Kennedy/Jenks Consultants

6 April 2001

MEMORANDUM

To: Ronald Timm, Washington State Department of Ecology, Bellevue, WA

From: Said Amali, Project Manager

Subject: Results of Task 1 - Unsaturated Soil Modeling of PCE Fate and Transport
The Shops At First Street Site, Bellevue, WA
K/J 946059.00

This technical memorandum presents the objectives, methodology, and results of modeling of tetrachloroethylene (PCE) fate and transport in unsaturated soil at the subject site. This information is provided to the State of Washington Department of Ecology as part of completing Task 1 of our work plan dated 22 September 2000 for the subject site.

The objective of Task 1 is to evaluate whether concentrations of PCE remaining in soil below the Phase 1 remedial excavation area and in the area adjacent to the storm sewer manhole are protective of groundwater quality. Computer modeling was conducted using conservative input values and assumptions to simulate scenarios for downward migration of PCE toward groundwater. Summary of evaluation results and recommendations for follow-up activities are presented below for each of the two areas. Modeling approach, input/output, and results are provided subsequently.

SUMMARY

Phase 1 Excavation Area

The PCE-containing soils in this area were excavated to a depth of 15 feet below ground surface (ft bgs) in 1994 and the excavation filled with clean soil. Of the borings advanced following excavation, the samples collected from boring BB-3 represented the greatest amount of PCE mass remaining in the soil profile below 15 ft bgs. The highest detected PCE concentration at this boring was 4.64 milligrams per kilogram (mg/kg) detected in the sample collected at 35 ft bgs. The deepest soil sample from this boring containing detectable levels of PCE (0.05 mg/kg) was collected at 55 ft bgs. Samples collected from other borings represented considerably less PCE mass in the soil profile. The detected soil PCE concentrations, listed in Table 5 of the site RI/FS report, are enclosed as Attachment A.

Under conservative simulation conditions (low soil carbon content, high soil air content, low soil bulk density), the initial PCE concentration distribution observed in soil in 1994 has the potential to leach to groundwater at levels exceeding 5 micrograms per liter (ug/L). However, based on a sensitivity analysis, use of site-specific data may result in a significant change in the amount of PCE leaching to groundwater. For example, the model results are very sensitive to fraction organic carbon (as discussed further below under Model Sensitivity). Figure 1 depicts the change in the simulated aqueous concentration of PCE in soil water in contact with groundwater under equilibrium condition over time. The different curves represent the conservative fraction organic carbon value of 0.001 and a higher value of 0.01. These results indicate that site-

specific values for a number of input parameters will allow a more realistic evaluation of PCE migration potential.

Area Surrounding Sewer Manhole

The soil near the sewer manhole contained PCE to 100 ft bgs as evidenced in soil sampling results obtained from boring BB-15 in 1994. PCE was detected at a concentration of 4,180mg/kg in soil adjacent to the bottom of the manhole (15 ft bgs) contained 4,180 mg/kg of PCE. The PCE concentrations in soil decreased to 6.96 mg/kg at 25 ft bgs, further decreasing to less than 1 mg/kg below 35 ft bgs. The deepest soil sample, collected at 100 ft bgs near the water table, contained PCE at a concentration of 0.2 mg/kg (see Attachment A).

Under conservative simulation conditions (low soil carbon content, high soil air content, low soil bulk density), the initial PCE concentration distribution observed in soil in 1994 has the potential to leach to groundwater at levels exceeding 5 ug/L. However, the soil vapor extraction system operating near the manhole since 1996 has likely reduced the PCE concentrations in the soil to a depth of 20 ft bgs in that area. Simulation results indicate that, in the absence of site-specific data, the soil PCE concentrations surrounding the manhole to a depth of 35 ft should be no higher than 0.5 mg/kg (MTCA Method A) to prevent PCE from reaching groundwater at levels exceeding 5 ug/L. This result is based on assuming zero recharge following lining the manhole to prevent leakage of storm water (See Task 3 of the work plan). Figure 2 depicts the temporal change in PCE concentrations in soil water in contact with groundwater under the following scenarios:

- The 1994 soil concentrations, fraction organic carbon = 0.001, recharge = 1% of incident rainfall = 0.03 ft/yr.
- A target cleanup level of 0.99 mg/kg to a depth of 35 ft bgs, fraction organic carbon = 0.001, no recharge.
- A target cleanup level of 0.5 mg/kg to a depth of 35 ft bgs, fraction organic carbon = 0.001, no recharge.
- A target cleanup level of 0.99 mg/kg to a depth of 35 ft bgs, fraction organic carbon = 0.01, no recharge.

RECOMMENDATIONS

Phase 1 Excavation Area

Conduct Task 2 of the work plan as proposed. Based on the modeling results, it is proposed that additional laboratory analysis of selected soil samples be performed for parameters that significantly influence PCE migration in the unsaturated zone including fraction organic carbon, soil bulk density, porosity, hydraulic conductivity, and grain size distribution. The additional data will be used to conduct a more refined modeling of PCE migration potential in the area of the

manhole. The details of the additional analyses (sample locations and depths, analysis methodology, and laboratory) will be communicated to Ecology in a separate memorandum upon approval of this concept.

Area Surrounding Sewer Manhole

Conduct Tasks 2 and 3 of the work plan as proposed. Based on the modeling results, the target depth of the planned soil borings will be 35 ft bgs. The site-specific PCE fate and transport data, described above, will be used to conduct a more refined modeling of PCE migration potential in the area of the manhole.

MODELING APPROACH

For the Phase 1 excavation area, only the conditions observed in 1994 were used for conducting the simulations. For the manhole area soils, the following two PCE fate and transport scenarios were modeled:

1) The soil PCE concentrations observed in 1994.

2) Reduced PCE concentrations in soil (compared with 1994 levels) at and beneath the manhole bottom. The reduced concentrations were selected to allow evaluation of potential alternative soil cleanup levels that are protective of groundwater quality.

Selected model

The VLEACH model version 2.2a was selected to perform the fate and transport simulations for the two areas of the site. The EPA has developed this model for screening-level evaluation of chemical mobility and has used it at many sites across the U.S. Kennedy/Jenks Consultants has used this model numerous times to develop an understanding of vertical migration potential for many organic chemicals and metals in soils.

VLEACH is a one dimensional finite-difference model that estimates the impact from mobilization and migration of a sorbed organic contaminant (PCE in this case) in the vadose zone on the underlying groundwater over time. The model is used to show the movement of the contaminant from the solid phase to the vapor phase (by gaseous diffusion) and from the solid phase to the dissolved phase in water (by advection in the liquid phase). Other attenuation mechanisms such as biodegradation or dispersion are not accounted for by this model and therefore, the model results provide a conservative estimate of PCE transport. Contaminant transport mechanisms are simulated from initial conditions defined by the user. For each time step in the simulation, the total mass in each cell is re-calculated and re-equilibrated for each phase.

Key Assumptions

Several key assumptions were made in performing the model simulations. Because of these assumptions the model results are considered conservative (predicting more PCE leaching than may occur in reality). These assumptions are as follows:

- *Recharge* – A recharge rate of 0.03 ft/yr, equal to one percent of the total incident rainfall of approximately 3 ft/yr (Online data available from Western Regional Climate Center), was assumed for Scenario 1 of the manhole area soil. A recharge rate of zero was assumed for the Phase I excavation area simulations and the remaining manhole area scenarios based on the 1) presence of buildings on site, 2) presence of a competent pavement, and 3) assumption of no leakage of storm water out of the manhole following lining.

