Appendix H: RISC Output for Benzene and Xylene

SUMMARY OF CLEAN-UP LEVELS

Clean-up Levels in Surface Soil Receptor: Child Resident - Typical	SSTLs [mg/kg]
Benzene	8.1E+02
Xylenes	4.2E+04

The exposure routes that depend on this source are:
Ingestion of soil
Dermal contact with soil

Vapor Model Soil Source

The receptor considered is: Child Resident - Typical

Exposure pathways depending on this source:
Inhalation of indoor air

Summary of Original Source Conditions for Vapor Model Soil Source

	Original Source Conc [mg/kg]	Solubility [mg/l]	Residual Conc. [mg/kg]
Benzene	1.1E+00	1.8E+03	3.7E+02
Xylenes	2.0E+01	2.0E+02	1.2E+02

Site-Specific Target Levels (SSTLs) for Vapor Model Soil Source

	SSTL [mg/kg]
Benzene	1.1E+00
Xylenes	2.0E+01

Title:
New Project
09/30/05 11:39

Scenarios:
Child Resident - Typical

Routes:
INGESTION OF SOIL
DERMAL CONTACT WITH SOIL
INHALATION OF INDOOR AIR

Chemicals:
Benzene
Xylenes

SUMMARY OF INPUT PARAMETERS	SCENARIO: 1
LIFETIME AND BODY WEIGHT	
Body Weight (kg)	11.1
Lifetime (years)	70.0
INGESTION OF SOIL	
Soil Ingestion Rate (mg/day)	109.
Exp. Frequency Soil (events/year)	130.
Exp. Duration Soil (years)	6.00
Absorption Adjustment Factor for Ingestion of Soil (-)	
Benzene	1.0
Xylenes	1.0
Soil Bioavailability (-)	
Benzene	1.0
Xylenes	1.0
DERMAL CONTACT WITH SOIL	
Total Skin Surface Area (cm^2)	6.176E+03
Fraction Skin Exposed to Soil (-)	0.225
Adherence Factor for Soil (mg/cm^2)	0.200
Exposure Freq. Soil (events/year)	130.
Exposure Duration Soil (years)	6.00
Absorption Adjustment Factor for Dermal Exposure to Soil (-)	
Benzene	0.10
Xylenes	0.10
Soil Bioavailability (-)	
Benzene	1.0
Xylenes	1.0
INHALATION OF INDOOR AIR	
Inhalation rate (m^3/hr)	0.150
Time indoors (hours/day)	20.7
Lung Retention Factor (-)	1.00
Exp. Freq. Indoor Air (events/yr)	365.
Exp. Duration Indoor Air (yr)	6.00
Absorption Adjustment Factor for Inhalation (-)	
Benzene	1.0
Xylenes	1.0

MEDIA CONCENTRATIONS

Concentration in Surficial Soil (mg/kg)	
- Used to calculate risk and hazard index.	
Benzene	8.09E+02
Xylenes	4.19E+04
Concentration in Indoor Air (mg/m^3)	
Obtained from Fate and Transport output	
AVERAGE Concentration (over exposure duration)	
(used to calculate carcinogenic risk)	
Exposure Duration (years)	6.0
Benzene	3.10E-02
Xylenes	0.22
Concentration used to calculate hazard index	
(Averaged over 7 years or exposure duration, if less than 7 years)	
Exposure Duration (years)	6.0
Benzene	3.10E-02
Xylenes	0.22

SLOPE FACTORS AND REFERENCE DOSES

Ingestion Slope Factor [1/(mg/kg-day)]	
Benzene	3.40E-02
Xylenes	ND
Ingestion Reference Dose (mg/kg-day)	
Benzene	4.00E-03
Xylenes	0.18
Inhalation Slope Factor [1/(mg/kg-day)]	
Benzene	1.10E-02
Xylenes	ND
Inhalation Reference Dose (mg/kg-day)	
Benzene	8.60E-03
Xylenes	6.10E-02
Dermal Slope Factor [1/(mg/kg-day)]	
Benzene	2.90E-02
Xylenes	ND
Dermal Reference Dose (mg/kg-day)	
Benzene	4.00E-03
Xylenes	0.20

