RI/FS WORK PLAN ADDENDUM
VAPOR INHALATION PATHWAY ASSESSMENT

Remedial Investigation/Feasibility Study
Astoria Area-Wide Petroleum Site
Astoria, Oregon

December 12, 2003

Prepared by:

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December 12, 2003
10077.007

Oregon Department of Environmental Quality
Northwest Region
2020 SW Fourth Avenue
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VIA Email/Hand Delivery

Attention: Anna Coates

Subject: RI/FS Work Plan Addendum
Vapor Inhalation Pathway Evaluation
Astoria Area-Wide Petroleum Site
Astoria, Oregon
DEQ ECSI File #2277

Dear Ms. Coates:

Enclosed are three bound and one unbound copies of the above-referenced document. This work plan is being submitted to you on behalf of the Astoria Area-Wide PRP group as described in "RI/FS and IRAM Development Work Plan, Phase 1," dated July 15, 2002. These investigations have been conducted under DEQ Order No. ECSR-NWR-01-11.

Please call me at (503)768-5121 if you have any questions or comments.

Sincerely,
EnviroLogic Resources, Inc.

Thomas J. Calabrese, R.G.
Principal/Hydrogeologist

cc: Distribution list attached

clients/port of astoria/007 IRAMS/air monitoring/airpathwayevaluation/deq121203.doc

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VAPOR INHALATION PATHWAY ASSESSMENT

Remedial Investigation/Feasibility Study
Astoria Area-Wide Petroleum Site
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DEQ ECSI File #2277

December 12, 2003

Prepared for:
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RI/FS WORK PLAN ADDENDUM
AIR QUALITY ASSESSMENT

Remedial Investigation/Feasibility Study
Astoria Area-Wide Petroleum Site
Astoria, Oregon

December 12, 2003

This work plan has been prepared by *EnviroLogic Resources, Inc*., of Portland, Oregon, and GeoSyntec Consultants of Santa Barbara, California.

EnviroLogic Resources, Inc. Project No. 10077.007

By

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CONTENTS

RI/FS WORK PLAN ADDENDUM
VAPOR INHALATION PATHWAY ASSESSMENT

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Astoria Area-Wide Petroleum Site
Astoria, Oregon

1.0 INTRODUCTION

This work plan addendum presents the rationale, methods, and procedures to be used to assess the vapor inhalation pathway at the Astoria Area-Wide Petroleum Site. This work plan is based on data collected from the Phase 1 Remedial Investigation/Feasibility Study (RI/FS) field activities and historical information documented in the RI/FS and Interim Remedial Action Measures (IRAM) Work Plan, Phase 1 (RI/FS Work Plan)(*EnviroLogic Resources*, July 2002). The Phase 1 field activities were completed at the site in August and September 2002. The data and results of the Phase 1 RI/FS field activities are presented in the Technical Memorandum, Phase 1 Source/Soil Characterization (Phase 1 Soil TM) dated January 30, 2003 (*EnviroLogic Resources*, January 2003). Discussion of the soil data collected during the Phase 1 field activities is presented in the RI/FS Work Plan Addendum, Phase 2 Soil Characterization Work Plan (*EnviroLogic Resources*, July 2003c). Interpretation and discussion of the ground-water data collected during the Phase 1 field activities is presented in the RI/FS Work Plan Addendum, Phase 1 Ground Water Characterization Work Plan (*EnviroLogic Resources*, July 2003b).

The RI/FS is being performed pursuant to a Unilateral Order issued in December 2001 by the Oregon Department of Environmental Quality (DEQ) to eight entities. The Order (No. ECSR-NWR-01-11) requires these current and former facility owners and operators involved in industrial and commercial activities to investigate and potentially cleanup properties within the Astoria Area-Wide site. ChevronTexaco Products Company (ChevronTexaco), Delphia Oil Company (Delphia), McCall Oil and Chemical Company (McCall), Ed Niemi Oil Company (Niemi Oil), Flying Dutchman and Harris Enterprises (Harris/Van West), Port of Astoria (the Port), Qwest Communications International (Qwest), and Shell Oil Company (Shell), collectively

potentially responsible parties (PRPs), are identified in the Order and have agreed to comply with its requirements. The following is a list of the consultants representing each PRP:

PRP	**CONSULTANT**
ChevronTexaco	SAIC
Delphia Oil	Maul Foster & Alongi, Inc.
Harris/Van West	Kleinfelder, Inc.
McCall Oil	Anchor Environmental, LLC
Niemi Oil	AMEC, Inc.
Port of Astoria	*EnviroLogic Resources, Inc.*
Qwest	Tetra Tech EM, Inc.
Shell Oil	Hart Crowser, Inc.