- *Soil Fraction Organic Carbon (Foc)* – A conservatively low Foc value of 0.001 was used at the site. There is very little data publicly available to characterize this parameter for the glacial till soils of the Puget Sound area. This Foc value is generally accepted as the minimum above which organic partitioning dominates sorption of organic chemicals, such as PCE, over mineral sorption. Higher values of Foc reduce the potential for PCE migration to groundwater.

- *Soil Bulk Density And Porosity* – A soil dry bulk density of 1.47 grams per milliliter (g/mL) was assumed based on literature values presented in VLEACH manual. An effective porosity value of 0.37 was also assumed. Both these parameters are used in the model for migration calculations. A higher bulk density results in a greater mass of chemical that is sorbed. A lower porosity reduces the migration rate and allows less of an air-filled porosity for PCE partitioning into the soil gas phase. Based on the observations of soil conditions recorded on the log of boring BB-15, the soils encountered were characterized as predominantly very dense to very stiff sandy silt to sandy lean clay. The assumed bulk density may underestimate the actual density and overestimate porosity leading to overestimation of migration potential. The log of boring BB-15 is enclosed as Attachment B.

- *No Degradation* – The VLEACH model does not account for aqueous dilution/dispersion, three-dimensional vapor-phase migration, or biological degradation of PCE. These natural attenuation mechanisms will reduce PCE concentrations in soil and decrease the potential of PCE to reach groundwater. The VLEACH model design is therefore, inherently biased toward protection of groundwater quality.

Sensitivity Analysis

The impact of varying several input parameters on soil water PCE concentrations over time was evaluated in a sensitivity analysis. The chemical-specific input values were not varied during this evaluation. Of the soil-specific input values, fraction organic carbon, soil porosity, and soil air content (through porosity and soil water content) greatly influenced model results. Varying

water recharge rate around the value assumed for the site did not appreciably affect model results. The sensitivity results indicate that site-specific values of soil parameters can help significantly refine the evaluation of PCE migration potential at the site.

Model Input Parameters/Values

Key model input parameters, parameter values, and the rationale for each value selected are listed in the attached Table 1. Attachment C contains model input files for each simulation scenario represented on Figures 1 and 2.

Model Output

Model output files were generated during the simulations. Due to the size of these electronic files, they can be communicated to you via e-mail or on a computer diskette, if requested. Table 2 presents a summary of temporal changes in concentrations of PCE in soil water at 100 ft bgs (at simulated groundwater depth) for the simulations presented in Appendix C for both areas modeled.

Enclosure(s)

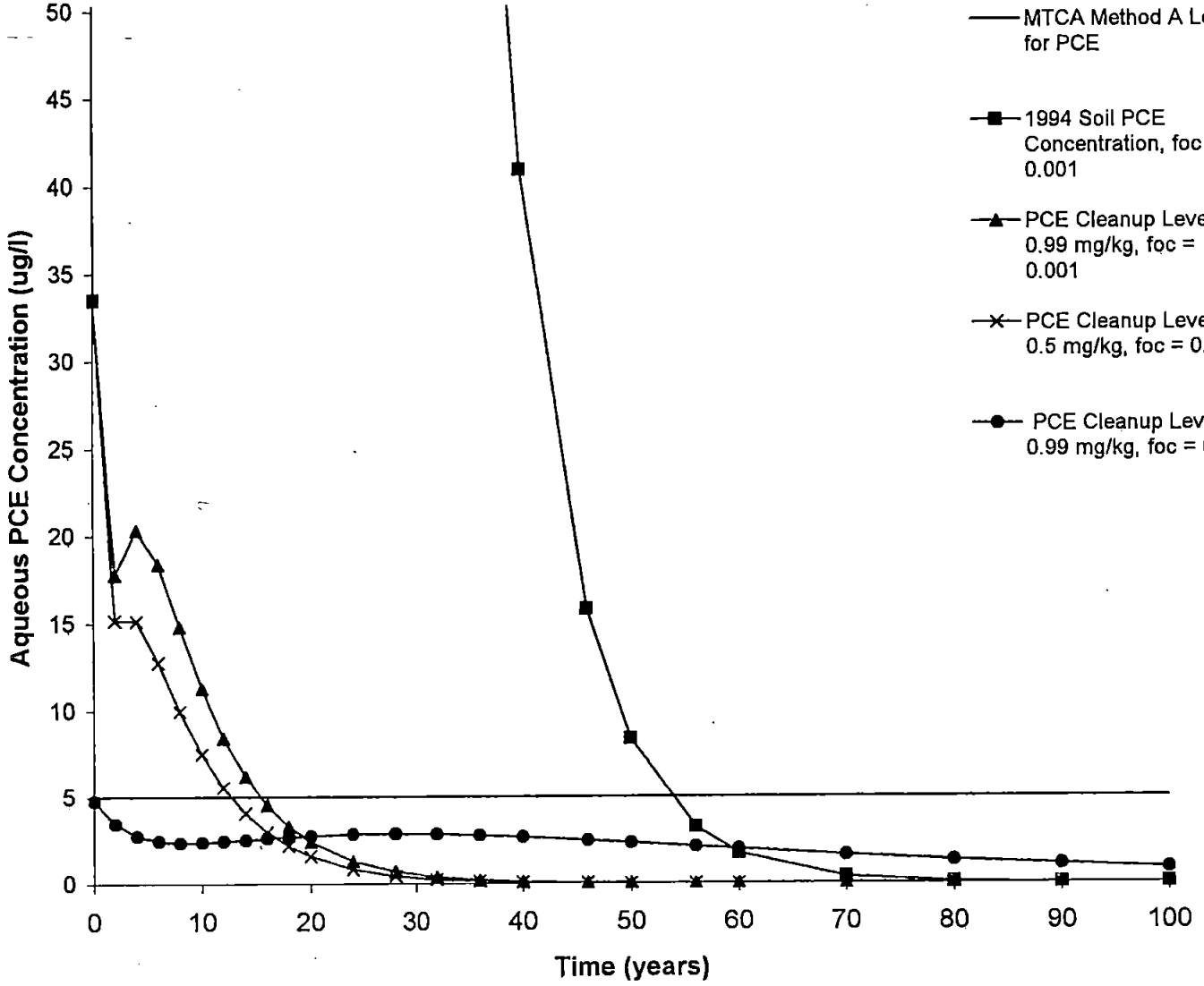
cc: Richard Kessler, The Benenson Capital Company, New York, NY
Beth Ginsberg, Stoel Rives, Seattle, WA

TABLE 1
VLEACH Model Input Parameters
The Shops At First Street Site, Bellevue, WA

Parameter	Definition	Value	Rationale
K_{oc}	Organic carbon distribution coefficient	400 cm^3/g	Average of values listed in Mackay et al. (1999)
K_H	Henry's law Constant	0.7	Average of values listed in Mackay et al. (1999)
Solubility	Water solubility of contaminant	140 mg/l	Lower value reported in Mackay et al. (1999)
D_a	Free air diffusion coefficient	0.62 m^2/d	EPA Soil Screening Guidance (1996), Appendix C
r	recharge rate, ft/yr	0.03, 0	One percent of average annual rainfall for Bellevue area, or no recharge, as simulated.
ρ_b	Dry soil bulk density, grams per milliliter	1.47 g/ml	Value assumed for site soils based on values given in VLEACH manual Appendix B.
Effective porosity	Volume of void space within soil	0.37	Value assumed for site soils.
Vol. water content	Volume of soil void space filled with water	0.1	Value assumed for site soils.
f_{oc}	Fraction of organic carbon content	0.001	Minimum value that can be assumed for soils for organic sorption.
Initial soil PCE concentration	Initial soil PCE concentration	As described above in the memorandum.	Input is based on available analytical data. Separate simulations may be run to evaluate different PCE concentration distribution scenarios
Depth to groundwater	Depth to groundwater	100 feet	Based on area hydrogeology description provided in site RI/FS report.

