Technical Memorandum
Superfund JE Model Spreadsheet Error
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1. Summary

An error was recently discovered in one of the cells of the GW-Screen-040903 version of the US EPA Superfund version of the Johnson and Ettinger Model[1]. Some of the California DTSC versions of the JE model are affected as well (see Table 1, below). The cell formula error causes the capillary zone total porosity to be the same as vadose zone, even if different soil types are selected. Therefore, this error only affects the calculations if the vadose zone and capillary zone soils are different. Although in most cases the difference in results is small, in some cases it can be more significant.

2. Detailed Description

Cell H10 in sheet INTERCALCS, defining the capillary zone soil moisture, is currently DATAENTER!J44. However, Cell J44 in sheet DATAENTER is the user entered vadose zone soil porosity. The correct formula for cell H10 is as follows:

=VLOOKUP(DATENTER!G29,Soil_Data,6,FALSE).

This formula looks up the capillary zone total porosity based on the user entered capillary zone soil type (cell G29 in sheet DATAENTER).

3. Known versions of the JE model affected

GW-adv version is not affected because of its formulation for soil stratigraphy. **Soil-gas** versions of the model are not affected because they do not consider the capillary zone.

Table 1. Model versions affected by spreadsheet model error.

Source	Website	Spreadsheet Name	Description
USEPA	http://www.epa.gov/superfund/programs/risk/airmodel/johnson_ettinger.htm	GW-SCREEN-040903.xls	Basic groundwater screening spreadsheet.
Cal. DTSC	http://www.dtsc.ca.gov/science technology/je_models.html	Screen_Level_Model_Groundwater_Coarse_Soil.xls* Screen_Level_Model_Groundwater_Fine_Soil.xls** Screen_Level_Model_Groundwater_Unclassified_Soil.xls	California specific basic groundwater screening spreadsheets.

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[1] Helen Dawson, US EPA Region 8, personal communication.

*As configured, spreadsheet avoids error (vadose zone / capillary zone soil types identical).
**As configured, spreadsheet subject to error (vadose zone / capillary zone soil types are different).

4. Test Case

A suite of model runs was performed using different soil types to gauge the impact of this error. The model was run using TCE and a set of default parameters (see Appendix A). Tables 2 and 3 indicate the relative effects on indoor exposure groundwater concentrations for different soil type combinations.

Table 2. Results of JE Spreadsheet Model Error Comparison Study.

Run	Vadose Zone Soil Type	Capillary Zone Soil Type	Final indoor exposure groundwater conc., (μg/L)	Final indoor exposure groundwater conc., (μg/L) (with error)	% Difference
1	Sand	Sand	0.11	0.11	0%
2	Sand	Loamy Sand	0.23	0.35	52%
3	Sand	Sandy Loam	0.58	0.93	60%
4	Sand	Loam	0.87	2.40	175%
5	Loamy Sand	Sand	0.11	0.10	-12%
6	Loamy Sand	Loamy Sand	0.24	0.24	0%
7	Loamy Sand	Sandy Loam	0.58	0.52	-10%
8	Loamy Sand	Loam	0.88	1.25	43%
9	Sandy Loam	Sand	0.12	0.11	-9%
10	Sandy Loam	Loamy Sand	0.24	0.26	7%
11	Sandy Loam	Sandy Loam	0.59	0.59	0%
12	Sandy Loam	Loam	0.89	1.42	60%
13	Loam	Sand	0.14	0.12	-14%
14	Loam	Loamy Sand	0.27	0.22	-16%
15	Loam	Sandy Loam	0.61	0.42	-31%
16	Loam	Loam	0.90	0.90	0%

Table 3. Matrix of JE Error Effect on Final Indoor Exposure Groundwater Concentration (Percent Error)

		Capillary Zone Soil Type			
		Sand	Loamy Sand	Sandy Loam	Loam
Vadose Zone Soil Type	Sand	0%	52%	60%	175%
	Loamy Sand	-12%	0%	-10%	43%
	Sandy Loam	-9%	7%	0%	60%
	Loam	-14%	-16%	-31%	0%

Appendix A. Model Inputs.