The areas within which the investigations are focused are termed the Astoria Area-Wide Petroleum Site (Astoria Area-Wide) and the Regional Study Area (RSA). The boundary of the RSA is shown in Figure 1. Figure 2 shows the locations of each of the properties subject to the Order.

2.0 BACKGROUND

The Astoria Area-Wide site includes facilities and properties located at and near the Port of Astoria in Astoria, Oregon (Figure 1). The RSA includes the Astoria Area-Wide site and the surrounding areas. The RSA is located in Section 7, Township 8 North, Range 9 West, and Section 12, Township 8 North, Range 10 West, Willamette Base and Meridian. The Astoria Area-Wide site includes property bounded by Portway to the northeast, the Columbia River to the northwest, Hamburg Street (including the former McCall bulk plant) to the southwest, and Marine Drive to the southeast.

The topography of the area consists of a prominent hill overlooking the RSA from the southeast. West Marine Drive (US Highways 26, 30, and 101) is located on a topographic bench, at the base of the prominent hill, approximately 15 feet above the level of the Port facilities. The Columbia River flows to the west on the northwest side of the RSA. Youngs Bay lies to the southwest.

The area around the Port has been used for petroleum storage and distribution since the 1920s. Aboveground storage tanks (ASTs), underground storage tanks (USTs), and pipelines are present on several of the facilities subject to this investigation. Historically, the area was home to at least four bulk petroleum storage facilities and five vehicle fueling or service stations between West Marine Drive and the Columbia River in the RSA. Inactive pipelines associated with several of the former bulk fuel storage facilities extend onto Pier 2. A complete site history and a summary of remedial actions completed at the Astoria Area-Wide site are presented in the RI/FS Work Plan (*Envirologic Resources*, July 2002).

The occurrence of free product or light non-aqueous phase liquids (LNAPL) has been documented at several locations within the Astoria Area-Wide site. Currently LNAPL is only known to be present in monitoring wells located near the Port office in the vicinity of a 1993 diesel release from the McCall Oil pipeline. Historically LNAPL was also present in two monitoring wells situated between the Niemi Oil Cardlock and the Harris/Van West properties in

the vicinity of a 1990 release from Harris/VanWest and in a trench between the Youngs Bay Texaco and Qwest properties in the vicinity of a 1997 gasoline release at Youngs Bay Texaco.

3.0 LOCAL HYDROGEOLOGY

Based on a review of the boring logs completed as part of the Phase 1 soil characterization activities most of the Astoria Area-Wide site is underlain by grey and light brown sand fill. Lenses of silt and clay are present in the fill as well as gravel, wood and other organics. In addition, two native materials were encountered beneath the site: native river deposits and the Astoria Formation. The native materials were encountered at depth, consistent with the conceptual hydrogeologic model presented in the RI/FS Work Plan.

Native river deposits consisting of dark greenish-grey silty sandy clay with cobbles were encountered beneath the Qwest site at a depth of 9 feet below ground surface (bgs). Mudstone and yellowish-red and yellowish-brown silts were encountered in soil borings located at the Harris/Van West site and the Youngs Bay Texaco site. The mudstone and silts were encountered near the base of the borings from depths of 14 to 18 feet bgs. The mudstone and silt are interpreted to be part of the Astoria Formation.

Ground-water is generally encountered between 7 and 11 feet bgs at the site, except along West Marine Drive. The three sites along West Marine Drive have a ground surface elevation approximately 15 feet above the remainder of the site and the depth to ground-water was generally 22 feet bgs. Boring logs and a summary of physical and engineering parameters of selected soil samples are presented in the Phase 1 Soil TM.

4.0 PHASE 1 DATA RELATING TO AIR EXPOSURE PATHWAY

In August and September 2002 the Phase 1 source/soil characterization field work was completed at the site in accordance with the RI/FS Work Plan. The Phase 1 investigation included the advancement of 139 direct-push soil borings. Temporary well points were installed in 86 of the soil borings. Soil and ground-water samples were collected from the soil borings and temporary well points for chemical analysis. Soil analytical results are discussed in the RI/FS Addendum, Phase 2 Soil Characterization Work Plan (*EnviroLogic Resources*, July 2003c). Ground-water analytical results are discussed in the RI/FS Phase 1 Ground-Water Assessment Work Plan (*EnviroLogic Resources*, July 2003b)

As a preliminary screen of the vapor inhalation pathways at the Astoria Area Wide site, Phase 1 soil and ground-water analytical data are compared to DEQ Risk-Based Concentrations (RBCs) (DEQ, 2003) for volatilization to outdoor air and vapor intrusion into buildings. For the majority of the site the exposure pathway will be an occupational scenario. An urban residential scenario will be used in the vicinity of the apartment building near the Harris/Van West and Qwest sites.