SUMMARY OF RESULTS

INGESTION OF SOIL

Daily Doses and Risk for : Benzene	
CADD (mg/kg-day)	2.82E-03
LADD (mg/kg-day)	2.41E-04
Cancer Risk (-)	8.209E-06
Hazard Index (-)	7.042E-01
Daily Doses and Risk for : Xylenes	
CADD (mg/kg-day)	1.46E-01
LADD (mg/kg-day)	1.25E-02
Cancer Risk (-)	0.000E+00
Hazard Index (-)	8.150E-01

DERMAL CONTACT WITH SOIL

Daily Doses and Risk for : Benzene	
CADD (mg/kg-day)	7.18E-04
LADD (mg/kg-day)	6.16E-05
Cancer Risk (-)	1.785E-06
Hazard Index (-)	1.795E-01
Daily Doses and Risk for : Xylenes	
CADD (mg/kg-day)	3.72E-02
LADD (mg/kg-day)	3.19E-03
Cancer Risk (-)	0.000E+00
Hazard Index (-)	1.860E-01

INHALATION OF INDOOR AIR

Daily Doses and Risk for : Benzene

CADD (mg/kg-day)	8.61E-03
LADD (mg/kg-day)	7.38E-04
Cancer Risk (-)	8.121E-06
Hazard Index (-)	1.002E+00

Daily Doses and Risk for : Xylenes

CADD (mg/kg-day)	6.10E-02
LADD (mg/kg-day)	5.22E-03
Cancer Risk (-)	0.000E+00
Hazard Index (-)	9.992E-01

FATE AND TRANSPORT MODEL OUTPUT FOR: Benzene

Start of model output for:
Johnson and Ettinger Indoor air model
with volatile emissions from soil

Calculating Vapor Phase Concentration at Source:
(Using Equilibrium Partitioning Equation)

Inputs:

Total concentration in soil [mg/kg].....	1.1
Total porosity [-].....	0.30
Air content [-].....	0.18
Moisture content [-].....	0.12
Fraction organic carbon [-].....	2.00E-03
Organic carbon partitioning coeff. [ml/g]...	59.
Soil bulk density [g/cm3].....	1.7
Henrys Law coeff. [-].....	0.23
Chemical solubility [mg/l].....	1.75E+03

Outputs:

Calculated dissolved phase conc. [mg/l].....	5.1
Effective solubility [mg/l].....	1.75E+03

Source concentration is BELOW residual limit
because calculated dissolved phase conc.
is LESS than the effective solubility.

Dissolved phase conc. at source [mg/l].....	5.1
Source vapor concentration [g/cm^3].....	1.16E-06
Source vapor concentration [mg/m^3].....	1.16E+03
Residual level [mg/kg].....	3.72E+02

(assuming pure chemical solubility)

VAPOR TRANSPORT FROM SOIL TO INDOOR AIR USING THE JOHNSON-ETTINGER MODEL

Effective Diffusion Coefficient for Vadose zone

Total thickness of subunit [cm].....	50.
Air-filled porosity [-].....	0.18
Water-filled porosity [-].....	0.12
Total porosity [-].....	0.30
Effective diff. coeff. for subunit....[cm^2/s]	3.22E-03

Effective Diffusion Coefficient for Foundation

Total thickness of subunit [cm].....	15.
Air-filled porosity [-].....	0.25
Water-filled porosity [-].....	0.0
Total porosity [-].....	0.25
Effective diff. coeff. for subunit....[cm^2/s]	1.39E-02

Contaminant Flux Into Building

Soil gas flow rate [cm3/sec].....	0.24
Diffusive (x-sectional) area for flux [m^2]...	1.50E+02
Conc. in soil vapor at foundation [g/cm3].....	1.14E-06
Conc. in soil vapor " " [mg/m3].....	1.14E+03
Flux rate into building [g/cm^2/s].....	1.15E-12
Flux rate " " [mg/m^2/d].....	0.99
Attenuation Coefficient [-].....	2.68E-05

(Indoor Air Conc./Conc. in soil vapor at the source)

Source concentration [g/cm3].....	1.16E-06
Source " [mg/m3].....	1.16E+03
Indoor air concentration [g/cm3].....	3.10E-11
Indoor " " [mg/m3].....	3.10E-02

CONCENTRATION IN BUILDING (annual average)
Benzene

Time (yr)	Flux into Building (mg/m^2/day)	Concentration in Building (mg/m^3)	Soil Gas Conc. at Building (mg/m^3)
1.0	9.92E-01	3.10E-02	1.14E+03

The concentration is constant (steady-state model)