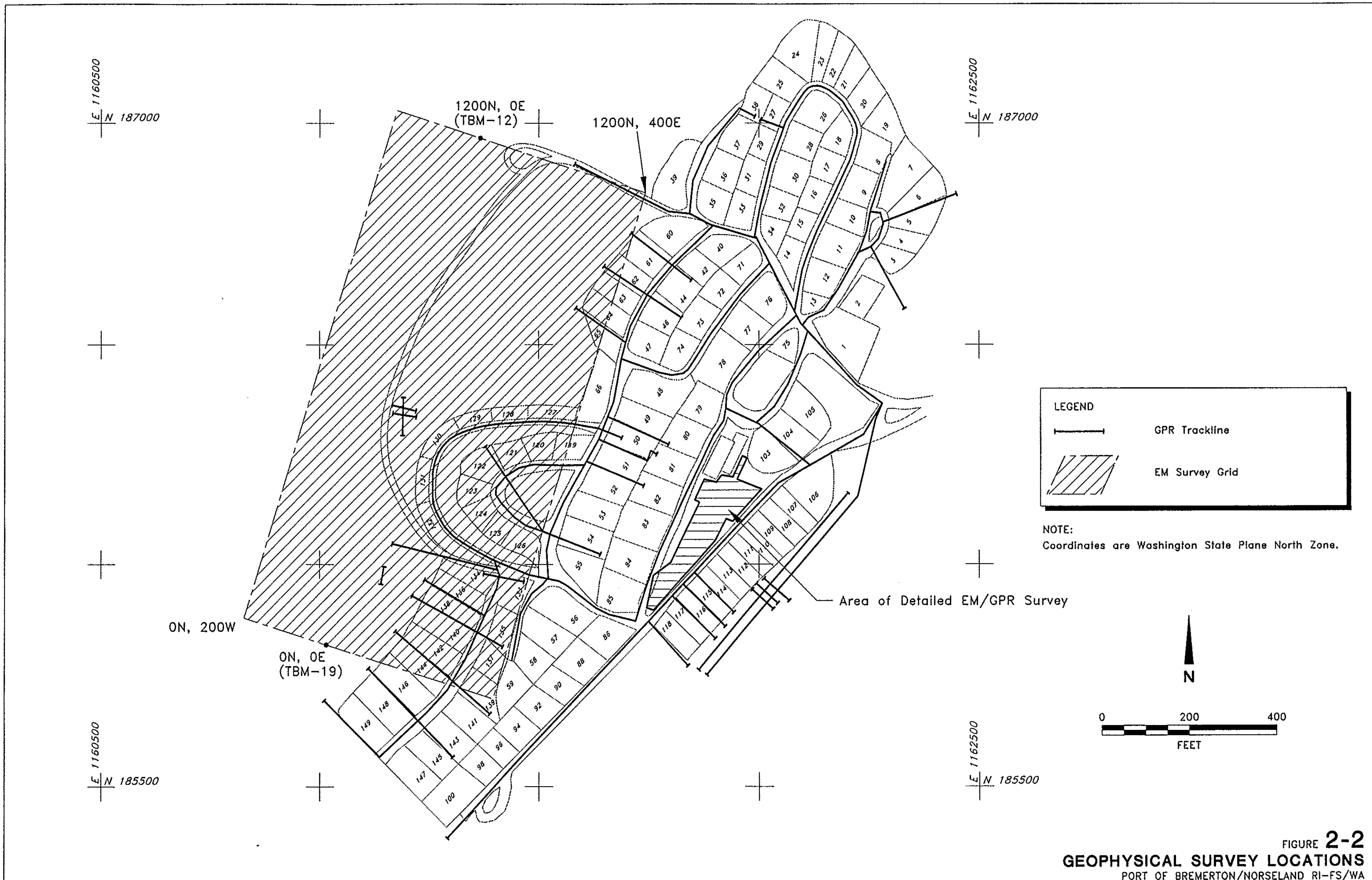


FIGURE 2-2
GEOPHYSICAL SURVEY LOCATIONS
PORT OF BREMERTON/NORSELAND RI-FS/WA

LEGEND

⊙	SV-9	Soil Vapor Probe (Sampled)
◐	SV-17	Soil Vapor Probe (Not Sampled)

NOTE:
Coordinates are Washington State Plane North Zone.

FIGURE **2-3**

SOIL VAPOR PROBE LOCATIONS

PORT OF BREMERTON/NORSELAND RI-FS/WA

Golder Associates

C:\OPT\9331280\2003\51488 10-9-95 11:05 XREF: NONE

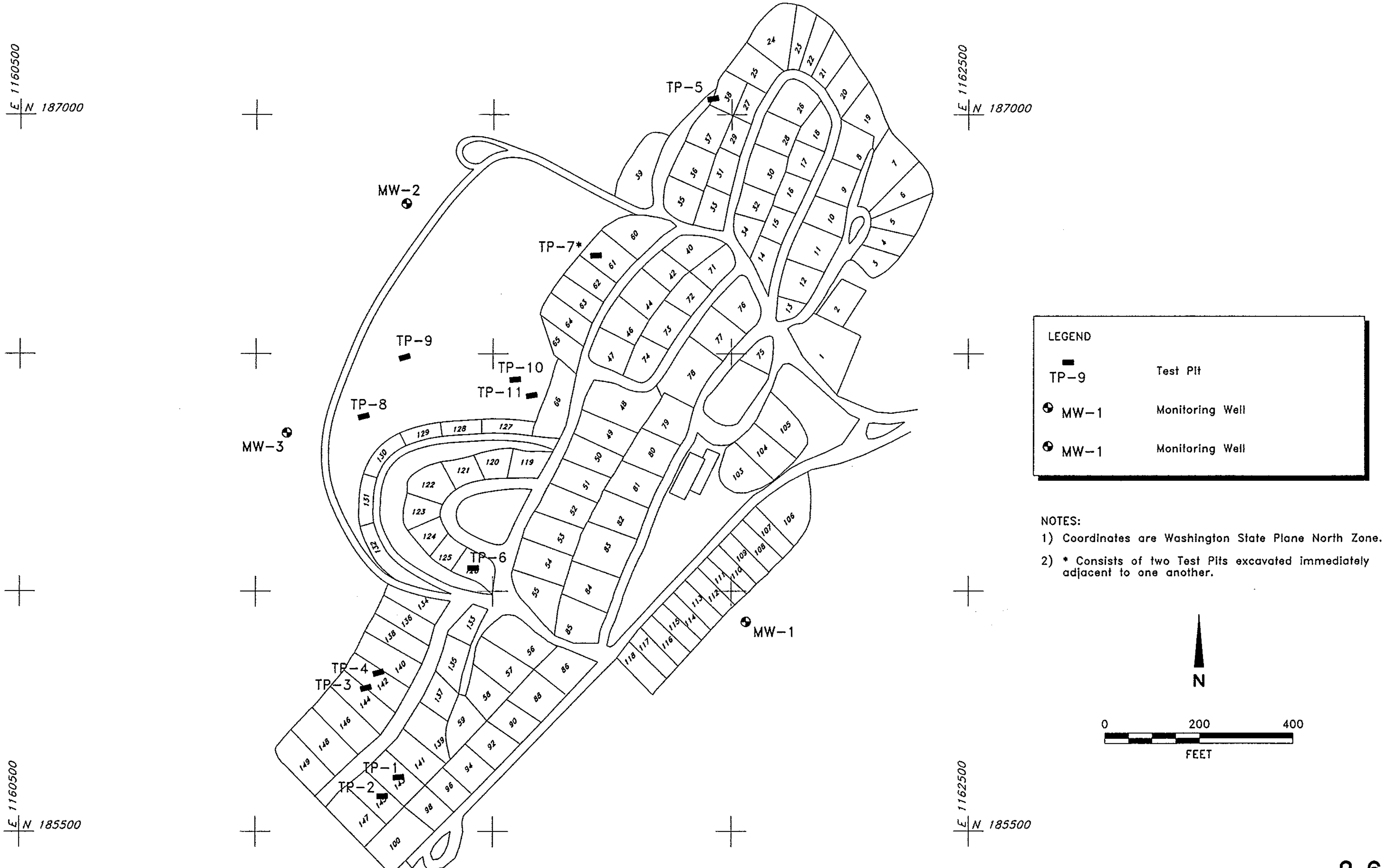


FIGURE **2-6**
TEST PIT AND MONITORING WELL LOCATIONS
PORT OF BREMERTON/NORSELAND RI-FS/WA

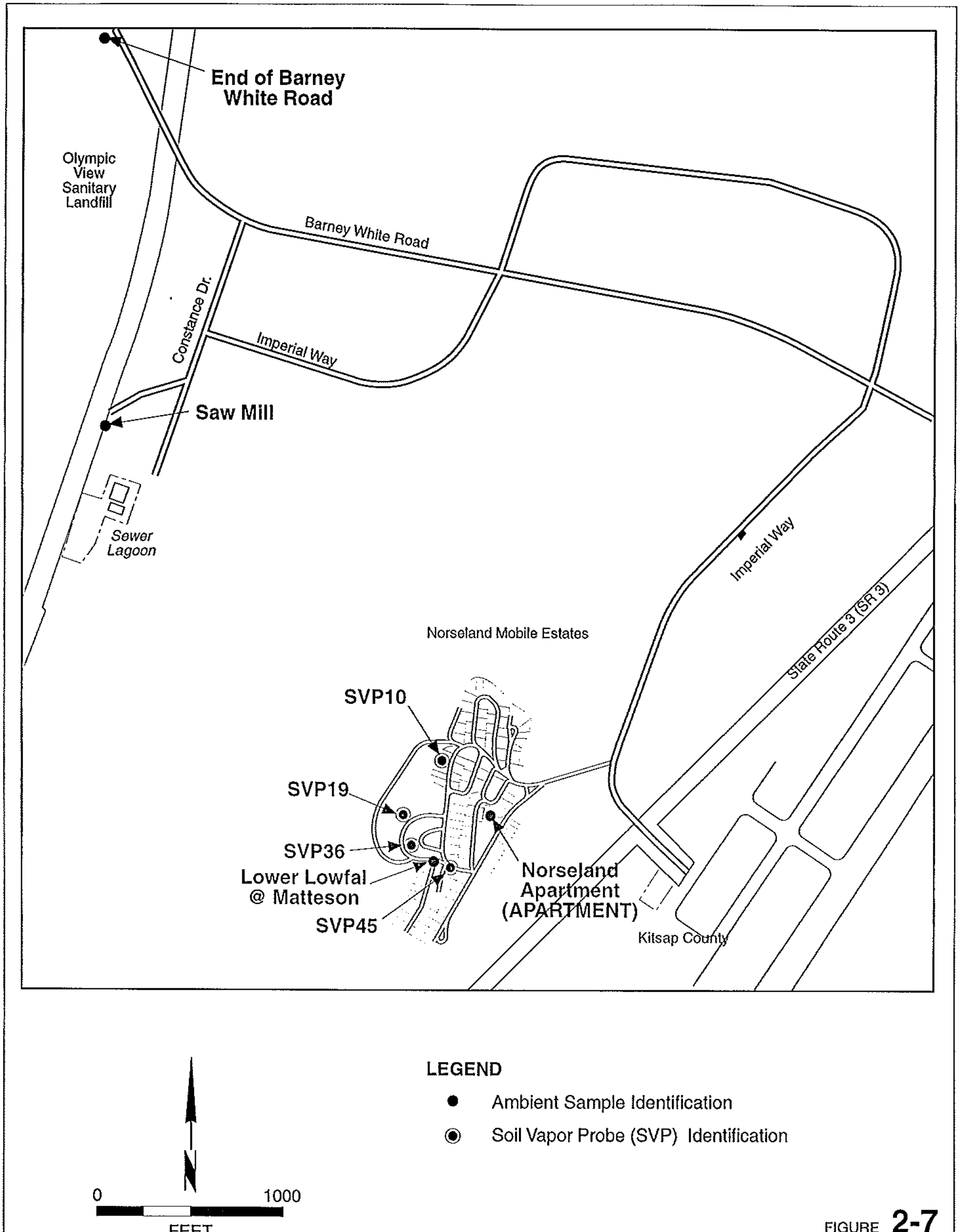
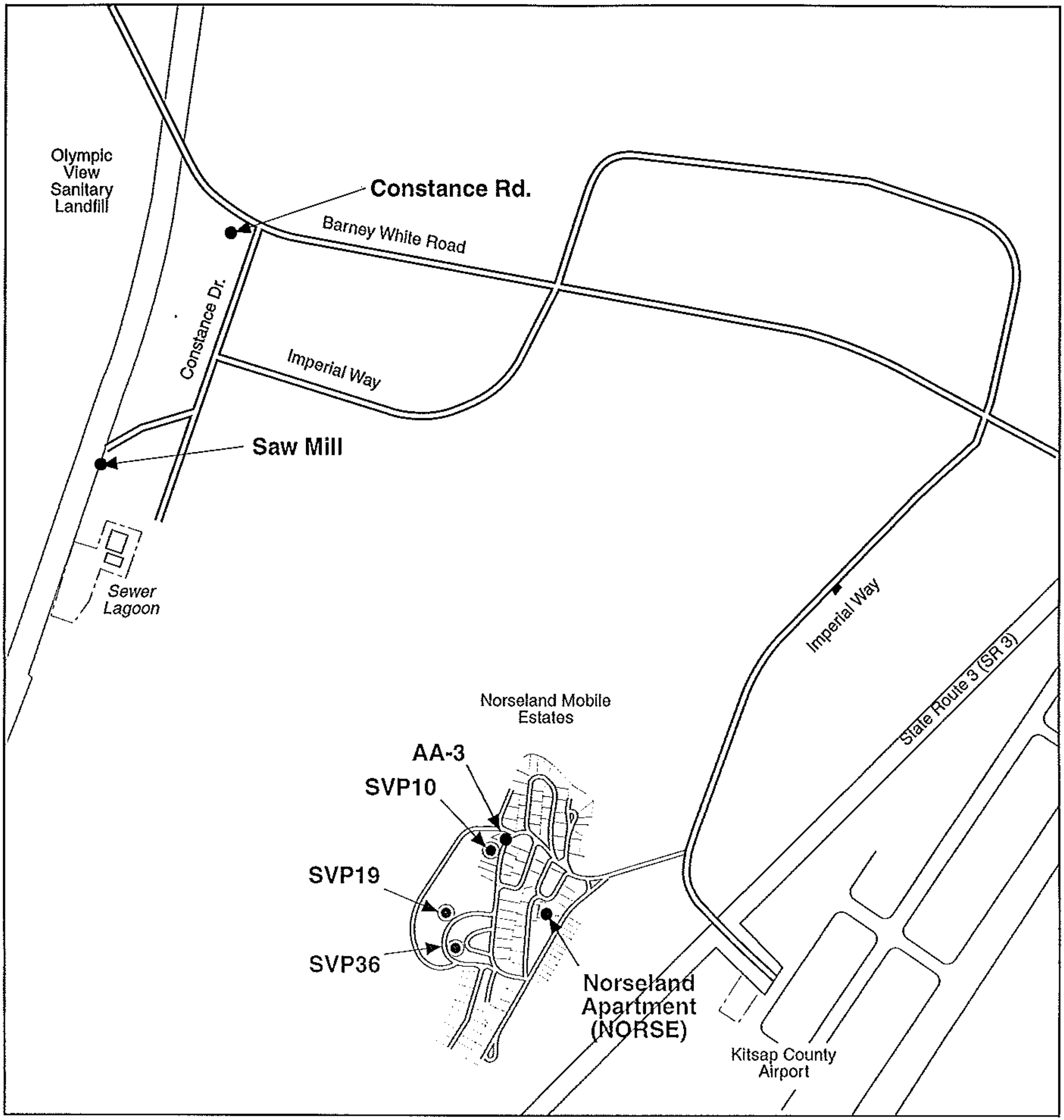
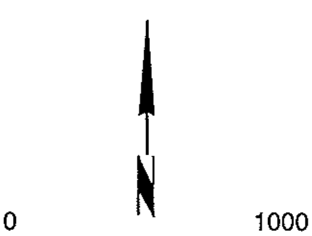


FIGURE **2-7**
SAMPLE LOCATIONS OF THE MARCH 9, 1995 ODOR EVENT
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 60242 DATE 10/4/95 DRAWN BY EA

Golder Associates





LEGEND

- ● Ambient Sample Identification
- ◉ Soil Vapor Probe (SVP) Identification

FIGURE **2-8**

SAMPLE LOCATIONS OF THE MARCH 17, 1995 ODOR EVENT

PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 54500 DATE 10/4/95 DRAWN BY TB

Golder Associates

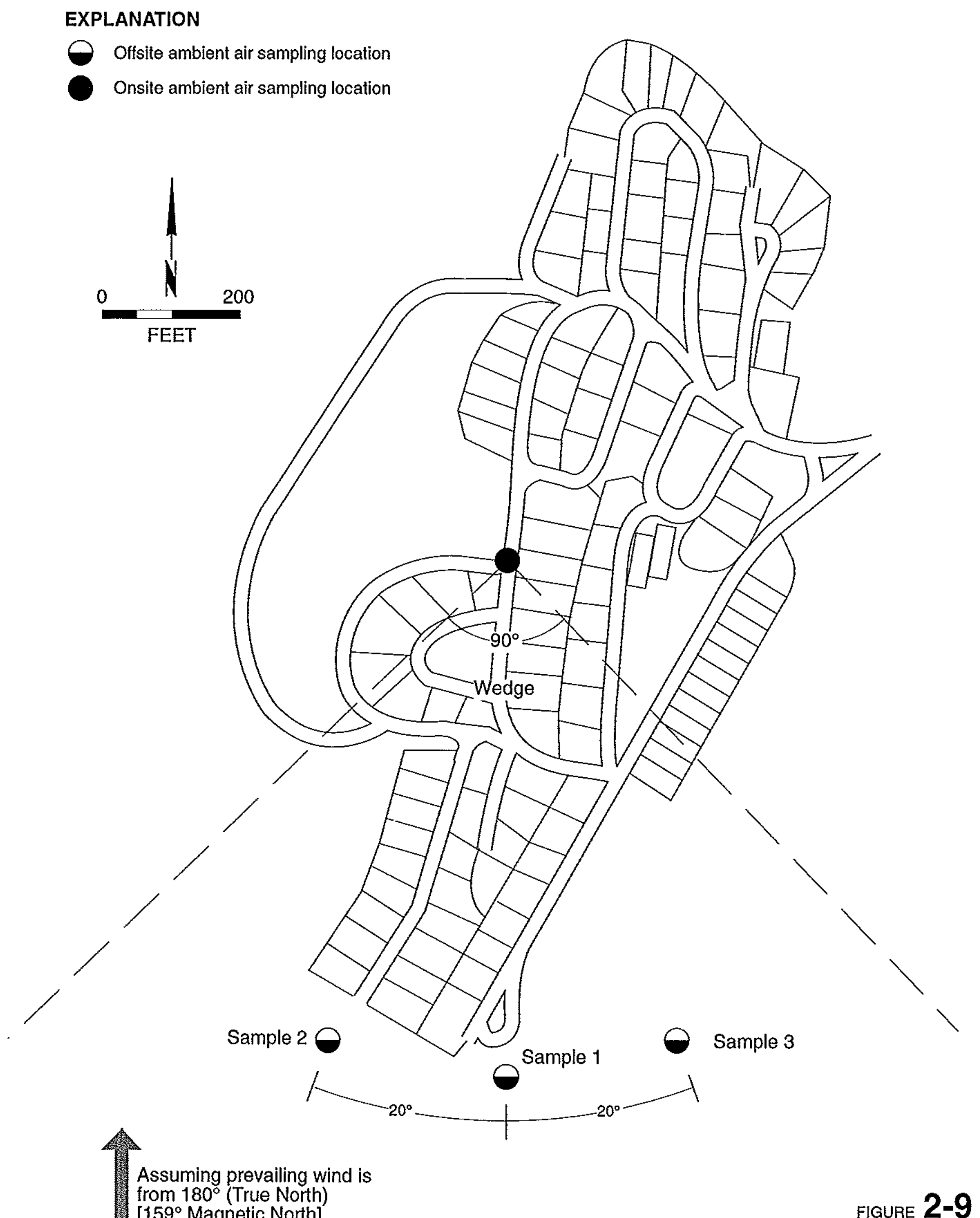


FIGURE 2-9
CONCEPTUAL MODEL FOR ESTABLISHING OFFSITE AMBIENT AIR SAMPLE LOCATIONS
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 55565 DATE 9/27/95 DRAWN BY CB

Golder Associates

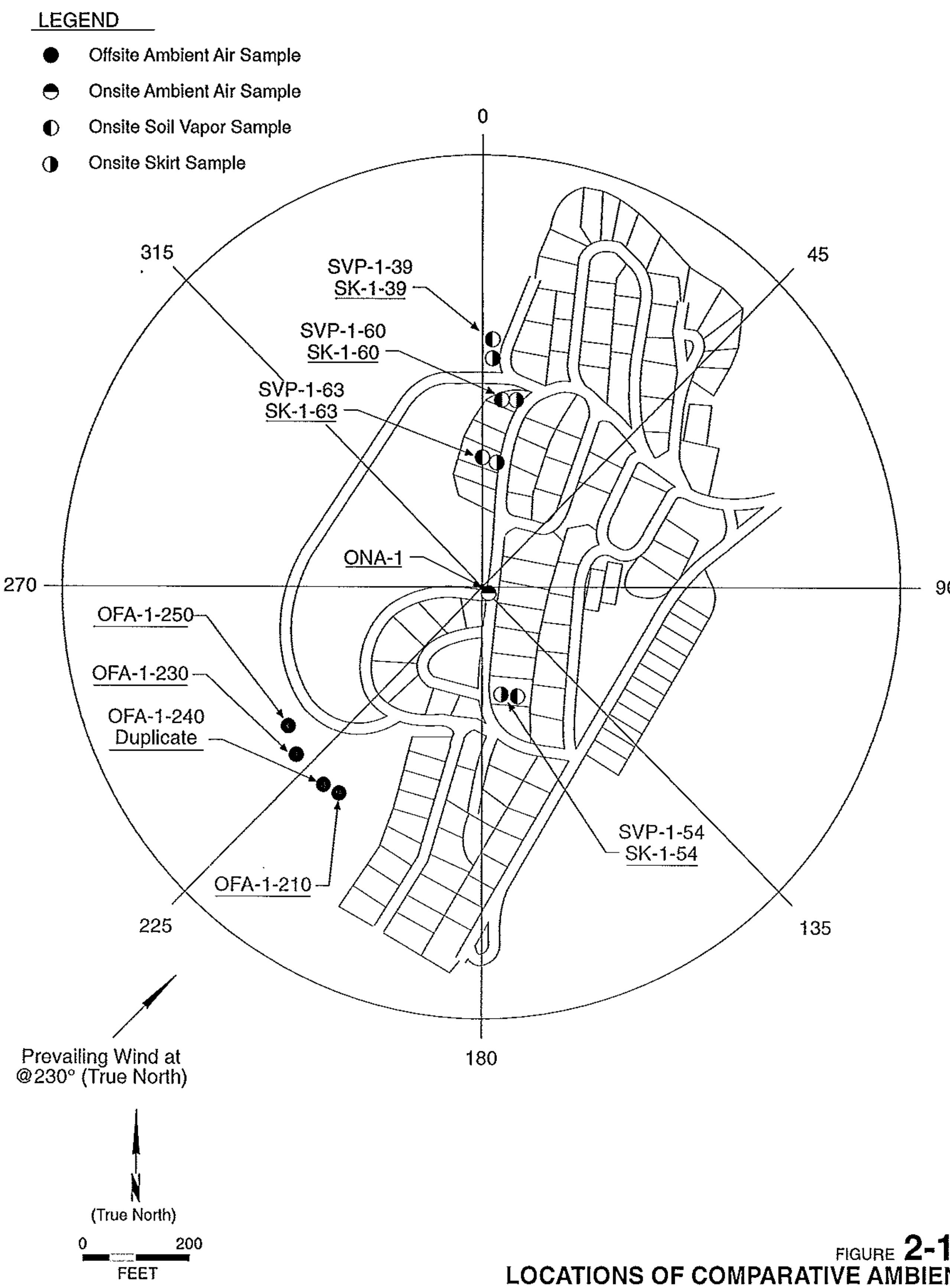


FIGURE **2-10**

LOCATIONS OF COMPARATIVE AMBIENT AIR SAMPLING, EVENT 1 - MAY 30, 1995 NORSELAND SITE 15:00-16:00

PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 60646 DATE 9/27/95 DRAWN BY TK

