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NIROP FRIDLEY
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Minnesota Pollution Control Agency

December 27, 1996

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Commanding Officer
Southern Division
Naval Facilities Engineering Command
Attn.: Scott A. Glass, Code 18610
P.O. Box 190010
North Charleston, South Carolina 29419-9010

RE: Naval Industrial Reserve Ordnance Plant Superfund Site

Dear Mr. Glass:

The Minnesota Pollution Control Agency (MPCA) staff has established new soil cleanup numbers for Operable Unit 2 (OU2) for the Naval Industrial Reserve Ordnance Plant (NIROP) Superfund site pursuant to the Federal Facility Agreement, dated March 27, 1991, between the MPCA, the U.S. Environmental Protection Agency (EPA), and the U.S. Navy (Navy).

The soil cleanup numbers are found in Table 7 of Attachment I to this letter and were developed using the SESOIL modeling software.

As you are aware in the MPCA staff letter of July 26, 1996, the staff requested that the Navy delete sections of the OU3 Remedial Investigation/Feasibility Study Work Plan pertaining to the discussion of the MPCA staff soil cleanup model. This request was based upon the staff's belief that the former MPCA Soil Cleanup Model was outdated. The MPCA staff believes that the SESOIL modeling software has generated soil cleanup numbers that better reflect conditions at the NIROP site. However, the cleanup numbers reflect actual site data for OU2 provided by RMT, Inc. on behalf of the Navy. This OU2 data is of sufficient quality for development of valid cleanup numbers.

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The MPCA staff recommends delaying development of OU3 vadose zone soil cleanup numbers based on leaching of contaminants to ground water until OU3 site soil data is available.

If you have any questions regarding this letter, please me at (612) 296-7818.

Sincerely,

David N. Douglas
Project Manager
Response Unit I
Site Response Section
Ground Water and Solid Waste Division

DND:lkk

Enclosure

cc: Joel Murphy, Navy (w/ enclosure)
Thomas Bloom, EPA (w/ enclosure)
Mark Perry, Brown & Root Environmental (w/ enclosure)

Attachment I

Soil Cleanup Numbers for Operable Unit 2
of the Naval Industrial Reserve Ordnance Plant

Leaching Potential of Compounds from Naval Industrial Ordnance Plant Operable Unit 2 Soils

Introduction

This is a brief overview of the approach used to develop cleanup numbers for trichloroethylene (TCE), 1, 1, 1-trichloroethane (TCA), tetrachloroethylene (PCE) and dichloroethylene (DCE) in the Operable Unit 2 (OU2) soils at Naval Industrial Reserve Ordnance Plant (NIROP). Soil type, chemical concentrations by depth, soil organic carbon concentrations by depth, and dilution values are briefly discussed and referenced. This is not intended as a detailed discussion of soil modeling, the SESOIL model, or the derivations for model default values which are beyond the scope of this summary.

The MPCA staff recognizes that no model can yield numbers that are infallible in predicting the soil concentration of a compound that, once exceeded, will impact soil by leaching from the soil. However, because remedial decisions for a site rest largely on the risk contaminants in the soil pose to underlying ground water, it is imperative to adopt some modeling approach to develop realistic contaminant-specific cleanup numbers for the soil. We have adopted the SESOIL model as a reasonable and necessary approach to the development of these numbers. In addition, a reasonable dilution term for the leachate is incorporated that is representative of aquifer conditions while protecting ground water as a resource.

The SESOIL model is based on an adsorption-desorption understanding of contaminant transport in the subsurface soil (Cl=Cs*Kd, where Cl is the leachate concentration, Cs is the chemical concentration in soil, and Kd is the chemical specific adsorption constant), and accommodates data representative of four layers, with the option of further dividing each layer into ten sublayers. The model considers chemical concentration, organic matter (each by sublayer), soil type, hydrologic data (site specific) partitioning coefficients, Henry's constant, biodegradation rates, volatility, and other chemical data to predict leachate concentrations exiting from each sublayer. Our primary concern is with the leachate emanating from the lowest sublayer that enters the groundwater. Hydrologic data and details concerning the calibration of the model with regional climatic data, though available for review, is beyond the scope of this summary. Information on details concerning the SESOIL model can be found elsewhere (1).

The dilution term, or dilution attenuation factor (DAF), is based upon site specific aquifer hydraulic conductivity, ground water gradient, depth of mixing in the ground water, the length of the contaminated source area, and the rate of hydraulic infiltration to the aquifer. Each of these values is discussed in the section below. The DAF term is used in conjunction with the leachate concentration predicted by SESOIL to derive a soil cleanup number for the site.

Discussion of Chemical and Site Specific Values used in the SESOIL Leaching Model

Soil data for the model was taken from the Remedial Investigation (RI) for the OU2 soils unit for NIROP (2). Soil samples were collected at roughly two foot intervals to ground water, resulting in depth profiles for TCE, TCA, PCE, and DCE, as well as for organic carbon. In addition, detailed soil boring logs are available that provide soil characteristics necessary for modeling. The hydraulic conductivity, hydraulic gradient, and source area length data were also obtained from the RI report. Other compound specific data, such as molecular weight, Henry's constant, and partitioning constants are found in supporting literature (3).

No biodegradation is assumed in these modeling efforts. Although certain rates can be assumed for simple aromatic compounds (most notably BTEX), chlorinated aliphatic compounds are more recalcitrant. Therefore, biodegradation is assumed to be zero unless site-specific microcosm data indicates otherwise.

Table 1 shows the maximum concentrations of TCE, TCA, PCE, and DCE (COCs) found by depth in the OU2 soils. It is important to note that these concentrations are not representative of one soil boring at the site, but are a compilation of the highest concentrations found by depth interval from the data. Though the results are not based on modeling the maximum values, it is useful to compare the results of the modeling with these numbers to gain perspective on how site conditions compare to the model derived cleanup numbers.

Table 2 shows the average concentrations of the COCs by depth in the OU2 soils, and is the data used in the modeling effort. As in Table 1, these are not representative of a single boring at the site. Figure 1 graphically represents the average concentration of the COCs as a function of depth for the OU2 soils.

As outlined above, SESOIL uses site-specific soil data in layers. Table 3 includes the data for the COC and total organic carbon (TOC) concentrations that were used in each of the four broad layers. These layers were defined by grouping similar TOC concentrations: layer 1, with the highest TOC value of 9918 parts per million (ppm) from one-three feet; layer 2, with the roughly similar 6143 and 4658 ppm values from three-eight feet; layer 3, with TOC concentrations of 3086 and 2209 ppm from eight-twelve feet; and the remaining fourth layer defined from 13-20 feet. Table 3 also lists the corresponding COC data by

depth (taken from Table 2). Each of these layers was further divided into ten sublayers as detailed in Table 4. (This data also appears in the data output file in Attachment 1, but is repeated in Table 4 for clarity.) Attachment 1 gives greater detail on particular data, including soil density, soil porosity values, COC solubility, diffusion coefficients, molecular weight, Henry's constants, and Koc values.

Soil boring logs indicate that the soil in OU2 is a coarse to silty poorly graded sand. The logs indicate the presence of clay in certain borings, but is intermittent in occurrence. The model was therefore run with data corresponding to a sandy soil.

The model runs simulated leaching over 25 years with a resolution of one month intervals. The leachate concentrations at the lowest soil sublayer as a function of time appear in Table 5, and plotted graphically against time in Figures 2 and 3. These data are plotted against time in Figure 2. Figure 3 plots PCE leachate alone against time on a different ordinate scale to give greater resolution to this COC leachate. The highest leachate concentration (*Csi*, shown at the top of Table 5) predicted over the 25 year simulation is carried forward in the development of the soil cleanup number.

Because the concentration of the leachate at the lowest soil layer is not indicative of the ground water concentration of that COC, a dilution term for the leachate has been factored into the leachate concentration. From the RI report, hydraulic conductivity for the shallow ground water was estimated at 6.62256×10^5 cm/year, and the hydraulic gradient estimated at 5×10^{-4} ft/ft. There is no data on the thickness of the shallow ground water unit at OU2. Recent seismic imaging data suggest that the ground water at 20 feet is in contact with the Prairie du Chien ground water. However, we have adopted a zone of mixing for the ground water at 12.5 feet, which is the default that is used in the calculation of the DAF term here. The infiltration rate to the ground water from the soil is 16.7 cm/year, based on climatological data and hydrological calibration of the model. The allowable zone of mixing is confined to the vertical boundaries of the source area (source area A), estimated at 2.4384×10^4 cm. The calculation of the DAF term is therefore estimated at 1.3 (Table 6).

To obtain an estimate of COC soil concentrations that will not result in the degradation of ground water above the Health Risk Limit (HRL), the ratio of the *Csi* to a representative present concentration of COC in the soil column (*Csf*) is found, then multiplied by the HRL:

$$(Csi/Csf)*\text{HRL} = \text{estimated soil cleanup number}$$

Csf was estimated by vertically averaging the values in Table 2 for each COC. Table 7 lists each of these values per COC, with the corresponding soil cleanup number appearing at the bottom of the table.

References:

1. The New SESOIL User's Guide. Stephen J. Scott and David M. Hetrick 1994. Available through the Wisconsin Department of Natural Resources, Madison, Wisconsin.

2. The Remedial Investigation Report for the Soils Operable Unit at the Naval Industrial Ordnance Plant, September 1993. RMT, Inc. Madison, Wisconsin.

3. Handbook of Environmental Fate and Exposure Data for Organic Chemicals. 1991. Philip H. Howard, ed. Lewis Publishers, Chelsea, Michigan.