TABLE 2
Summary of VLEACH Model Results
PCE Concentrations in Soil Water in Contact With Groundwater
Phase I Excavation Area
The Shops at First Street, Bellevue, WA

Time (years)	1994 Soil Concentrations, f_{oc} = 0.001 (ug/l)	1994 Soil Concentrations, f_{oc} = 0.01 (ug/l)
0	0.00	0.00
2	17.47	0.17
4	31.38	0.43
6	32.05	0.78
8	26.96	1.17
10	20.95	1.60
12	15.72	2.02
14	11.61	2.44
16	8.51	2.84
18	6.22	3.20
20	4.54	3.52
30	0.93	4.48
40	0.19	4.56
50	0.04	4.17
60	0.01	3.60
70	0.00	3.01
80	0.00	2.47
90	0.00	2.01
100	0.00	1.62



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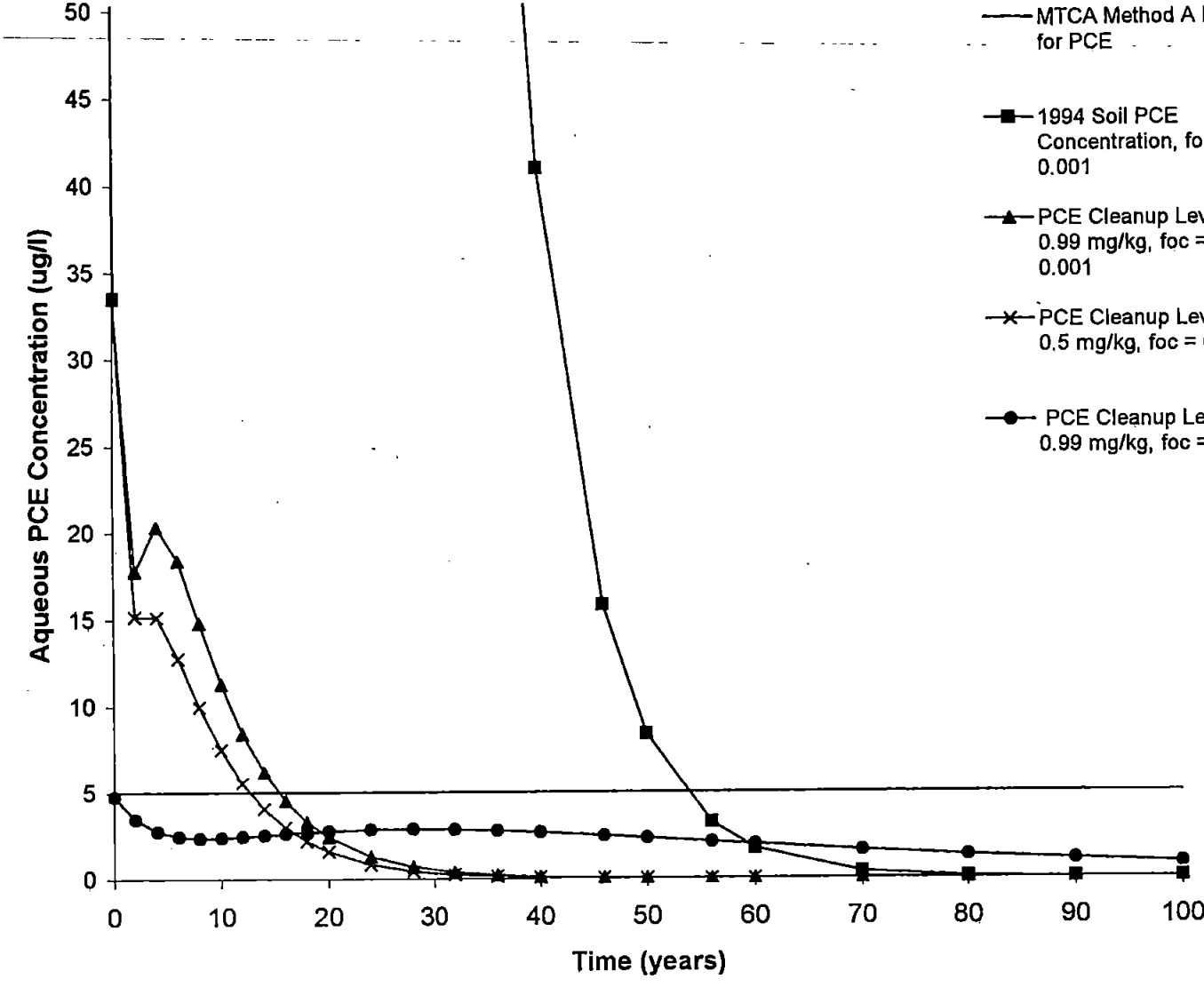
The Shops At First Street Site
Bellevue, WA

VLEACH Model Results
Stormwater Manhole Area

Figure 2
K/J 946059.00



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VLEACH Model Results
Stormwater Manhole Area

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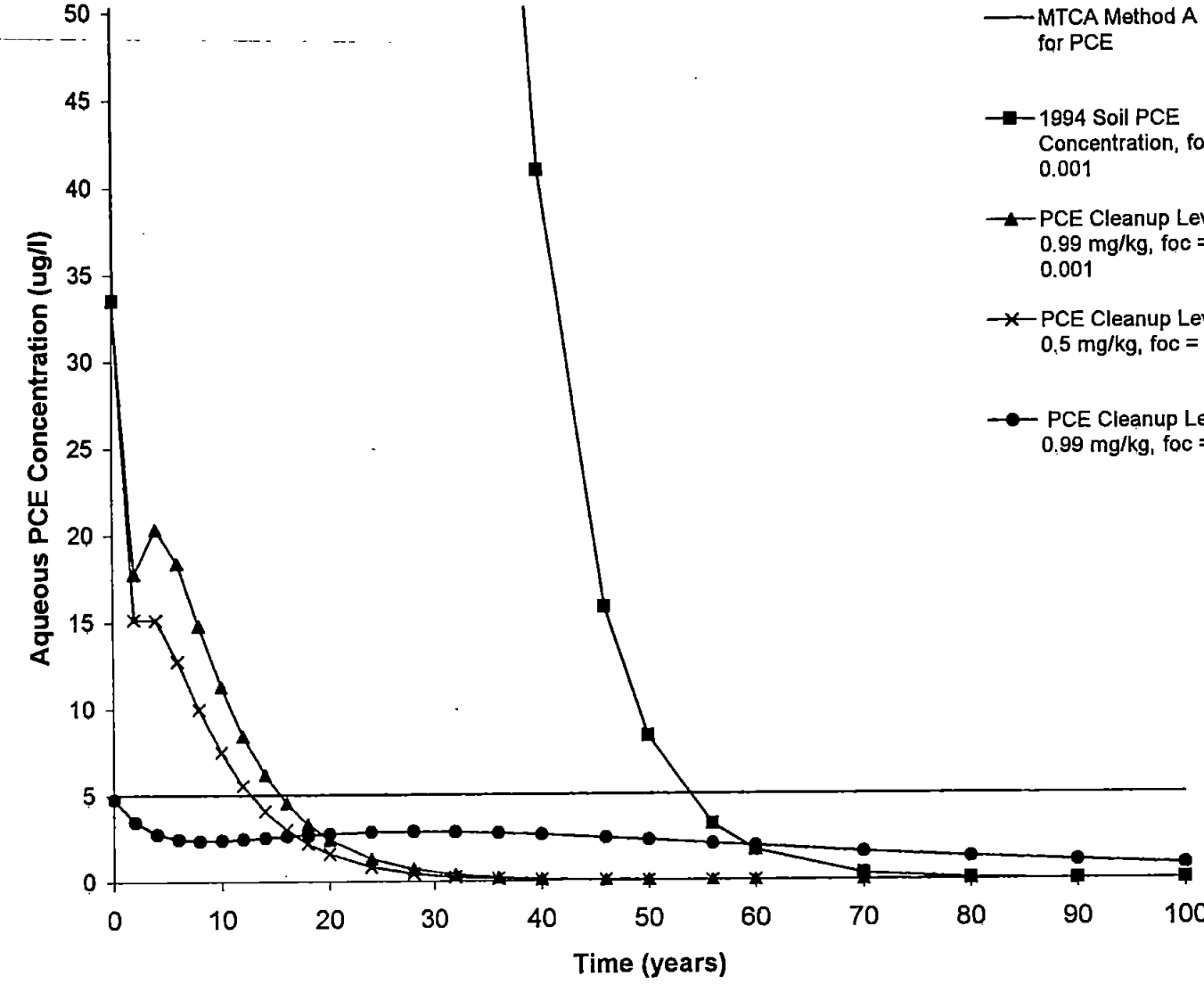

