July 15, 2004
10077.007

Oregon Department of Environmental Quality
Northwest Region
2020 SW Fourth Avenue
Suite 400
Portland, Oregon 97201-4987

VIA Email

Attention: Anna Coates

Subject: Response to DEQ Review Comments
Vapor Inhalation Pathway Assessment
Astoria Area-Wide Petroleum Site
Astoria, Oregon
DEQ ECSI File #2277
Order ECSR-NWR-01-11

Dear Ms. Coates:

Oregon Department of Environmental Quality (DEQ) has provided *EnviroLogic Resources, Inc*., with review comments on the RI/FS Work Plan Addendum, Vapor Inhalation Pathway Assessment, Astoria Area-Wide Petroleum Site, Astoria, Oregon. The Vapor Inhalation Pathway Assessment, RI/FS Work Plan Addendum is dated December 12, 2003, and DEQs comment letter is dated February 20, 2004. As discussed with DEQ, this letter is being submitted instead of a revised work plan addendum.

In response to DEQ's general comments the Astoria Area-Wide PRP Group (Group) would like to emphasize that the purpose of the Vapor Inhalation Pathway Assessment work plan addendum is to assess the need for any further action(s), such as an Interim Remedial Action Measure (IRAM), at the Astoria Area-Wide site (site). Accordingly, we evaluated the worst case for vapor inhalation at the site, which by agreement is the portion of the Port of Astoria Office Building which is underlain by the free product plume.

The Phase 2 soil sample results and quarterly ground-water monitoring results support that this is the area of most potential concern. If an IRAM is determined to be required for the Port of Astoria Office Building, then other portions of the site will be reviewed to determine if additional vapor pathway testing is needed.

To evaluate temporal variability in soil gas samples collected at this portion of the site, DEQ has suggested collecting quarterly samples. However, while sample collection at multiple dates will result in a larger data set for evaluation of the subsurface vapor intrusion pathway, we do not believe quarterly sampling is necessary. Rather, the Group proposes two soil vapor sampling events: one in the summer and one in the winter. This approach will provide data to evaluate the range in soil gas concentrations during different times of the year. Since multiple soil vapor

samples will be collected, semi-permanent soil gas probes will be installed instead of the temporary soil gas probes proposed in the original work plan.

Responses to DEQ's Section Comments

No sampling locations are proposed near the maintenance shop because soil vapor data collection around the Port Office Building is considered to provide the most conservative results for the evaluation of the vapor intrusion pathway. This building overlies a large portion of the free-phase hydrocarbon and represents the area with the higher potential soil vapor source concentrations. This area will be evaluated for applicability of an IRAM. If an IRAM is determined to be required for the Port of Astoria Office Building, then other portions of the site, including the Port of Astoria Maintenance Shop, will be evaluated for additional vapor pathway testing.

A summary of the Phase 2 soil and quarterly ground-water monitoring results for locations within 10 feet of Val's Texaco building are attached as a revised Table 4 from the Work Plan Addendum. All analytes are below RBCs for occupational scenarios for vapor intrusion into buildings.

In response to DEQ's comments with regard to providing more detail on evaluating and modeling the data, the Group believes that the work plan is consistent with DEQ guidance. The RBCs for the soil and ground water to indoor pathways calculated by DEQ are based on the example equations provided in the Standard Guide for Risk-Based Corrective Action at Petroleum Release Sites (ASTM, 1995). These models are based on the Johnson and Ettinger vapor intrusion model (Johnson and Ettinger, 1991), but assume that the convective contribution to the vapor migration is small and can be neglected. More recent guidance on the evaluation of this pathway (USEPA, 2002, 2003) suggests that both the diffusive and convective contributions to vapor transport should be considered. Consequently, the site-specific RBCs will be calculated using the Johnson and Ettinger Model considering both transport mechanisms.

The soil gas RBC is determined by:

$$\mathrm{RBC}_{\mathrm{soil\,gas}} = RBC_{air} \Big/ \alpha \qquad (1)$$

where $\mathrm{RBC}_{\mathrm{air}}$, the risk based concentration in air, is the value listed in Appendix A of the ODEQ risk-based decision making guidance (ODEQ, 2003) and α, the vapor intrusion attenuation factor, is defined as the ratio of the indoor air and soil gas concentrations.