GW-SCREEN	CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)						
Version 3.0; 04/03							
		YES	X				
			OR				
		CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION					
		(enter "X" in "YES" box and initial groundwater conc. below)					
		YES					
		ENTER	**ENTER**				
			Initial				
		Chemical	groundwater				
		CAS No.	conc.,				
		(numbers only,	CW				
		no dashes)	(µg/L)	Chemical			
		79016		Trichloroethylene			
		ENTER	**ENTER**	**ENTER**	**ENTER**		
	MORE ↓	Depth					
		below grade			Average		
		to bottom	Depth		soil/		Average vapor
		of enclosed	below grade	SCS	groundwater		flow rate into bldg.
		space floor,	to water table,	soil type	temperature,		(Leave blank to calculate)
		LF	LWT	directly above	TS		Qsoil
		(cm)	(cm)	water table	(oC)		(L/m)
		200	400	S	10		5
	MORE ↓						
		ENTER		**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**
		Vadose zone		User-defined	Vadose zone	Vadose zone	Vadose zone	Vadose zone
		SCS		vandose zone	SCS	soil dry	soil total	soil water-filled
		soil type		soil vapor	soil type	bulk density,	porosity,	porosity,
		(used to estimate	OR	permeability,		$\rho_{\beta\varsigma}$	nV	$\theta_{\omega\varsigma}$
		soil vapor		kv				
		permeability)		(cm2)		(g/cm3)	(unitless)	(cm3/cm3)
		S			S	1.66	0.375	0.054
	MORE ↓						
		ENTER	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**
		Target	Target hazard	Averaging	Averaging		
		risk for	quotient for	time for	time for	Exposure	Exposure
		carcinogens,	noncarcinogens,	carcinogens,	noncarcinogens,	duration,	frequency,
		TR	THQ	ATC	ATNC	ED	EF
		(unitless)	(unitless)	(yrs)	(yrs)	(yrs)	(days/yr)
		1.0E-06	1	70	30	30	350
		Used to calculate risk-based					
		groundwater concentration.					
	END						

Figure 1. Model Inputs for Spreadsheet Model with Error.

GW-SCREEN		CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)					
Version 3.0; 04/03							
		YES	X				
			OR				
		CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION					
		(enter "X" in "YES" box and initial groundwater conc. below)					
		YES					
					Incremental	Hazard	
		ENTER	**ENTER**		Infinite	risk from	quotient
		Chemical	Initial groundwater		source bldg.	vapor intrusion to	from vapor intrusion to
		CAS No.	conc.,		conc.,	indoor air,	indoor air,
		(numbers only,	CW		Cbuilding	carcinogen	noncarcinogen
		no dashes)	(μg/L)	Chemical	(μg/m3)	(unitless)	(unitless)
		79016	6.60E-01	Trichloroethylene	2.1E-01	NA	NA
	MORE ↓	**ENTER** Depth below grade to bottom of enclosed space floor, LF (cm)	**ENTER** Depth below grade to water table, LWT (cm)	**ENTER** SCS soil type directly above water table	**ENTER** Average soil/ groundwater temperature, TS (oC)		**ENTER** Average vapor flow rate into bldg. (Leave blank to calculate) Qsoil (L/m)
		200	400	S	10		5
	MORE ↓	**ENTER** Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined vandose zone soil vapor permeability, kv (cm2)	**ENTER** Vadose zone SCS soil type	**ENTER** Vadose zone soil dry bulk density, $\rho\beta\varsigma$ (g/cm3)	**ENTER** Vadose zone soil total porosity, nV (unitless)	**ENTER** Vadose zone soil water-filled porosity, $\theta\omega\varsigma$ (cm3/cm3)
		S			S	1.66	0.375	0.054
	MORE ↓	**ENTER** Target risk for carcinogens, TR (unitless)	**ENTER** Target hazard quotient for noncarcinogens, THQ (unitless)	**ENTER** Averaging time for carcinogens, ATC (yrs)	**ENTER** Averaging time for noncarcinogens, ATNC (yrs)	**ENTER** Exposure duration, ED (yrs)	**ENTER** Exposure frequency, EF (days/yr)
		1.0E-06	1	70	30	30	350
		Used to calculate risk-based groundwater concentration.					
	END						

Figure 2. Model Inputs for Corrected Spreadsheet Model.