The generic RBCs were developed by the DEQ using modeling with conservative input parameters to derive values that are protective under most potential site conditions. Therefore, many generic RBCs may be more conservative than necessary to provide adequate protection from compounds of concern present in soil and ground water at a particular site. Thus, the generic RBCs appear to be appropriate for providing initial screening criteria to assess air exposure pathway risks.

4.1 OCCUPATIONAL RECEPTOR SCENARIO

Soil and ground-water analytical data with detected concentrations that exceed the RBCs for an occupational receptor scenario are discussed in the following sections. The exceedances are also presented in Table 1 (soil) and Table 2 (ground water). Table 3 explains data qualifiers associated with the analytical data.

4.1.1 SOIL

Benzene and 1,3,5-trimethylbenzene were the only constituents of interest (COIs) detected above a corresponding air exposure pathway RBC in soil samples submitted for chemical analysis. These two constituents were detected above the occupational RBC for vapor intrusion into buildings (RBCsi). A total of 13 samples (1 field duplicate) exceeded the occupational RBCsi for benzene (1.2 mg/kg) and 2 samples exceeded the RBCsi for 1,3,5-trimethylbenzene (140 mg/kg). These samples are listed in Table 1 and the locations of these soil borings are shown on Figure 3. No COIs were detected above their corresponding RBC for volatilization to outdoor air (RBCso) in an occupational scenario.

4.1.2 GROUND WATER

Benzene was the only compound detected in ground-water at a concentration above the occupational RBC for an air exposure pathway. For the exposure pathway of volatilization to outdoor air (RBCwo) for an occupational scenario, no exceedances were reported. For the exposure pathway of vapor intrusion into buildings (RBCwi) for an occupational scenario, one exceedance for benzene was found. The only exceedance reported for the benzene RBCwi (2,700 ug/l) was in the ground-water sample collected at TW-612(N).

4.2 URBAN RESIDENTIAL RECEPTOR SCENARIO

There is currently one known residential structure present at the Astoria Area-Wide site. This is an apartment building located to the southwest of Harris/Van West. The apartment building also adjoins the southeastern portion of the Qwest property (Figure 3). This apartment building is located in a predominantly commercial/industrial area and is located in close proximity to U.S. Highway 101 (West Marine Drive). Therefore, the urban residential receptor scenario presented is considered most representative.

The soil and ground-water analytical data for soil borings located within approximately 50 feet of the perimeter of the apartment building have been reviewed. This evaluation included soil and ground-water analytical data from SB-405(F), SB-406(F), SB-816(Q), SB-817(Q), SB-818(Q), SB-819(Q), SB-829(Q), SB-830(Q), and SB-833(Q). At these locations, no COIs were detected in soil or ground-water at concentrations greater than the RBCs for volatilization to outdoor air or vapor intrusion into buildings.

5.0 VAPOR INHALATION PATHWAY ASSESSMENT LOCATIONS

The basic objective of this vapor inhalation pathway assessment work plan is to use the existing Phase 1 soil and ground-water analytical data to determine areas requiring additional evaluation. For this evaluation, the Phase 1 ground-water and soil analytical data were screened at each property considering the specific building occupation and outdoor activities. Four areas were identified for further evaluation. These areas include: 1) the Port office building and maintenance shop; 2) the former Mobil/Niemi Oil Bulk Plant ; 3) the Niemi Oil Cardlock; and 4) Val's Texaco. Each area is discussed in more detail in the following sections.

5.1 PORT OFFICE BUILDING AND MAINTENANCE SHOP

The Port office building footprint appears to partially overlie a free petroleum product plume containing diesel and gasoline components. In addition, analytical results from soil borings in this area exceed RBCs for the vapor inhalation pathway as noted in Section 4.0. To refine the evaluation of the potential subsurface vapor migration to indoor air pathway at this property, four soil gas samples located near the Port office/administrative building will be collected. The locations of the proposed soil gas samples are shown in Figure 4. Details on the sample collection and analysis are discussed in Sections 6.0 and 7.0, respectively.

5.2 FORMER MOBIL/NIEMI OIL BULK PLANT

Phase 1 soil boring samples in the immediate vicinity of the former ASTs and ancillary equipment exceeded the RBCsi for 1,3,5-trimethylbenzene and benzene. However, detected concentrations of all COIs in the Phase 1 soil samples were below the RBCso. Benzene was detected in one Phase 1 ground-water sample (TW-612(N)) at a concentration greater than the corresponding RBCwi. Detected concentrations of all COIs in Phase 1 ground-water samples were below the RBCwo. Currently, the former Mobil/Niemi Oil office/storage building is the only on-site structure that may be routinely occupied. This building is presently leased by the Port for commercial activity. The building is located over 50 feet away and in an inferred upgradient

direction from the area where the petroleum COI concentrations exceed the RBCsi and RBCwi. Based on the results of Phase 1 sampling, no additional assessment of the vapor inhalation pathway is proposed at this time.