Golder Associates

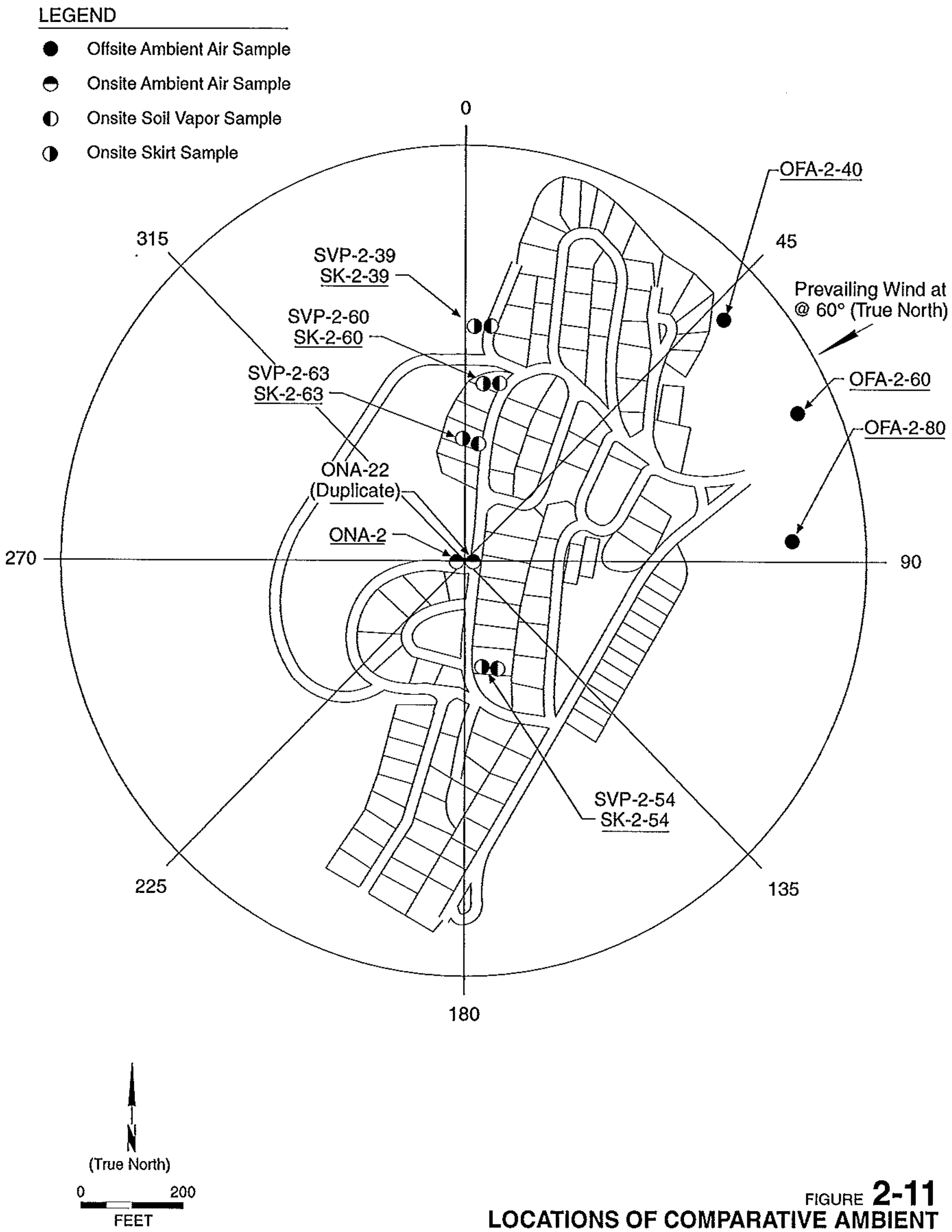


FIGURE **2-11**

LOCATIONS OF COMPARATIVE AMBIENT AIR SAMPLING, EVENT 2 - JUNE 1, 1995 NORSELAND SITE 18:48-19:48

PORT OF BREMERTON/NORSELAND RI-FS/WA

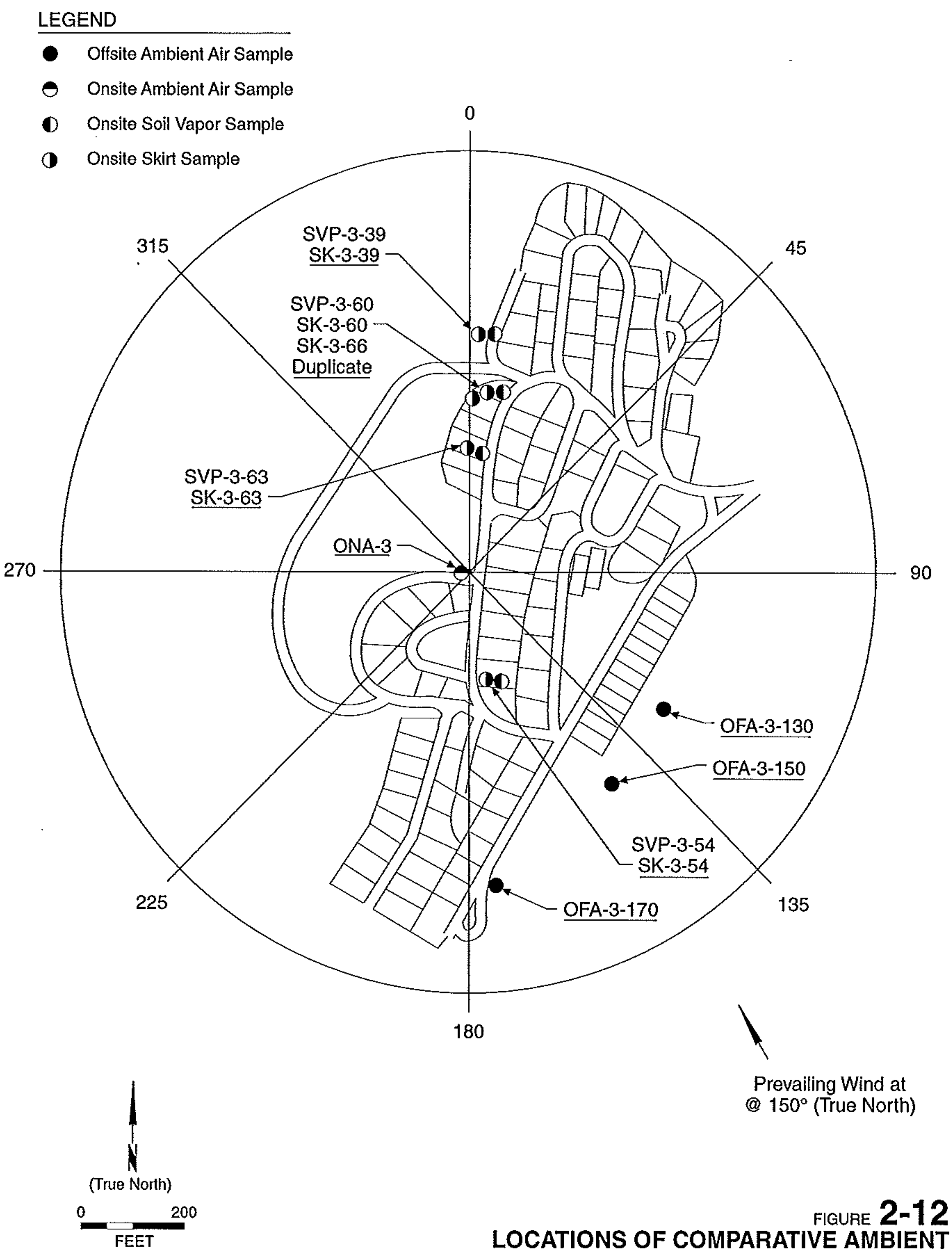


FIGURE **2-12**
LOCATIONS OF COMPARATIVE AMBIENT AIR SAMPLING, EVENT 3 - JUNE 6, 1995 NORSELAND SITE 21:00-22:00
PORT OF BREMERTON/NORSELAND RI-FS/WA

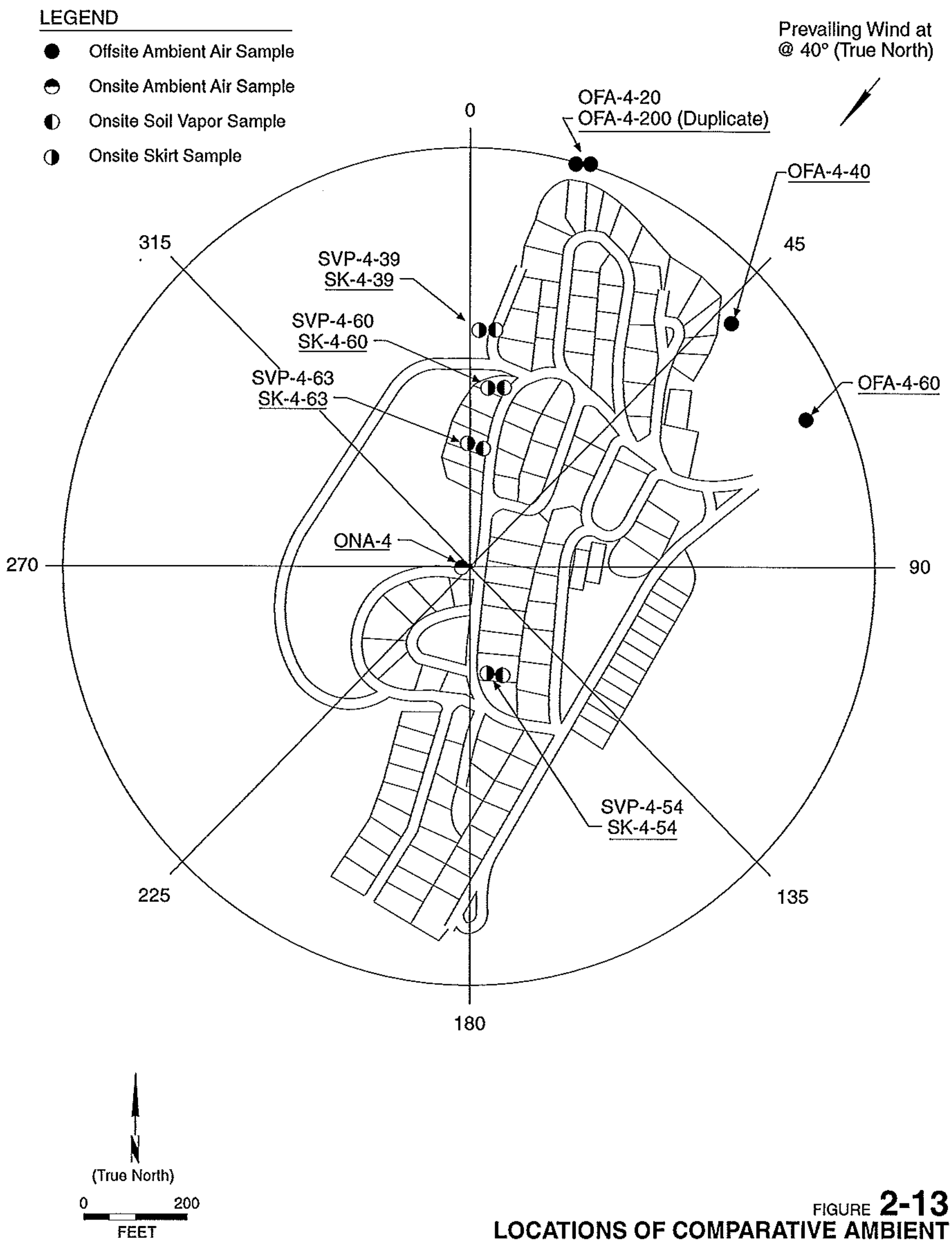


FIGURE **2-13**

LOCATIONS OF COMPARATIVE AMBIENT AIR SAMPLING, EVENT 4 - JUNE 7, 1995 NORSELAND SITE 10:25-11:25

PORT OF BREMERTON/NORSELAND RI-FS/WA

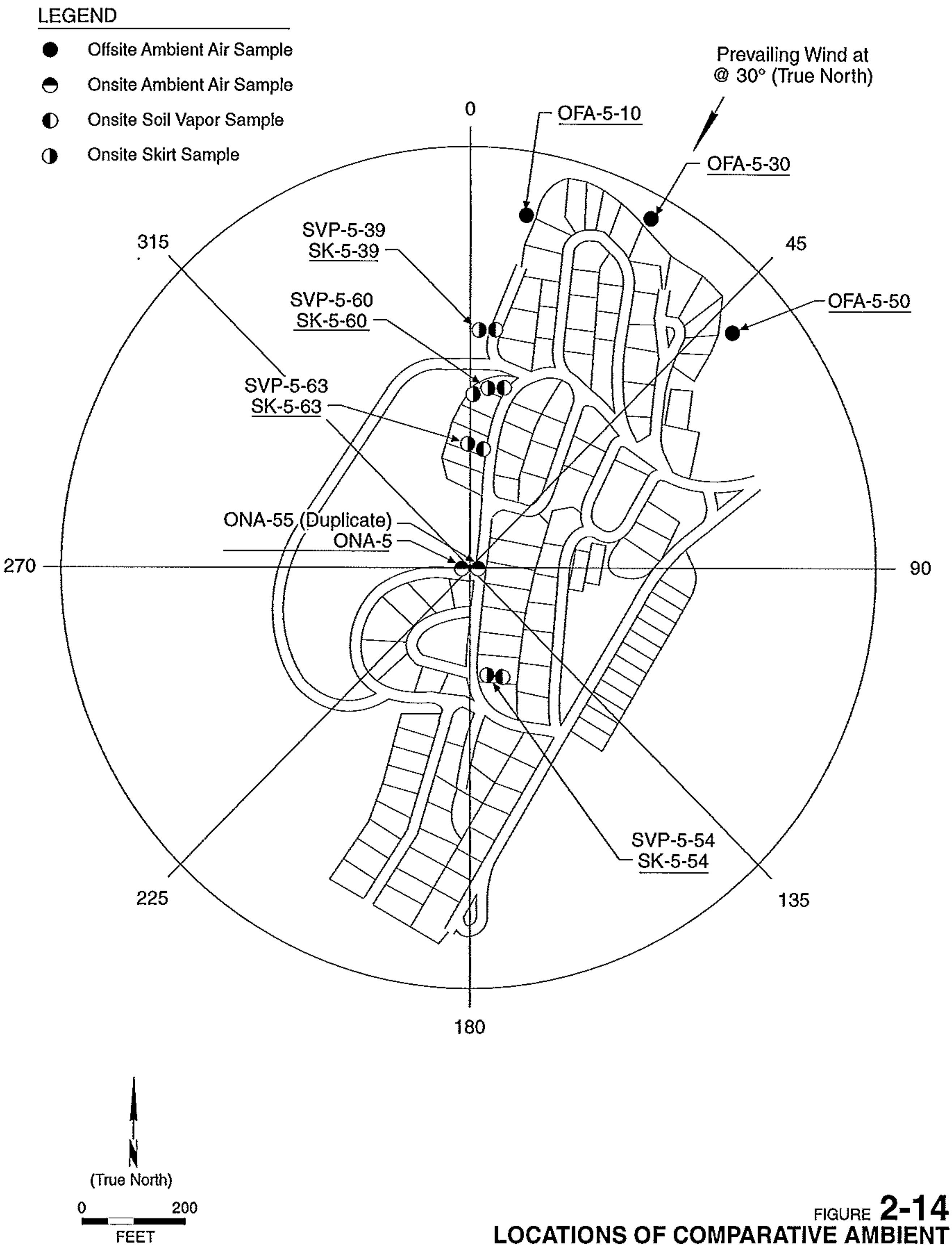


FIGURE **2-14**

LOCATIONS OF COMPARATIVE AMBIENT AIR SAMPLING, EVENT 5 - JUNE 14, 1995
NORSELAND SITE 07:17-08:17
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 60285 DATE 9/27/95 DRAWN BY EA

Golder Associates

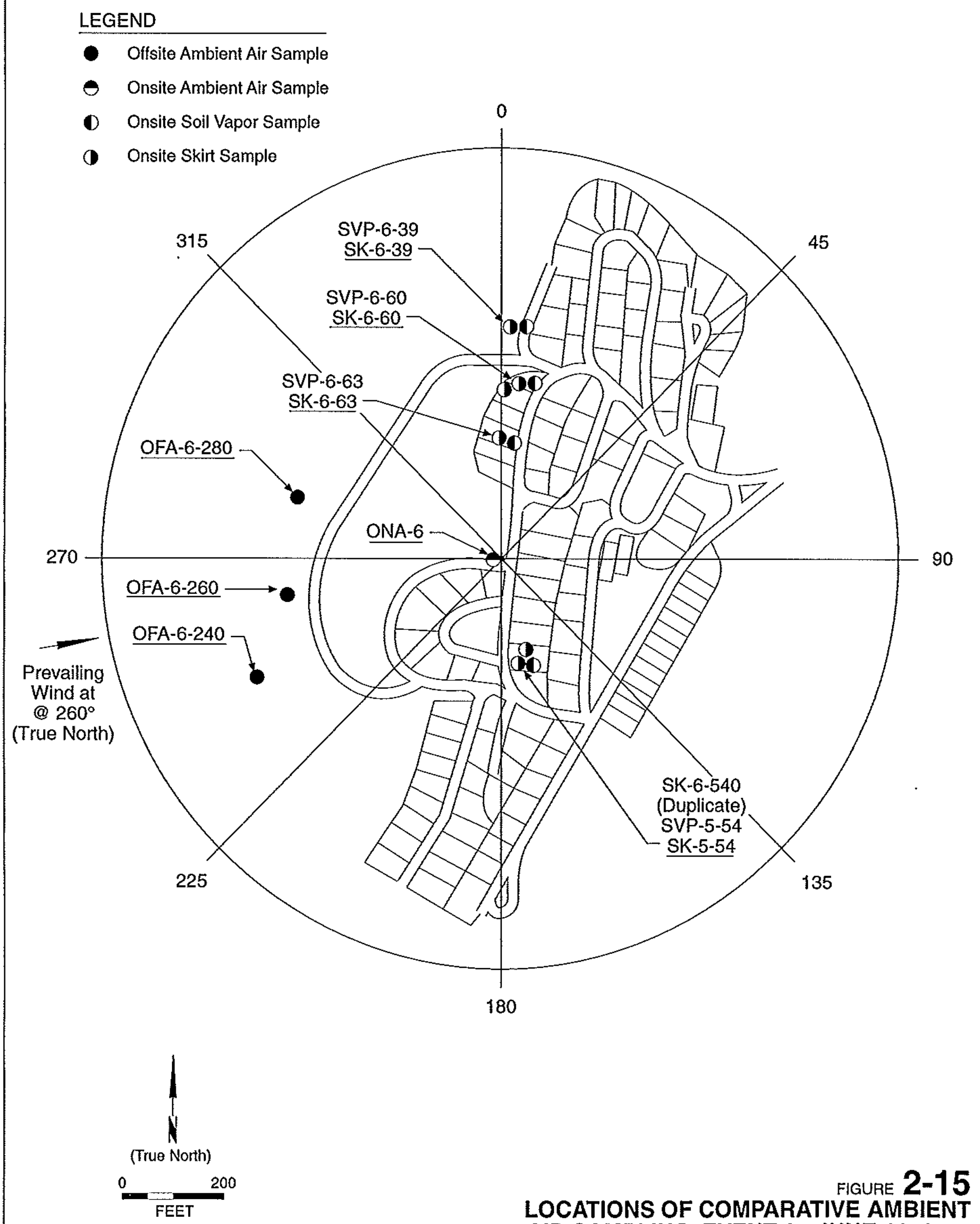


FIGURE **2-15**

LOCATIONS OF COMPARATIVE AMBIENT AIR SAMPLING, EVENT 6 - JUNE 16, 1995
NORSELAND SITE 03:45-04:45
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 60623 DATE 9/27/95 DRAWN BY TK