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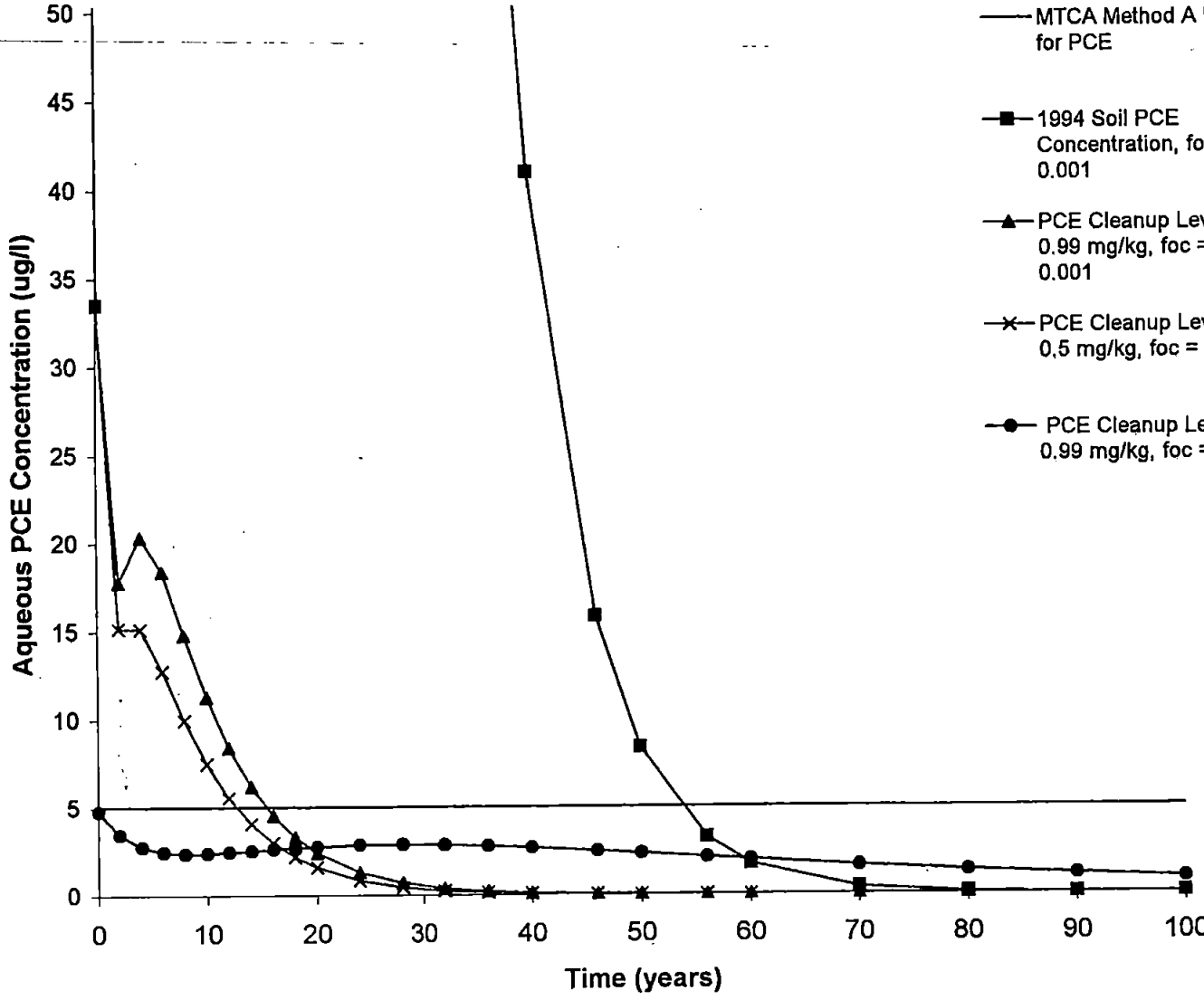

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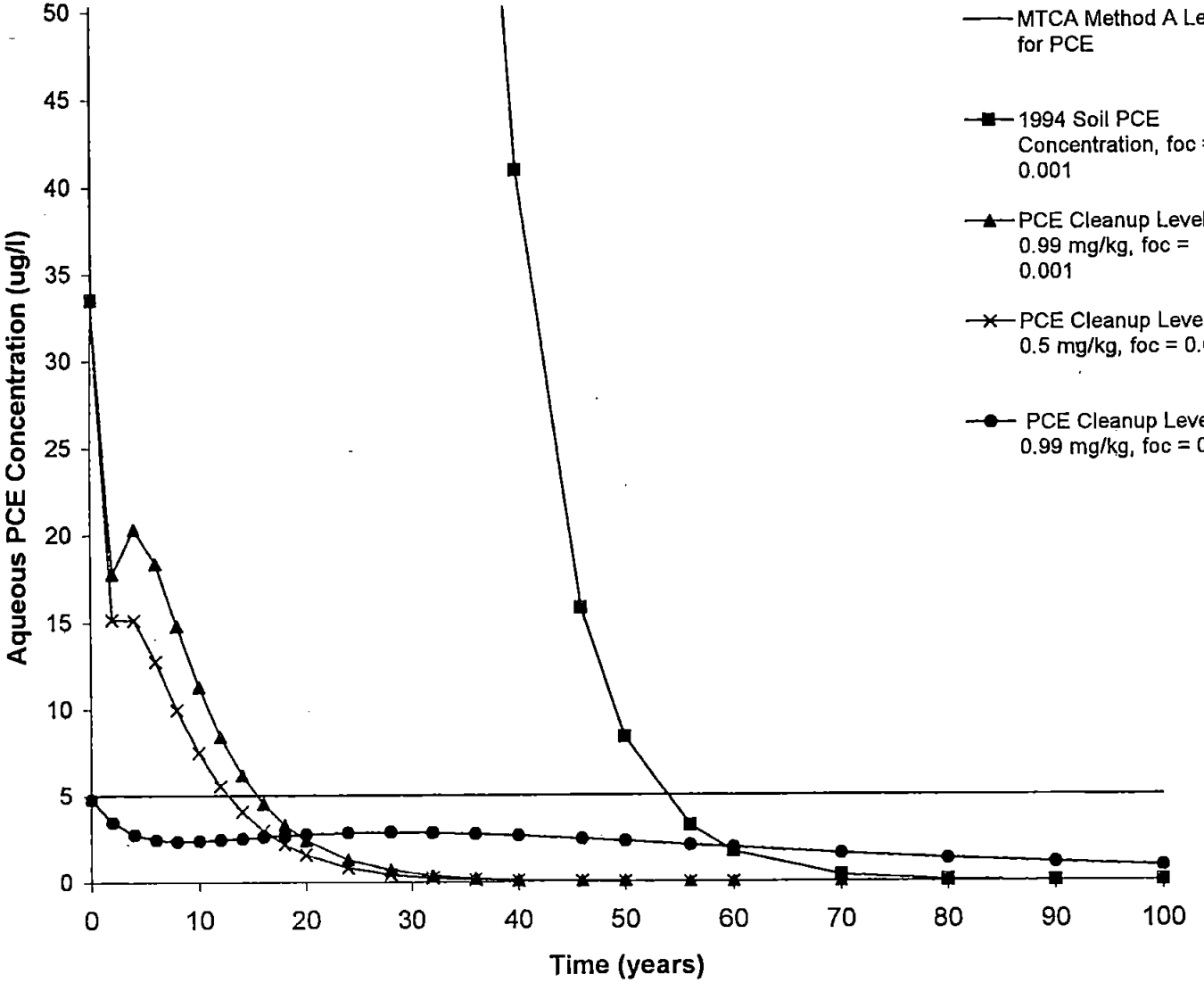