5.3 NIEMI OIL CARDLOCK

Soil concentrations from four Phase 1 soil samples completed at the Niemi Oil Cardlock facility exceeded the RBCsi for 1,3,5-trimethylbenzene and benzene. Detected concentrations of all COIs in soil at the facility were below the RBCso. Also, detected concentrations of all COIs in Phase 1 ground-water samples were below the vapor inhalation pathways. Currently, the facility is an unattended commercial fueling cardlock with no buildings. Based on the results of the Phase 1 soil sampling, no additional air quality assessment is proposed at this time.

5.5 VAL'S TEXACO

One soil sample (SB-316(D)) collected from the Val's Texaco site during the Phase 1 investigation contained benzene at a concentration that exceeds the RBCsi. There were no other exceedances of RBCsi or RBCso for occupational scenarios in soil. There were no exceedances of RBCwi or RBCwo in reconnaissance ground-water samples collected during the Phase 1 investigation.

SB-316(D) was collected over 10 feet away from the Val's Texaco office (see Figure 3). Based on information provided in Table 2.4 of the DEQ Guidance (2003), the RBCsi pathway should only be considered for samples collected beneath or within 10 feet of a commercial building or within 50 feet of a residential building. Additional investigation was warranted to evaluate if soil and ground water within 10 feet of the building exceed the RBCsi and RBCwi values.

As part of the Phase 2 soil assessment work, one Geoprobe boring was completed approximately 6 feet east of the Val's Texaco office (SB-324(D)) and one monitoring well was placed 10 feet south of the office (MW-13(A), aka SB-326(D)). Soil boring locations for SB-324(D) and

SB-326(D) are shown on Figure 3. Soil samples collected from both locations were analyzed for RBDM VOCs by EPA Method 8260B to evaluate whether soil adjacent to the building exceeded the RBCsi. Concentrations of VOCs were below RBCsi values. Ground-water samples from MW-13(A) were analyzed for RBDM VOCs during the first quarterly ground-water monitoring event to further evaluate whether ground water under the building exceeded the RBCwi. Concentrations of VOCs in MW-13(A) were below the RBCwi.

Based on the soil and ground-water data discussed above, Delphia does not propose any further air quality assessment at this time.

6.0 PORT OFFICE BUILDING SOIL GAS SAMPLING PROBE INSTALLATION AND SAMPLE COLLECTION

Four temporary soil gas probes (SGP) will be installed around the Port office building at the locations shown on Figure 4. These probes will be designed to monitor soil gas approximately 5 ft bgs. Installation of the soil gas probes will be consistent with the methods described in the California Department of Toxic Substances Control (DTSC) and California Regional Water Quality Control Board – Los Angeles Region (LARWQCB) active soil gas investigation advisory. The temporary SGPs will be installed by a licensed drilling subcontractor using a direct push method (GeoProbe® or equivalent). Details of the temporary SGP installation protocol are presented in Appendix A.

Following the temporary SGP installation, three probes volumes of soil gas will be purged and samples collected into individually certified Summa® canisters. Sample collection methods and procedures will be consistent with the methods described in the California DTSC and LARWQCB active soil gas investigation advisory and are presented in Appendix B. Sample handling and documentation will be conducted in accordance with procedures described in the RI/FS Work Plan.

After field screening and sampling activities are completed, the temporary probes will be pulled out and, if the borehole remains open it will be filled with bentonite chips to surface.

7.0 AIR ANALYTICAL METHODS

Following sample collection, the soil gas samples will be submitted to an accredited laboratory and analyzed for gasoline-range petroleum hydrocarbons (as TPH-G – C6 to C10 range), benzene, toluene, ethylbenzene, xylene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene by EPA Method TO-14A/TO-15 Direct Injection. The reporting limits from this analysis will provide data suitable for risk-based assessment. Currently the PRP group anticipates air analysis will be conducted by Air Toxics, Ltd. of Folsom, California.

8.0 DATA EVALUATION

Risk-based concentrations for vapor migration of soil gas to indoor air will be developed consistent with the approach used by the DEQ in the development of RBC_{si} and RBC_{wi}. The same screening-level models and exposure assumptions used by DEQ will be used along with conservative, site-specific input parameters. These site-specific RBCs will be compared to the soil gas results obtained in this investigation.

If measured soil gas concentrations exceed these calculated RBCs, then collection of sub-slab soil gas samples, crawlspace air samples, and/or indoor air samples will be considered. The method for additional evaluation will be selected based on the results of this investigation.

At sites where additional soil and ground-water samples are being collected, sample analytical results will be compared to the RBCs for the volatilization to outdoor air and vapor intrusion into buildings exposure pathways. Based on that comparison the need for additional evaluation will be determined.