Golder Associates

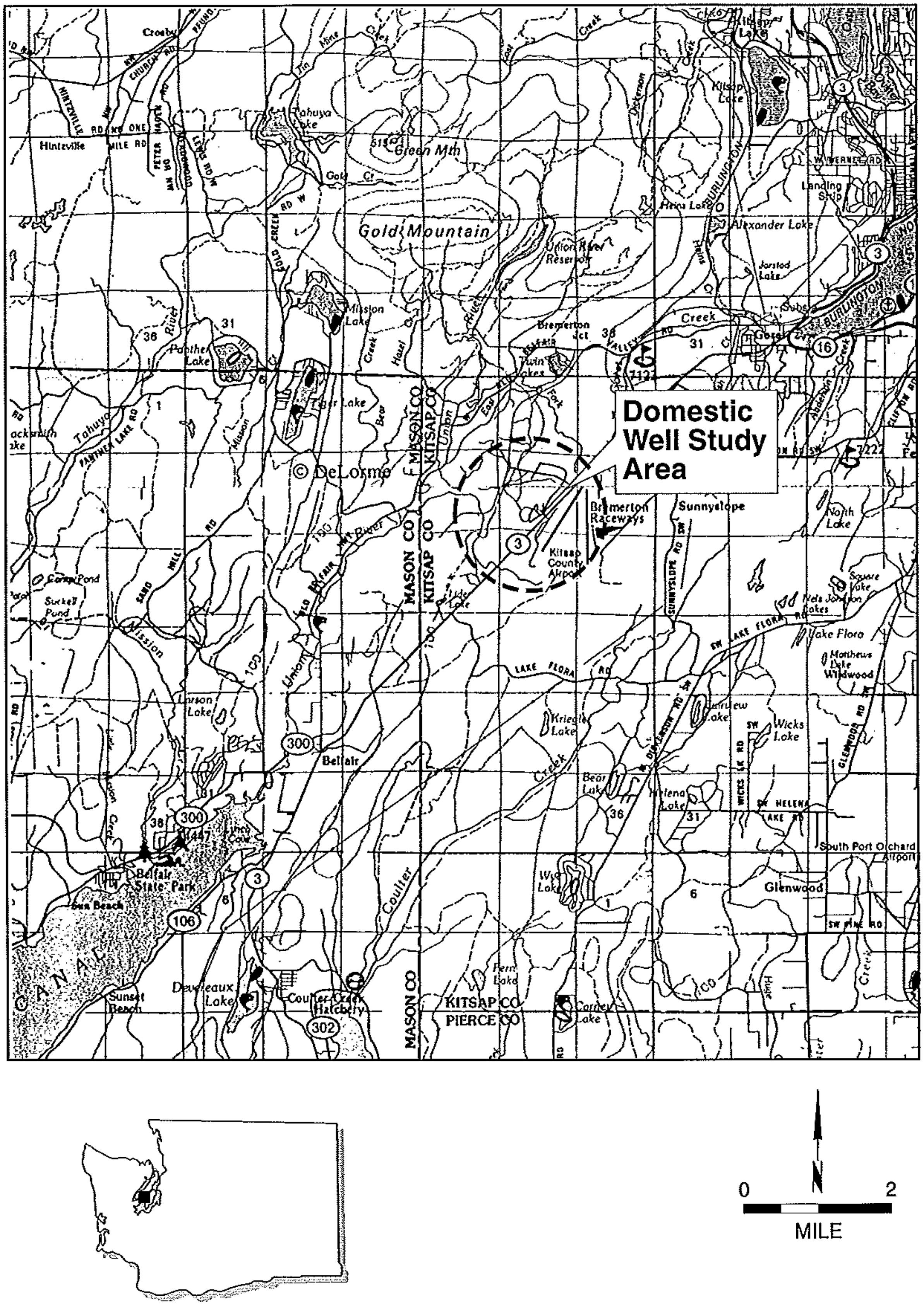


FIGURE **2-16**

DOMESTIC WELL STUDY AREA

PORT OF BREMERTON/NORSELAND RI-FS/WA

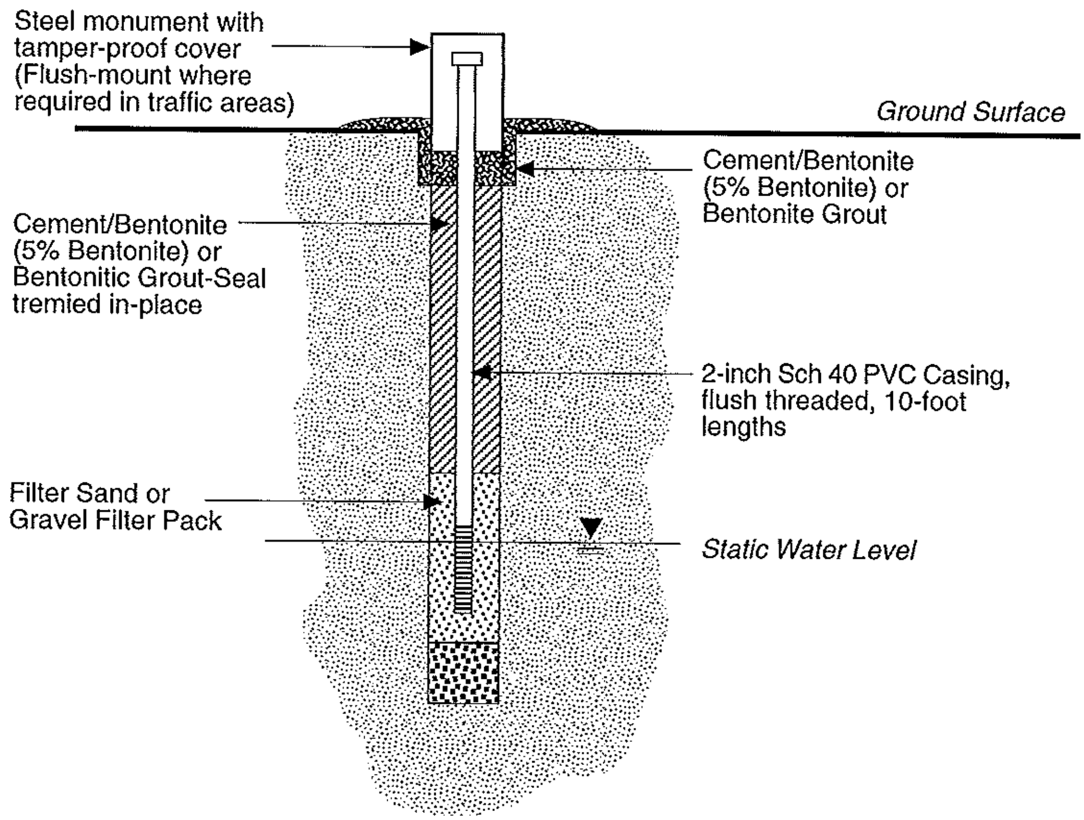


FIGURE **2-17**
WELL CONSTRUCTION SCHEMATIC
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 55781 DATE 10/12/95 DRAWN BY EA

Golder Associates

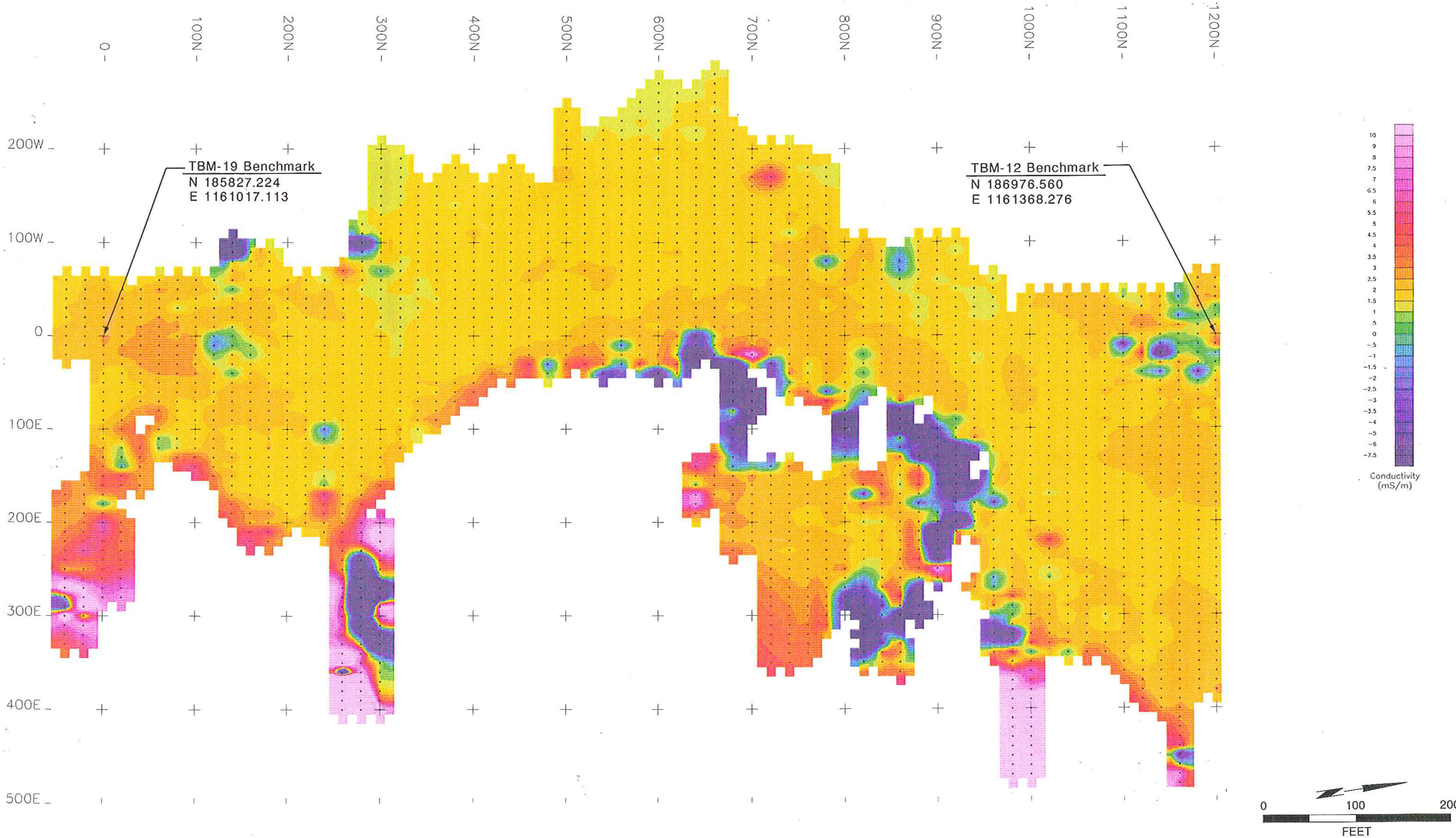


FIGURE **3-1**

EM-31 SURVEY CONDUCTIVITY DATA

PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933-1280.2003 DRAWING NO. 60897 DATE 10/6/95 DRAWN BY TK