Table 1. Maximum concentrations of trichloroethylene, tetrachloroethylene, dichloroethylene, and trichloroethane found in OU2 soil by depth.*

Soil Depth (ft)	TCE (ppb)	PCE (ppb)	TCA (ppb)	DCE (ppb)
3	37	3	2	3
5	110	9	9	32
8	6300	500	14000	62000
10	54000	130	0	0
12	15	3	0	8
15	45	2	0	0
18	28	110	0	9
20	220	9	0	69
22	230	39	0	130
24	57	25	1	19

* Data from: *Remedial Investigation Report for the Soils Operable Unit at the Naval Industrial Ordnance Plant*, September, 1993. Appendix E.

Table 2. Average concentrations of trichloroethylene, tetrachloroethylene, dichloroethylene, and trichloroethane in OU2 soil by depth.*

Soil Depth (ft)	TCE (ppb)	PCE (ppb)	TCA (ppb)	DCE (ppb)
3	21	3	2	3
5	55	7	8	32
8	4539	62	3508	12828
10	6858	36	0	0
12	5	2	0	8
15	13	2	0	0
18	7	39	0	6
20	1.5	6	0	69
22	39	10	0	35
24	24	9	0	10

* Derived from data in: *Remedial Investigation Report for the Soils Operable Unit at the Naval Industrial Ordnance Plant*, September, 1993. Appendix E.

Table 3. Model input values according to depth and model layer for total organic carbon (TOC) and concentrations of TCE, PCE, TCA, and DCE.

Model Layer*	Depth			TOC (ppm)			TCE (ppb)	PCE (ppb)	TCA (ppb)	DCE (ppb)
	(ft)	(cm)	Layer thickness (cm)	Soil Conc.	Ave.	Fraction	TCE (ppb)	PCE (ppb	TCA (ppb	DCE (ppb)
1	1-3	0-91	91	9918	9918	1.00	21	3	2	3
2	3-5	91-152	154	6143	5400	0.54	55	7	8	32
	5-8	152-244		4658			4513	62	3508	12828
3	8-10	244-305	122	3086	2674	0.26	6858	36	0	0
	10-12	305-366		2209			5	2	0	8
4	13-15	366-457	244	1377	2293	0.23	13	2	0	0
	16-18	366-548		3842			7	39	0	6
	18-20**	548-610		1660			1.5	6	0	69

* Each of the four layers are further subdivided into ten sublayers for modelling puprposes. See SESOIL model input sheets for specific values entered per sublayer.

** Water table assumed at 20 ft.

Table 4.

Layer	Sublayer	COC (in ppb) TCE	PCE	TCA	DCE	Fraction TOC*
1	1	21	3	2	3	1.0
	2	21	3	2	3	
	3	21	3	2	3	
	4	21	3	2	3	
	5	21	3	2	3	
	6	21	3	2	3	
	7	21	3	2	3	
	8	21	3	2	3	
	9	21	3	2	3	
	10	21	3	2	3	
2	1	55	7	8	32	0.54
	2	55	7	8	32	
	3	55	7	8	32	
	4	55	7	8	32	
	5	55	7	8	32	
	6	4513	62	3508	12828	
	7	4513	62	3508	12828	
	8	4513	62	3508	12828	
	9	4513	62	3508	12828	
	10	4513	62	3508	12828	
3	1	6858	36	0	0	0.26
	2	6858	36	0	0	
	3	6858	36	0	0	
	4	6858	36	0	0	
	5	6858	36	0	0	
	6	5	2	0	8	
	7	5	2	0	8	
	8	5	2	0	8	
	9	5	2	0	8	
	10	5	2	0	8	
4	1	13	2	0	0	0.23
	2	13	2	0	0	
	3	13	2	0	0	
	4	7	39	0	6	
	5	7	39	0	6	
	6	7	39	0	6	
	7	1.5	6	0	69	
	8	1.5	6	0	69	
	9	1.5	6	0	69	
	10	1.5	6	0	69	

* Sesoil utilizes TOC data as a fraction of the maximum value found in the soil. Thus, layer 1 has a value of 1.0, layer 2 a value of 9918/5400, or 0.54, and so on.

Table 5. SESOIL model results: leachate entering ground water versus time.

		Compound	TCE	PCE	DCE	TCA
		Max. Conc.	1.39E-02	7.68E-03	1.49E-01	0.00E+00
YEAR	MONTH	Total Months	Leachate (ppm)			
1	1	1	3.78E-03	6.53E-03	1.11E-01	0.00E+00
1	2	2	3.94E-03	6.68E-03	9.00E-02	0.00E+00
1	3	3	4.02E-03	6.67E-03	8.09E-02	0.00E+00
1	4	4	4.09E-03	6.71E-03	7.83E-02	0.00E+00
1	5	5	4.14E-03	6.73E-03	7.85E-02	0.00E+00
1	6	6	4.41E-03	7.27E-03	7.43E-02	0.00E+00
1	7	7	4.53E-03	7.45E-03	7.86E-02	0.00E+00
1	8	8	4.62E-03	7.68E-03	8.08E-02	0.00E+00
1	9	9	4.73E-03	7.53E-03	8.27E-02	0.00E+00
1	10	10	4.85E-03	6.98E-03	8.50E-02	0.00E+00
1	11	11	4.98E-03	6.39E-03	8.67E-02	0.00E+00
1	12	12	5.08E-03	5.74E-03	8.84E-02	0.00E+00
2	1	13	5.15E-03	5.15E-03	8.87E-02	0.00E+00
2	2	14	5.20E-03	4.68E-03	8.66E-02	0.00E+00
2	3	15	5.26E-03	4.15E-03	8.78E-02	0.00E+00
2	4	16	5.31E-03	3.69E-03	8.88E-02	0.00E+00
2	5	17	5.36E-03	3.24E-03	9.02E-02	0.00E+00
2	6	18	5.63E-03	3.09E-03	8.55E-02	0.00E+00
2	7	19	5.94E-03	2.80E-03	9.05E-02	0.00E+00
2	8	20	6.24E-03	2.55E-03	9.31E-02	0.00E+00
2	9	21	6.61E-03	2.33E-03	9.55E-02	0.00E+00
2	10	22	7.01E-03	2.12E-03	9.84E-02	0.00E+00
2	11	23	7.41E-03	1.93E-03	1.01E-01	0.00E+00
2	12	24	7.69E-03	1.72E-03	1.04E-01	0.00E+00
3	1	25	7.91E-03	1.54E-03	1.05E-01	0.00E+00
3	2	26	8.15E-03	1.40E-03	1.04E-01	0.00E+00
3	3	27	8.28E-03	1.24E-03	1.06E-01	0.00E+00
3	4	28	8.40E-03	1.10E-03	1.07E-01	0.00E+00
3	5	29	8.49E-03	9.67E-04	1.09E-01	0.00E+00
3	6	30	9.17E-03	9.23E-04	1.09E-01	0.00E+00
3	7	31	9.75E-03	8.35E-04	1.19E-01	0.00E+00
3	8	32	1.03E-02	7.61E-04	1.26E-01	0.00E+00
3	9	33	1.11E-02	6.97E-04	1.35E-01	0.00E+00
3	10	34	1.18E-02	6.34E-04	1.43E-01	0.00E+00
3	11	35	1.25E-02	5.75E-04	1.49E-01	0.00E+00
3	12	36	1.30E-02	5.15E-04	1.48E-01	0.00E+00
4	1	37	1.34E-02	4.60E-04	1.39E-01	0.00E+00
4	2	38	1.37E-02	4.18E-04	1.28E-01	0.00E+00
4	3	39	1.38E-02	3.70E-04	1.20E-01	0.00E+00
4	4	40	1.39E-02	3.29E-04	1.13E-01	0.00E+00
4	5	41	1.29E-02	2.89E-04	1.05E-01	0.00E+00
4	6	42	1.21E-02	2.76E-04	9.50E-02	0.00E+00

4	7	43	1.15E-02	2.49E-04	9.37E-02	0.00E+00
4	8	44	1.07E-02	2.27E-04	8.96E-02	0.00E+00
4	9	45	1.00E-02	2.08E-04	8.53E-02	0.00E+00
4	10	46	9.34E-03	1.89E-04	8.12E-02	0.00E+00
4	11	47	8.67E-03	1.72E-04	7.67E-02	0.00E+00
4	12	48	7.97E-03	1.54E-04	7.21E-02	0.00E+00
5	1	49	7.27E-03	1.37E-04	6.67E-02	0.00E+00
5	2	50	6.67E-03	1.25E-04	6.11E-02	0.00E+00
5	3	51	6.08E-03	1.10E-04	5.73E-02	0.00E+00
5	4	52	5.55E-03	9.81E-05	5.34E-02	0.00E+00
5	5	53	5.03E-03	8.62E-05	4.97E-02	0.00E+00
5	6	54	4.70E-03	8.23E-05	4.50E-02	0.00E+00
5	7	55	4.43E-03	7.44E-05	4.44E-02	0.00E+00
5	8	56	4.14E-03	6.78E-05	4.24E-02	0.00E+00
5	9	57	3.86E-03	6.20E-05	4.04E-02	0.00E+00
5	10	58	3.60E-03	5.65E-05	3.84E-02	0.00E+00
5	11	59	3.34E-03	5.12E-05	3.63E-02	0.00E+00
5	12	60	3.07E-03	4.58E-05	3.41E-02	0.00E+00
6	1	61	2.80E-03	4.10E-05	3.15E-02	0.00E+00
6	2	62	2.56E-03	3.72E-05	2.89E-02	0.00E+00
6	3	63	2.34E-03	3.29E-05	2.71E-02	0.00E+00
6	4	64	2.14E-03	2.93E-05	2.53E-02	0.00E+00
6	5	65	1.93E-03	2.57E-05	2.35E-02	0.00E+00
6	6	66	1.81E-03	2.45E-05	2.13E-02	0.00E+00
6	7	67	1.70E-03	2.22E-05	2.10E-02	0.00E+00
6	8	68	1.59E-03	2.02E-05	2.00E-02	0.00E+00
6	9	69	1.49E-03	1.85E-05	1.91E-02	0.00E+00
6	10	70	1.38E-03	1.68E-05	1.81E-02	0.00E+00
6	11	71	1.28E-03	1.53E-05	1.71E-02	0.00E+00
6	12	72	1.18E-03	1.37E-05	1.61E-02	0.00E+00
7	1	73	1.08E-03	1.22E-05	1.49E-02	0.00E+00
7	2	74	9.86E-04	1.11E-05	1.36E-02	0.00E+00
7	3	75	9.00E-04	9.79E-06	1.28E-02	0.00E+00
7	4	76	8.21E-04	8.70E-06	1.19E-02	0.00E+00
7	5	77	7.43E-04	7.64E-06	1.11E-02	0.00E+00
7	6	78	6.95E-04	7.29E-06	1.01E-02	0.00E+00
7	7	79	6.55E-04	6.59E-06	9.91E-03	0.00E+00
7	8	80	6.12E-04	6.00E-06	9.46E-03	0.00E+00
7	9	81	5.71E-04	5.49E-06	9.01E-03	0.00E+00
7	10	82	5.32E-04	4.99E-06	8.57E-03	0.00E+00
7	11	83	4.93E-04	4.52E-06	8.09E-03	0.00E+00
7	12	84	4.53E-04	4.04E-06	7.60E-03	0.00E+00
8	1	85	4.14E-04	3.61E-06	7.04E-03	0.00E+00
8	2	86	3.79E-04	3.28E-06	6.44E-03	0.00E+00
8	3	87	3.46E-04	2.89E-06	6.05E-03	0.00E+00
8	4	88	3.16E-04	2.57E-06	5.64E-03	0.00E+00
8	5	89	2.86E-04	2.25E-06	5.24E-03	0.00E+00
8	6	90	2.67E-04	2.15E-06	4.75E-03	0.00E+00
8	7	91	2.52E-04	1.94E-06	4.68E-03	0.00E+00