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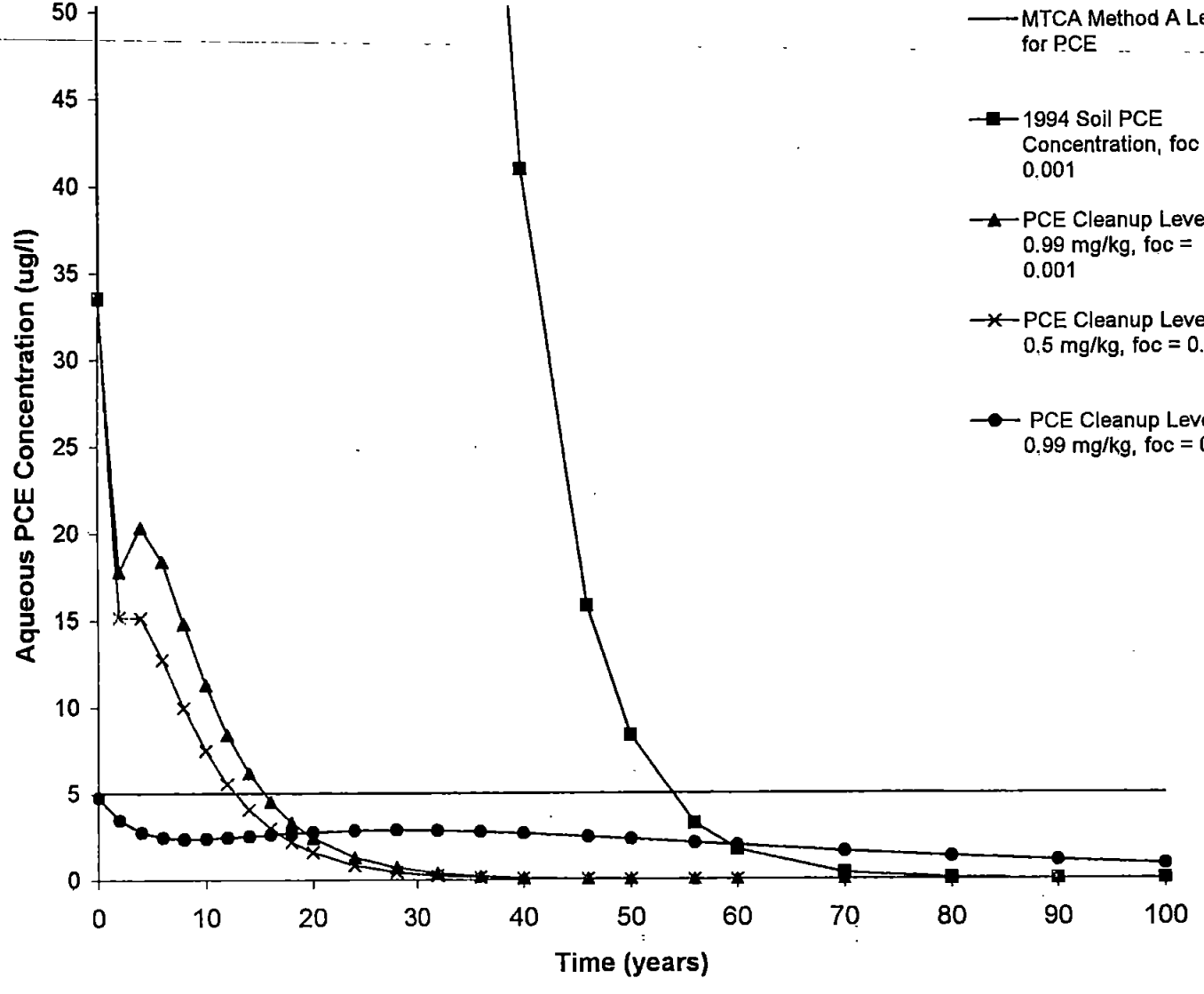

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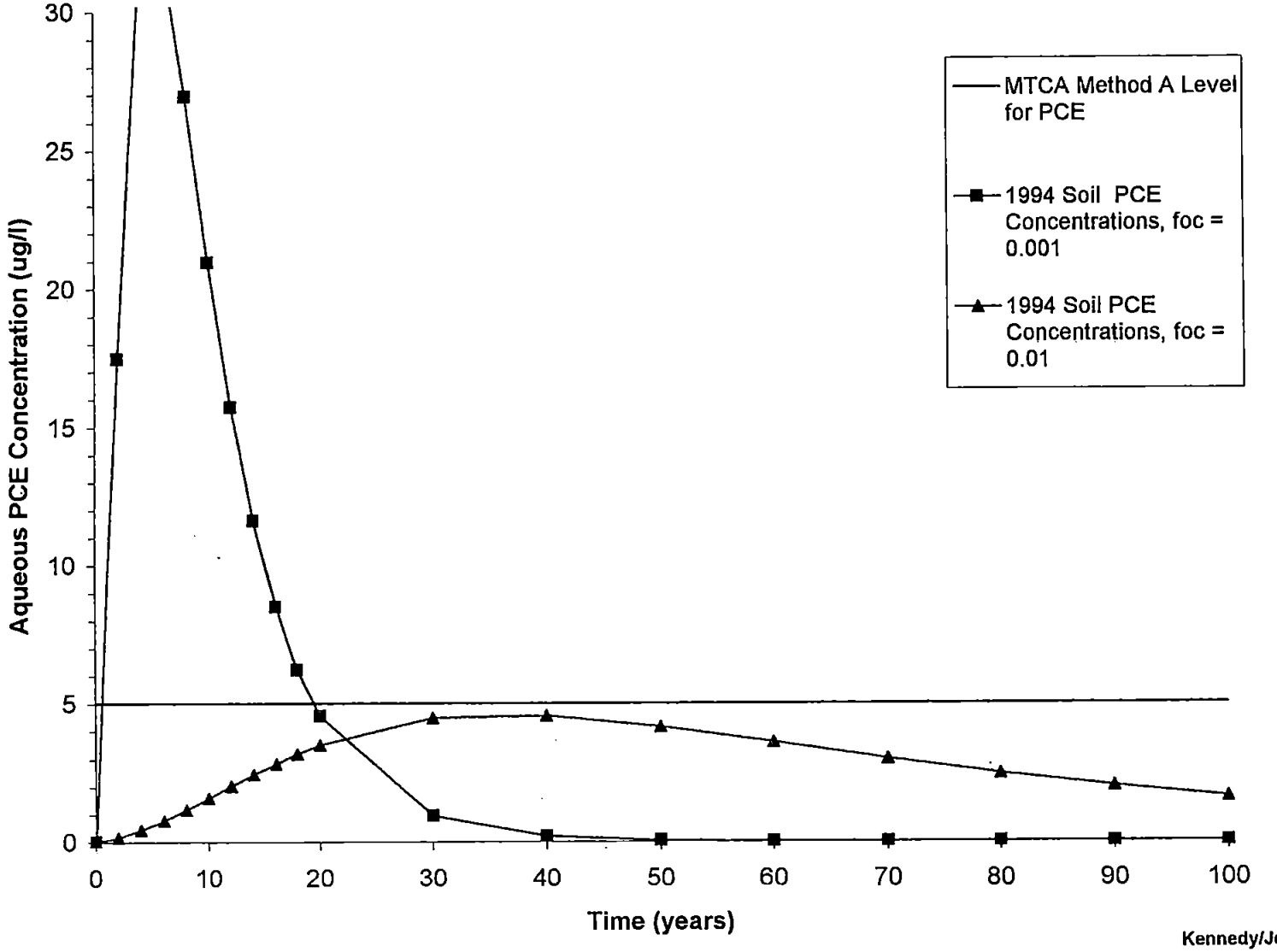