Golder Associates

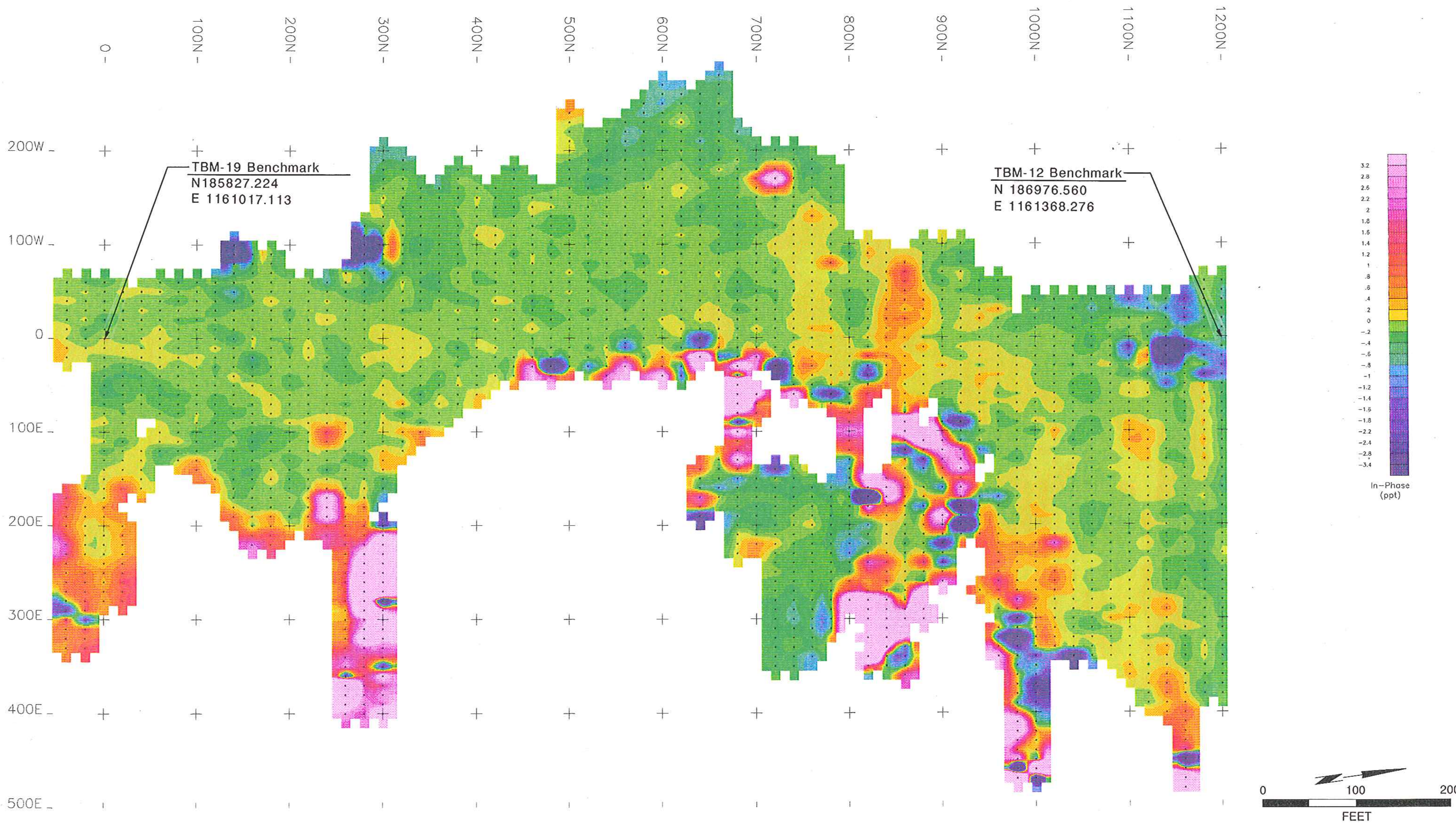


FIGURE **3-2**
EM-31 SURVEY IN-PHASE DATA
PORT OF BREMERTON/NORSELAND RI-FS/WA

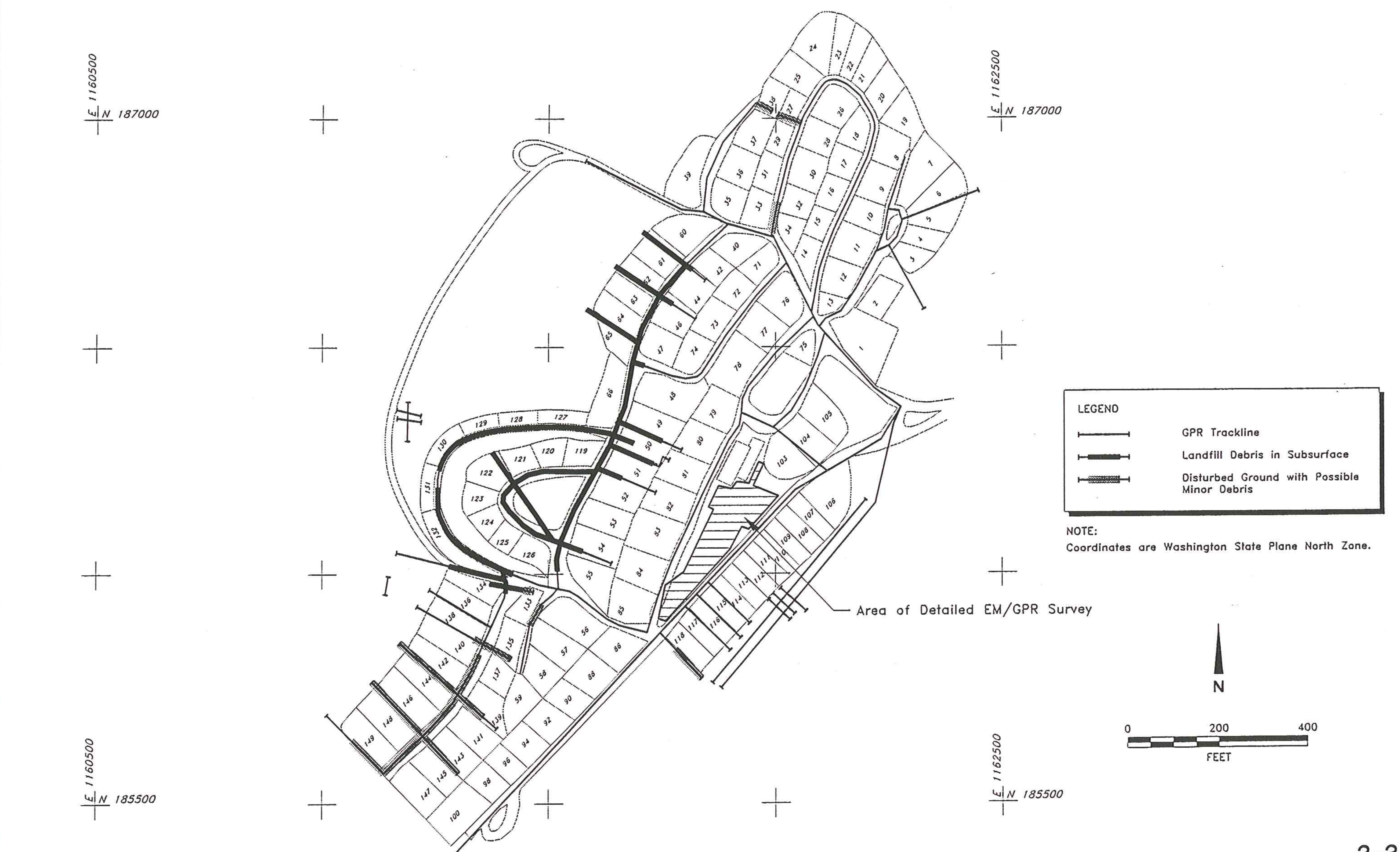


FIGURE 3-3
GPR SURVEY RESULTS
PORT OF BREMERTON/NORSELAND RI-FS/WA

C:\DPT\9331280\2003\52388 10-11-95 14:37xrf: NONE

Golder Associates

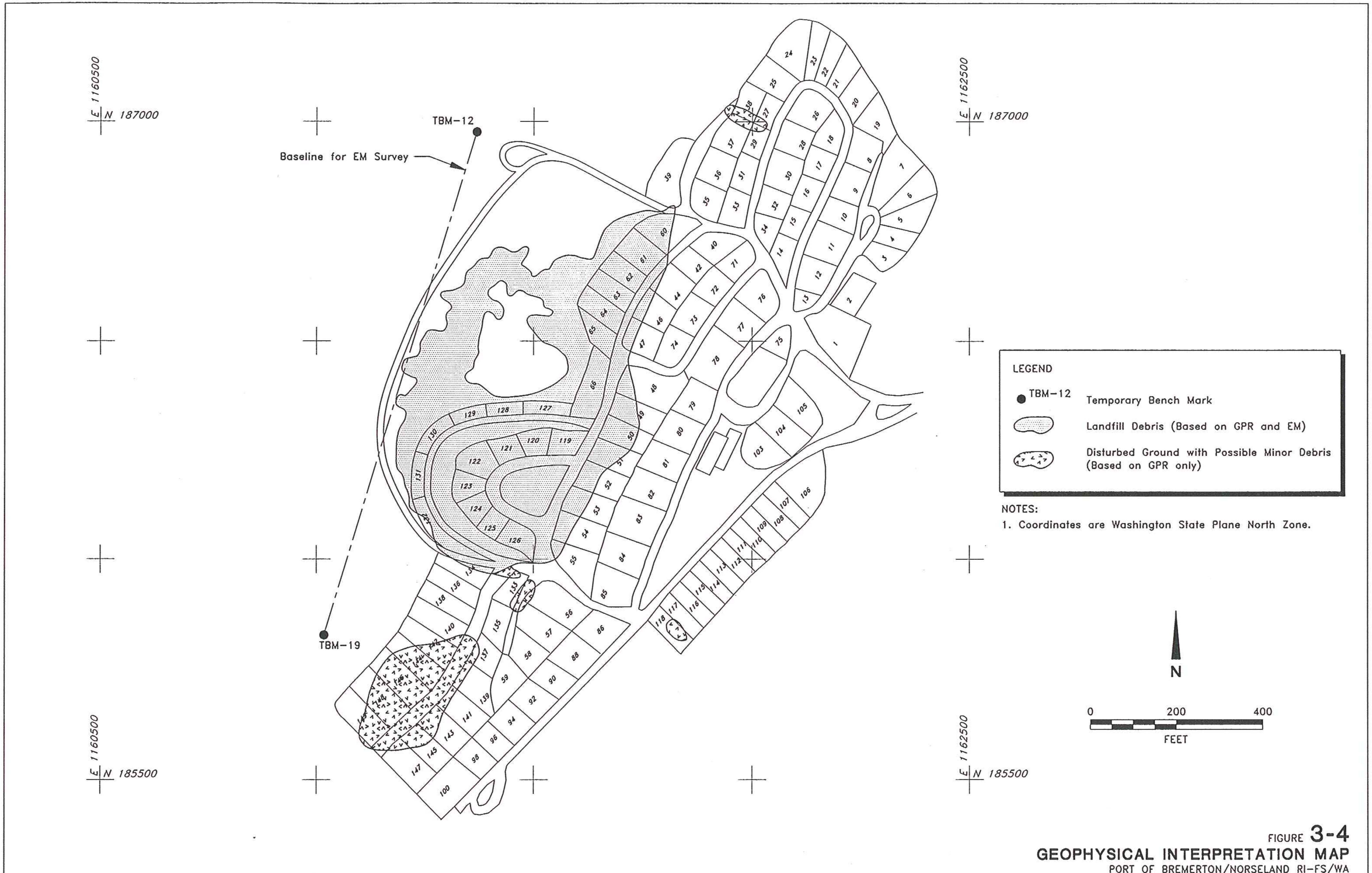


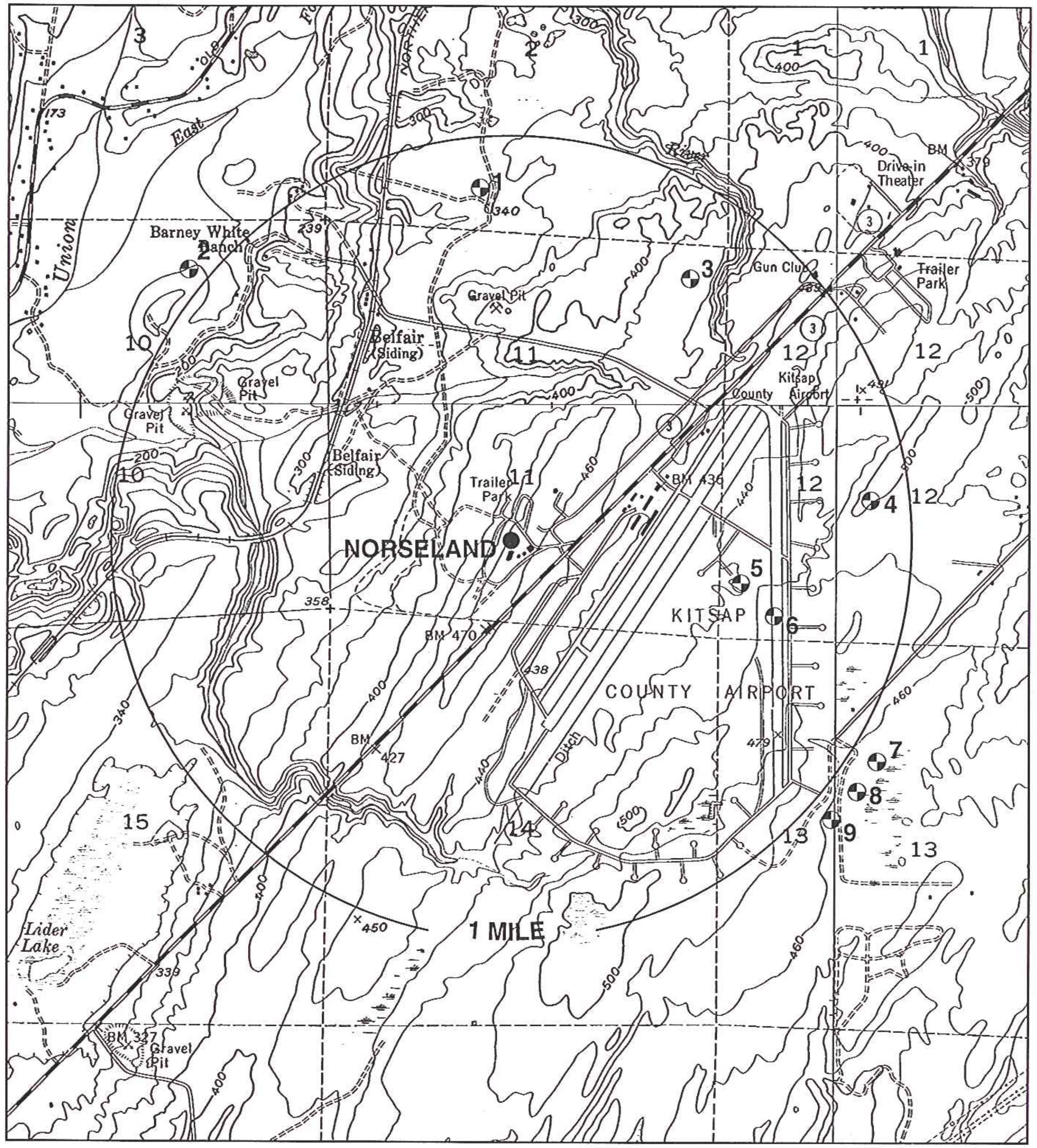
FIGURE **3-4**

GEOPHYSICAL INTERPRETATION MAP

PORT OF BREMERTON/NORSELAND RI-FS/WA

C:\ADCADD\CIVIL\P\9331280\2003\52389 10-17-95 12:11 xrf: NONE

Golder Associates



0 4000
FEET

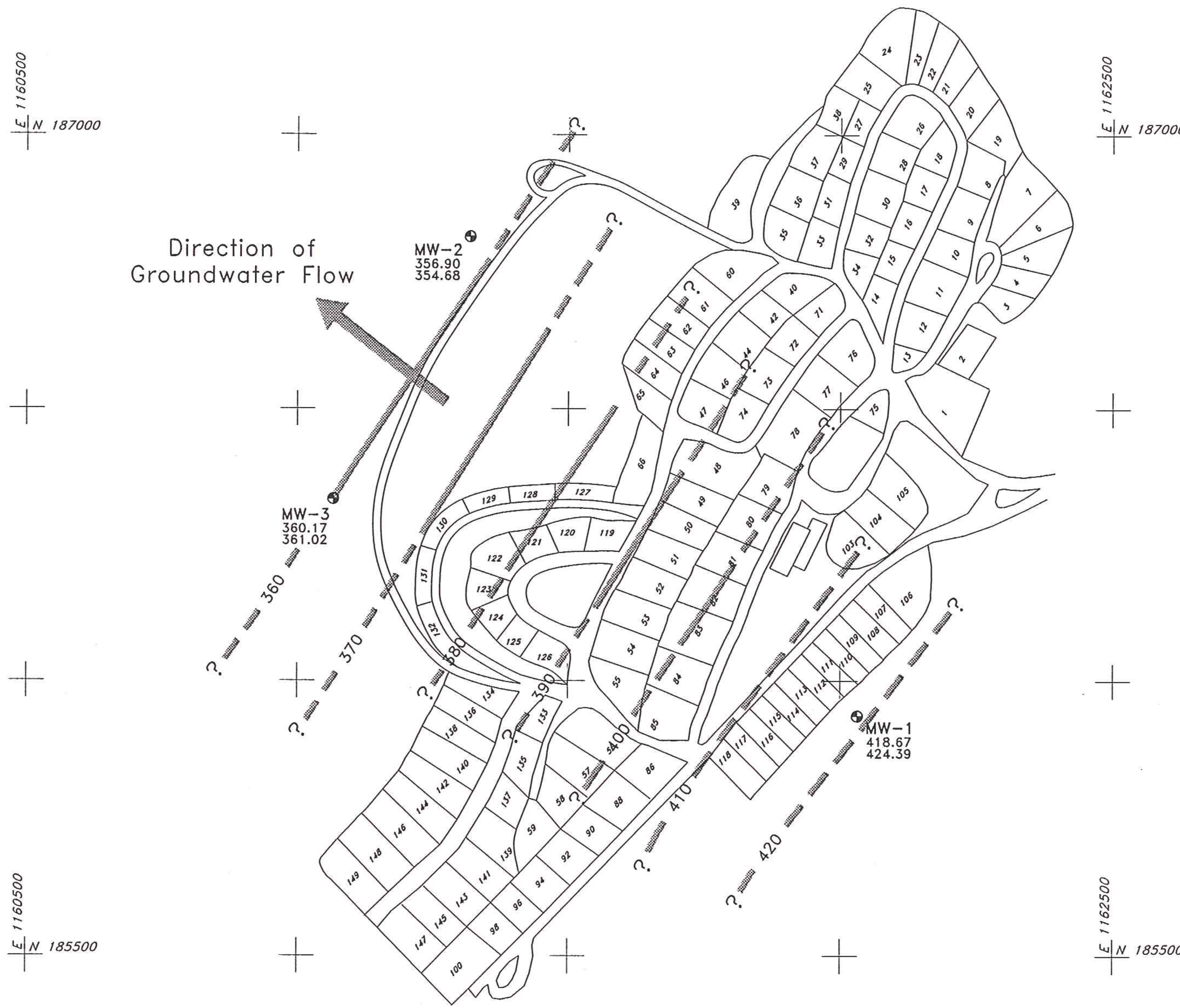
Legend

Well identified in Ecology records search (see Table 3-1)

FIGURE **3-5**
APPROXIMATE LOCATIONS OF NEARBY WELLS
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933-1280.2003 DRAWING NO. 54770 DATE 10/12/94 DRAWN BY TB

Golder Associates



LEGEND

420	Groundwater Elevation Contour, ft AMSL
MW-1 418.67 424.39	Monitoring Well and Groundwater Elevations (ft AMSL) for August and December 1994

NOTES:

1. Coordinates are Washington State Plane North Zone.
2. Contours based on the August 1994 water levels.

N

0 200 400
FEET

FIGURE 3-6
GROUNDWATER ELEVATIONS
PORT OF BREMERTON/NORSELAND RI-FS/WA

C:\ADCADD\CIVIL\P\9331280\2003\52392 10-16-95 16:30 xrf: NONE

Golder Associates

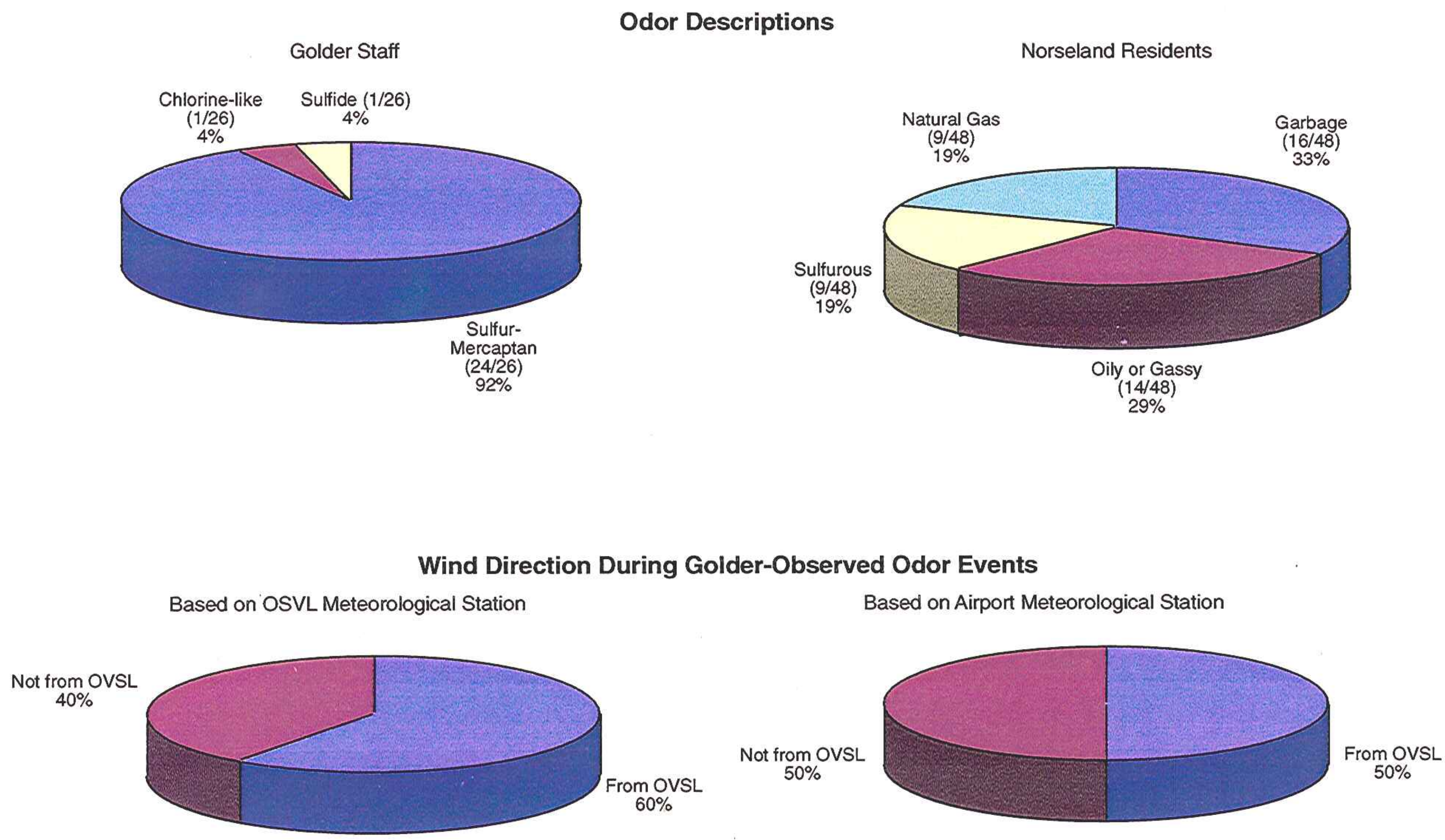


FIGURE **5-1**
ODOR MONITORING RESULTS
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933-1280.2003 DRAWING NO. 67050 DATE 8/6/96 DRAWN BY TK

Golder Associates

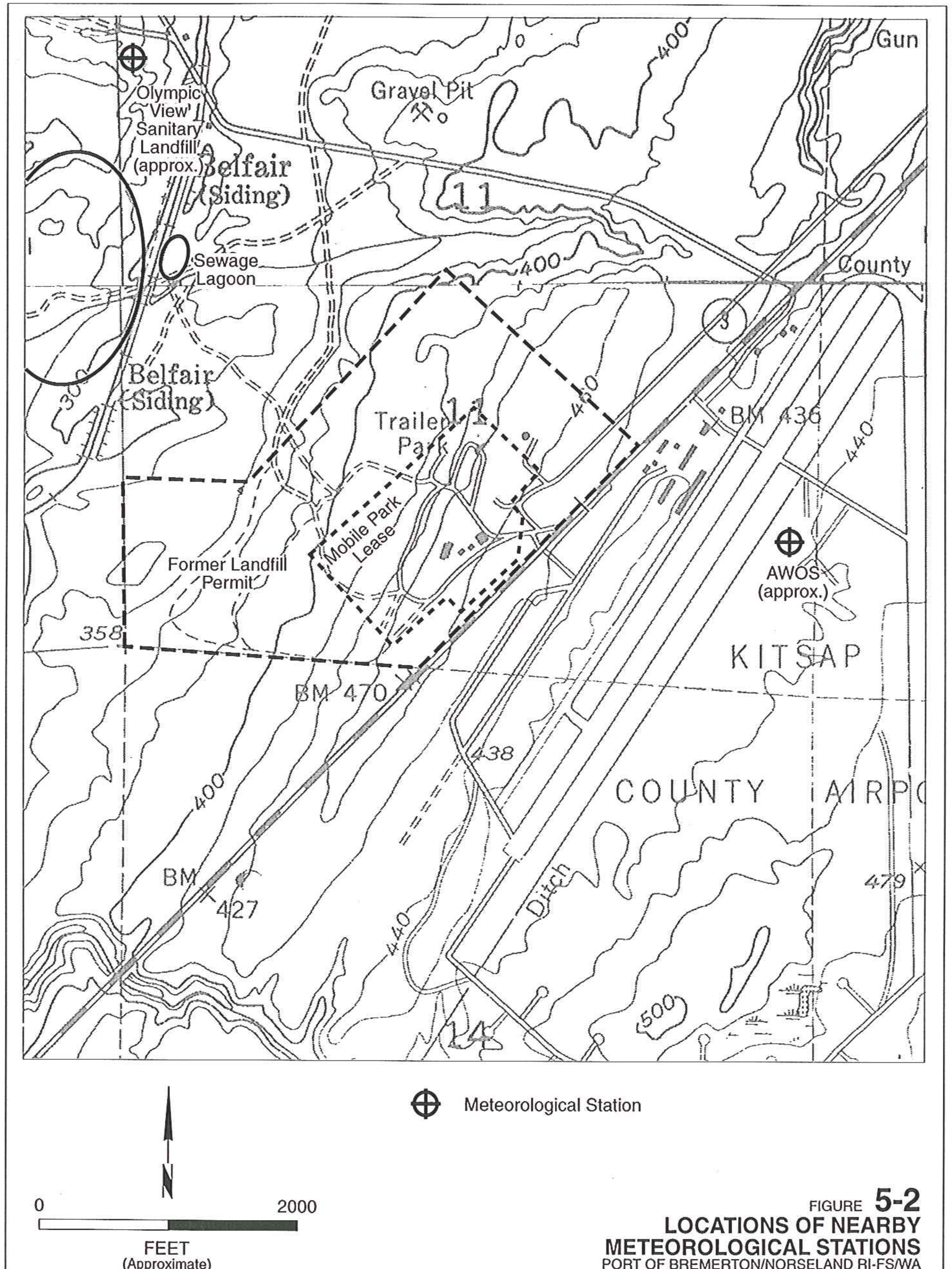


FIGURE **5-2**
LOCATIONS OF NEARBY METEOROLOGICAL STATIONS
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 67053 DATE 12/3/96 DRAWN BY TK

Golder Associates

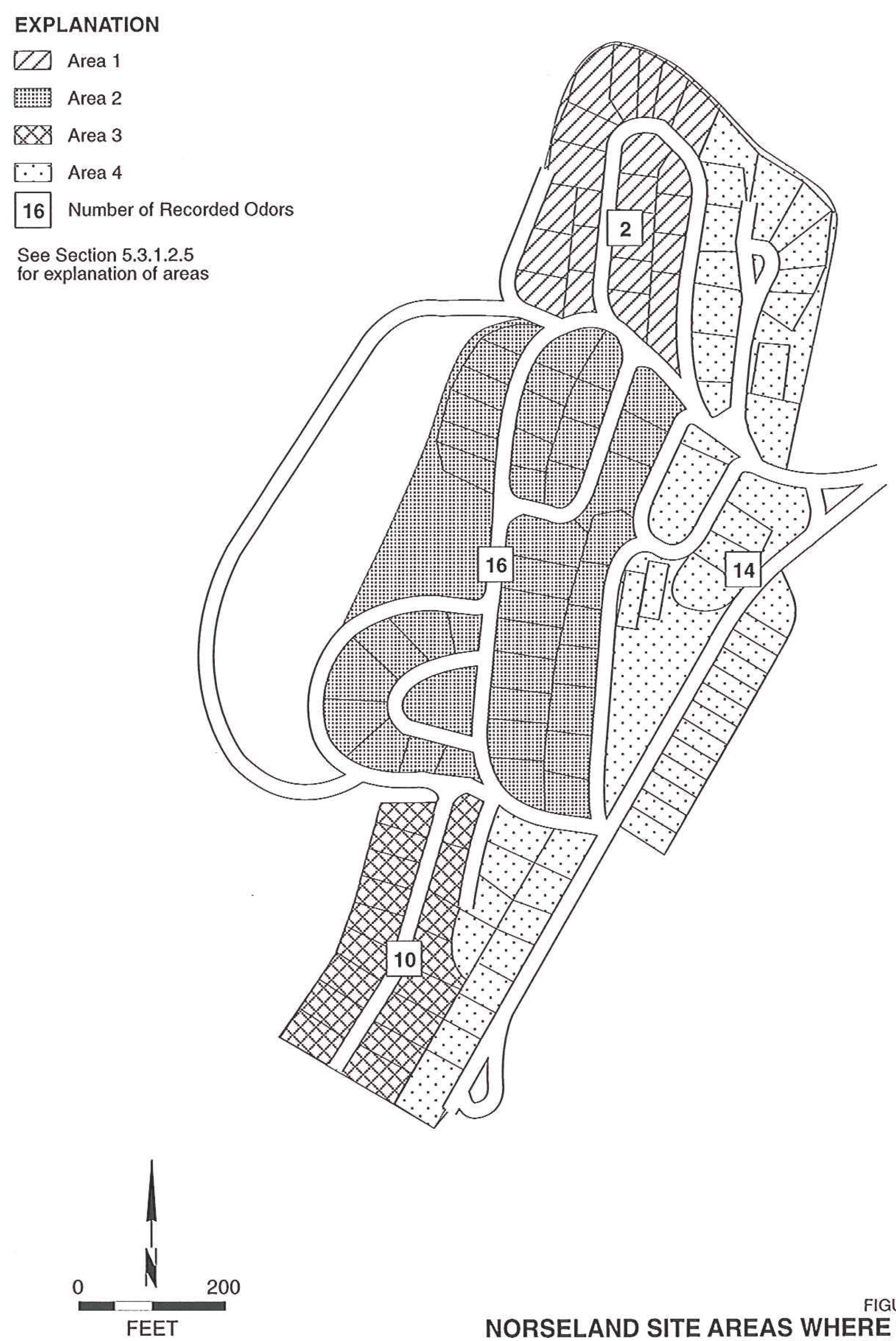


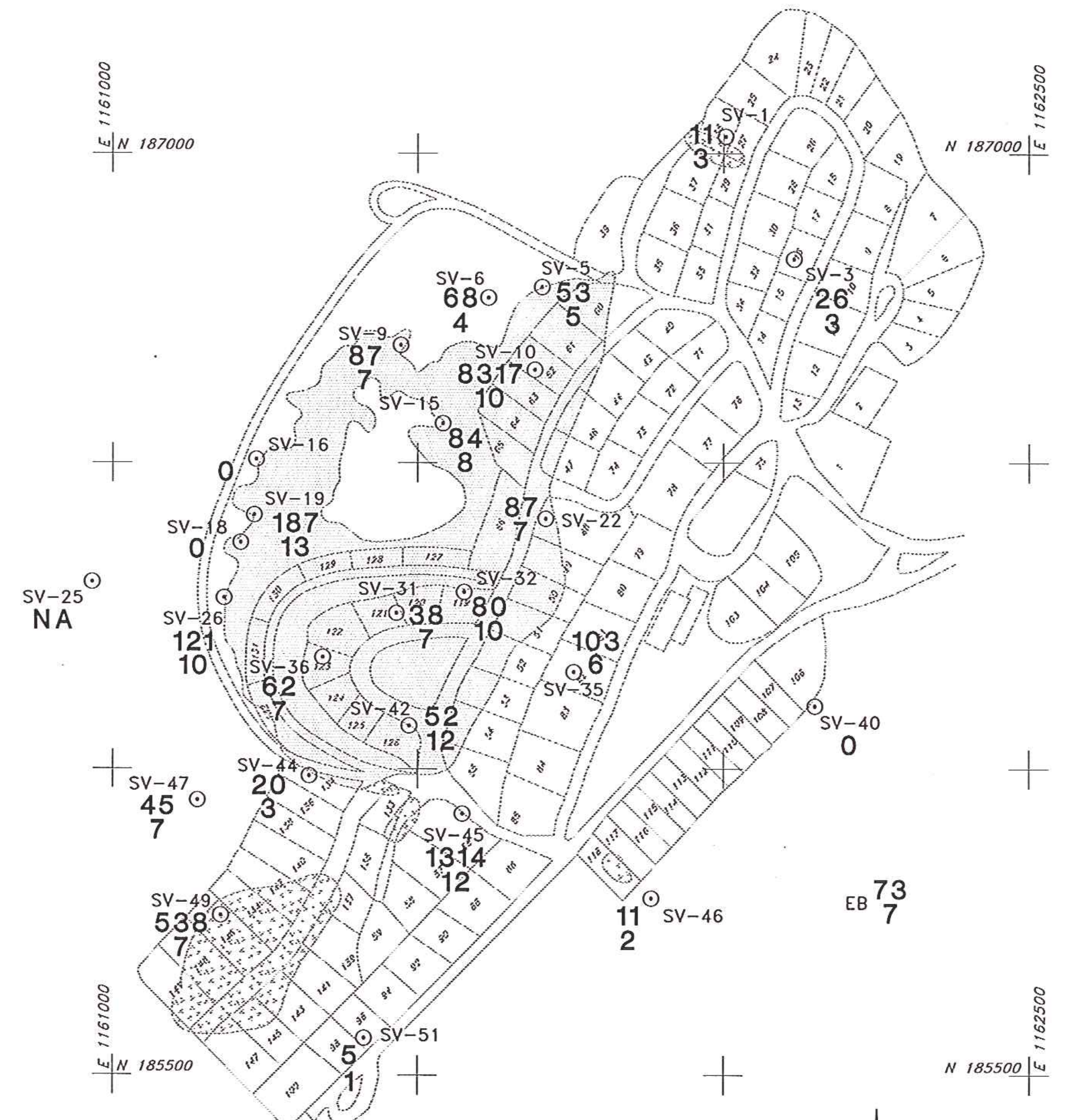
FIGURE **5-3**

NORSELAND SITE AREAS WHERE ODORS WERE OBSERVED BY GOLDER ASSOCIATES

PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 54769 DATE 8/6/96 DRAWN BY EA

