WEST & ASSOCIATES ENGINEERS, INC.

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ADDITIONAL INFORMATION:

LARRY -
Please review proposed
Risk Based Closure Assessment
Scope -
Brian West

- Want BB site pass a Tier 1 => Do Tier 1 then Tier 2

AUGUST 17, 1999

SCOPING DOCUMENT:
APPROACH FOR EVALATING RISK-BASED CLOSURE
WEYERHAEUSER PAPER COMPANY – ALAMEDA BOX PLANT

Warren Hansen in Seattle.

OVERVIEW

The purpose of this work plan is to describe the proposed approach for a human-health risk-based evaluation of residual contaminants at the Alameda Box Plant site. The site has been proposed to the Alameda County Health Agency for closure and the agency has requested this evaluation as part of its final review. This work plan includes a summary of available data on contaminants and site conditions, description of applicable pathways of exposure, assumed future land-use/exposure scenarios, and proposed contaminant transport/exposure models to be included in the evaluation.

As describe herein, the following exposure pathways and scenarios are proposed for evaluation under a Tier-2 Risk Based approach as per ASTM Guidance (ASTM 1994):

- Groundwater-to-ambient air – residential exposure scenario (child and adult)
- Groundwater-to-indoor air – residential exposure scenario (child and adult)
- Direct Contact with subsurface soil – worker scenario

x Soil Vapors to indoor and to ambient air - residential exposure (Most SS [?] below GW use soil data from above avg GWE in MW-3/B)

The Farmer or Thibodeaux-Hwang models included in the ASTM guidance are proposed as alternate means for estimating the groundwater-to-soil surface flux terms. If the Farmer Model is used, an additional term representing first-order decay will be included, as this is appropriate for the limited (remaining) contaminant mass at the site (details regarding the Tier-2 models are provided below). The Thibodeaux Hwang model also assumes a finite contaminant source. The ASTM Box Model will be used to estimate ambient air concentrations in the air column above the soil surface. The Johnson & Ettinger model as set forth in the RBCA guidance and the Task Group Work Book (ASTM RBCA Task Group 1995) will be used to provide a soil-to-indoor air flux term. Human health risk exposure assumptions set forth in the Risk Assessment Guidance (EPA 1989) will be used to establish Risk-Based Screening Levels (RBSLs) for air and soil.

POST-REMEDIATION SITE DATA

Soil and groundwater sampling at the site indicate declining and residual contamination at low (post-remediation) levels (West & Associates 1999a, 1999b). Goundwater results obtained in February 1994 showed maximum TPH(gas) and benzene concentrations of 5,400 and 3,900 ug/l respectively in MW-3. Recent testing in two additional boreholes beneath the south side of the building foundation showed TPH(gas) = 4,520 ug/l and benzene at 13.7 ug/L in the shallow groundwater (depth, approximately 12-13 ft BGS). Most of the residual contamination at the site appears to be in the groundwater beneath the building; only extremely low concentrations of TPH and BTEX-related concentrations were present in the soil samples. Residual groundwater contaminants detected in the July 1999 sampling event are listed below:

- was soil sample taken from boreholes

* ASTM RBCA does not take child into consideration, only adults. Assume a risk of 10^{-5} and calculate backwards to determine SSTLs.

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GROUNDWATER ANALYTE	Borehole 9		Borehole 10	
	R/L (ug/L)	Result (ug/L)	R/L (ug/L)	Result (ug/L)
TPH as gasoline	50	392	200	4520
Benzene	0.5	3.8	0.5	13.7
Toluene	0.5	ND	0.5	3.8
Ethylbenzene	0.5	1.2	0.5	22.3
M&P-xylene	0.5	ND	0.5	3.0
1,1-Dichloroethane	0.5	34.7	0.5	6.1
1,1-Dichloroethene	0.5	0.6	0.5	ND
Trichloroethene	0.5	2.2	0.5	ND
1,1,2-Trichloroethane	0.5	1.7	0.5	ND

Date Sampled: 07/16/99.
ND = Not detected. Compound may be present at concentrations below reporting limit.
R/L= Reporting limit.
(Excelchem Environmental Labs 1999. – See original laboratory reports for analytical methods and other details.)

All TPH except that quantified as benzene will be assumed to consist of the TPH(gas) fraction with the most conservative (most toxic) provisional EPA inhalation reference dose: aromatic EC>10-12 fraction with an inhalation RfD of 0.05. use GW data from recent borehole and MW-3 (avg) or use max in MW-3 w/in 1998-1999.