8	8	92	2.35E-04	1.76E-06	4.47E-03	0.00E+00
8	9	93	2.20E-04	1.61E-06	4.26E-03	0.00E+00
8	10	94	2.05E-04	1.46E-06	4.05E-03	0.00E+00
8	11	95	1.90E-04	1.32E-06	3.82E-03	0.00E+00
8	12	96	1.74E-04	1.18E-06	3.59E-03	0.00E+00
9	1	97	1.59E-04	1.05E-06	3.33E-03	0.00E+00
9	2	98	1.46E-04	9.51E-07	3.05E-03	0.00E+00
9	3	99	1.33E-04	8.36E-07	2.86E-03	0.00E+00
9	4	100	1.21E-04	7.39E-07	2.66E-03	0.00E+00
9	5	101	1.10E-04	6.45E-07	2.48E-03	0.00E+00
9	6	102	1.03E-04	6.11E-07	2.25E-03	0.00E+00
9	7	103	9.68E-05	5.49E-07	2.21E-03	0.00E+00
9	8	104	9.04E-05	4.95E-07	2.11E-03	0.00E+00
9	9	105	8.44E-05	4.49E-07	2.01E-03	0.00E+00
9	10	106	7.86E-05	4.04E-07	1.91E-03	0.00E+00
9	11	107	7.29E-05	3.62E-07	1.81E-03	0.00E+00
9	12	108	6.69E-05	3.20E-07	1.70E-03	0.00E+00
10	1	109	6.11E-05	2.83E-07	1.57E-03	0.00E+00
10	2	110	5.60E-05	2.51E-07	1.44E-03	0.00E+00
10	3	111	5.11E-05	2.18E-07	1.35E-03	0.00E+00
10	4	112	4.66E-05	1.90E-07	1.26E-03	0.00E+00
10	5	113	4.22E-05	1.62E-07	1.17E-03	0.00E+00
10	6	114	3.94E-05	1.51E-07	1.06E-03	0.00E+00
10	7	115	3.72E-05	1.32E-07	1.05E-03	0.00E+00
10	8	116	3.47E-05	1.16E-07	9.99E-04	0.00E+00
10	9	117	3.24E-05	1.01E-07	9.51E-04	0.00E+00
10	10	118	3.02E-05	8.66E-08	9.04E-04	0.00E+00
10	11	119	2.80E-05	7.30E-08	8.54E-04	0.00E+00
10	12	120	2.57E-05	6.10E-08	8.02E-04	0.00E+00
11	1	121	2.34E-05	5.02E-08	7.43E-04	0.00E+00
11	2	122	2.15E-05	4.11E-08	6.80E-04	0.00E+00
11	3	123	1.96E-05	3.24E-08	6.38E-04	0.00E+00
11	4	124	1.79E-05	2.55E-08	5.95E-04	0.00E+00
11	5	125	1.62E-05	1.94E-08	5.53E-04	0.00E+00
11	6	126	1.51E-05	1.53E-08	5.01E-04	0.00E+00
11	7	127	1.42E-05	9.80E-09	4.94E-04	0.00E+00
11	8	128	1.33E-05	4.80E-09	4.72E-04	0.00E+00
11	9	129	1.24E-05	2.00E-10	4.49E-04	0.00E+00
11	10	130	1.15E-05	1.00E-10	4.27E-04	0.00E+00
11	11	131	1.07E-05	1.00E-10	4.04E-04	0.00E+00
11	12	132	9.81E-06	1.00E-10	3.79E-04	0.00E+00
12	1	133	8.95E-06	1.00E-10	3.51E-04	0.00E+00
12	2	134	8.20E-06	1.00E-10	3.21E-04	0.00E+00
12	3	135	7.47E-06	1.00E-10	3.01E-04	0.00E+00
12	4	136	6.81E-06	1.00E-10	2.81E-04	0.00E+00
12	5	137	6.16E-06	1.00E-10	2.61E-04	0.00E+00
12	6	138	5.75E-06	1.00E-10	2.37E-04	0.00E+00
12	7	139	5.42E-06	1.00E-10	2.33E-04	0.00E+00
12	8	140	5.05E-06	1.00E-10	2.23E-04	0.00E+00

12	9	141	4.71E-06	1.00E-10	2.12E-04	0.00E+00
12	10	142	4.38E-06	1.00E-10	2.02E-04	0.00E+00
12	11	143	4.05E-06	1.00E-10	1.91E-04	0.00E+00
12	12	144	3.71E-06	1.00E-10	1.79E-04	0.00E+00
13	1	145	3.39E-06	1.00E-10	1.66E-04	0.00E+00
13	2	146	3.10E-06	1.00E-10	1.52E-04	0.00E+00
13	3	147	2.82E-06	1.00E-10	1.42E-04	0.00E+00
13	4	148	2.57E-06	1.00E-10	1.33E-04	0.00E+00
13	5	149	2.32E-06	1.00E-10	1.24E-04	0.00E+00
13	6	150	2.16E-06	1.00E-10	1.12E-04	0.00E+00
13	7	151	2.03E-06	1.00E-10	1.10E-04	0.00E+00
13	8	152	1.89E-06	1.00E-10	1.05E-04	0.00E+00
13	9	153	1.75E-06	1.00E-10	1.00E-04	0.00E+00
13	10	154	1.63E-06	1.00E-10	9.54E-05	0.00E+00
13	11	155	1.51E-06	1.00E-10	9.01E-05	0.00E+00
13	12	156	1.38E-06	1.00E-10	8.46E-05	0.00E+00
14	1	157	1.25E-06	1.00E-10	7.84E-05	0.00E+00
14	2	158	1.14E-06	1.00E-10	7.17E-05	0.00E+00
14	3	159	1.03E-06	1.00E-10	6.73E-05	0.00E+00
14	4	160	9.35E-07	1.00E-10	6.27E-05	0.00E+00
14	5	161	8.39E-07	1.00E-10	5.83E-05	0.00E+00
14	6	162	7.77E-07	1.00E-10	5.28E-05	0.00E+00
14	7	163	7.32E-07	1.00E-10	5.21E-05	0.00E+00
14	8	164	6.76E-07	1.00E-10	4.97E-05	0.00E+00
14	9	165	6.20E-07	1.00E-10	4.74E-05	0.00E+00
14	10	166	5.70E-07	1.00E-10	4.51E-05	0.00E+00
14	11	167	5.23E-07	1.00E-10	4.25E-05	0.00E+00
14	12	168	4.76E-07	1.00E-10	4.00E-05	0.00E+00
15	1	169	4.27E-07	1.00E-10	3.70E-05	0.00E+00
15	2	170	3.90E-07	1.00E-10	3.39E-05	0.00E+00
15	3	171	3.49E-07	1.00E-10	3.18E-05	0.00E+00
15	4	172	3.09E-07	1.00E-10	2.96E-05	0.00E+00
15	5	173	2.71E-07	1.00E-10	2.75E-05	0.00E+00
15	6	174	2.50E-07	1.00E-10	2.50E-05	0.00E+00
15	7	175	2.25E-07	1.00E-10	2.46E-05	0.00E+00
15	8	176	1.99E-07	1.00E-10	2.35E-05	0.00E+00
15	9	177	1.77E-07	1.00E-10	2.24E-05	0.00E+00
15	10	178	1.56E-07	1.00E-10	2.13E-05	0.00E+00
15	11	179	1.36E-07	1.00E-10	2.01E-05	0.00E+00
15	12	180	1.16E-07	1.00E-10	1.89E-05	0.00E+00
16	1	181	9.93E-08	1.00E-10	1.75E-05	0.00E+00
16	2	182	8.50E-08	1.00E-10	1.60E-05	0.00E+00
16	3	183	7.00E-08	1.00E-10	1.50E-05	0.00E+00
16	4	184	5.50E-08	1.00E-10	1.40E-05	0.00E+00
16	5	185	4.10E-08	1.00E-10	1.30E-05	0.00E+00
16	6	186	3.50E-08	1.00E-10	1.18E-05	0.00E+00
16	7	187	2.55E-08	1.00E-10	1.16E-05	0.00E+00
16	8	188	1.70E-08	1.00E-10	1.11E-05	0.00E+00
16	9	189	9.50E-09	1.00E-10	1.05E-05	0.00E+00