Golder Associates



LEGEND

52 ⊙ SV-9 / 6	Soil Vapor Probe With Total VOC Concentration (ppbV) and number of VOCs Detected
(shaded)	Landfill Debris (Based on GPR and EM)
(dotted)	Disturbed Ground with Possible Minor Debris (Based on GPR only)
EB	Equipment Blank

N

0 250 500
FEET

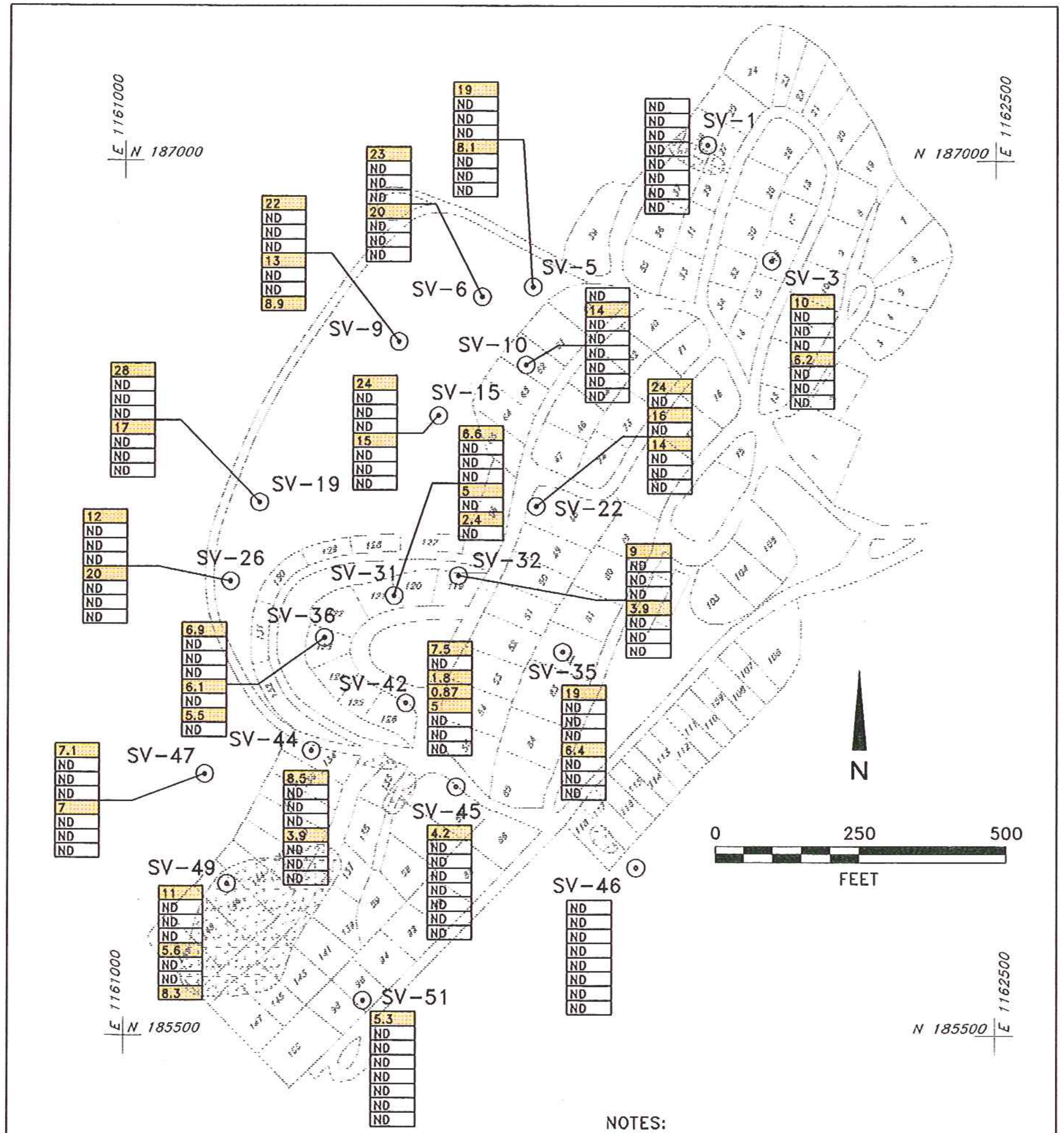
NOTES:

1) Coordinates are Washington State Plane North Zone.
2) Total concentration and number of compounds detected based on the EPA TO-14 analysis. NA – Not analysed.

FIGURE 5-4

INITIAL SOIL GAS STUDY RESULTS
Number of Compounds Detected and Total VOCs

PORT OF BREMERTON/NORSELAND RI-FS/WA



LEGEND

SV-9 ⊙ Soil Vapor Probe (Sampled)

Acetaldehyde (ppbV)
Benzene (ppbV)
Chloroform (ppbV)
Chloromethane (ppbV)
Formaldehyde (ppbV)
TCE (ppbV)
PCE (ppbV)
2-Propenenitrile (ppbV)

Color Indicates Exceedance of the Screening Value

NA = Not Analyzed
ND = Not Detected

NOTES:

1) Coordinates are Washington State Plane North Zone.

2) Results from TO-14 analysis, except for formaldehyde and acetaldehyde, which were analysed by EPA TO-11.

FIGURE **5-5**

INITIAL SOIL GAS STUDY RESULTS
Distribution of Chemicals Exceeding Screening Values
PORT OF BREMERTON/NORSELAND RI-FS/WA

C:\SDSKPROJ\JPM\9331280\2003\65714 8-7-96 10:36 xrf: NONE

Golder Associates

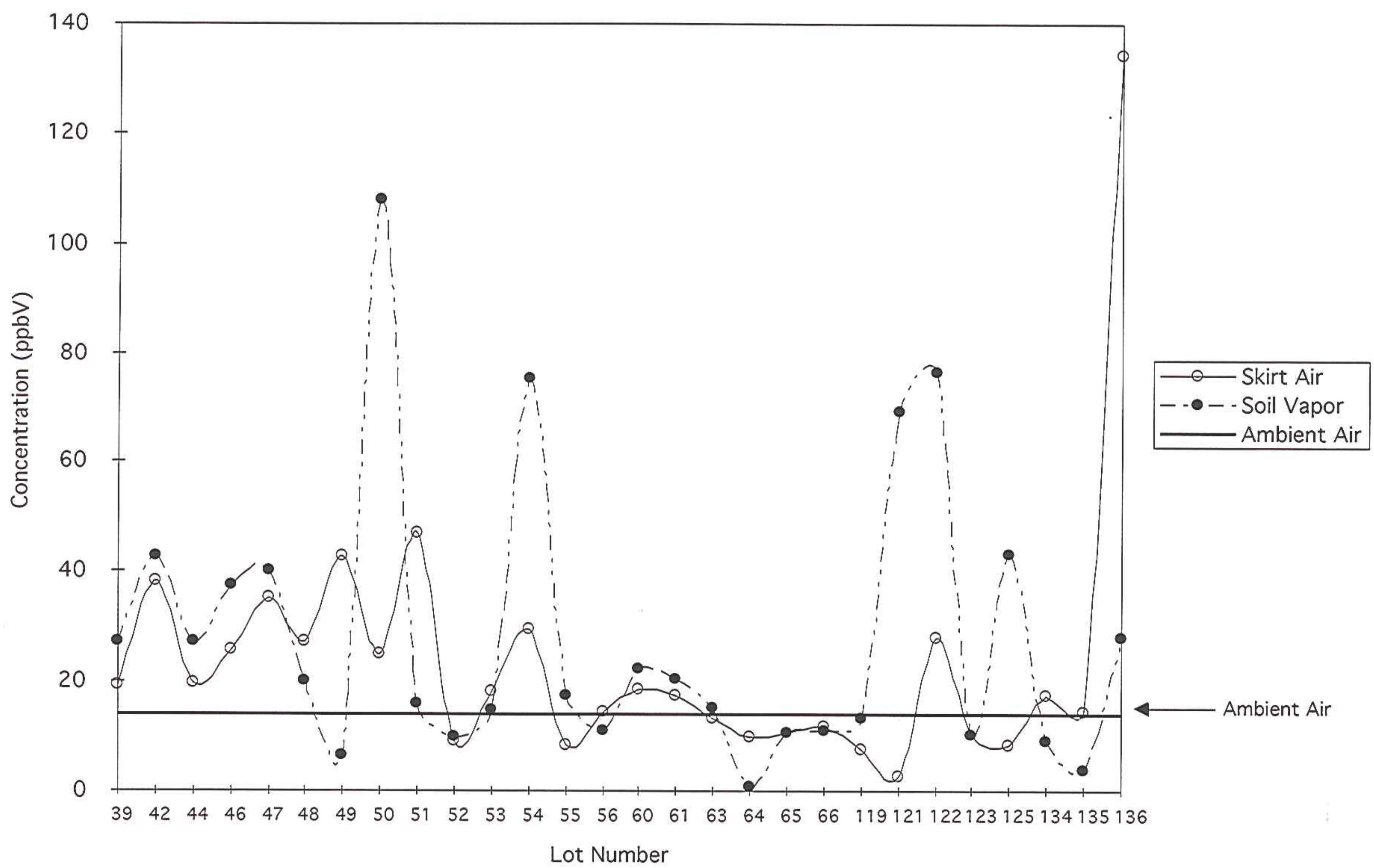
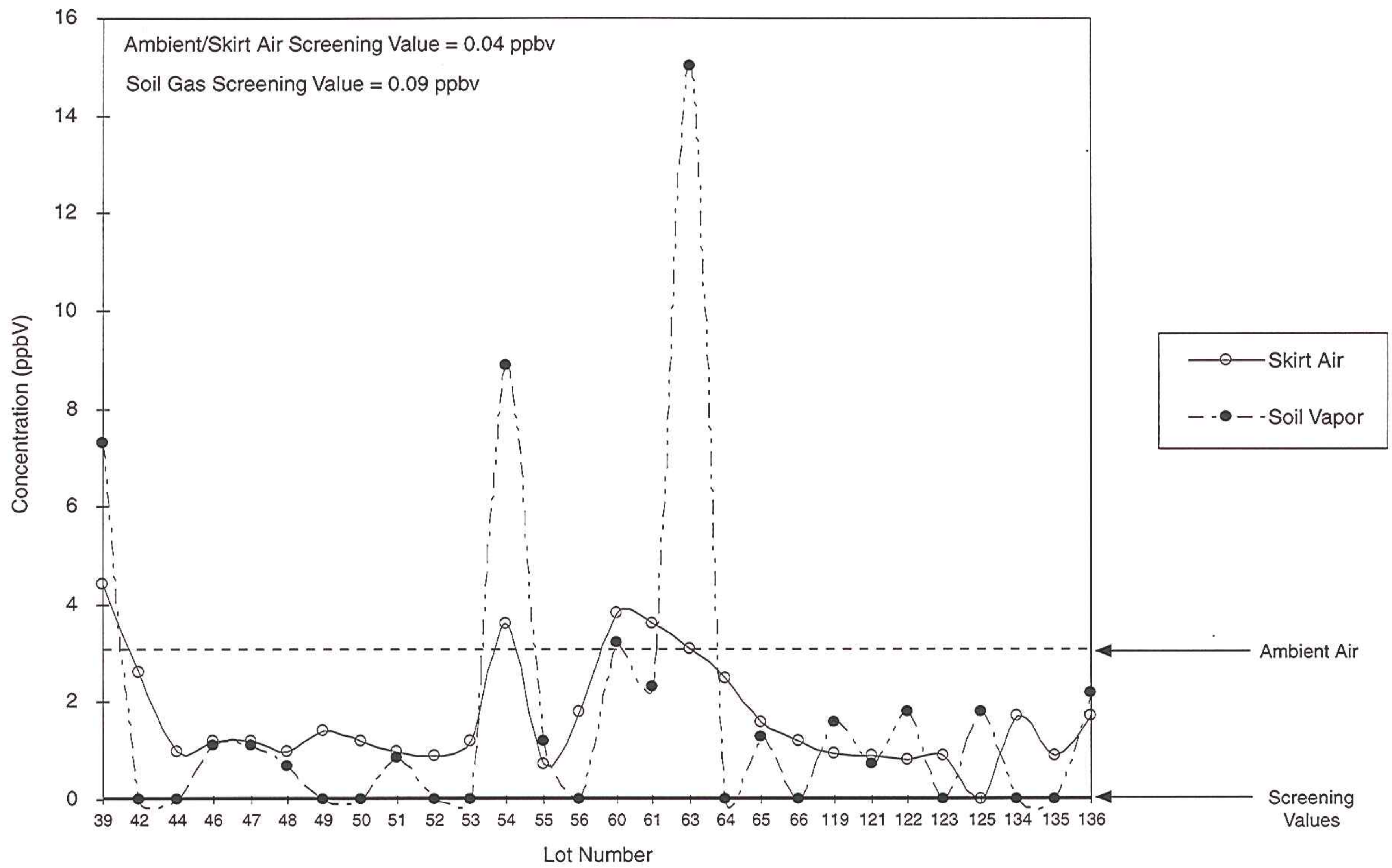


FIGURE **5-6**
SOIL VAPOR AND SKIRT AIR DATA
TOTAL VOLATILE ORGANICS
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 66944 DATE 8/7/96 DRAWN BY EA

Golder Associates

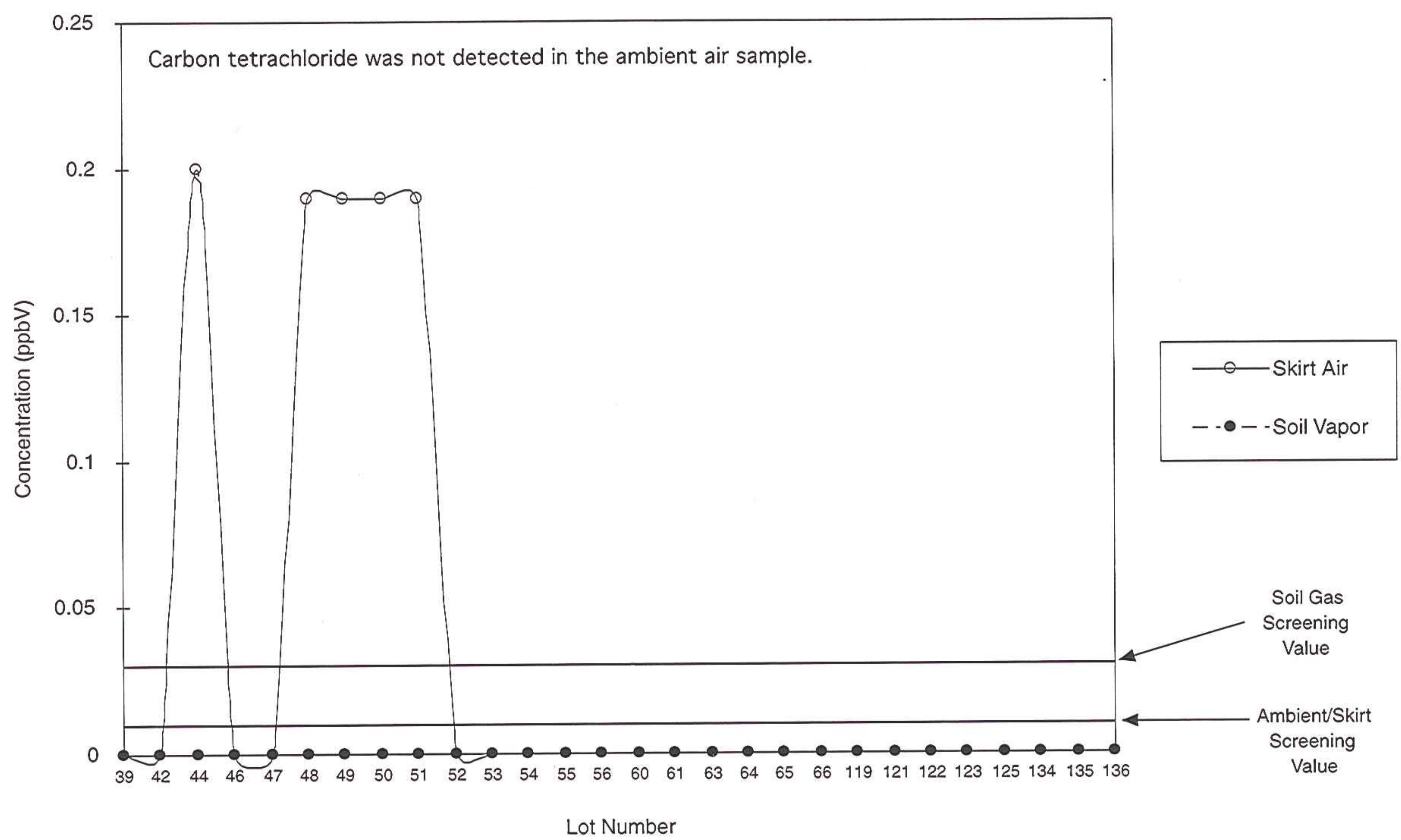


ND plotted as 0. Detection limit was generally about .7 to 1.2 ppb-v.

FIGURE 5-7
SOIL VAPOR AND SKIRT AIR DATA
BENZENE
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 54789 DATE 10/15/96 DRAWN BY CB

Golder Associates

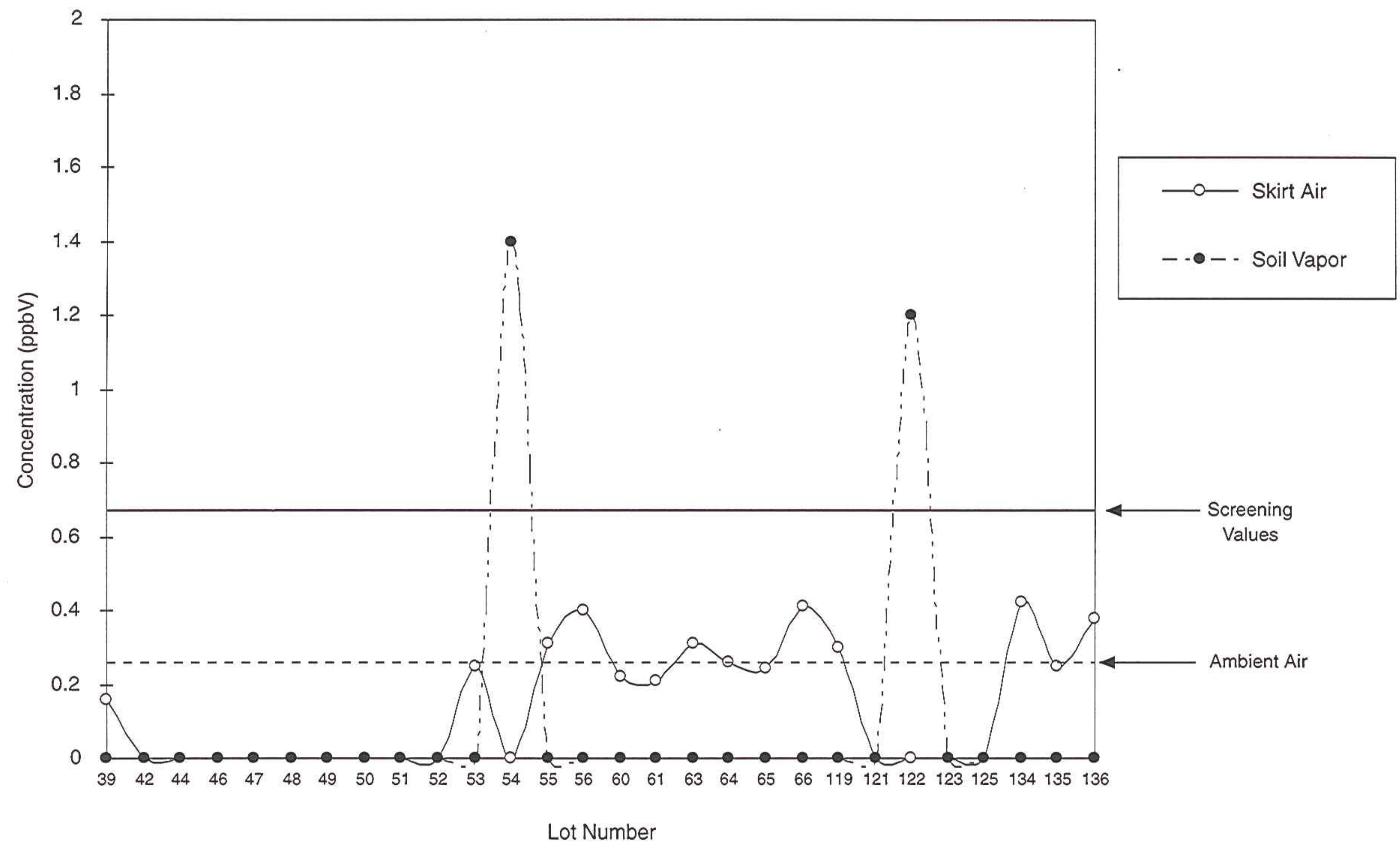


ND plotted as 0. Detection limit was generally about .15 to 1.2 ppb-v.