9.0 REFERENCES

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TABLES

TABLE 1
DEQ RBC AIR EXPOSURE PATHWAY EXCEEDANCES FOR SOIL

Remedial Investigation/Feasibility Study
Astoria Area-Wide Petroleum Site
Astoria, Oregon

Locator ID	Sample ID	Sample Date	Depth	1,3,5-Trimethylbenzene	Benzene	
VAPOR INTRUSION INTO BUILDINGS: Occupational Receptor Scenario				140	1.2	
			feet	mg/kg	mg/kg	
SB-316(D)	SB-316-D-10.0	8/20/2002	10	55.1	**1.52**	
SB-501(M)	SB-501 (M) 8-12	8/29/2002	10		**6.11**	
SB-506(M)	SB-506 (M) 8-12	8/29/2002	10		**2.14**	
SB-507(M)	SB-507 (M) 8-12	8/29/2002	10		**2.61**	
SB-508(M)	SB-508 (M) 8-12	8/29/2002	10		**3.12**	
SB-510(M)	SB-510 (M) 8-12	8/29/2002	10		**1.43**	J
SB-602(N)	SB-602(N)-7	9/13/2002	7	**189**	**7.84**	
SB-603(N)	SB-603(N)-7	9/13/2002	7	40.3	2.5	U
SB-605(N)	SB-605(N)-7	9/13/2002	7	137	**3.22**	
SB-612(N)	SB-612 (N)-7	9/12/2002	7	**148**	**5.35**	
SB-612(N)	SB-612 (N)-7	9/12/2002	7		**17.2**	
SB-720(P)	SB-720(P)-8.5	8/23/2002	8.5		**5.86**	
SB-820(Q)	SB-820 (Q)-9C	8/29/2002	9		**3.54**	J
SB-821(Q)	SB-821 (Q)-5	8/29/2002	5		**1.29**	J

RBC= Risk Based Concentration from Appendix A of the RBDM Guidance document
mg/kg = milligrams per kilogram
NE=Not Established
This is only a partial listing of analytical results for each soil sample. See report text for reference to complete analytical results.

TABLE 2
DEQ RBC AIR EXPOSURE PATHWAY EXCEEDANCES FOR GROUND WATER

Remedial Investigation / Feasibility Study
Astoria Area-Wide Petroleum Site
Astoria, Oregon

Locator ID	Sample ID	Sample Date	Benzene
VAPOR INTRUSION INTO BUILDINGS: Occupational Receptor Scenario			**2700** ug/L
TW-612(N)	TW-612(N)	9/12/2002	**3060**

Notes:

RBC= Risk Based Concentration from Appendix A of the RBDM Guidance document
ug/L = micrograms per liter

This is only a partial listing of analytical results for each ground-water sample. See report text for reference to complete analytical results.

TABLE 3
DATA QUALIFIER DEFINITIONS

Remedial Investigation/Feasibility Study
Astoria Area-Wide Petroleum Site
Astoria, Oregon

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

J- The analyte was positively identified; the associated numerical value appears to be bias low.