16	10	190	2.00E-09	1.00E-10	1.00E-05	0.00E+00
16	11	191	1.00E-10	1.00E-10	9.47E-06	0.00E+00
16	12	192	1.00E-10	1.00E-10	8.90E-06	0.00E+00
17	1	193	1.00E-10	1.00E-10	8.24E-06	0.00E+00
17	2	194	1.00E-10	1.00E-10	7.54E-06	0.00E+00
17	3	195	1.00E-10	1.00E-10	7.07E-06	0.00E+00
17	4	196	1.00E-10	1.00E-10	6.59E-06	0.00E+00
17	5	197	1.00E-10	1.00E-10	6.12E-06	0.00E+00
17	6	198	1.00E-10	1.00E-10	5.55E-06	0.00E+00
17	7	199	1.00E-10	1.00E-10	5.47E-06	0.00E+00
17	8	200	1.00E-10	1.00E-10	5.22E-06	0.00E+00
17	9	201	1.00E-10	1.00E-10	4.97E-06	0.00E+00
17	10	202	1.00E-10	1.00E-10	4.73E-06	0.00E+00
17	11	203	1.00E-10	1.00E-10	4.46E-06	0.00E+00
17	12	204	1.00E-10	1.00E-10	4.19E-06	0.00E+00
18	1	205	1.00E-10	1.00E-10	3.89E-06	0.00E+00
18	2	206	1.00E-10	1.00E-10	3.56E-06	0.00E+00
18	3	207	1.00E-10	1.00E-10	3.33E-06	0.00E+00
18	4	208	1.00E-10	1.00E-10	3.11E-06	0.00E+00
18	5	209	1.00E-10	1.00E-10	2.90E-06	0.00E+00
18	6	210	1.00E-10	1.00E-10	2.62E-06	0.00E+00
18	7	211	1.00E-10	1.00E-10	2.59E-06	0.00E+00
18	8	212	1.00E-10	1.00E-10	2.46E-06	0.00E+00
18	9	213	1.00E-10	1.00E-10	2.34E-06	0.00E+00
18	10	214	1.00E-10	1.00E-10	2.24E-06	0.00E+00
18	11	215	1.00E-10	1.00E-10	2.11E-06	0.00E+00
18	12	216	1.00E-10	1.00E-10	1.97E-06	0.00E+00
19	1	217	1.00E-10	1.00E-10	1.84E-06	0.00E+00
19	2	218	1.00E-10	1.00E-10	1.67E-06	0.00E+00
19	3	219	1.00E-10	1.00E-10	1.58E-06	0.00E+00
19	4	220	1.00E-10	1.00E-10	1.47E-06	0.00E+00
19	5	221	1.00E-10	1.00E-10	1.37E-06	0.00E+00
19	6	222	1.00E-10	1.00E-10	1.22E-06	0.00E+00
19	7	223	1.00E-10	1.00E-10	1.22E-06	0.00E+00
19	8	224	1.00E-10	1.00E-10	1.17E-06	0.00E+00
19	9	225	1.00E-10	1.00E-10	1.11E-06	0.00E+00
19	10	226	1.00E-10	1.00E-10	1.05E-06	0.00E+00
19	11	227	1.00E-10	1.00E-10	9.89E-07	0.00E+00
19	12	228	1.00E-10	1.00E-10	9.32E-07	0.00E+00
20	1	229	1.00E-10	1.00E-10	8.63E-07	0.00E+00
20	2	230	1.00E-10	1.00E-10	7.99E-07	0.00E+00
20	3	231	1.00E-10	1.00E-10	7.51E-07	0.00E+00
20	4	232	1.00E-10	1.00E-10	6.95E-07	0.00E+00
20	5	233	1.00E-10	1.00E-10	6.44E-07	0.00E+00
20	6	234	1.00E-10	1.00E-10	5.72E-07	0.00E+00
20	7	235	1.00E-10	1.00E-10	5.69E-07	0.00E+00
20	8	236	1.00E-10	1.00E-10	5.43E-07	0.00E+00
20	9	237	1.00E-10	1.00E-10	5.13E-07	0.00E+00
20	10	238	1.00E-10	1.00E-10	4.86E-07	0.00E+00

20	11	239	1.00E-10	1.00E-10	4.55E-07	0.00E+00
20	12	240	1.00E-10	1.00E-10	4.27E-07	0.00E+00
21	1	241	1.00E-10	1.00E-10	3.92E-07	0.00E+00
21	2	242	1.00E-10	1.00E-10	3.51E-07	0.00E+00
21	3	243	1.00E-10	1.00E-10	3.24E-07	0.00E+00
21	4	244	1.00E-10	1.00E-10	2.97E-07	0.00E+00
21	5	245	1.00E-10	1.00E-10	2.71E-07	0.00E+00
21	6	246	1.00E-10	1.00E-10	2.50E-07	0.00E+00
21	7	247	1.00E-10	1.00E-10	2.31E-07	0.00E+00
21	8	248	1.00E-10	1.00E-10	2.20E-07	0.00E+00
21	9	249	1.00E-10	1.00E-10	2.15E-07	0.00E+00
21	10	250	1.00E-10	1.00E-10	2.15E-07	0.00E+00
21	11	251	1.00E-10	1.00E-10	2.14E-07	0.00E+00
21	12	252	1.00E-10	1.00E-10	2.05E-07	0.00E+00
22	1	253	1.00E-10	1.00E-10	2.03E-07	0.00E+00
22	2	254	1.00E-10	1.00E-10	1.97E-07	0.00E+00
22	3	255	1.00E-10	1.00E-10	1.99E-07	0.00E+00
22	4	256	1.00E-10	1.00E-10	2.00E-07	0.00E+00
22	5	257	1.00E-10	1.00E-10	2.01E-07	0.00E+00
22	6	258	1.00E-10	1.00E-10	1.87E-07	0.00E+00
22	7	259	1.00E-10	1.00E-10	1.95E-07	0.00E+00
22	8	260	1.00E-10	1.00E-10	1.96E-07	0.00E+00
22	9	261	1.00E-10	1.00E-10	1.96E-07	0.00E+00
22	10	262	1.00E-10	1.00E-10	1.96E-07	0.00E+00
22	11	263	1.00E-10	1.00E-10	1.95E-07	0.00E+00
22	12	264	1.00E-10	1.00E-10	1.95E-07	0.00E+00
23	1	265	1.00E-10	1.00E-10	1.93E-07	0.00E+00
23	2	266	1.00E-10	1.00E-10	1.88E-07	0.00E+00
23	3	267	1.00E-10	1.00E-10	1.90E-07	0.00E+00
23	4	268	1.00E-10	1.00E-10	1.91E-07	0.00E+00
23	5	269	1.00E-10	1.00E-10	1.92E-07	0.00E+00
23	6	270	1.00E-10	1.00E-10	1.79E-07	0.00E+00
23	7	271	1.00E-10	1.00E-10	1.86E-07	0.00E+00
23	8	272	1.00E-10	1.00E-10	1.87E-07	0.00E+00
23	9	273	1.00E-10	1.00E-10	1.87E-07	0.00E+00
23	10	274	1.00E-10	1.00E-10	1.87E-07	0.00E+00
23	11	275	1.00E-10	1.00E-10	1.86E-07	0.00E+00
23	12	276	1.00E-10	1.00E-10	1.86E-07	0.00E+00
24	1	277	1.00E-10	1.00E-10	1.84E-07	0.00E+00
24	2	278	1.00E-10	1.00E-10	1.79E-07	0.00E+00
24	3	279	1.00E-10	1.00E-10	1.80E-07	0.00E+00
24	4	280	1.00E-10	1.00E-10	1.81E-07	0.00E+00
24	5	281	1.00E-10	1.00E-10	1.82E-07	0.00E+00
24	6	282	1.00E-10	1.00E-10	1.70E-07	0.00E+00
24	7	283	1.00E-10	1.00E-10	1.77E-07	0.00E+00
24	8	284	1.00E-10	1.00E-10	1.78E-07	0.00E+00
24	9	285	1.00E-10	1.00E-10	1.78E-07	0.00E+00
24	10	286	1.00E-10	1.00E-10	1.79E-07	0.00E+00
24	11	287	1.00E-10	1.00E-10	1.78E-07	0.00E+00

24	**12**	**288**	1.00E-10	1.00E-10	1.78E-07	0.00E+00
25	**1**	**289**	1.00E-10	1.00E-10	1.76E-07	0.00E+00
25	**2**	**290**	1.00E-10	1.00E-10	1.71E-07	0.00E+00
25	**3**	**291**	1.00E-10	1.00E-10	1.72E-07	0.00E+00
25	**4**	**292**	1.00E-10	1.00E-10	1.73E-07	0.00E+00
25	**5**	**293**	1.00E-10	1.00E-10	1.74E-07	0.00E+00
25	**6**	**294**	1.00E-10	1.00E-10	1.62E-07	0.00E+00
25	**7**	**295**	1.00E-10	1.00E-10	1.69E-07	0.00E+00
25	**8**	**296**	1.00E-10	1.00E-10	1.70E-07	0.00E+00
25	**9**	**297**	1.00E-10	1.00E-10	1.70E-07	0.00E+00
25	**10**	**298**	1.00E-10	1.00E-10	1.71E-07	0.00E+00
25	**11**	**299**	1.00E-10	1.00E-10	1.70E-07	0.00E+00
25	**12**	**300**	1.00E-10	1.00E-10	1.70E-07	0.00E+00

Table 6. Calculation of Dilution Term:

1. Dilution Factor: 1+ Kid/IL

K = Hydraulic conductivity
i = Hydraulic gradient
d = Depth of mixing in ground water
I = Infiltration rate to aquifer
L = Length of contaminant source area

2. NIROP data (from *Remedial Investigation Report for the Soils Operable Unit at the Naval Industrial Ordnance Plant, September, 1993)*

K = 662256 cm/yr
i = 0.0005 cm/cm
d = 12.5 feet*
I = 16.7 cm/yr*
L = 24384 cm

Kid/IL =(662256)(0.0005)(381)/(16.7)(24384) = **1.31**

Table 7. Calculation of Soil Cleanup Numbers

	Compound			
Term	TCE	PCE	DCE	TCA
Csi	1.156	0.0176	1.299	(No leaching predicted)
HRL	0.005	0.005	0.07	
Csf	0.01391	0.007681	0.149	
(Csi)(HRL)/(Csf)	0.415528	0.011457	0.610268	
DAF	1.31	1.31	1.31	
Soil Cleanup Number	**0.544342**	**0.015008**	**0.799452**	

Fig. 1. Actual Contaminant Concentrations in OU2 Soil (1991 data).