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VLEACH Model Results
Phase 1 Excavation Area

Figure 1
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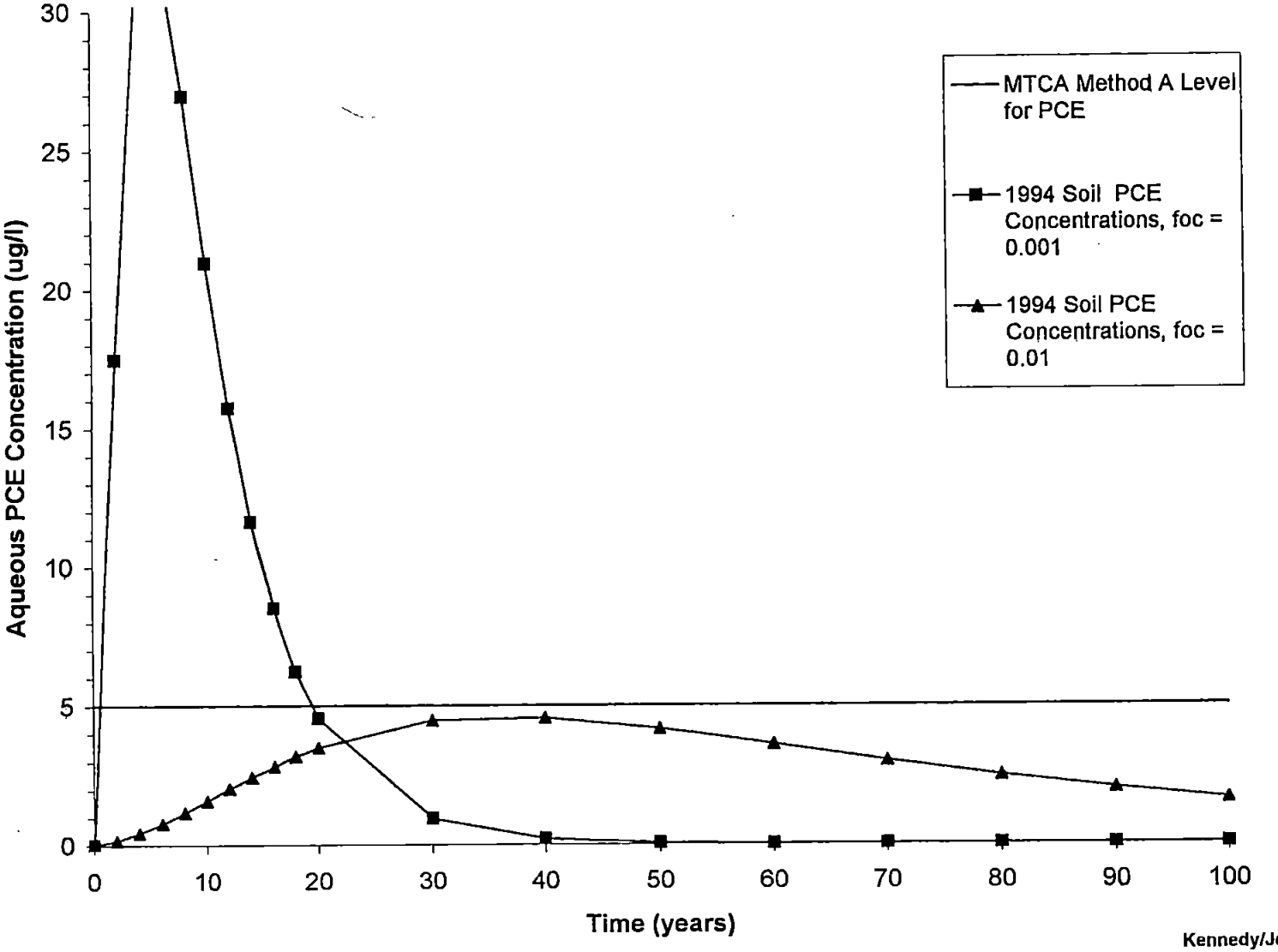

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VLEACH Model Results
Phase 1 Excavation Area

Figure 1
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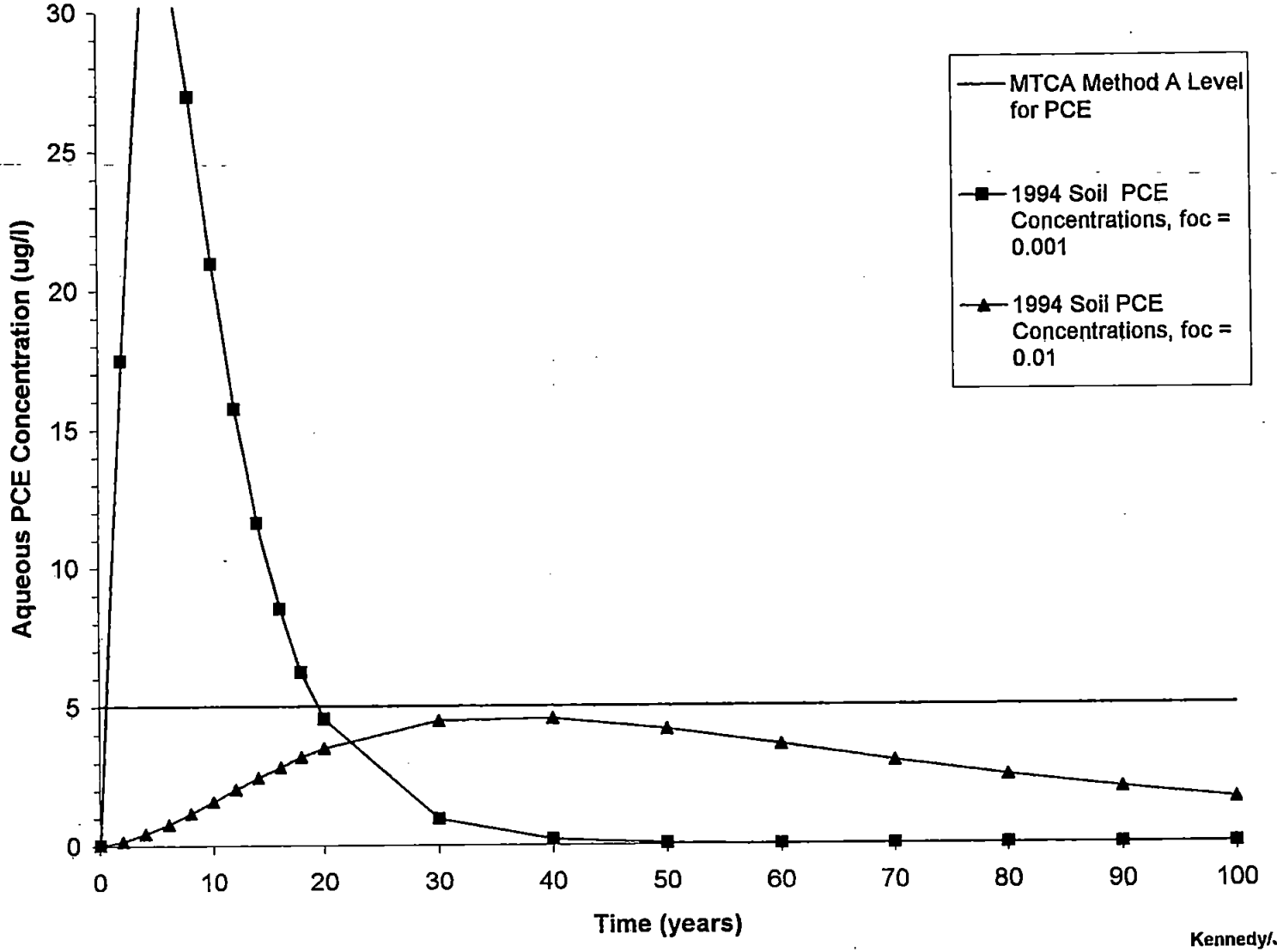