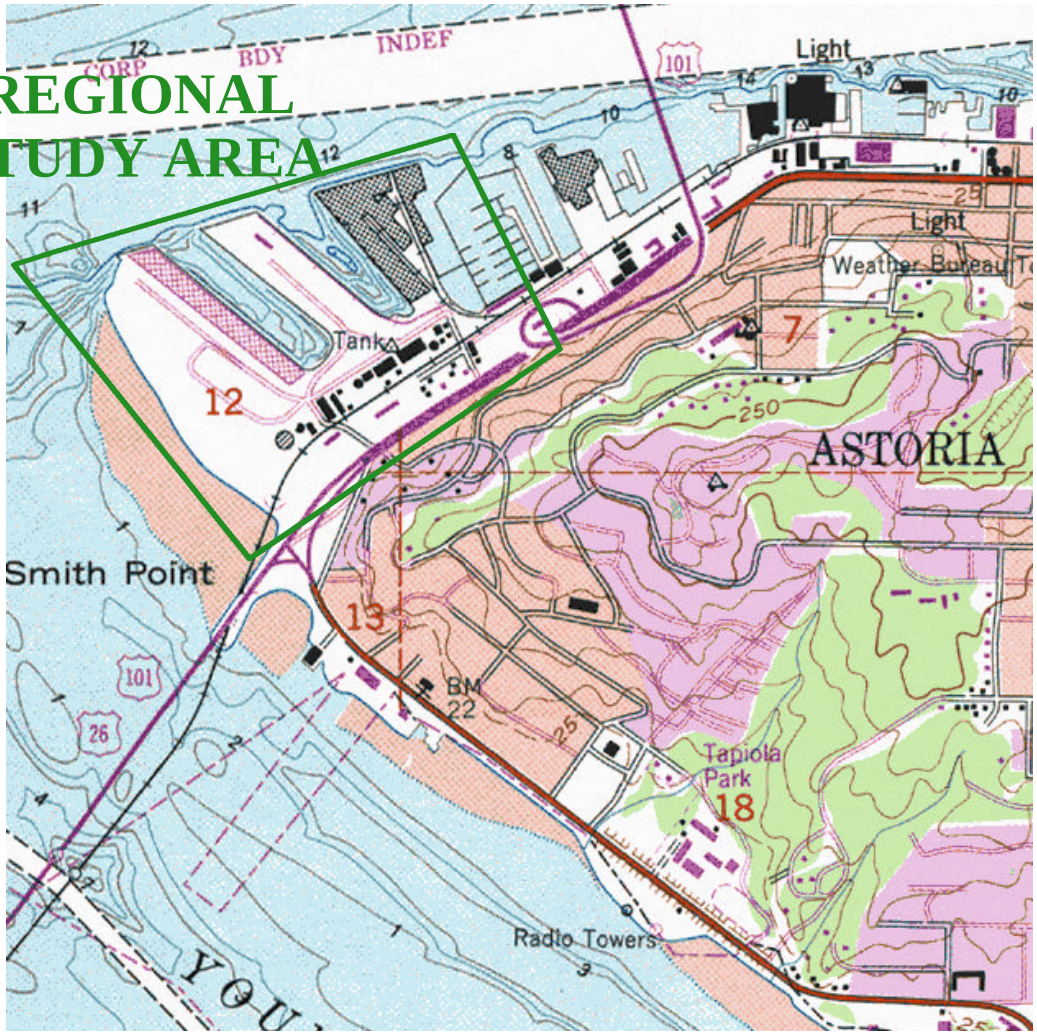
UJ- The analyte was not detected above the reporting limit. However, the reporting limit appears to be bias low and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

C Common laboratory contaminant

B The analyte was also identified in a field or laboratory blank associated with this sample or sample group.

R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

FIGURES



(from USGS, Astoria {1984}, OR 7.5' Quadrangles)

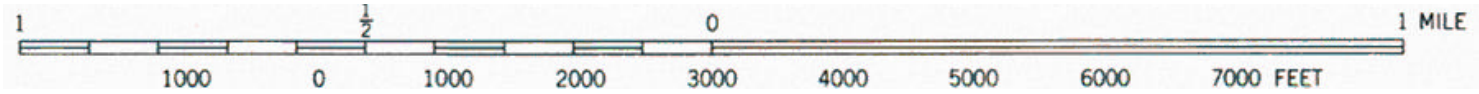


FIGURE 1

SITE LOCATION

Remedial Investigation/Feasibilty Study
Astoria Area-Wide Petroleum Site
Astoria, Oregon

EnviroLogic Resources, Inc.

Consulting Environmental & Water Resources Scientists

Columbia River

Young's Bay

Range 10 West

Range 9 West

REGIONAL STUDY AREA

Astoria Oil Services

Delphia

Shell Oil

Former Steelworks

Niemi Oil Cardlock

Former Furniture Manufacturing

Port Offices

Harris/Van West

Former Mobil/Niemi Oil Bulk Plant

Qwest

ChevronTexaco

McCall Oil Bulk Plant(Chevron)

Pier 1

Pier 2

Pier 3

Slip 1

Slip 2

E 7349500 E 7350000 E 7350500 E 7351000 E 7351500 E 7352000 E 7352500 E 7353000 E 7353500

N 938000 N 937500 N 937000 N 936500 N 936000 N 935500

12 7 13 18

N

0 300 600

SCALE IN FEET

EnviroLogic Resources, Inc.

Consulting Environmental & Water Resources Scientists

FIGURE 2

SITE PLAN

Remedial Investigation/Feasibility Study
Astoria Area-Wide Petroleum Site
Astoria, Oregon

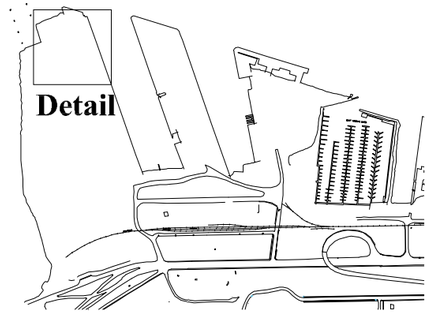
Techmemo – Fig1.dwg 10-13-03

Detail

EXPLANATION

SB-410(F) **Proposed Soil Boring**

SB-714(P) **Soil Boring Location**



KEY PLAN

Former Chevron/McCall Oil Bulk Plant

Former Mobil/Niemi Oil Bulk Plant

Port Offices

FORMER WATER TANK

PORTWAY

Former Shell Oil Bulk Plant

Qwest

Niemi Oil Cardlock

Delphia Oil

Apt. Bldg.