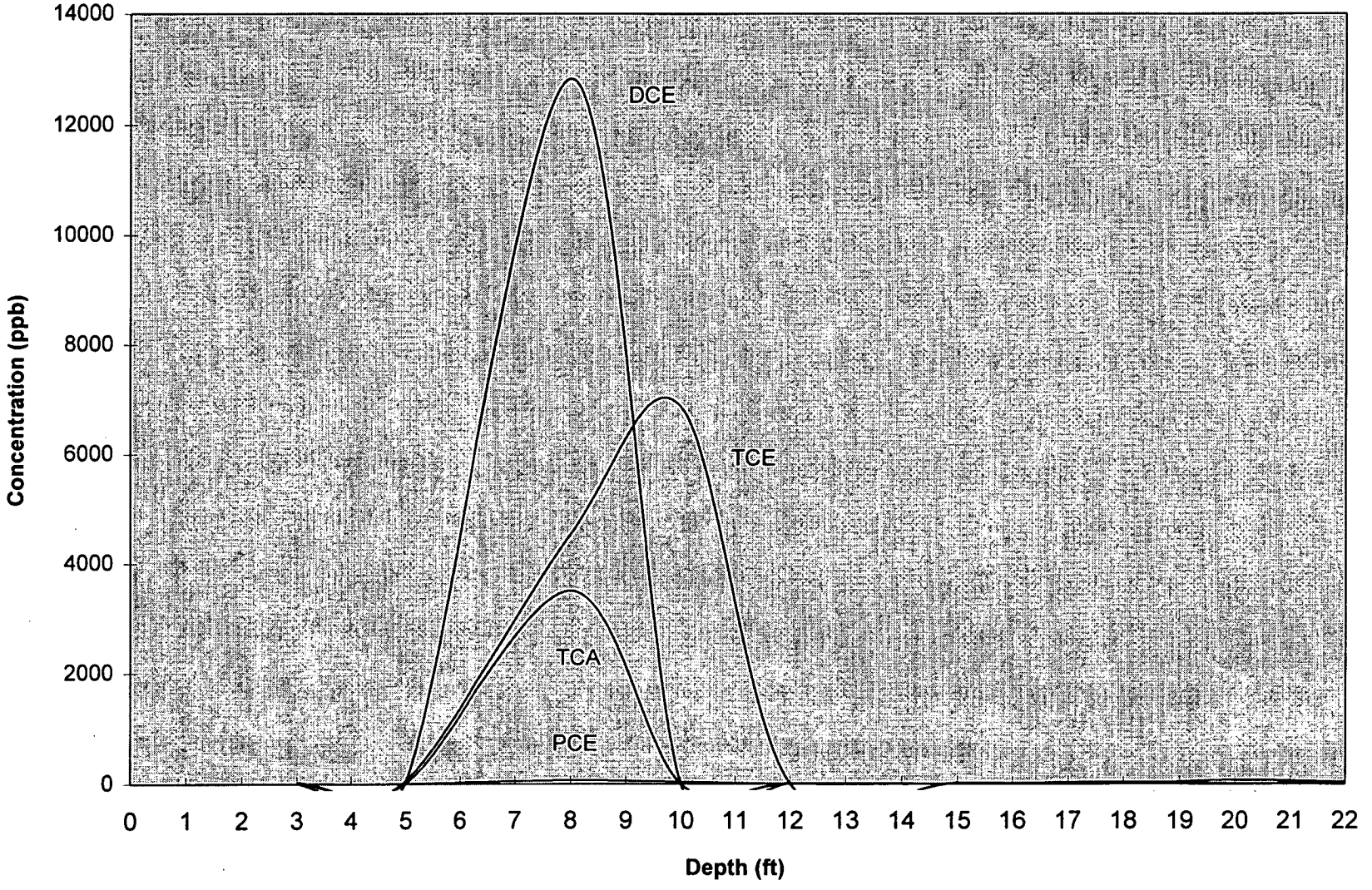


Fig. 2. Predicted Leachate at 20 ft (water table) versus Time

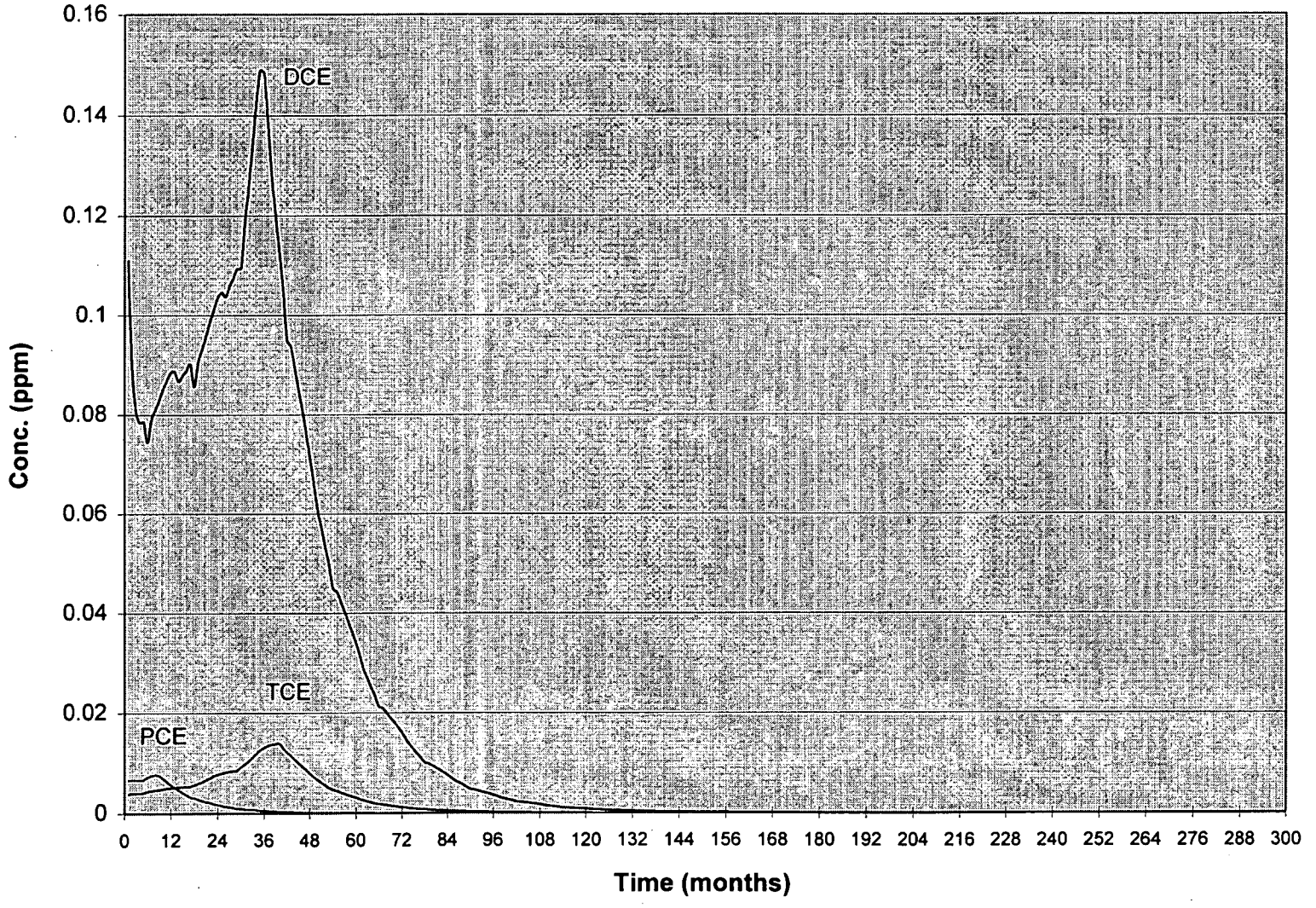


Fig. 3. Predicted PCE Leachate at 20 ft (water table) versus Time

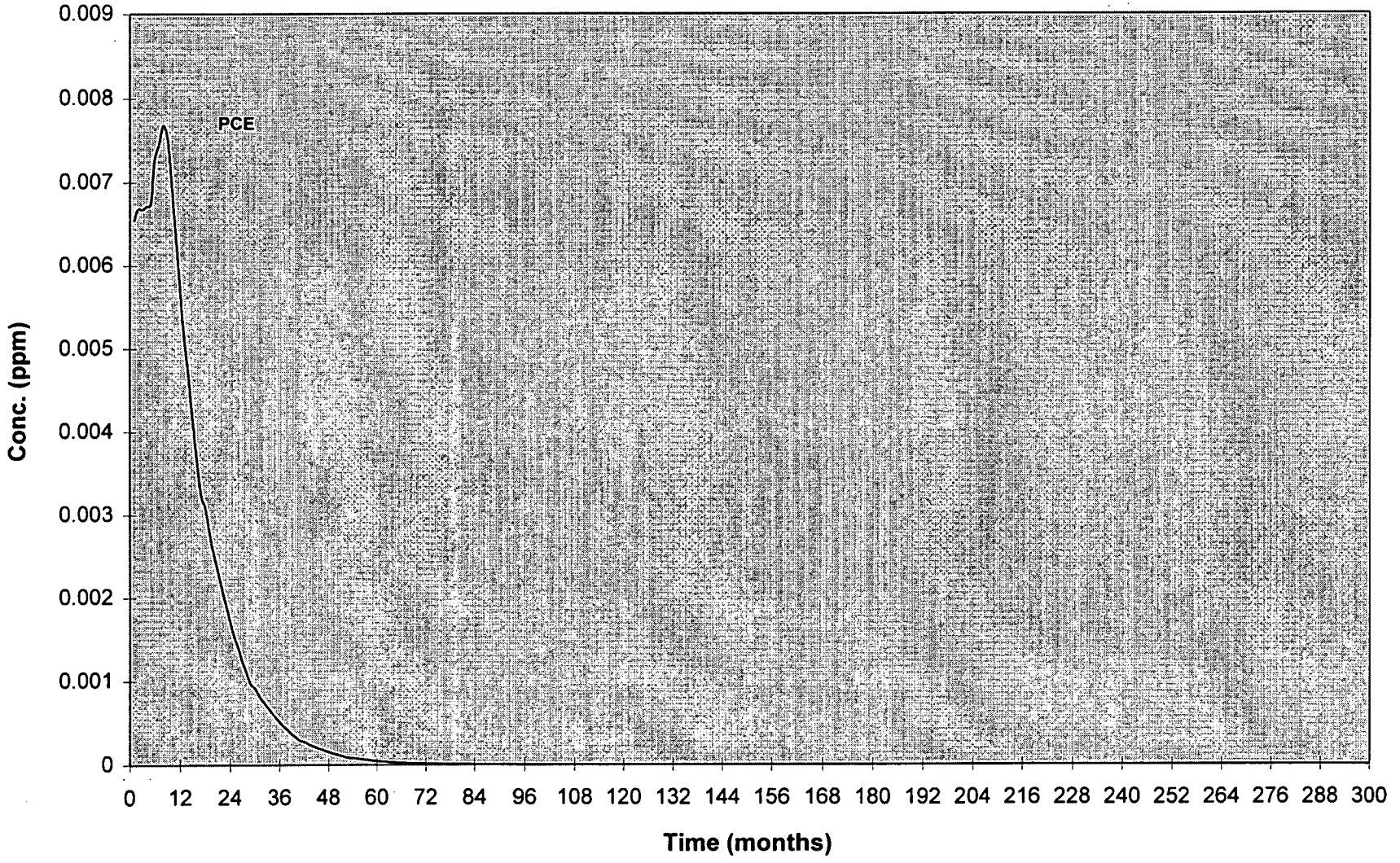
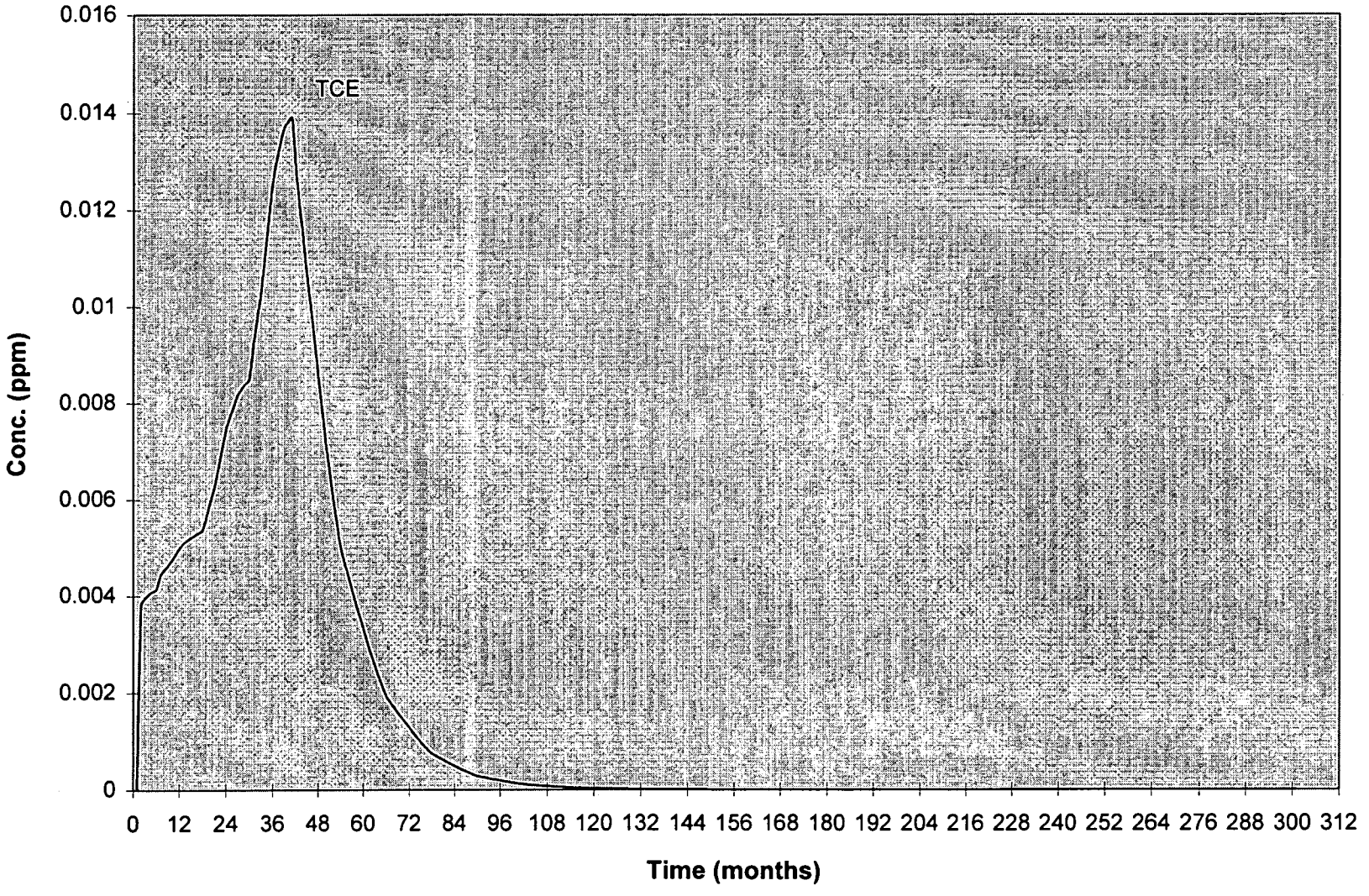


Fig. 4. Predicted TCE Leachate at 20 ft (water table) versus Time



ATTACHMENT 1

Specific soil and chemical SESOIL model input values

****** MONTHLY SESOIL MODEL OPERATION ******
MONTHLY SITE SPECIFIC SIMULATION

REGION : MINN-ST PAUL WSO AP
SOIL TYPE : sand
COMPOUND : TCE
WASHLOAD DATA :
APPLICATION AREA: NIROP TCE: Actual Site Concentrations by Depth

GENERAL INPUT PARAMETERS
==========

-- SOIL INPUT PARAMETERS --

SOIL DENSITY (G/CM**3): 1.60
INTRINSIC PERMEABILITY (CM**2): .000
DISCONNECTEDNESS INDEX (-): 4.70
POROSITY (-): .400
ORGANIC CARBON CONTENT (%): 1.00
CATION EXCHANGE CAPACITY (MILLI EQ./100G DRY SOIL): .000
FREUNDLICH EXPONENT (-): 1.00
1

-- CHEMICAL INPUT PARAMETERS --

SOLUBILITY (UG/ML): .110E+04
DIFFUSION COEFFICIENT IN AIR (CM**2/SEC): .810E-01
HENRYS LAW CONSTANT (M**3-ATM/MOLE): .117E-01