APPLICABLE EXPOSURE PATHWAYS

Exposure pathways to be considered in the risk-based evaluation. Contaminated media of concern include deep soil and groundwater in a limited area of the site. Although there are trace contaminants remaining in soil, most of these are reportedly at a depth where direct contact (ingestion and dermal adsorption) is not likely to occur. The only exception would be where workers come into contact with soil during excavation (i.e., during residential construction). A worker scenario (adult – short-term exposure) will therefore be evaluated.

The only potential exposure route for contaminated groundwater is vapor migration to ambient and indoor air. The aquifer is not a potable resource (high salinity) and contaminants are not migrating laterally to surface waters (San Francisco Bay). The groundwater is not currently being extracted for any alternate non-potable uses (cooling water, agriculture, etc.)

Due to the long-term industrial nature of the site vicinity, an ecological risk assessment is not proposed as part of this work.

LAND USE/EXPOSURE ASSUMPTIONS

It is assumed the final land use will be residential. The conceptual site model assumes long-term potential exposure to both children and adults living on-site in a residential setting. The worker scenario will be included in the evaluation, since workers installing utilities and/or foundations may come into direct contact with deep soil. Excavation to the water table is not anticipated so direct contact with groundwater is not anticipated. Potential worker exposure to contaminants in vapors would be of a much more limited duration compared to on-site residents and can be controlled using protective measures, if necessary.

PROPOSED TRANSPORT MODELS AND ASSUMPTIONS

The only cross-media transport-related pathway is groundwater-to-air. Analytical models set forth by the ASTM RBCA Task Group (1995) for evaluating groundwater to ambient air and enclosed space volatilization are proposed for use in this analysis, with an additional term for first-order decay for biodegradable contaminants such as benzene and TPH fractions. One subsurface source-to-ambient air analysis is based on the Farmer Model which derives a flux term for subsurface sources to ambient air. A mixing term is added which allows for contaminant dispersion/dilution in the air column overlying the soil surface:

$$VF_{wamb} = \frac{H}{1+\left[\frac{U_a * \delta_a * L_{GW}}{W * D_{WS}^{eff}}\right]} * 10^3 * \left[1/\lambda - e^{-\lambda T}/\lambda\right]/T$$

The risk-based screening level in water (RBSLw) in mg/L is calculated by dividing the screening level in air (RBSLa) by the volatilization factor (VFwamb). The derivation of the effective diffusion coefficient between groundwater and the soil surface is provided in RBCA guidance. Specific variables are described in Table 1.

A similar model, which also assumes a finite contaminant source, is the Thibodeaux-Hwang model and may be employed in this analysis as an alternative to the modified Farmer model, if appropriate.

The Johnson & Ettinger model for subsurface source-to-indoor air makes use of the flux terms derived by subsurface source models such as the Farmer or Thibodeaux-Hwang models, with an additional flux term for soil gas moving into a structure through cracks in the foundation. The following example incorporates the Farmer model:

$$VFwesp = \frac{H * \left[\frac{D_{ws}^{eff}/L_{GW}}{ER * L_B}\right]}{1+\left[\frac{D_{ws}^{eff}/L_{GW}}{ER * L_B}\right]+\left[\frac{D_{ws}^{eff}/L_{GW}}{\left(D_{crack}^{eff} * L_{crack}\right) * \eta}\right]} * 10^3 * \left[1/\lambda - e^{-\lambda T}/\lambda\right]/T$$

The risk-based screening level in water (RBSLw) in mg/L is calculated by dividing the screening level in air (RBSLa) by the volatilization factor (VFwesp). The derivation of the effective diffusion coefficients between groundwater and soil surface (D_{ws}^{eff}) and through foundation cracks (D_{crack}^{eff}) is provided in RBCA guidance. Specific variables are described in Table 1.

The models will be exercised for all volatile contaminants and each result evaluated to be sure multiple compounds do not exceed the target hazard quotient (non-carcinogens) or allowable carcinogenic risk.

Definitions and candidate default and site-specific values for the model variables are provided in Table 1.

PROPOSED HEALTH RISK EXPOSURE ASSUMPTIONS

Risk-based Screening Levels (RBSLs) for contaminants in soil and air must be developed for comparison to estimated concentrations at the point(s) of exposure. Exposure assumptions that are proposed for air inhalation and direct contact are included in Table 1.

PRESENTATION OF RESULTS

The completed evaluation of risk-based closure will be contained in a written "Risked Based Closure" report. Tables (spreadsheet printouts) will be included to document all risk calculations. Assumptions and models used in the analysis and proposed in this plan will be documented and referenced.

REFERENCES

ASTM 1994. Emergency Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites (ES 38 – 94). American Society for Testing and Materials. Philadelphia, PA. July 1994.