ChevronTexaco

Harris/Van West

BURLINGTON NORTHERN RAILROAD

INDUSTRY ST.

HAMBURG

PORTWAY ST.

WEST MARINE DR.

U.S. HWY. 101

U.S. HWY. 26

OR. HWY. 202

U.S. HWY. 101 ALT.

TAYLOR AVE.

AVE.

GVL

TANK

V/C

0 120 240

SCALE IN FEET

EnviroLogic Resources, Inc.

Consulting Environmental & Water Resources Scientists

FIGURE 3

SOIL BORING LOCATIONS

Remedial Investigation/Feasibility Study
Astoria Area-Wide Petroleum Site
Astoria, Oregon

EXPLANATION

SVP-02(M) ⊕ PROPOSED SOIL VAPOR SAMPLE LOCATION

IE=10.7(N)

IE=9.5(SE)
IE=4.96(N)

IE=11.9(SE)
IE=11.8(NW)

IE=13.5(NW)

IE=13.9(NE)

SVP-01(M) ⊕

SVP-02(M) ⊕

SVP-03(M) ⊕

SVP-04(M) ⊕

6" STORM PIPE

10" STORM PIPE

6" THE SEWER

PORT OFFICE BUILDING

PORTWAY

MH

SD

SS

0 30 60

SCALE IN FEET

EnviroLogic Resources, Inc.

Consulting Environmental & Water Resources Scientists

FIGURE 4

PROPOSED SOIL VAPOR SAMPLING LOCATIONS

Remedial Investigation/Feasibility Study
Astoria Area-Wide Petroleum Site
Astoria, Oregon

Air Monitoring Plan/Fig-4.dwg 12-12-03 GRH

APPENDIX A

SOIL GAS PROBE INSTALLATION

Soil Gas Probe Installation

1.1 Temporary Soil Gas Probes

1.1.1 Installation

The temporary SGPs will be installed by a licensed drilling subcontractor under PRP Group supervision. The SGPs will be installed by a direct push method (GeoProbe™ or equivalent).

The SGP will consist of 1-inch outer diameter (O.D.) polyvinyl chloride (PVC) with a 0.5-foot long screen (0.010-inch slot size) and a riser pipe with a slip cap on the base and a threaded cap on top. The bottom of the screened interval will be located 5 ft below ground surface. The threaded caps will have a tapped hole drilled through the top that will be fitted with a three way ¼-inch brass valve with barbed fittings. The threads on the well caps will be wrapped with Teflon™ tape to ensure a tight seal. A 2-inch diameter GeoProbe™ drill rod will be used to advance the borehole to the target depth (approximately 8 ft bgs) and the SPG will then be installed. The borehole annulus will be backfilled with sand to approximately 0.5 foot above the screen. A bentonite seal will then be placed above the sand to within 1.5 ft bgs.

Field documentation will include SGP locations (measured relative to two fixed points) and depths, date and time of installation, names of the drillers and supervising personnel, and general descriptions of weather conditions.

After field screening and sampling activities are completed, the temporary probes will be pulled out and, if the borehole remains open it will be filled with bentonite chips to surface and the bentonite will be hydrated.

APPENDIX B

SOIL GAS PROBE SAMPLING AND ANALYTICAL METHODS

1.0 Soil Gas Probe Sampling and Analytical Methods

1.1 SGP Purging and Field Screening of Soil Gas

Soil gas will be evacuated from the SGP and sand pack using a constant-flow gas sampling pump (*e.g.*, BIOS AirPro 6000D). A vacuum gauge will be attached on the three-way valve installed in the wellhead. Measurements of flow rate and vacuum (not to exceed approximately 1-inch of water) will be recorded during the purging of the SGP. After each SPG volume has been purged, the concentrations of VOCs, CO_2, CH_4, H_2S, and O_2 will be field screened as described below. The process will be repeated until a minimum of 3 probe volumes are purged and the field readings stabilize.

A photoionization detector (PID) will be used to screen for VOCs in soil gas. A portable landfill gas analyzer will be used to measure the concentrations of CH_4 (as lower explosive limit or "LEL"), CO_2, H_2S and O_2 in the field. The readings will be performed by attaching the instrument to a short piece of tubing (3 inches or less) connected to a filled Tedlar™ bag. For each sample, the instrument will read for a 15-second interval and the maximum reading observed during the interval will be recorded.

The landfill gas analyzer and PID will be field calibrated according to manufacturer's instructions. Calibrations will be checked after every 20 measurements and instruments re-calibrated if readings are greater than ±15% of the calibration standard.