The attenuation factor is calculated using the Johnson Ettinger Model:

$$\alpha = \frac{\frac{D_T^{eff} A_B}{Q_B L_{cb}} \times Exp\left(\frac{Q_{soil} L_{crk}}{D_{crk}^{eff} A_{crk}}\right)}{Exp\left(\frac{Q_{soil} L_{crk}}{D_{crk}^{eff} A_{crk}}\right) + \frac{D_T^{eff} A_B}{Q_B L_{cb}} + \frac{D_T^{eff} A_B}{Q_{soil} L_{cb}}\left(Exp\left(\frac{Q_{soil} L_{crk}}{D_{crk}^{eff} A_{crk}}\right) - 1\right)} \qquad (2)$$

Note that in the limit as Q_{soil} approaches zero, this equation reduces to Equation B-129 of the ODEQ risk-based decision making guidance (ODEQ, 2003).

The effective diffusion coefficient is calculated using:

$$D^{eff} = \frac{D_{air}\, n_{air}^{10/3}\, H + D_w\, n_w^{10/3}}{H\, n^2} \qquad (3)$$

and the building volumetric flow rate is calculated by:

$$Q_B = \frac{A_B\, L_B\, ER}{86{,}400\ s/day} \qquad (4)$$

All parameters in Equations 2-4 are defined in the DEQ guidance, except for the volumetric flow rate of soil gas to indoor air, Q_{soil}. While this parameter may be calculated from site-specific parameters (e.g., soil permeability, building pressure, depth of cracks, length of cracks), recent research and guidance suggests typical values for this parameter are in the range of 1 to 10 L/min (Johnson et. al, 1999, Johnson, 2002, USEPA, 2002 and USEPA, 2003). For the Astoria Area-Wide Petroleum Site evaluation, a value of 5 L/min will be used for Q_{soil}.

The parameters to be used in the soil gas RBC calculations are summarized in Table 1, attached. It is anticipated that only default parameters will be use in the calculations. However, site-specific data may be used for some of the parameters required for the vapor intrusion calculations. If values other than those listed below are used in the data evaluation, documentation of the basis for the site-specific value and sensitivity of this parameter will be provided. The input values that may be adjusted are noted in Table 1.

Previous studies have identified the critical parameters in the vapor intrusion pathway model (Johnson, 2002). Sensitivity of the model to the critical site-specific input parameters (as identified in Johnson, 2002) will be evaluated by considering the range of site specific parameters for the model input.

CLOSING COMMENTS

On behalf of the Group, we trust this letter sufficiently responds to DEQ's comments regarding the vapor intrusion pathway work plan and as requested by DEQ, will now serve as a supplement for implementing that work plan. Please call me at (503)768-5121 if you have any questions or comments regarding these vapor intrusion pathway comments.

Sincerely,
EnviroLogic Resources, Inc.

Thomas J. Calabrese, RG, CWRE
Principal/Hydrogeologist
Project Manager

cc: Distribution list attached

References

ASTM, 1995. Standard Guide for Risk-Based Corrective Action at Petroleum Release Sites, E 1739-95, American Society for Testing and Materials, West Conshohocken, PA.

Johnson, P.C. and R.A. Ettinger, 1991. Heuristic Model for Predicting the Intrusion of Contaminated Vapors Into Buildings. Environmental Science and Technology. 25(8), p.1445-1452.

Johnson, P.C., M.W. Kemblowski, and R.L. Johnson, 1999. Assessing the Significance of Subsurface Contaminant Vapor Migration to Enclosed Spaces: Site-Specific Alternatives to Generic Estimates. Journal of Soil Contamination. 8(3), p.389-421.

Johnson, P.C., 2002. Identification of Critical Parameters for the Johnson and Ettinger(1991) Vapor Intrusion Model. API Research Bulletin 17. http://api-ep.api.org/filelibrary/Bulletin17.pdf

ODEQ, 2003. Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites. September 22, 2003. http://www.deq.state.or.us/wmc/tank/documents/RBDM03Final.pdf

USEPA, 2002. Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils. http://www.epa.gov/correctiveaction/euis/vapor/complete.pdf

USEPA, 2003. User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings. http://www.epa.gov/superfund/programs/risk/airmodel/guide.pdf.