ADSORPTION COEFFICIENT ON ORGANIC CARBON(KOC): 171.
ADSORPTION COEFFICIENT ON SOIL (K): .000
MOLECULAR WEIGHT (G/MOL): 131.
VALENCE (-): .000
NEUTRAL HYDROLYSIS CONSTANT (/DAY): .000
BASE HYDROLYSIS CONSTANT (L/MOL-DAY): .000
ACID HYDROLYSIS CONSTANT (L/MOL-DAY): .000
DEGRADATION RATE IN MOISTURE (/DAY): .000
DEGRADATION RATE ON SOIL (/DAY): .000
LIGAND-POLLUTANT STABILITY CONSTANT (-): .000
NO. MOLES LIGAND/MOLE POLLUTANT (-): .000
LIGAND MOLECULAR WEIGHT (G/MOL): .000

-- APPLICATION INPUT PARAMETERS --

NUMBER OF SOIL LAYERS: 4
YEARS TO BE SIMULATED: 25
AREA (CM**2): 0.410E+08
APPLICATION AREA LATITUDE (DEG.): 44.9
SPILL (1) OR STEADY APPLICATION (0): 0
MODIFIED SUMMERS MODEL USED (1) OR NOT (0) FOR GWR. CONC.: 0

INITIAL CHEMICAL CONCENTRATIONS GIVEN (1) OR NOT GIVEN (0) 1
DEPTHS (CM): 91. 0.15E+03 0.12E+03 0.24E+03
NUMBER OF SUBLAYERS/LAYER 10 10 10 10
PH (CM): 0.00 0.00 0.00 0.00
INTRINSIC PERMEABILITIES (CM**2): 0.10E-07 0.10E-07 0.10E-07 0.10E-07
KDEL RATIOS (-): 1.0 1.0 1.0
KDES RATIOS (-): 1.0 1.0 1.0
OC RATIOS (-): 0.54 0.26 0.23
CEC RATIOS (-): 1.0 1.0 1.0
FRN RATIOS(-): 1.0 1.0 1.0
ADS RATIOS(-): 1.0 1.0 1.0
1