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Phase 1 Excavation Area

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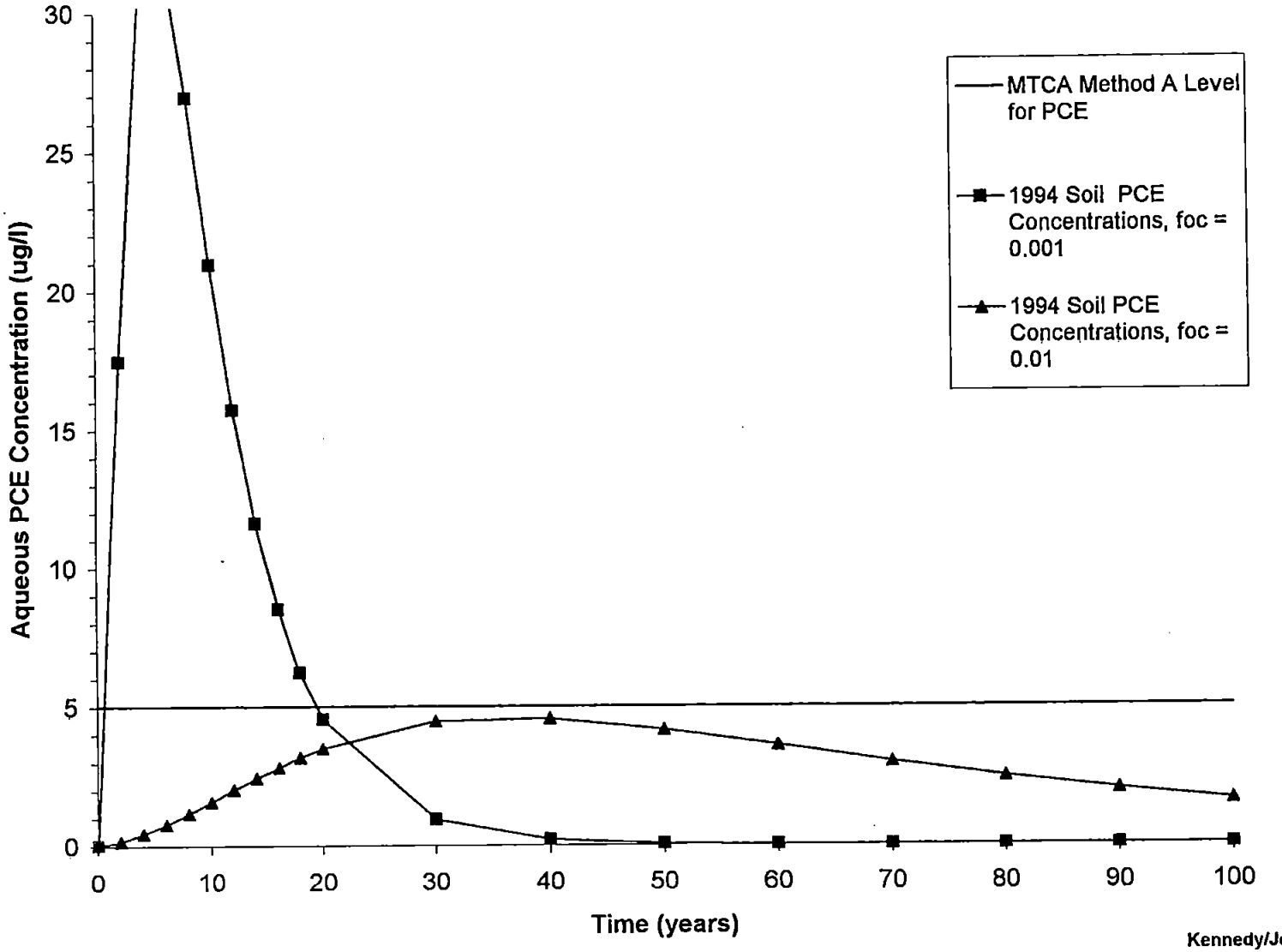