Field documentation will include instrument calibration information; date, time and location of readings; purging rate and vacuum induced; sampler's name; and a detailed description of the equipment set up for each location.

1.2 Soil Gas Sample Collection for Laboratory Analysis

Soil gas samples will be collected from the SGPs for laboratory analysis of VOCs immediately after completing the field screening activities described in Section 1.1.

Soil gas samples will be collected into clean Summa® canisters. Prior to filling the Summa® canisters, the gas sampling pump will be attached directly to the valve in the wellhead, and one probe volume will be purged to ensure a representative "fresh" sample will be collected. The canisters will be attached to the valve in the slip cap on the SPG with a short length (approximately 2 ft.) of ¼-inch Teflon™ tubing. When attached and opened to the SGP for sampling, the differential pressure causes the soil gas to flow into the canister. The canisters are equipped with accurate pin valves that can be opened gradually to control the inflow rate. The vacuum gauge installed on the valve on the wellhead will be monitored to ensure that the canisters are filled at an appropriate rate (vacuum maintained at less than 1-inch of water) and the valve closed before the canister is filled completely so that it maintains a slight vacuum.

The soil gas samples will be labeled and chain-of-custody forms completed using the labeling, handling, and custody procedures provided in the Sampling and Analysis Plan (SAP) for the Site. Note, however, that cooling the samples to 4°C is not required. The samples will be shipped to the laboratory by overnight courier. The samples will be analyzed for gasoline-range petroleum hydrocarbons (as TPH-G - C6 to C10 range) and benzene, toluene, ethylbenzene, xylene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene by EPA Method TO-14A/TO-15.

The sampling date and time of sample collection, number of canisters filled, sample identification, sampler's name, and sampling order of all samples and QA/QC samples will be recorded on the sampling field records.

Additional details on canister sampling and analytical methods are included in the attached guide provided by Air Toxics, Ltd.

AIR TOXICS LTD.

Method : Modified TO-3 (Gasoline Range)

Compound	Rpt. Limit (ppmv)
TPH (Gasoline Range)	0.025

Surrogate	Method Limits
Fluorobenzene (FID)	75-125

AIR TOXICS LTD.

Method : Modified TO-15-S (new RLs)

Compound	Rpt. Limit (ppbv)
Freon 12	0.10
Freon 114	0.10
Chloromethane	0.10
Vinyl Chloride	0.10
Bromomethane	0.10
Chloroethane	0.10
Freon 11	0.10
1,1-Dichloroethene	0.10
Freon 113	0.10
Methylene Chloride	0.20
1,1-Dichloroethane	0.10
cis-1,2-Dichloroethene	0.10
Chloroform	0.10
1,1,1-Trichloroethane	0.10
Carbon Tetrachloride	0.10
Benzene	0.10
1,2-Dichloroethane	0.10
Trichloroethene	0.10
1,2-Dichloropropane	0.10
cis-1,3-Dichloropropene	0.10
Toluene	0.10
trans-1,3-Dichloropropene	0.10
1,1,2-Trichloroethane	0.10
Tetrachloroethene	0.10
1,2-Dibromoethane (EDB)	0.10
Chlorobenzene	0.10
Ethyl Benzene	0.10
m,p-Xylene	0.10
o-Xylene	0.10
Styrene	0.10
1,1,2,2-Tetrachloroethane	0.10
1,3,5-Trimethylbenzene	0.10
1,2,4-Trimethylbenzene	0.10
1,3-Dichlorobenzene	0.10
1,4-Dichlorobenzene	0.10
alpha-Chlorotoluene	0.10
1,2-Dichlorobenzene	0.10
1,2,4-Trichlorobenzene	0.50
Hexachlorobutadiene	0.50
1,3-Butadiene	0.50
Acetone	0.50
Carbon Disulfide	0.50
2-Propanol	0.50
trans-1,2-Dichloroethene	0.50
Vinyl Acetate	0.50
2-Butanone (Methyl Ethyl Ketone)	0.50

AIR TOXICS LTD.

Method : Modified TO-15-S (new RLs)

Compound	Rpt. Limit (ppbv)
Hexane	0.50
Tetrahydrofuran	0.50
Cyclohexane	0.50
1,4-Dioxane	0.50
Bromodichloromethane	0.50
4-Methyl-2-pentanone	0.50
2-Hexanone	0.50
Dibromochloromethane	0.50
Bromoform	0.50
4-Ethyltoluene	0.50
Ethanol	0.50
Methyl tert-butyl ether	0.50
Heptane	0.50
Cumene	0.50
Propylbenzene	0.50

Surrogate	Method Limits
1,2-Dichloroethane-d4	70-130
Toluene-d8	70-130
4-Bromofluorobenzene	70-130