YEAR - 1 MONTHLY INPUT PARAMETERS
======== ==========

-- CLIMATIC INPUT PARAMETERS --

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
TEMP. (DEG C)	8.830	-0.830	-8.780	-12.390	-9.940	-3.280	6.000	12.610	17.890	20.830	19.830	14.280
CLOUD CVR (FRAC.)	0.550	0.700	0.600	0.700	0.600	0.600	0.600	0.600	0.600	0.500	0.550	0.600
REL. HUM.(FRAC.)	0.700	0.800	0.750	0.750	0.750	0.700	0.650	0.650	0.700	0.700	0.700	0.700
ALBEDO (-)	0.160	0.240	0.280	0.280	0.280	0.300	0.190	0.160	0.160	0.160	0.160	0.160
EVAPOT. (CM/DAY)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PRECIP. (CM)	4.790	3.680	0.500	0.500	0.500	10.260	5.320	8.210	9.950	8.950	9.070	6.110
M.TIME RAIN(DAYS)	0.460	0.530	0.480	0.460	0.470	0.610	0.510	0.400	0.330	0.250	0.320	0.370
M. STORM NO. (-)	3.440	3.030	2.780	2.340	2.170	3.830	4.690	6.630	6.800	5.600	5.890	5.220
M. SEASON (DAYS)	30.400	30.400	30.400	30.400	30.400	30.400	30.400	30.400	30.400	30.400	30.400	30.400

INITIAL POLLUTANT CONCENTRATIONS IN UG/ML,INPUT FOR MONTH 1 OF YEAR 1

LAYER 1:
SUBLAYER 1 2 3 4 5 6 7 8 9 10
INITIAL CONC. (UG/ML) 3.40E-02 3.40E-02 3.40E-02 3.40E-02 3.40E-02 3.40E-02 3.40E-02 3.40E-02 3.40E-02 3.40E-02

LAYER 2:
SUBLAYER 1 2 3 4 5 6 7 8 9 10

INITIAL CONC. (UG/ML) 8.80E-02 8.80E-02 8.80E-02 8.80E-02 8.80E-02 7.26E+00 7.26E+00 7.26E+00 7.26E+00 7.26E+00

LAYER 3:

SUBLAYER	1	2	3	4	5	6	7	8	9	10
INITIAL CONC. (UG/ML)	1.10E+01	1.10E+01	1.10E+01	1.10E+01	8.00E-03	8.00E-03	8.00E-03	8.00E-03	8.00E-03	8.00E-03

LAYER 4:

SUBLAYER	1	2	3	4	5	6	7	8	9	10
INITIAL CONC. (UG/ML)	2.10E-02	2.10E-02	2.10E-02	1.10E-02	1.10E-02	1.10E-02	3.20E-03	3.20E-03	3.20E-03	3.20E-03

****** MONTHLY SESOIL MODEL OPERATION ******
MONTHLY SITE SPECIFIC SIMULATION

REGION : MINN-ST PAUL WSO AP
SOIL TYPE : sand
COMPOUND : DCE
WASHLOAD DATA :
APPLICATION AREA: NIROP DCE: Actual soil concentrations by depth

GENERAL INPUT PARAMETERS
==========

-- SOIL INPUT PARAMETERS --

SOIL DENSITY (G/CM**3): 1.60
INTRINSIC PERMEABILITY (CM**2): .000
DISCONNECTEDNESS INDEX (-): 4.70
POROSITY (-): .400
ORGANIC CARBON CONTENT (%): 1.00
CATION EXCHANGE CAPACITY (MILLI EQ./100G DRY SOIL): .000
FREUNDLICH EXPONENT (-): 1.00
1

-- CHEMICAL INPUT PARAMETERS --

SOLUBILITY (UG/ML): 600.
DIFFUSION COEFFICIENT IN AIR (CM**2/SEC): .790E-01
HENRYS LAW CONSTANT (M**3-ATM/MOLE): .532E-02
ADSORPTION COEFFICIENT ON ORGANIC CARBON(KOC): 94.0
ADSORPTION COEFFICIENT ON SOIL (K): .000
MOLECULAR WEIGHT (G/MOL): 96.9
VALENCE (-): .000
NEUTRAL HYDROLYSIS CONSTANT (/DAY): .000
BASE HYDROLYSIS CONSTANT (L/MOL-DAY): .000
ACID HYDROLYSIS CONSTANT (L/MOL-DAY): .000
DEGRADATION RATE IN MOISTURE (/DAY): .000
DEGRADATION RATE ON SOIL (/DAY): .000
LIGAND-POLLUTANT STABILITY CONSTANT (-): .000
NO. MOLES LIGAND/MOLE POLLUTANT (-): .000
LIGAND MOLECULAR WEIGHT (G/MOL): .000

-- APPLICATION INPUT PARAMETERS --

NUMBER OF SOIL LAYERS: 4
YEARS TO BE SIMULATED: 25
AREA (CM**2): 0.410E+08
APPLICATION AREA LATITUDE (DEG.): 44.9
SPILL (1) OR STEADY APPLICATION (0): 0
MODIFIED SUMMERS MODEL USED (1) OR NOT (0) FOR GWR. CONC.: 0

INITIAL CHEMICAL CONCENTRATIONS GIVEN (1) OR NOT GIVEN (0) 1
DEPTHS (CM): 91. 0.15E+03 0.12E+03 0.24E+03
NUMBER OF SUBLAYERS/LAYER 10 10 10 10
PH (CM): 0.00 0.00 0.00 0.00
INTRINSIC PERMEABILITIES (CM**2): 0.10E-07 0.10E-07 0.10E-07 0.10E-07
KDEL RATIOS (-): 1.0 1.0 1.0
KDES RATIOS (-): 1.0 1.0 1.0
OC RATIOS (-): 0.54 0.26 0.23
CEC RATIOS (-): 1.0 1.0 1.0
FRN RATIOS(-): 1.0 1.0 1.0
ADS RATIOS(-): 1.0 1.0 1.0
1

YEAR - 1 MONTHLY INPUT PARAMETERS
======== ==========

-- CLIMATIC INPUT PARAMETERS --

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
TEMP. (DEG C)	8.830	-0.830	-8.780	-12.390	-9.940	-3.280	6.000	12.610	17.890	20.830	19.830	14.280
CLOUD CVR (FRAC.)	0.550	0.700	0.600	0.700	0.600	0.600	0.600	0.600	0.600	0.500	0.550	0.600
REL. HUM.(FRAC.)	0.700	0.800	0.750	0.750	0.750	0.700	0.650	0.650	0.700	0.700	0.700	0.700
ALBEDO (-)	0.160	0.240	0.280	0.280	0.280	0.300	0.190	0.160	0.160	0.160	0.160	0.160
EVAPOT. (CM/DAY)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PRECIP. (CM)	4.790	3.680	0.500	0.500	0.500	10.260	5.320	8.210	9.950	8.950	9.070	6.110
M.TIME RAIN(DAYS)	0.460	0.530	0.480	0.460	0.470	0.610	0.510	0.400	0.330	0.250	0.320	0.370
M. STORM NO. (-)	3.440	3.030	2.780	2.340	2.170	3.830	4.690	6.630	6.800	5.600	5.890	5.220
M. SEASON (DAYS)	30.400	30.400	30.400	30.400	30.400	30.400	30.400	30.400	30.400	30.400	30.400	30.400

INITIAL POLLUTANT CONCENTRATIONS IN UG/ML,INPUT FOR MONTH 1 OF YEAR 1

LAYER 1:

SUBLAYER	1	2	3	4	5	6	7	8	9	10
INITIAL CONC. (UG/ML)	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03

LAYER 2:

SUBLAYER	1	2	3	4	5	6	7	8	9	10

INITIAL CONC. (UG/ML) 5.10E-02 5.10E-02 5.10E-02 5.10E-02 5.10E-02 2.05E+01 2.05E+01 2.05E+01 2.05E+01 2.05E+01

LAYER 3:

SUBLAYER	1	2	3	4	5	6	7	8	9	10
INITIAL CONC. (UG/ML)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.30E-02	1.30E-02	1.30E-02	1.30E-02	1.30E-02

LAYER 4:

SUBLAYER	1	2	3	4	5	6	7	8	9	10
INITIAL CONC. (UG/ML)	0.00E+00	0.00E+00	0.00E+00	9.60E-03	9.60E-03	9.60E-03	1.10E-01	1.10E-01	1.10E-01	1.10E-01

****** MONTHLY SESOIL MODEL OPERATION ******
MONTHLY SITE SPECIFIC SIMULATION

REGION : MINN-ST PAUL WSO AP
SOIL TYPE : sand
COMPOUND : TCA
WASHLOAD DATA :
APPLICATION AREA: NIROP TCA: Actual soil concentration by depth

GENERAL INPUT PARAMETERS
==========

-- SOIL INPUT PARAMETERS --

SOIL DENSITY (G/CM**3): 1.60
INTRINSIC PERMEABILITY (CM**2): .000
DISCONNECTEDNESS INDEX (-): 4.70
POROSITY (-): .400
ORGANIC CARBON CONTENT (%): 1.00
CATION EXCHANGE CAPACITY (MILLI EQ./100G DRY SOIL): .000
FREUNDLICH EXPONENT (-): 1.00
1

-- CHEMICAL INPUT PARAMETERS --

SOLUBILITY (UG/ML): .149E+04
DIFFUSION COEFFICIENT IN AIR (CM**2/SEC): .800E-01
HENRYS LAW CONSTANT (M**3-ATM/MOLE): .408E-02
ADSORPTION COEFFICIENT ON ORGANIC CARBON(KOC): 126.
ADSORPTION COEFFICIENT ON SOIL (K): .000
MOLECULAR WEIGHT (G/MOL): 133.
VALENCE (-): .000
NEUTRAL HYDROLYSIS CONSTANT (/DAY): .000
BASE HYDROLYSIS CONSTANT (L/MOL-DAY): .000
ACID HYDROLYSIS CONSTANT (L/MOL-DAY): .000
DEGRADATION RATE IN MOISTURE (/DAY): .000
DEGRADATION RATE ON SOIL (/DAY): .000
LIGAND-POLLUTANT STABILITY CONSTANT (-): .000
NO. MOLES LIGAND/MOLE POLLUTANT (-): .000
LIGAND MOLECULAR WEIGHT (G/MOL): .000