ASTORIA AREA-WIDE PETROLEUM SITE
Distribution List

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TABLE 4 (revised)
SUMMARY ANALYTICAL RESULTS FOR VAL'S TEXACO

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

Locator ID	Sample ID	Date	Depth	Benzene	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	Methyl-t-butyl ether	1,2-Dibromoethane	1,2-Dichloroethane
Ground Water (ug/L)									
MW-13(A)	MW-13(A)	10/22/2003	na	259	17.4	42.8	10U	2.5U	2.5U
MW-13(A)	MW-13(A)	1/15/2004	na	750	393	10U	40U	10U	6.8
Soil (mg/kg)									
SB-324(D)	SB-324(D)-10	9/10/2003	10	0.141	18.2	0.41	0.4U	0.1U	0.1U
SB-324(D)	SB-324(D)-15	9/10/2003	15	0.0328	0.824	0.146	0.2U	0.05U	0.05U
SB-324(D)	SB-324(D)-2	9/10/2003	2	0.05U	0.0526	0.05U	0.2U	0.05U	0.05U
SB-324(D)	SB-324(D)-5	9/10/2003	5	0.05U	0.0187	0.05U	0.2U	0.05U	0.05U
SB-324(D)	SB-324(D)-DUP	9/10/2003	15	0.156	7.29	0.86	0.2U	0.05U	0.05U
SB-325(D)	SB-325(D)-10	9/10/2003	10	0.05U	0.1U	0.05U	0.2U	0.05U	0.05U
SB-325(D)	SB-325(D)-15	9/10/2003	15	0.05U	0.1U	0.05U	0.2U	0.05U	0.05U
SB-325(D)	SB-325(D)-2	9/10/2003	2	0.05U	0.1U	0.05U	0.2U	0.05U	0.05U
SB-325(D)	SB-325(D)-5	9/10/2003	5	0.05U	0.1U	0.05U	0.2U	0.05U	0.05U
SB-325(D)	SB-325(D)-DUP	9/10/2003	2	0.05U	0.1U	0.05U	0.2U	0.05U	0.05U
SB-326(D)	SB-326(D)-10	9/9/2003	10	0.639	26.6	9.67	1U	0.25U	0.25U
SB-326(D)	SB-326(D)-2	9/9/2003	2	0.0689	0.123	0.0537	0.2U	0.05U	0.05U
SB-326(D)	SB-326(D)-5	9/9/2003	5	0.599	22.5	8.02	1U	0.25U	0.25U

Notes:
mg/kg milligrams per killigram
ug/L micrograms per liter
U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

Table 1. Soil Gas RBC Calculation Input Parameters

Parameter	Symbol	Default Value	Reference	Consider Site-Specific Value?[1]
Air Risk Based Concentration (ug/m^3)	RBC_{air}	Chemical-Specific	ODEQ, 2003 Appendix A	No
Area of Building (cm^2)	A_B	1.0 E+06	10 m x 10 m Bldg	Yes
Soil gas volumetric flow rate (L/min)	Q_{soil}	5	USEPA Vapor Intrusion Guidance (USEPA, 2002)	Yes
Depth to soil gas sample (cm)	L_{cb}	152.5	5 ft x 30.5 cm/ft	Yes
Foundation wall thickness (cm)	L_{crk}	15	ODEQ, 2003 Appendix C	Yes
Foundation crack fraction	f_{crk}	0.001	ODEQ, 2003 Appendix C	No
Soil porosity	n	0.38	ODEQ, 2003 Appendix C	Yes
Soil air filled porosity	n_a	0.26	ODEQ, 2003 Appendix C	Yes
Soil water filled porosity	n_w	0.12	ODEQ, 2003 Appendix C	Yes
Crack air filled porosity	n_{acrk}	0.26	ODEQ, 2003 Appendix C	No
Crack water filled porosity	n_{wcrk}	0.12	ODEQ, 2003 Appendix C	No
Building air exchange rate (1/day)	ER	48	ODEQ, 2003 Appendix C	No
Building height (cm)	L_B	300	ODEQ, 2003 Appendix C	Yes
Henry's law coefficient	H	Chemical-Specific	ODEQ, 2003 Appendix D	No
Diffusion coefficient in air (cm^2/s)	Dair	Chemical-Specific	ODEQ, 2003 Appendix D	No
Diffusion coefficient in water (cm^2/s)	Dwater	Chemical-Specific	ODEQ, 2003 Appendix D	No

ODEQ, 2003. Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites.

[1] If site-specific value is used in data evaluation, documentation of the basis for the site-specific value will be provided.