ASTM RBCA Task Group 1995. RBCA State Risk Policy/Strategy Issues Workbook.

Johnson, P.C., and R.A. Ettinger. 1991. Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings. Environmental Science and Technology. Vol. 25. P. 1445-1452.

U.S. Environmental Protection Agency. 1994. Integrated Risk Information System (IRIS). Risk Assessment Office. Cincinnati, OH.

U.S. Environmental Protection Agency. 1989. Risk Assessment Guidance for Superfund. Volume I. Human Health Evaluation Manual, Part A. EPA/540/1-89/002. NTIS No. PB90-155581. Washington, DC.

West & Associates 1999a. Letter to L. Seto, Alameda County Health Agency from B.W. West. May 17, 1999.

West & Associates 1999b. Letter to L. Seto, Alameda County Health Agency from B. Mahoney. July 21, 1999

which COCs will be evaluated — VOCs/HVOCs

TABLE 1. Definitions and Candidate Default and Site-Specific Values for the Model Variables.

CONSTANTS				
H	Henry's Law constant	chem-spec.	(cm3-H20)/(cm2-air)	
u	viscosity of gas	1.80E-04	g/cm-s	J&E
Kd	soil-water sorption coeff	chem-spec.	ml/g	
Koc	carbon-water sorp coeff	chem-spec.	ml/g	
Dair	diffusion coeff in air	chem-spec.	cm2/s	
Dwtr	diffusion coeff in water	chem-spec.	cm2/s	
SITE-RELATED				
Foc	fraction of organic carbon	0.01	(fraction)	ASTM, 95
h-cap	thickness of capillary fringe	5	cm	ASTM, 95
h-v	thickness of vadose zone	288	cm	site-spec.
Oacap	vol air content in capillary fringe soil	0.038	(fraction)	ASTM, 95
Owcap	vol water content in cap fringe soil	0.342	(fraction)	ASTM, 95
Oas	vol air content in vadoza zone soil	0.26	(fraction)	ASTM, 95
Ows	vol water content in vadose zone soil	0.12	(fraction)	ASTM, 95
Ot	total soil porosity	0.38	(fraction)	= Oas + Ows
Pb	soil bulk density	1.7	g/cm3	ASTM, 95
k	soil permeability	1.00E-07	cm2	J&E
Lgw	depth to groundwater	288	cm	site-spec.
Ua	Wind speed above ground surface in mixing zone	225	cm/s	ASTM, 95
da	ambient air mixing zone height	200	cm	ASTM, 95
W	width of source area parallel to wind	1500	cm	ASTM, 95
STRUCTURAL-RELATED				
Ab	area of building	1.38E+06	cm2	J&E
Qbld	bldg ventilation rate	3.86E+04	cm3/s	calculated
Lcrack	thickness of foundation	19.2	cm	PJ
dP	building underpressure	1.00E+02	g/cm-s2	J&E
Xcrk	floor/wall seam perimeter	3400	cm	J&E
Zcrk	depth of crack below surface	200	cm	J&E
N	area of cracks/area of bldg	0.01	(fraction)	ASTM, 95
O-acrack	volumetric air content in crks	0.26	[cm3-air/cm3	ASTM, 95
O-wcrack	volumetric wtr content in crks	0.12	[cm3-wtr/cm:	ASTM, 95
ER	Air exchange rate	1.40E-04	l/s	ASTM, 95
LB	volume to infiltration ratio	200	cm	ASTM, 95
HEALTH RISK-RELATED				
CARCINOGENIC - RESIDENTIAL		ADULT	CHILD	
SF	slope factor (inhalation)	chem-spec.	chem-spec.	(mg/kg-day)-1
TR	Carcinogenic Target Risk	1.00E-06	1.00E-06	(fraction)
AT (carc)	averaging time - carc	70	6	years
BW	body weight	70	16	kg
IR	inhalation rate	20	15	m3/day
ED	exposure duration	30	6	years
EF	exposure frequency	350	350	days/yr
NON-CARCINOGENIC - RESIDENTIAL		ADULT	CHILD	
RfD (non ca	Non-carc Ref Dose (inhalation)	chem-spec.	chem-spec.	mg/kg-day
THQ (non-c	target hazard quotient	1	1	
AT (non car	averaging time - non-carc	30	6	years
BW	body weight	70	16	kg
IR	inhalation rate	20	15	m3/day
ED	exposure duration	30	6	years
EF	exposure frequency	350	350	days/yr
FIRST-ORDER DECAY COMPONENTS				
T	averaging time for fluxes	25	yr	ASTM, 95
T1/2	contaminant half-life	chem-spec.	yrs	
r	contaminant decay rate	chem-spec.	1/yr	calculated