FIGURE **5-8**
SOIL VAPOR AND SKIRT AIR DATA
CARBON TETRACHLORIDE
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 66942 DATE 10/15/96 DRAWN BY CB

Golder Associates

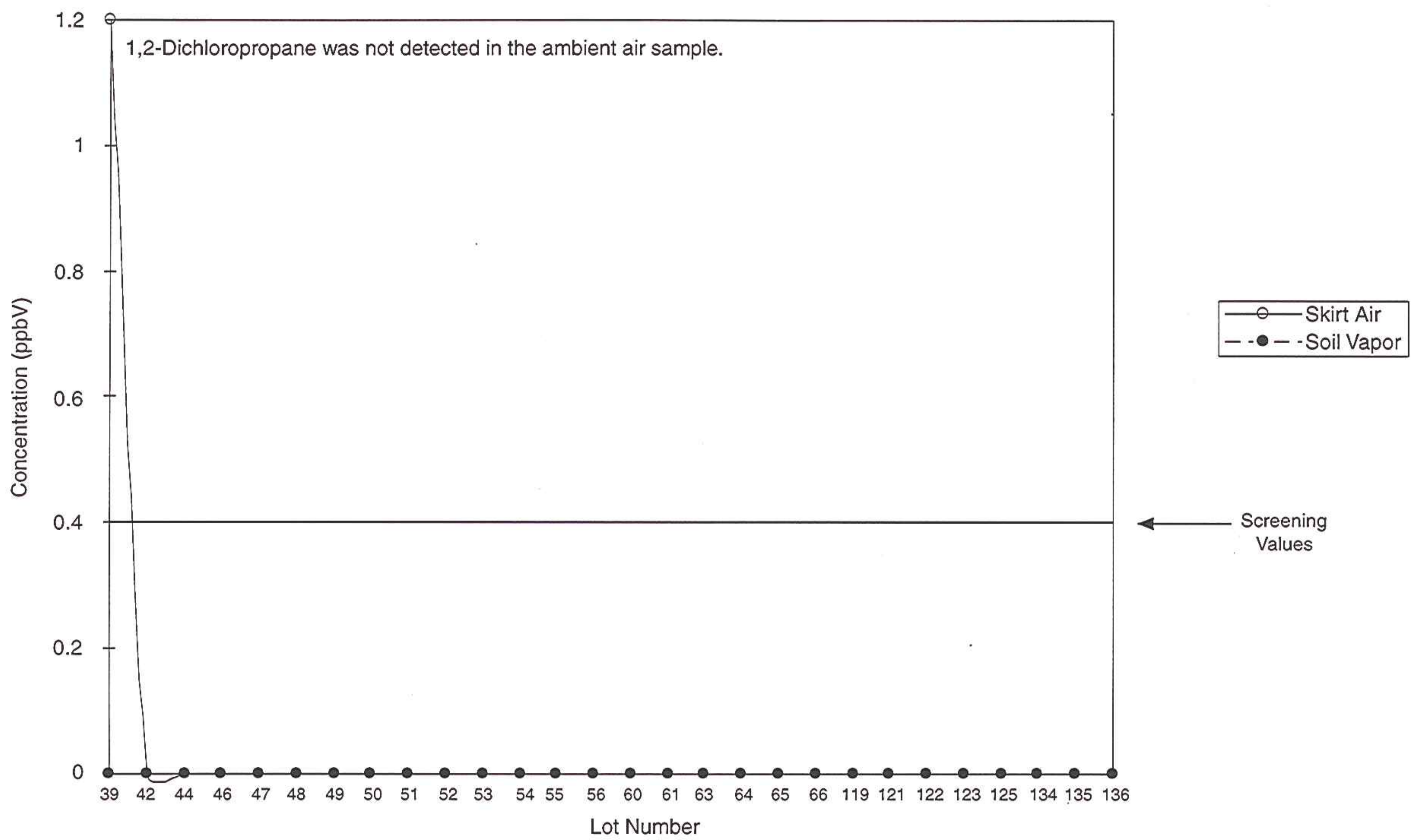


ND plotted as 0. Detection limit was generally about .15 to 1.2 ppb-v.

FIGURE **5-9**
SOIL VAPOR AND SKIRT AIR DATA
CHLOROMETHANE
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 54792 DATE 10/15/96 DRAWN BY CB

Golder Associates

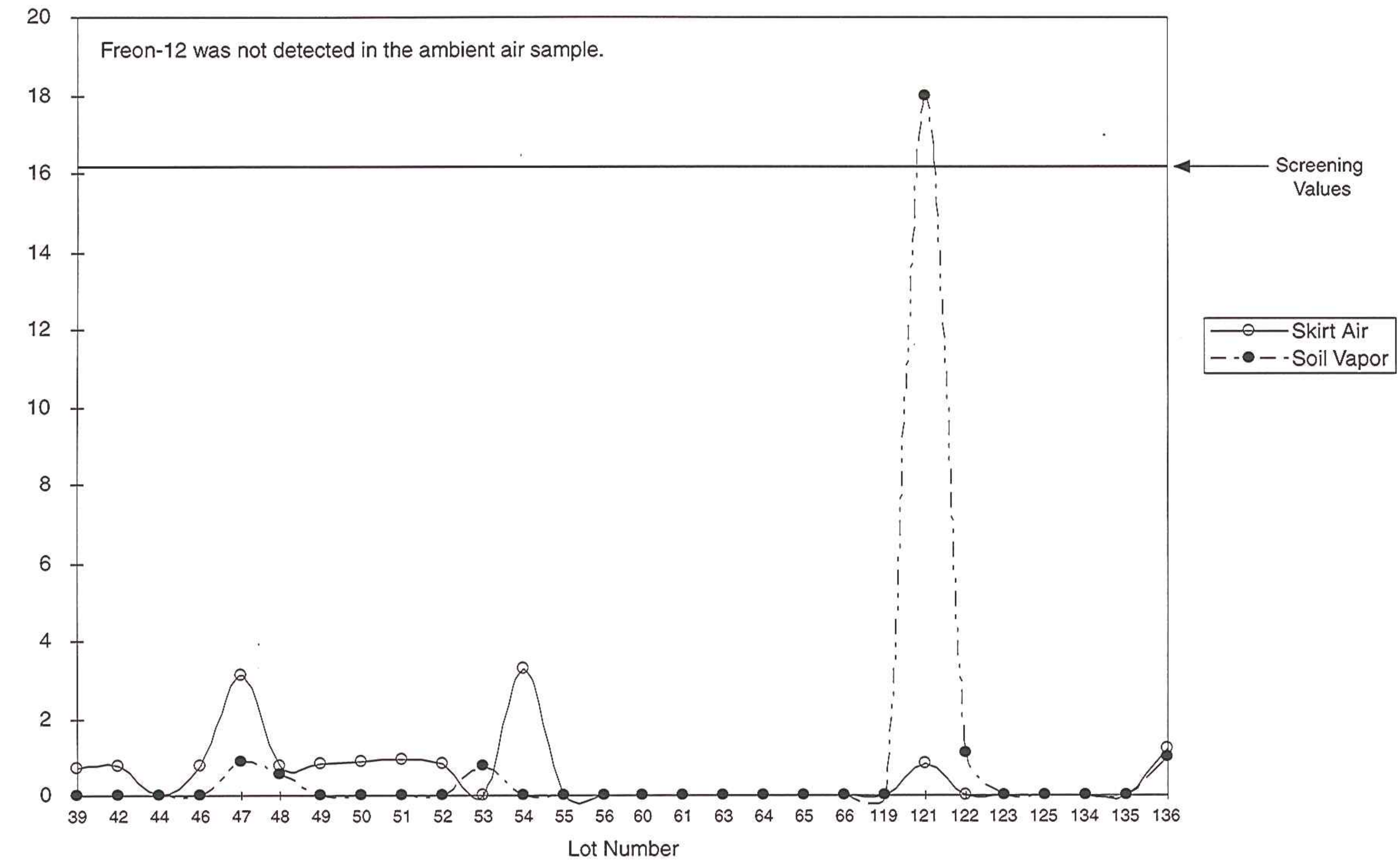


ND plotted as 0. Detection limit was generally about .15 to 1.2 ppb-v.

FIGURE **5-10**
SOIL VAPOR AND SKIRT AIR DATA
1,2-DICHLOROPROPANE
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 66943 DATE 10/15/96 DRAWN BY CB

Golder Associates



ND plotted as 0. Detection limit was generally about .7 to 1.2 ppb-v.

FIGURE **5-11**

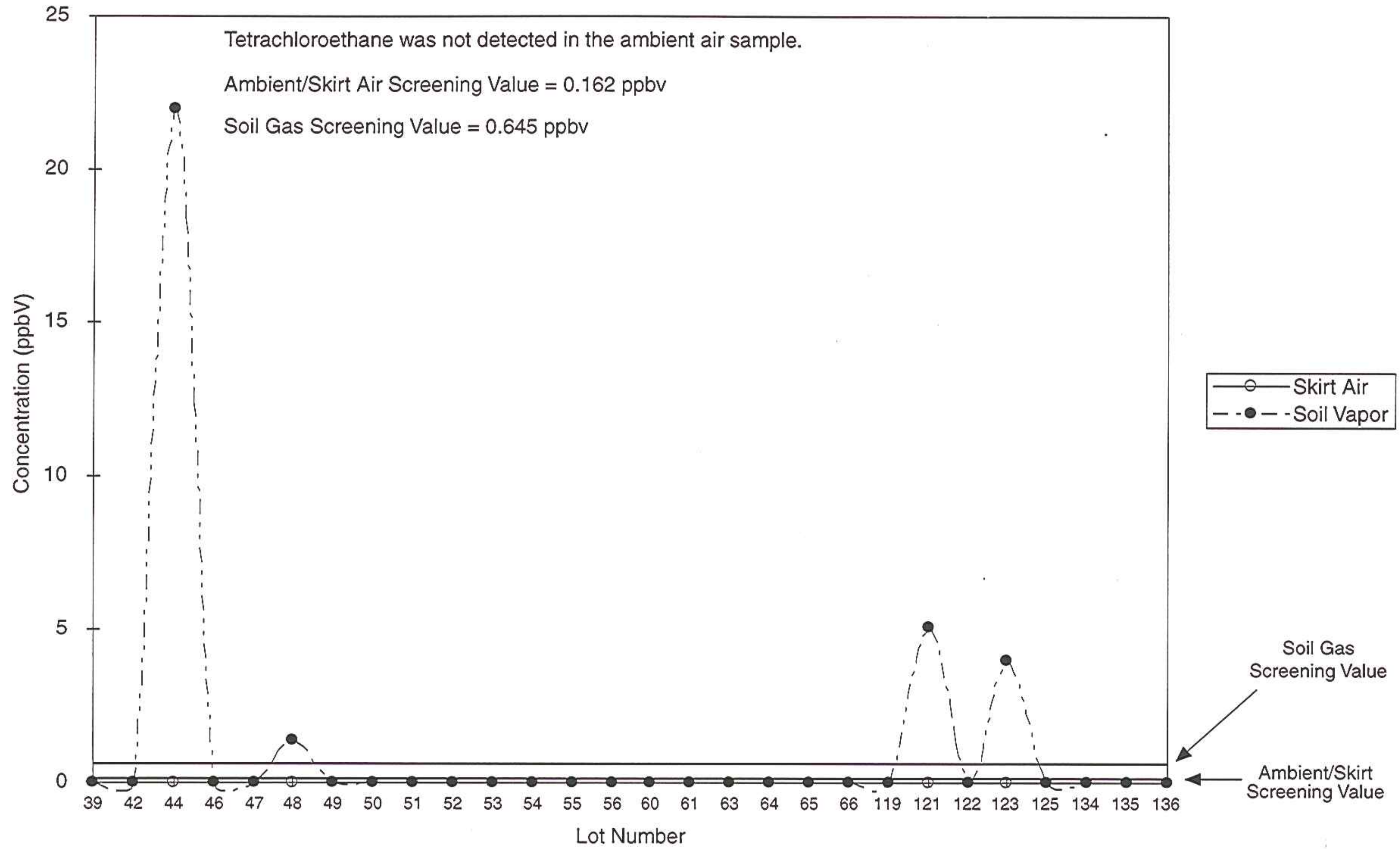
SOIL VAPOR AND SKIRT AIR DATA

FREON 12

PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 54793 DATE 10/15/96 DRAWN BY CB

Golder Associates

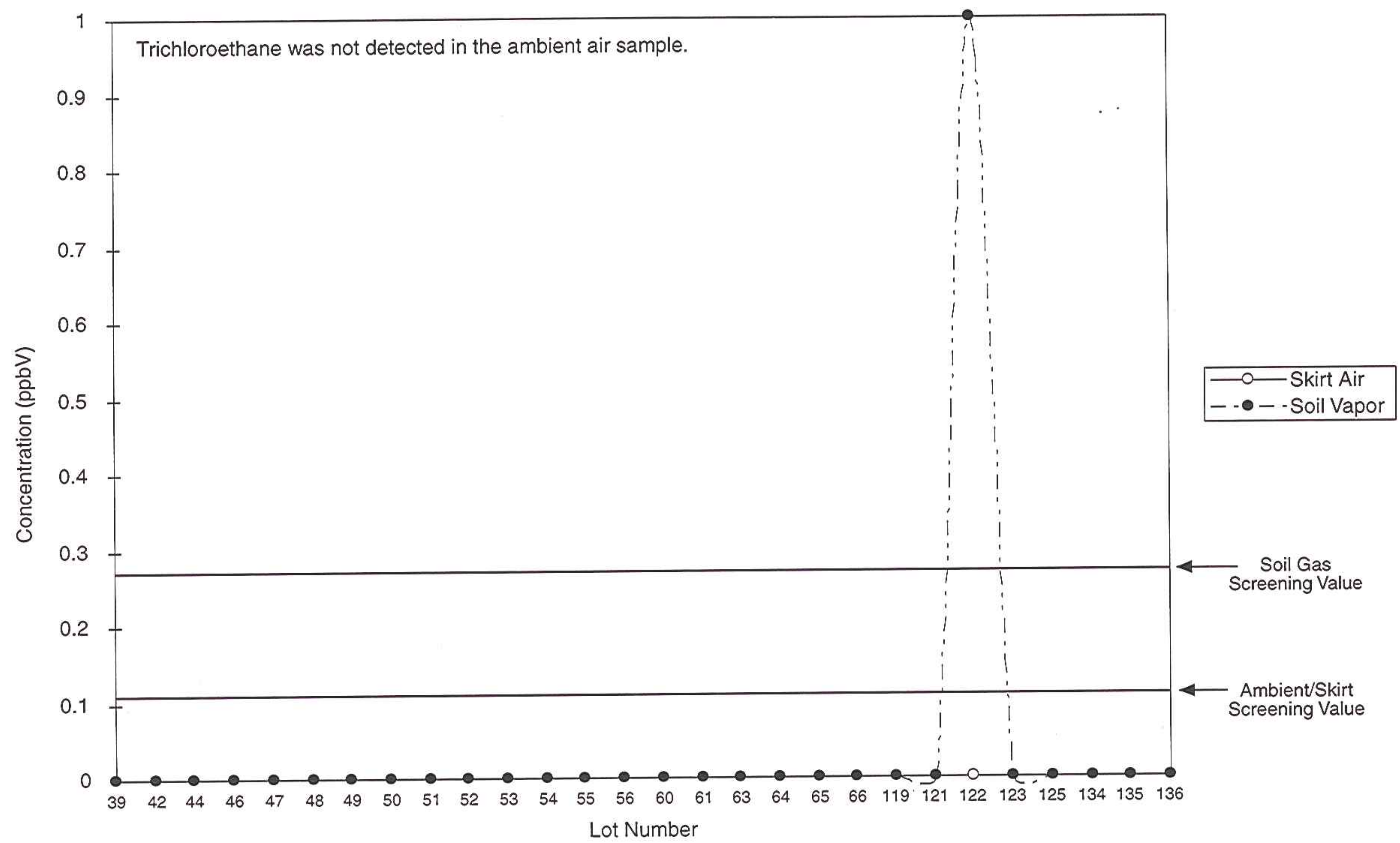


ND plotted as 0. Detection limit was generally about .15 to 1.2 ppb-v.

FIGURE **5-12**
SOIL VAPOR AND SKIRT AIR DATA
TETRACHLOROETHENE
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 54794 DATE 10/16/96 DRAWN BY CB

Golder Associates



ND plotted as 0. Detection limit was generally about .15 to 1.2 ppb-v.

FIGURE **5-13**

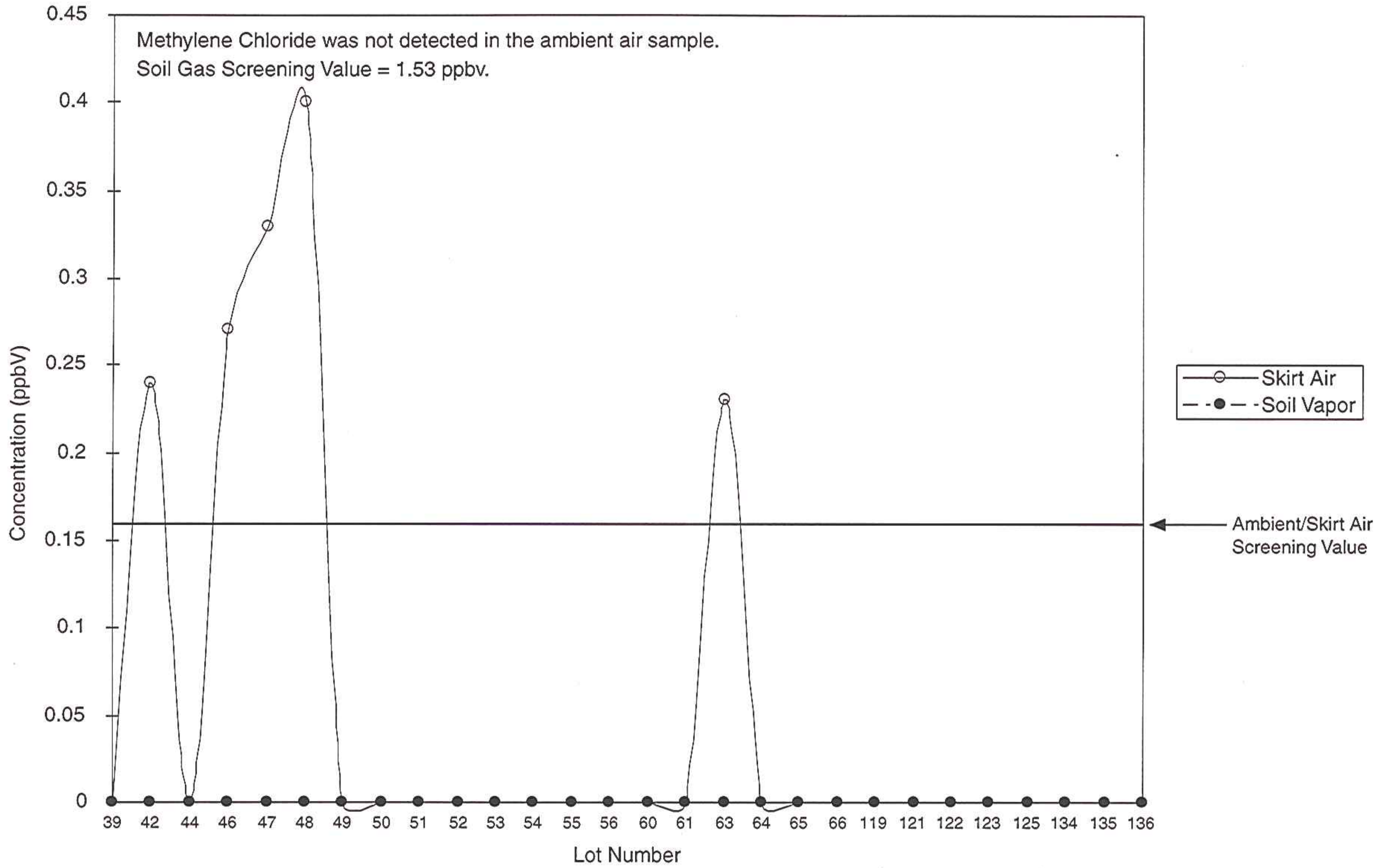
SOIL VAPOR AND SKIRT AIR DATA

TRICHLOROETHENE

PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 54795 DATE 10/16/96 DRAWN BY CB

Golder Associates

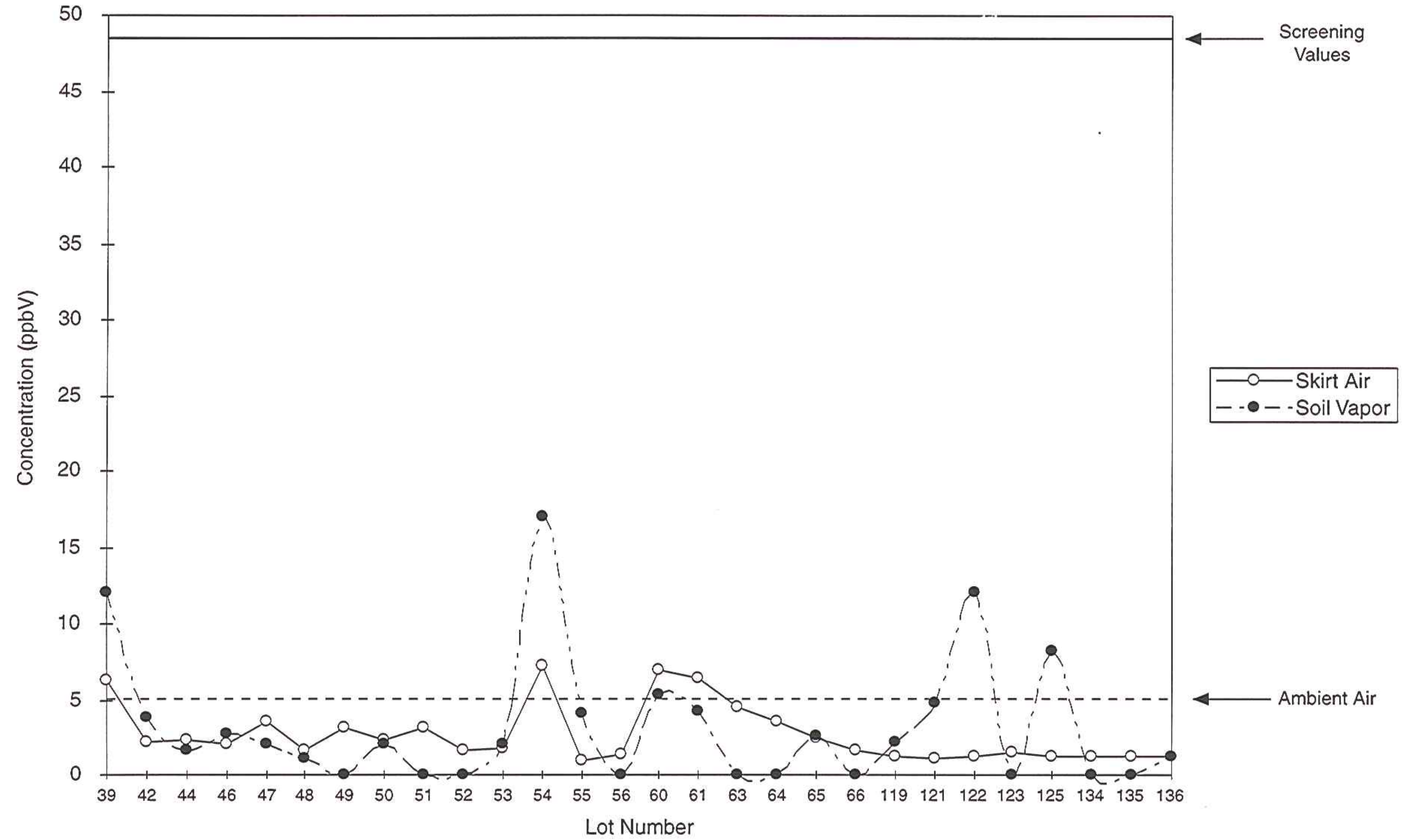


ND plotted as 0. Detection limit was generally about .7 to 1.2 ppb-v.