-- APPLICATION INPUT PARAMETERS --

NUMBER OF SOIL LAYERS: 4
YEARS TO BE SIMULATED: 25
AREA (CM**2): 0.410E+08
APPLICATION AREA LATITUDE (DEG.): 44.9
SPILL (1) OR STEADY APPLICATION (0): 0

MODIFIED SUMMERS MODEL USED (1) OR NOT (0) FOR GWR. CONC.: 0
INITIAL CHEMICAL CONCENTRATIONS GIVEN (1) OR NOT GIVEN (0) 1
DEPTHS (CM): 91. 0.15E+03 0.12E+03 0.24E+04
NUMBER OF SUBLAYERS/LAYER 10 10 10 10
PH (CM): 0.00 0.00 0.00 0.00
INTRINSIC PERMEABILITIES (CM**2): 0.10E-07 0.10E-07 0.10E-07 0.10E-07
KDEL RATIOS (-): 1.0 1.0 1.0
KDES RATIOS (-): 1.0 1.0 1.0
OC RATIOS (-): 0.54 0.26 0.23
CEC RATIOS (-): 1.0 1.0 1.0
FRN RATIOS(-): 1.0 1.0 1.0
ADS RATIOS(-): 1.0 1.0 1.0
1

YEAR - 1 MONTHLY INPUT PARAMETERS
======== ==========

-- CLIMATIC INPUT PARAMETERS --

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
TEMP. (DEG C)	8.830	-0.830	-8.780	-12.390	-9.940	-3.280	6.000	12.610	17.890	20.830	19.830	14.280
CLOUD CVR (FRAC.)	0.550	0.700	0.600	0.700	0.600	0.600	0.600	0.600	0.600	0.500	0.550	0.600
REL. HUM.(FRAC.)	0.700	0.800	0.750	0.750	0.750	0.700	0.650	0.650	0.700	0.700	0.700	0.700
ALBEDO (-)	0.160	0.240	0.280	0.280	0.280	0.300	0.190	0.160	0.160	0.160	0.160	0.160
EVAPOT. (CM/DAY)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PRECIP. (CM)	4.790	3.680	0.500	0.500	0.500	10.260	5.320	8.210	9.950	8.950	9.070	6.110
M.TIME RAIN(DAYS)	0.460	0.530	0.480	0.460	0.470	0.610	0.510	0.400	0.330	0.250	0.320	0.370
M. STORM NO. (-)	3.440	3.030	2.780	2.340	2.170	3.830	4.690	6.630	6.800	5.600	5.890	5.220
M. SEASON (DAYS)	30.400	30.400	30.400	30.400	30.400	30.400	30.400	30.400	30.400	30.400	30.400	30.400

INITIAL POLLUTANT CONCENTRATIONS IN UG/ML,INPUT FOR MONTH 1 OF YEAR 1

LAYER 1:

SUBLAYER	1	2	3	4	5	6	7	8	9	10
INITIAL CONC. (UG/ML)	3.20E-03	3.20E-03	3.20E-03	3.20E-03	3.20E-03	3.20E-03	3.20E-03	3.20E-03	3.20E-03	3.20E-03

LAYER 2:

SUBLAYER	1	2	3	4	5	6	7	8	9	10

INITIAL CONC. (UG/ML) 1.30E-02 1.30E-02 1.30E-02 1.30E-02 1.30E-02 5.61E+00 5.61E+00 5.61E+00 5.61E+00 5.61E+00

LAYER 3:

SUBLAYER	1	2	3	4	5	6	7	8	9	10
INITIAL CONC. (UG/ML)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

LAYER 4:

SUBLAYER	1	2	3	4	5	6	7	8	9	10
INITIAL CONC. (UG/ML)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

****** MONTHLY SESOIL MODEL OPERATION ******
MONTHLY SITE SPECIFIC SIMULATION

REGION : MINN-ST PAUL WSO AP
SOIL TYPE : sand
COMPOUND : PCE
WASHLOAD DATA :
APPLICATION AREA: NIROP PCE: Actual soil concentrations by depth

GENERAL INPUT PARAMETERS
==========

-- SOIL INPUT PARAMETERS --

SOIL DENSITY (G/CM**3): 1.60
INTRINSIC PERMEABILITY (CM**2): .000
DISCONNECTEDNESS INDEX (-): 4.70
POROSITY (-): .400
ORGANIC CARBON CONTENT (%): 1.00
CATION EXCHANGE CAPACITY (MILLI EQ./100G DRY SOIL): .000
FREUNDLICH EXPONENT (-): 1.00
1

-- CHEMICAL INPUT PARAMETERS --

SOLUBILITY (UG/ML): 150.
DIFFUSION COEFFICIENT IN AIR (CM**2/SEC): .720E-01
HENRYS LAW CONSTANT (M**3-ATM/MOLE): .287E-01
ADSORPTION COEFFICIENT ON ORGANIC CARBON(KOC): 279.
ADSORPTION COEFFICIENT ON SOIL (K): .000
MOLECULAR WEIGHT (G/MOL): 166.
VALENCE (-): .000
NEUTRAL HYDROLYSIS CONSTANT (/DAY): .000
BASE HYDROLYSIS CONSTANT (L/MOL-DAY): .000
ACID HYDROLYSIS CONSTANT (L/MOL-DAY): .000
DEGRADATION RATE IN MOISTURE (/DAY): .000
DEGRADATION RATE ON SOIL (/DAY): .000
LIGAND-POLLUTANT STABILITY CONSTANT (-): .000
NO. MOLES LIGAND/MOLE POLLUTANT (-): .000
LIGAND MOLECULAR WEIGHT (G/MOL): .000

-- APPLICATION INPUT PARAMETERS --

NUMBER OF SOIL LAYERS: 4
YEARS TO BE SIMULATED: 25
AREA (CM**2): 0.410E+08
APPLICATION AREA LATITUDE (DEG.): 44.9
SPILL (1) OR STEADY APPLICATION (0): 0

MODIFIED SUMMERS MODEL USED (1) OR NOT (0) FOR GWR. CONC.: 0
INITIAL CHEMICAL CONCENTRATIONS GIVEN (1) OR NOT GIVEN (0) 1
DEPTHS (CM): 91. 0.15E+03 0.12E+03 0.24E+03
NUMBER OF SUBLAYERS/LAYER 10 10 10 10
PH (CM): 0.00 0.00 0.00 0.00
INTRINSIC PERMEABILITIES (CM**2): 0.10E-07 0.10E-07 0.10E-07 0.10E-07
KDEL RATIOS (-): 1.0 1.0 1.0
KDES RATIOS (-): 1.0 1.0 1.0
OC RATIOS (-): 0.54 0.26 0.23
CEC RATIOS (-): 1.0 1.0 1.0
FRN RATIOS(-): 1.0 1.0 1.0
ADS RATIOS(-): 1.0 1.0 1.0
1

YEAR - 1 MONTHLY INPUT PARAMETERS
======== ==========

-- CLIMATIC INPUT PARAMETERS --

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
TEMP. (DEG C)	8.830	-0.830	-8.780	-12.390	-9.940	-3.280	6.000	12.610	17.890	20.830	19.830	14.280
CLOUD CVR (FRAC.)	0.550	0.700	0.600	0.700	0.600	0.600	0.600	0.600	0.600	0.500	0.550	0.600
REL. HUM.(FRAC.)	0.700	0.800	0.750	0.750	0.750	0.700	0.650	0.650	0.700	0.700	0.700	0.700
ALBEDO (-)	0.160	0.240	0.280	0.280	0.280	0.300	0.190	0.160	0.160	0.160	0.160	0.160
EVAPOT. (CM/DAY)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PRECIP. (CM)	4.790	3.680	0.500	0.500	0.500	10.260	5.320	8.210	9.950	8.950	9.070	6.110
M.TIME RAIN(DAYS)	0.460	0.530	0.480	0.460	0.470	0.610	0.510	0.400	0.330	0.250	0.320	0.370
M. STORM NO. (-)	3.440	3.030	2.780	2.340	2.170	3.830	4.690	6.630	6.800	5.600	5.890	5.220
M. SEASON (DAYS)	30.400	30.400	30.400	30.400	30.400	30.400	30.400	30.400	30.400	30.400	30.400	30.400

INITIAL POLLUTANT CONCENTRATIONS IN UG/ML,INPUT FOR MONTH 1 OF YEAR 1

LAYER 1:

SUBLAYER	1	2	3	4	5	6	7	8	9	10
INITIAL CONC. (UG/ML)	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03

LAYER 2:

SUBLAYER	1	2	3	4	5	6	7	8	9	10

INITIAL CONC. (UG/ML) 1.10E-02 1.10E-02 1.10E-02 1.10E-02 1.10E-02 9.90E-02 9.90E-02 9.90E-02 9.90E-02 9.90E-02

LAYER 3:

SUBLAYER	1	2	3	4	5	6	7	8	9	10
INITIAL CONC. (UG/ML)	5.80E-02	5.80E-02	5.80E-02	5.80E-02	5.80E-02	3.20E-03	3.20E-03	3.20E-03	3.20E-03	3.20E-03

LAYER 4:

SUBLAYER	1	2	3	4	5	6	7	8	9	10
INITIAL CONC. (UG/ML)	3.20E-03	3.20E-03	3.20E-03	6.20E-02	6.20E-02	6.20E-02	9.60E-03	9.60E-03	9.60E-03	9.60E-03