FIGURE **5-14**
SOIL VAPOR AND SKIRT AIR DATA
METHYLENE CHLORIDE
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 67676 DATE 10/16/96 DRAWN BY CB

Golder Associates



ND plotted as 0. Detection limit was generally about .7 to 1.2 ppb-v.

FIGURE **5-15**

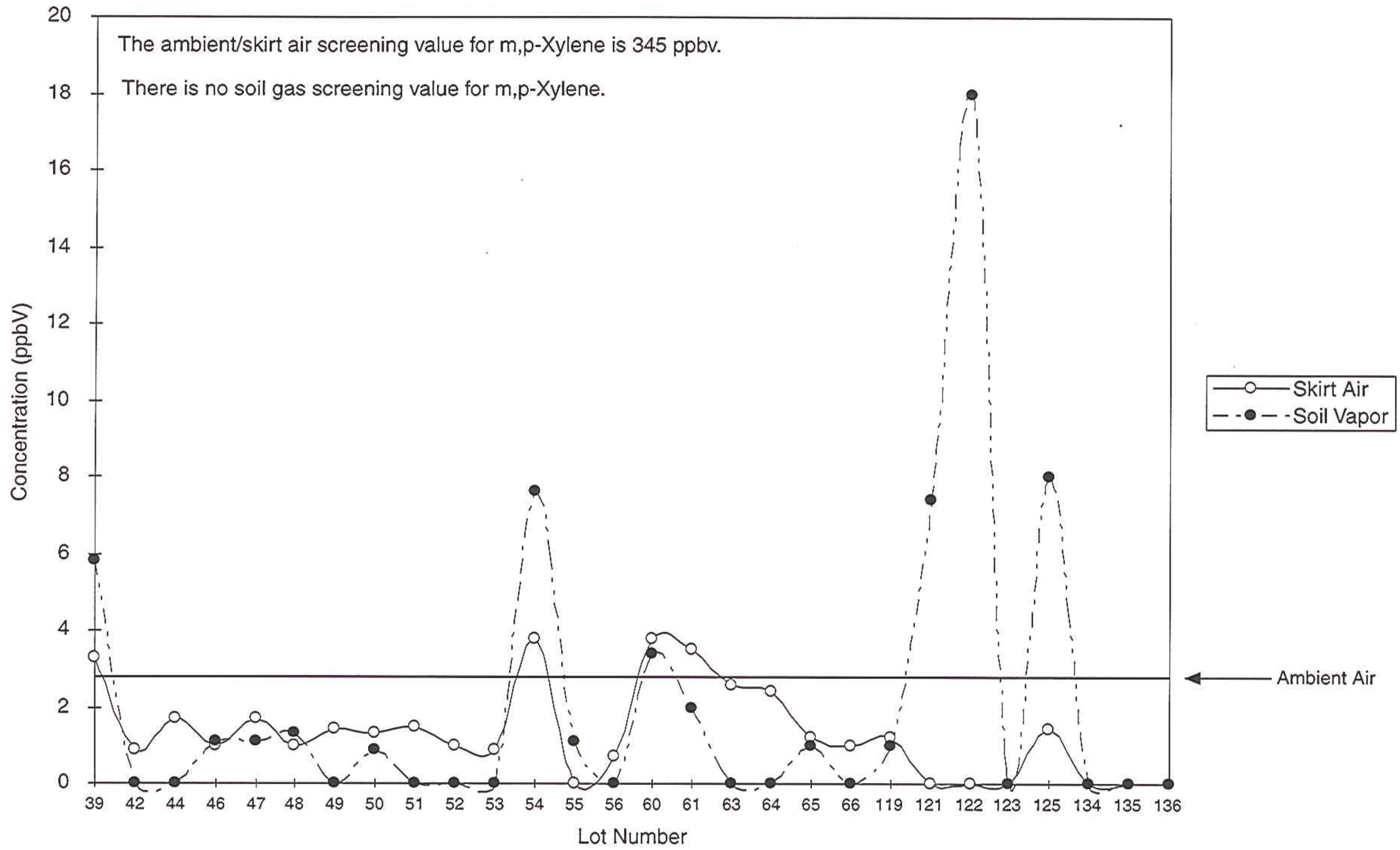
SOIL VAPOR AND SKIRT AIR DATA

TOLUENE

PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 54790 DATE 10/16/96 DRAWN BY CB

Golder Associates



ND plotted as 0. Detection limit was generally about .7 to 1.2 ppb-v.

FIGURE **5-16**
SOIL VAPOR AND SKIRT AIR DATA
m,p-XYLENE
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 54791 DATE 10/16/96 DRAWN BY CB

Golder Associates

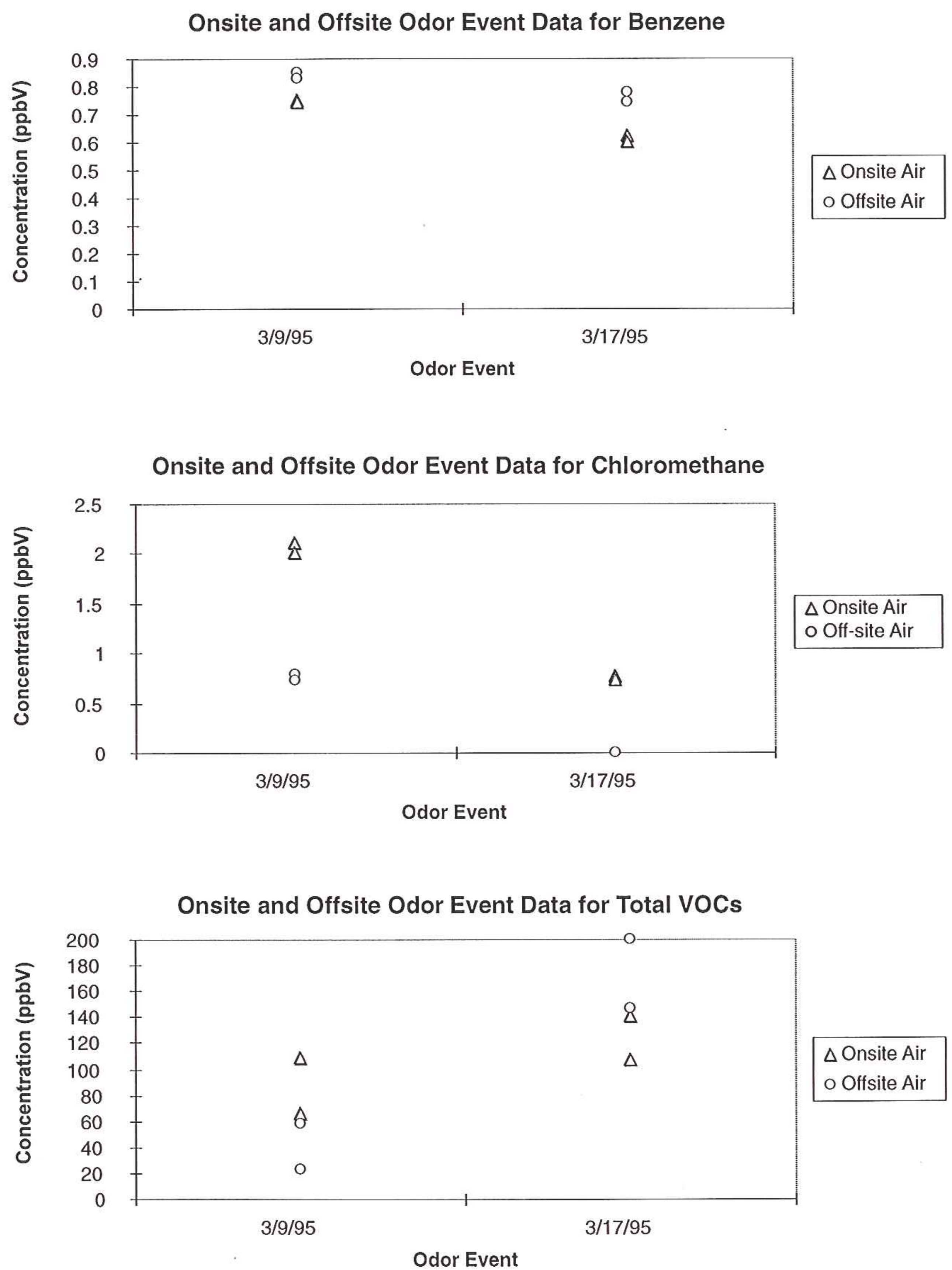


FIGURE **5-17**
ODOR EVENT DATA
PORT OF BREMERTON/NORSELAND RI-FS/WA

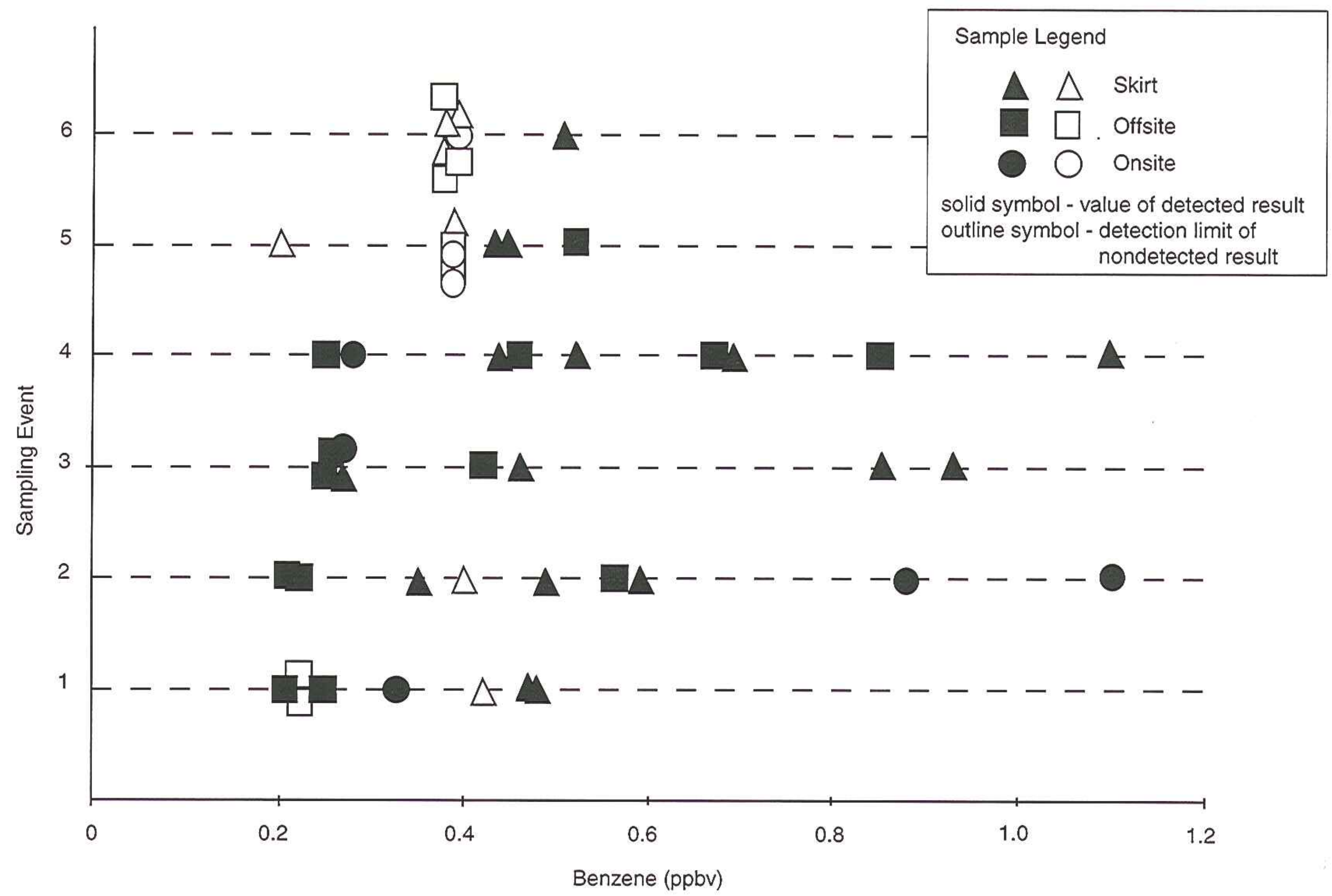


FIGURE **5-18**
BENZENE CONCENTRATION (ppbv) IN SKIRT, OFFSITE AND ONSITE AIR SAMPLES
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 54802 DATE 10/15/96 DRAWN BY TB

Golder Associates

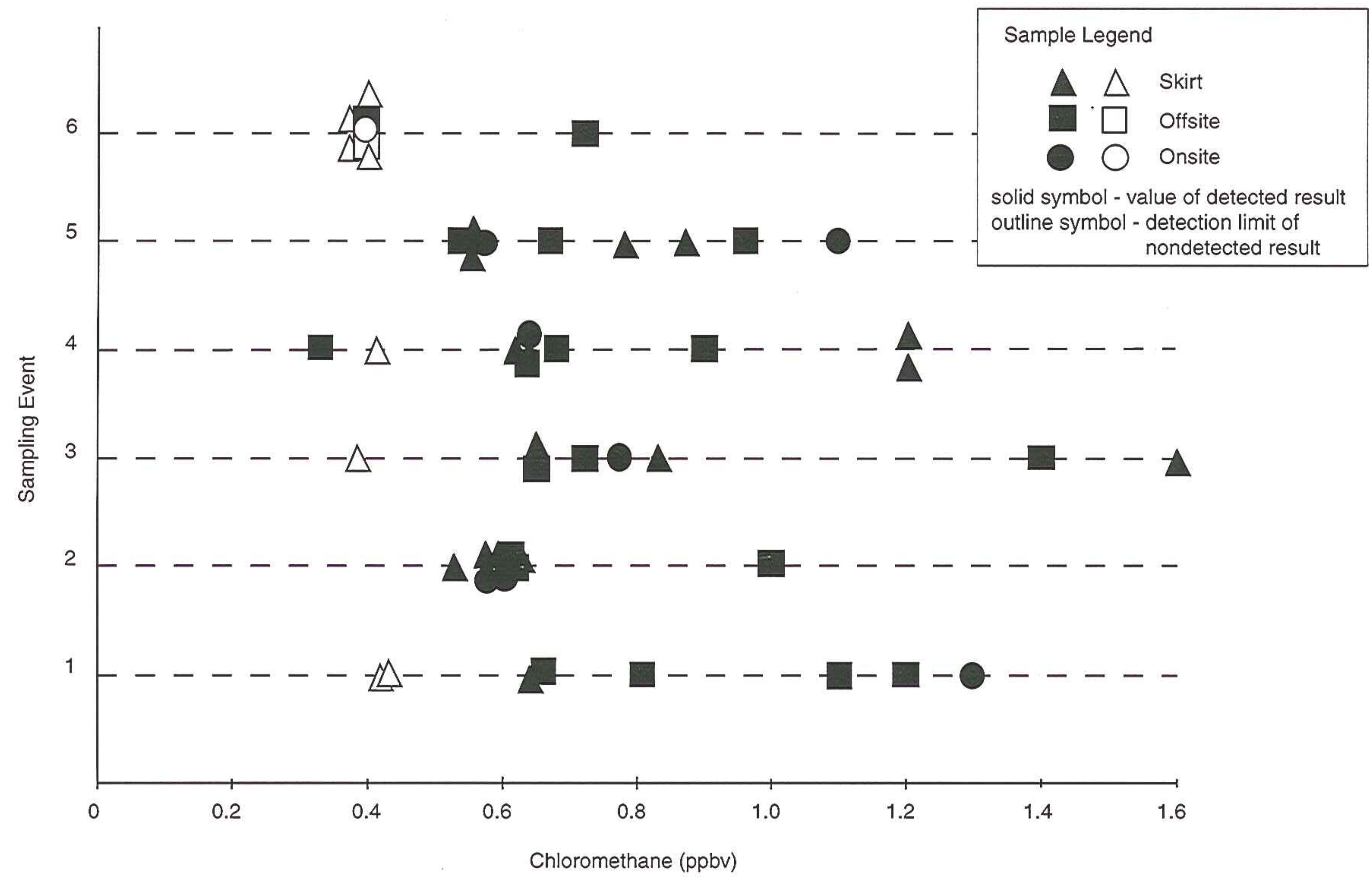


FIGURE **5-19**
CHLOROMETHANE CONCENTRATION (ppbv) IN SKIRT, OFFSITE AND ONSITE AIR SAMPLES
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 54803 DATE 10/15/96 DRAWN BY TB

Golder Associates

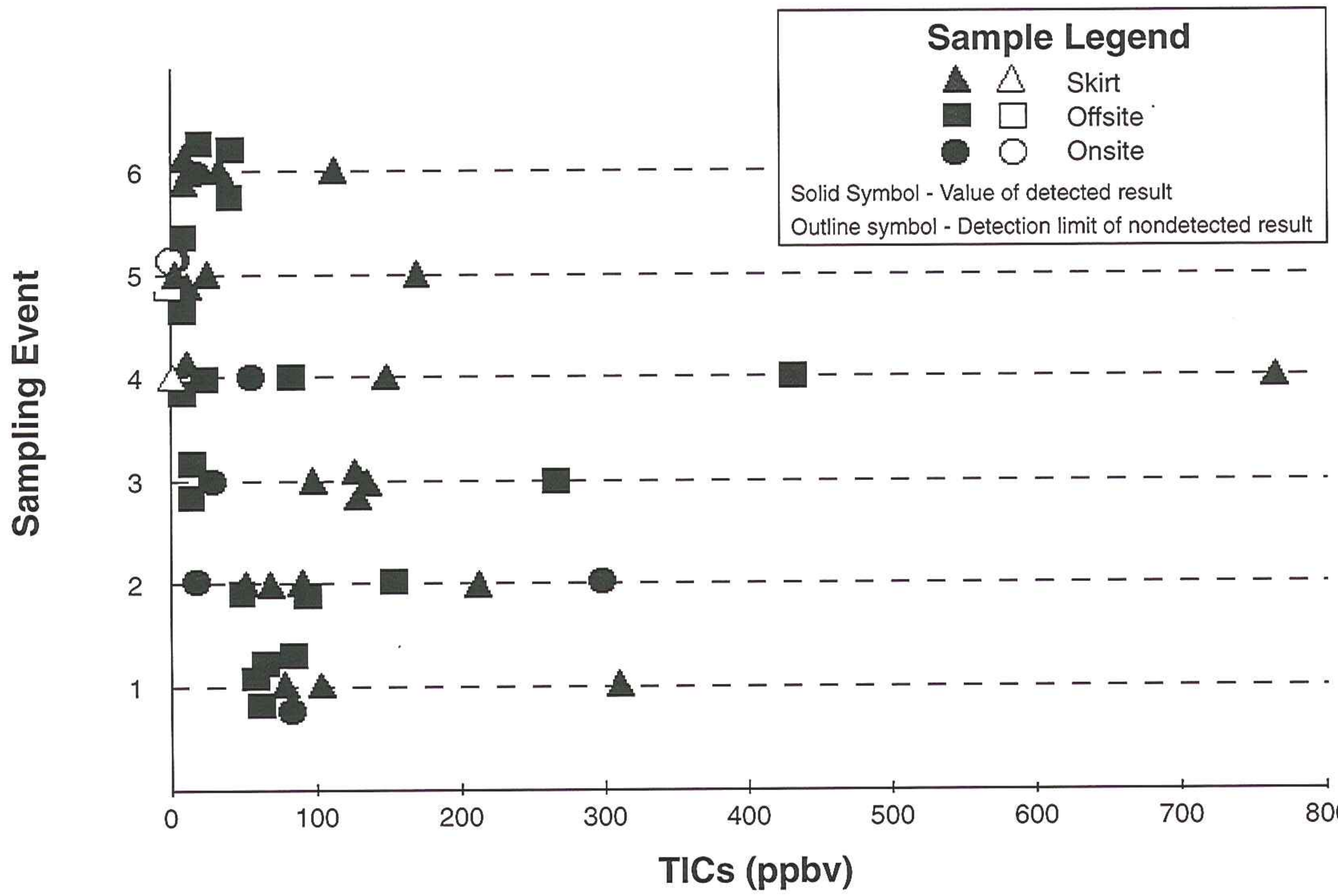


FIGURE **5-20**
TIC CONCENTRATIONS (ppb-v) IN SKIRT, OFFSITE AND ONSITE AIR SAMPLES

PROJECT NO. 933-1280.2003 DRAWING NO. 67052 DATE 10/15/96 DRAWN BY TK

Golder Associates

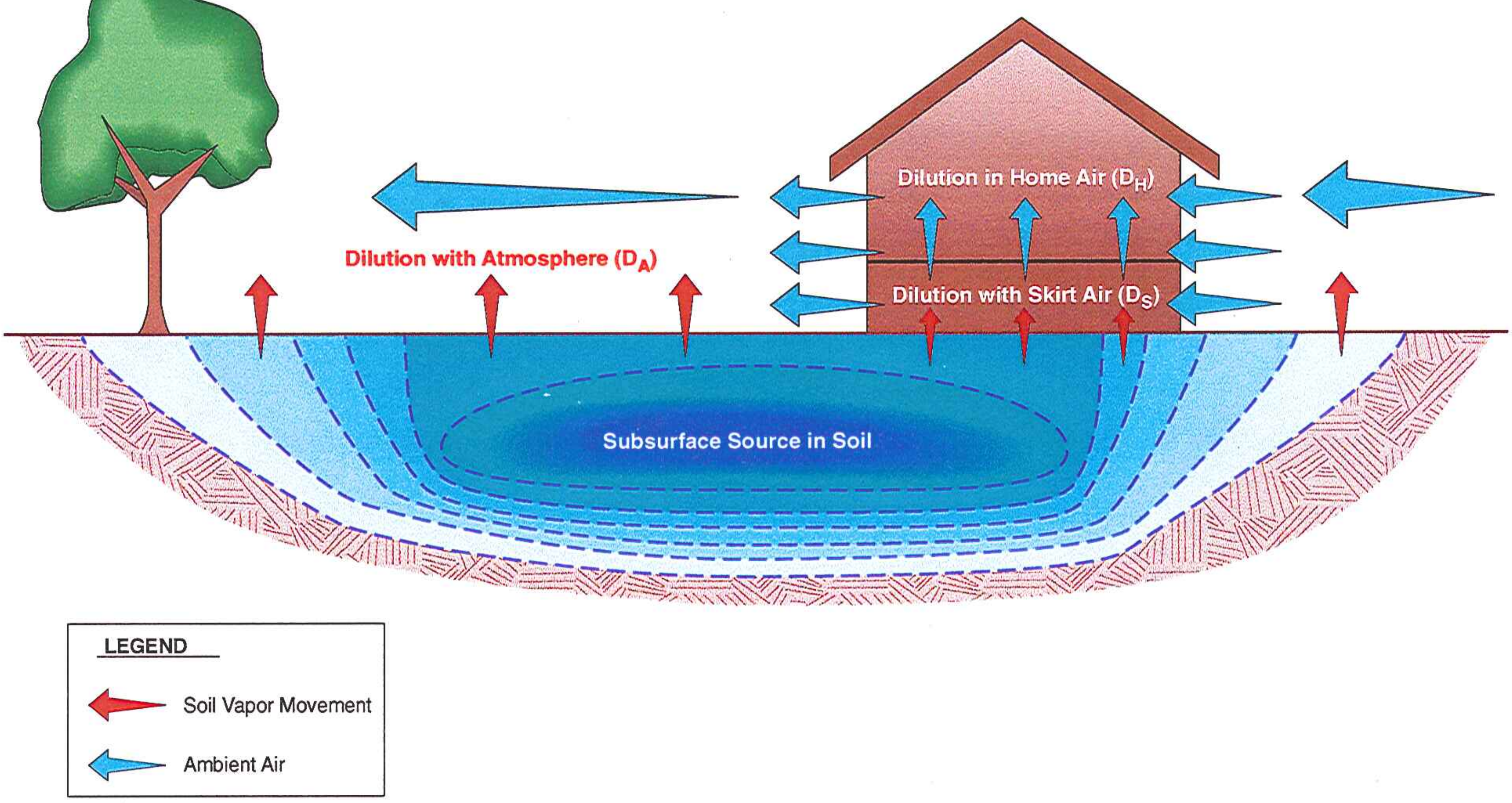
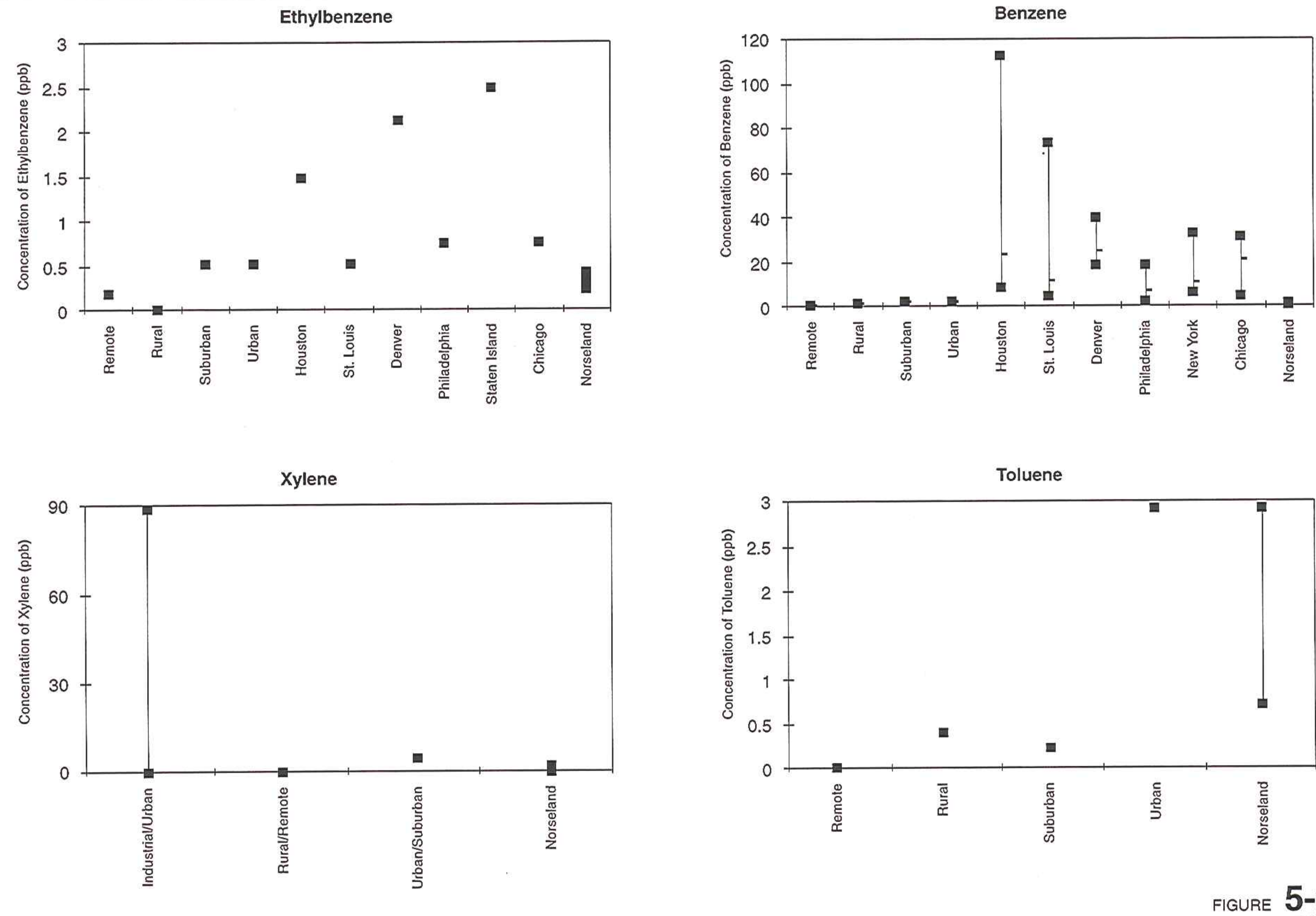


FIGURE **5-21**
CONCEPTUAL MODEL OF SUBSURFACE SOIL VAPOR TRANSPORT TO BREATHABLE AIR
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 67054 DATE 10/16/96 DRAWN BY TK

Golder Associates

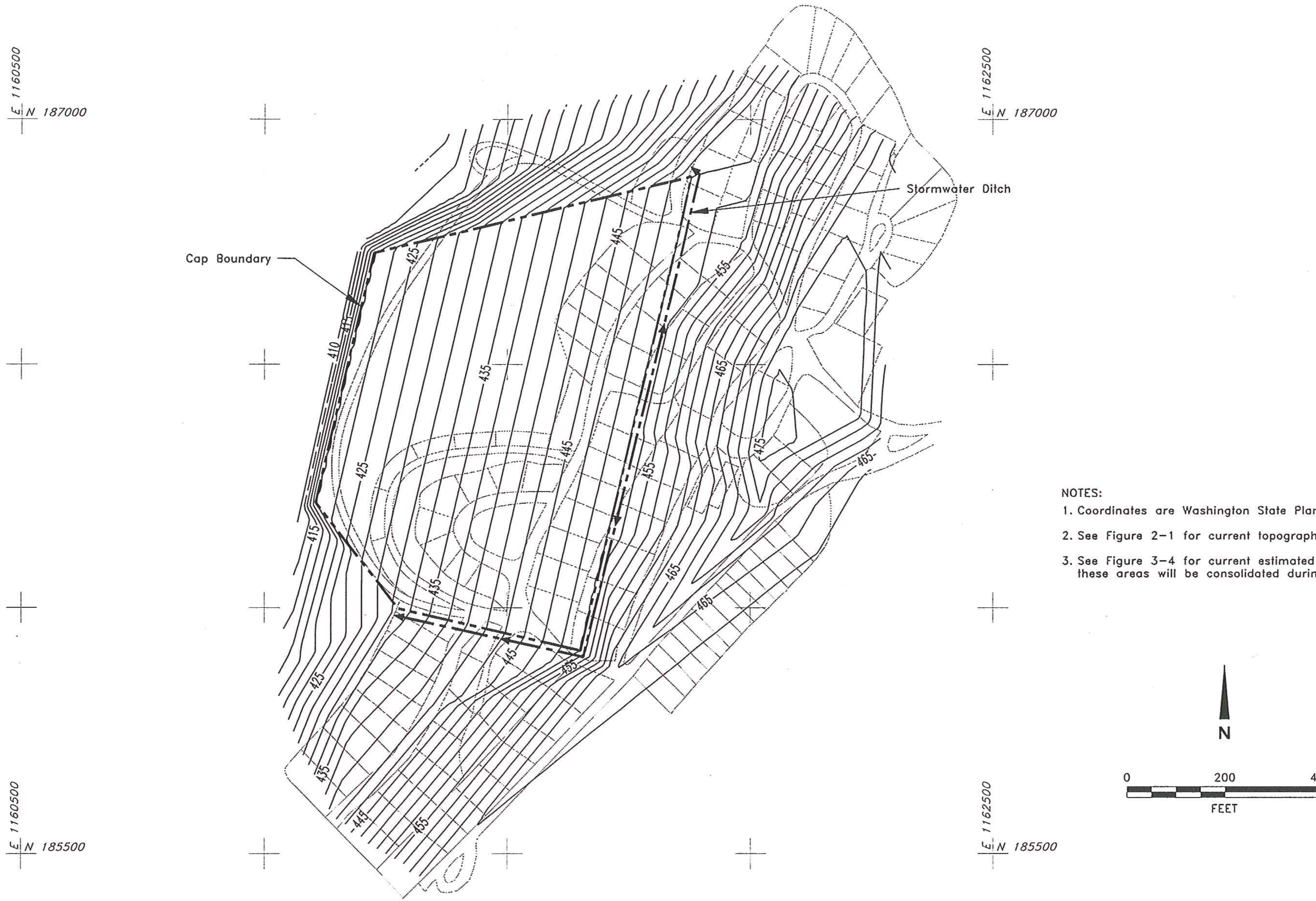


See Section 5.4.3.2 for explanation of data

FIGURE **5-22**
BTEX CONCENTRATIONS
TYPICAL AMBIENT AIR VS. NORSELAND
PORT OF BREMERTON/NORSELAND RI-FS/WA

PROJECT NO. 933 1280.2003 DRAWING NO. 67055 DATE 10/16/96 DRAWN BY TK

Golder Associates



NOTES:

1. Coordinates are Washington State Plane North Zone.
2. See Figure 2-1 for current topography.
3. See Figure 3-4 for current estimated waste areas; these areas will be consolidated during grading.

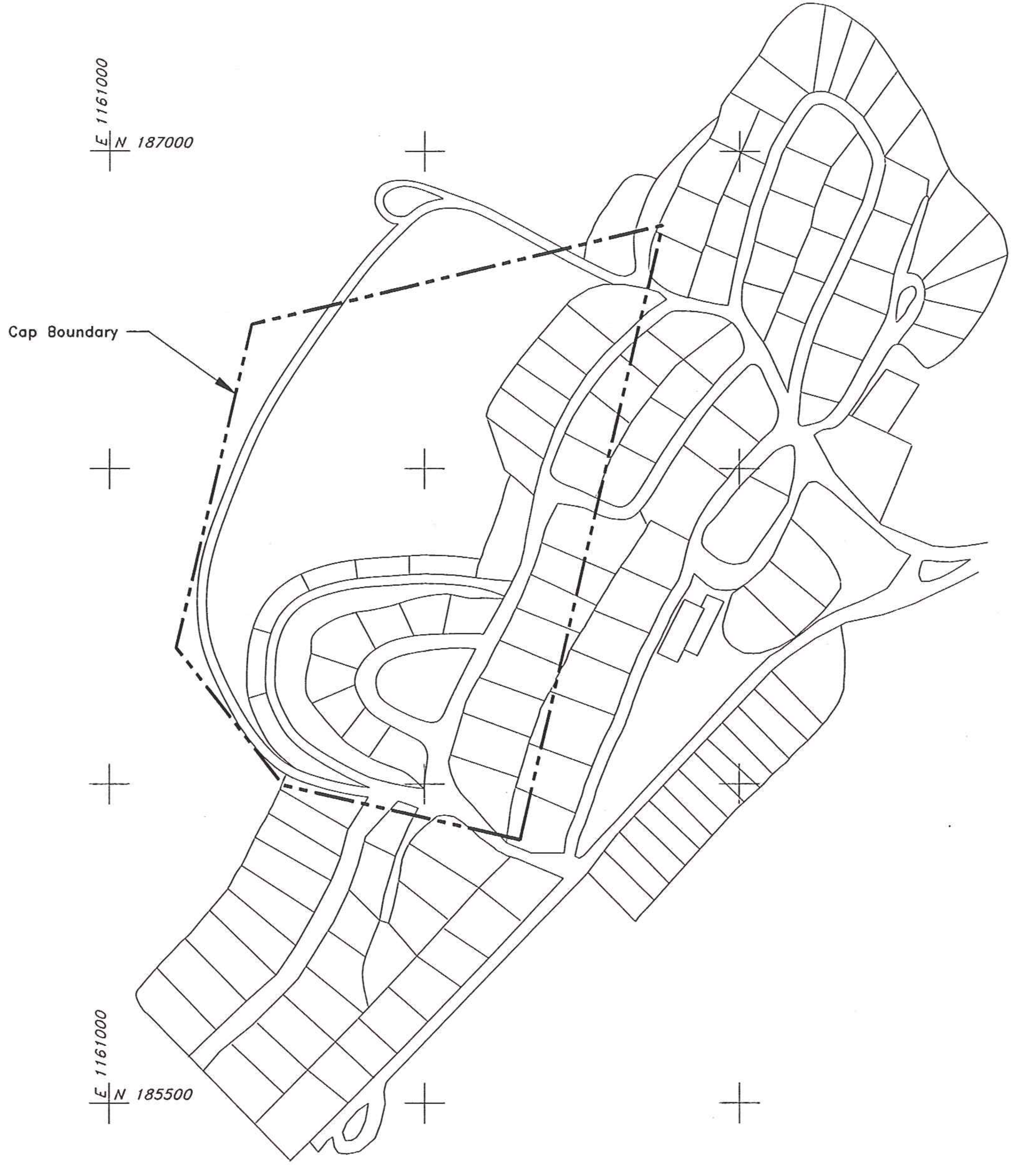
FIGURE **7-1**

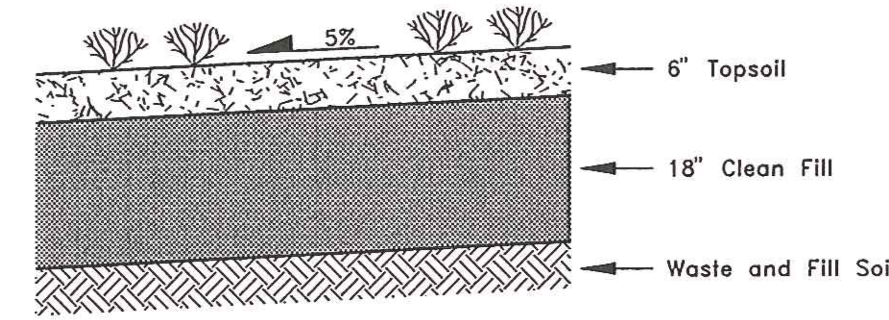
CONCEPTUAL CAP GRADING AND LAYOUT

PORT OF BREMERTON/NORSELAND RI-FS/WA

C:\DJH\9331280\2003\63520 10-19-95 14:58 xrf: NONE

Golder Associates





CAP CROSS-SECTION

NOT TO SCALE

NOTES:

1. Coordinates are Washington State Plane North Zone.
2. See Figure 7-1 for conceptual grading plan.

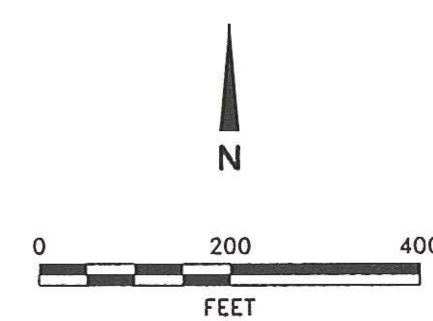


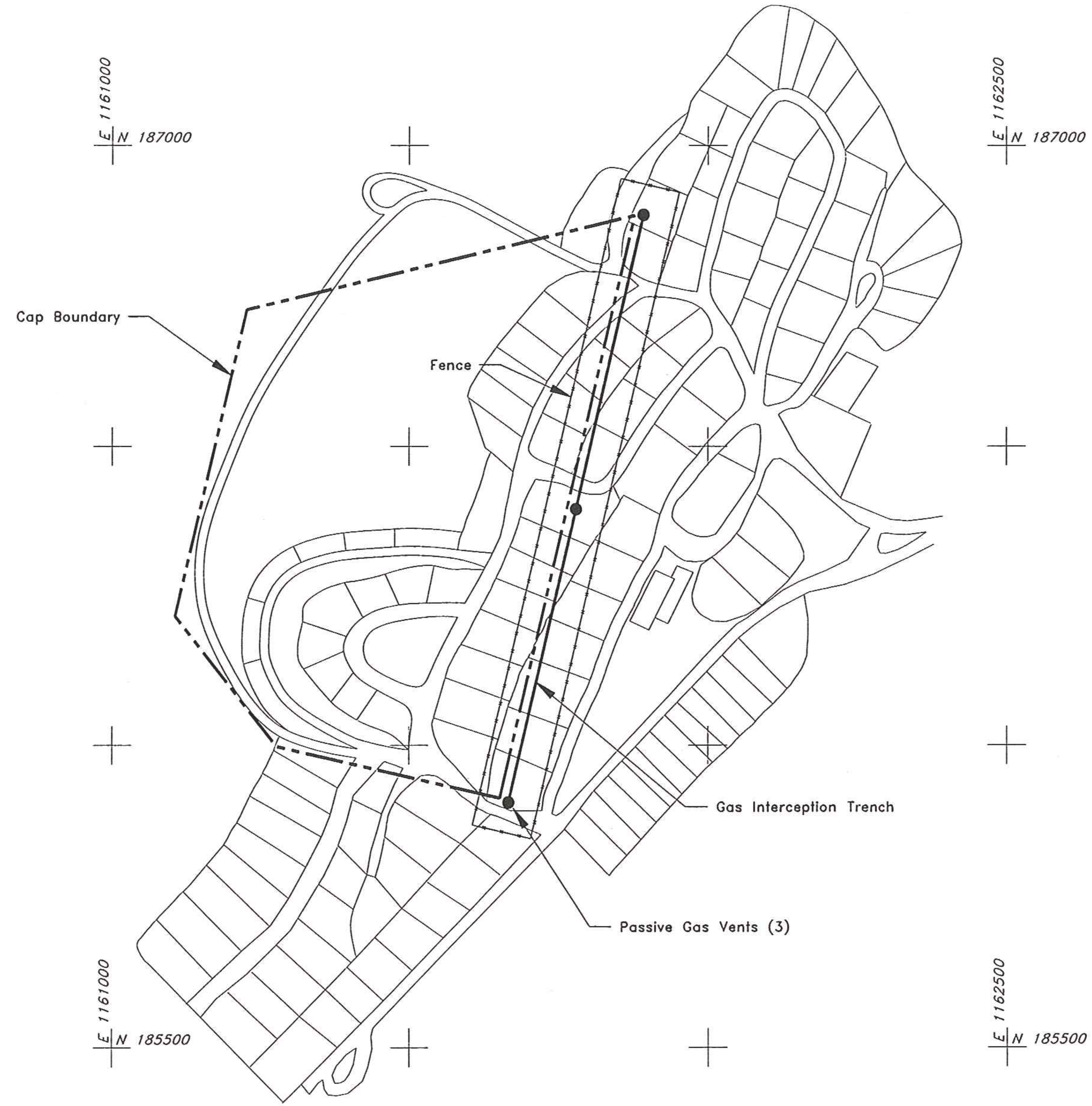
FIGURE **7-2**

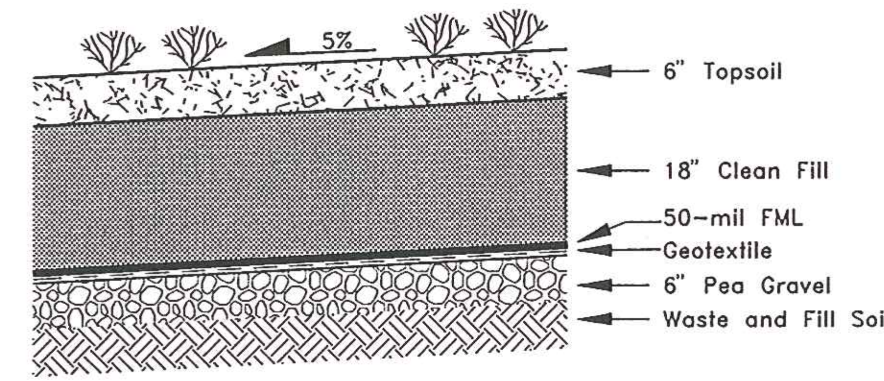
ALTERNATIVE 3 - PERMEABLE SOIL CAP

PORT OF BREMERTON/NORSELAND RI-FS/WA

C:\ADCADD\CIVIL\P\9331280\2003\63521   10-18-95 14:15 xrf: NONE

Golder Associates





CAP CROSS-SECTION

NOT TO SCALE

NOTES:

1. Coordinates are Washington State Plane North Zone.
2. See Figure 7-1 for conceptual grading plan.

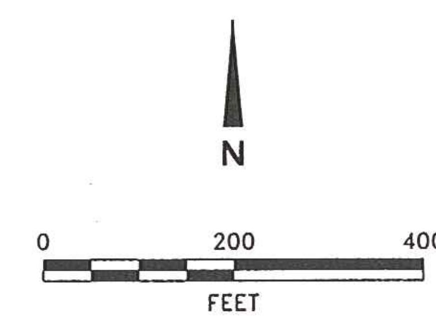


FIGURE 7-3

ALTERNATIVE 4 - LOW-PERMEABILITY CAP

PORT OF BREMERTON/NORSELAND RI-FS/WA

C:\ADCADD\CIVIL\P\9331280\2003\63522 10-19-95 10:50 xrf: NONE

Golder Associates