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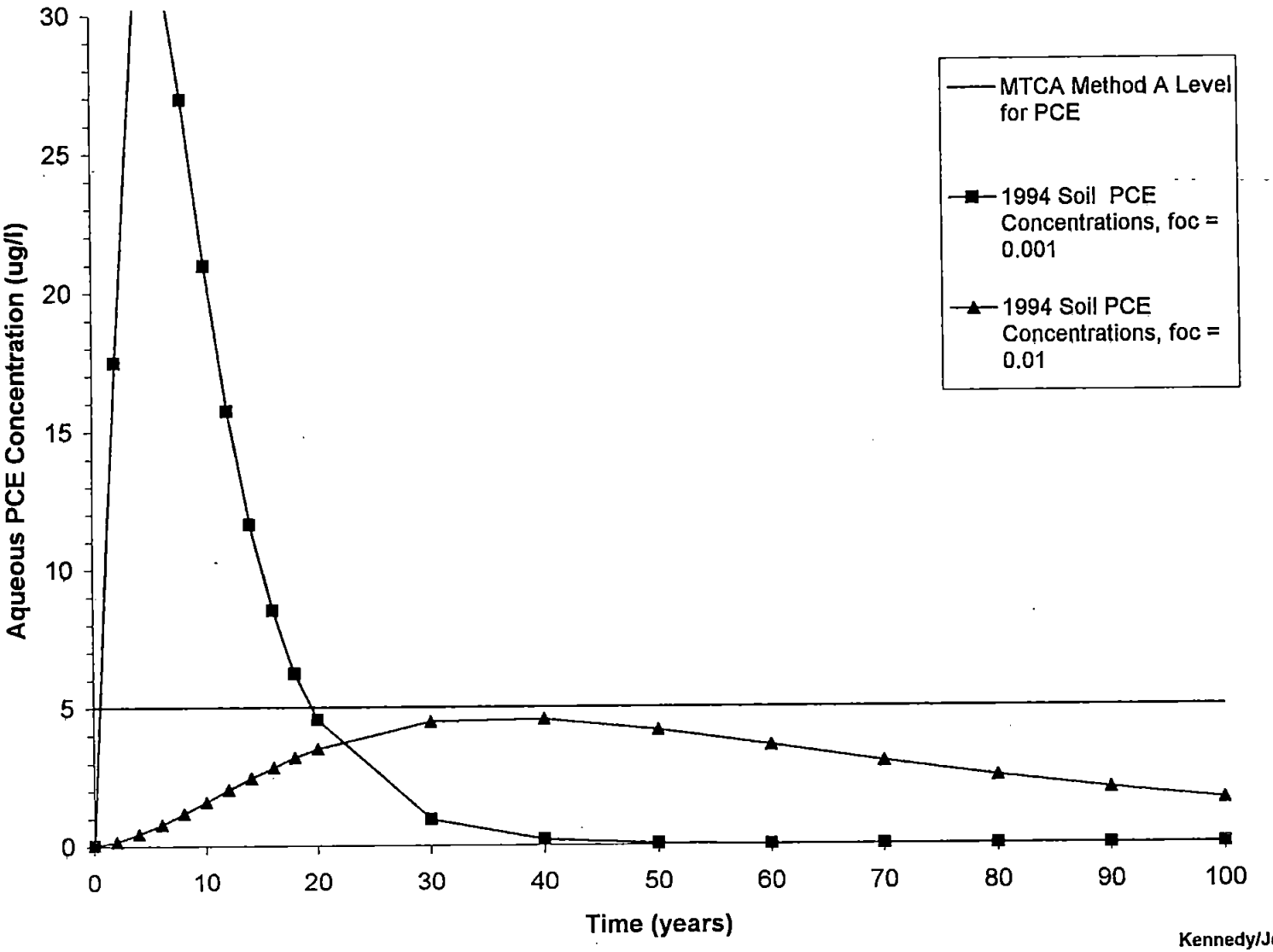
VLEACH Model Results
Phase 1 Excavation Area

Figure 1
K/J 946059.00



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The Shops At First Street Site
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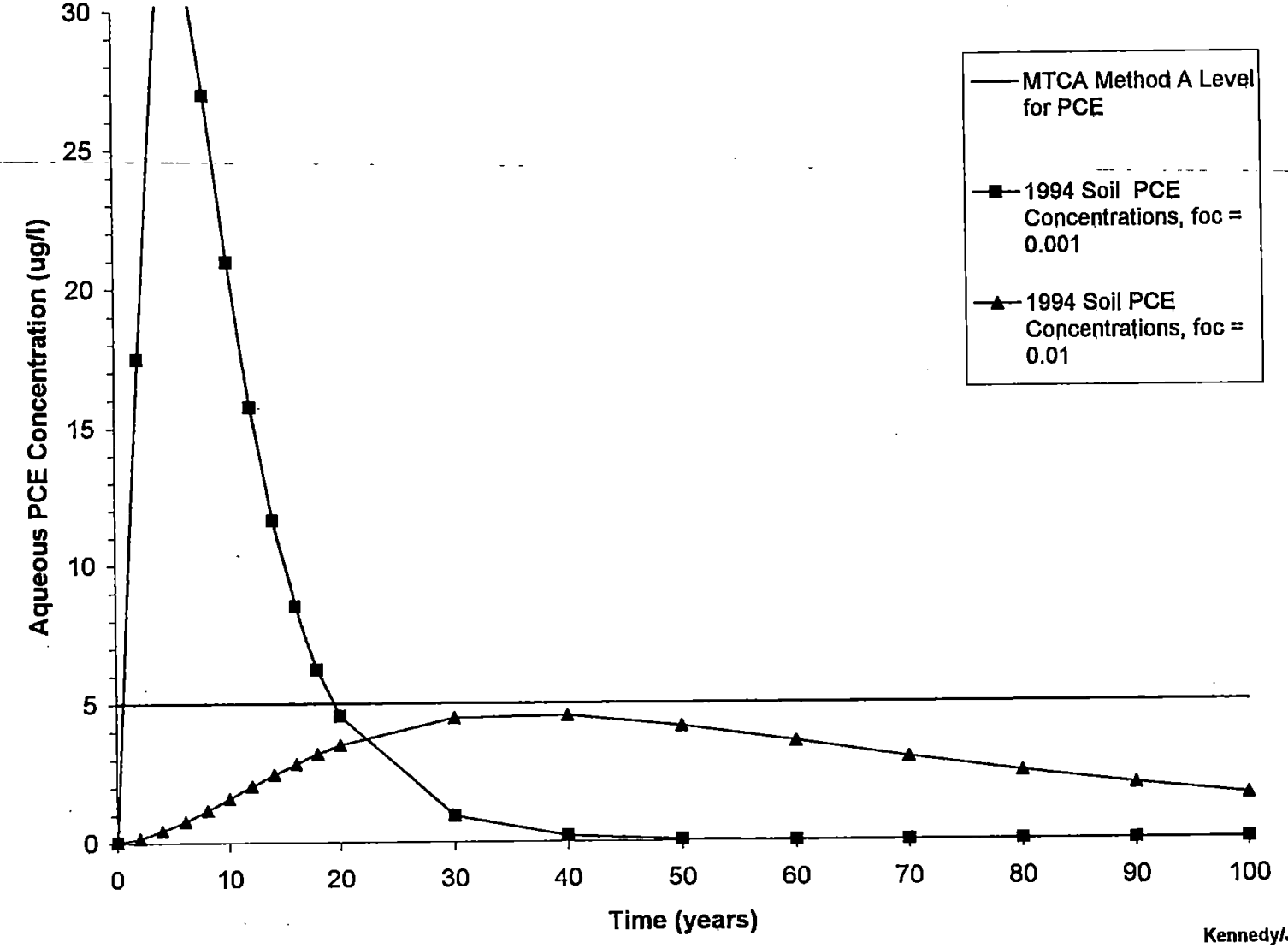
VLEACH Model Results
Phase 1 Excavation Area

Figure 1
K/J 946059.00



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The Shops At First Street Site
Bellevue, WA

VLEACH Model Results
Phase 1 Excavation Area

Figure 1
K/J 946059.00

Attachment A

Subsurface Soil Analytical Results

TABLE 5

SUMMARY OF ONSITE MOBILE LABORATORY SUBSURFACE SOIL ANALYTICAL RESULTS

Boring	Depth (ft)	Detected Volatile Organic Compound (mg/kg)
		Perchloroethylene (PCE)
BB-1	15	0.16
	25	ND
	35	ND
	45	ND/ND[a]
	55	ND
	60	ND
	65	ND
	70	ND
BB-2	15	0.07
	25	*0.88*
	35	*0.77/0.95*[a]
	45	0.16
	55	0.16
	60	ND
	65	ND
	70	ND
BB-3	15	0.43
	25	0.37
	35	*4.64*
	45	0.19
	55	0.05
	60	ND
	65	ND
	70	ND
BB-4	15	0.13/0.17[a]
	25	0.12
	35	ND
	45	ND
	55	ND
	60	ND
	65	ND
	70	ND
BB-5	15	ND
	25	0.15/0.10[a]
	35	0.24

TABLE 5

SUMMARY OF ONSITE MOBILE LABORATORY SUBSURFACE SOIL ANALYTICAL RESULTS

Boring	Depth (ft)	Detected Volatile Organic Compound (mg/kg) Perchloroethylene (PCE)
BB-5 (cont.)	45	***1.34***
	55	0.30
	60	0.09
	65	0.08
	70	ND
BB-6	15	0.13
	25	***0.69***
	35	***2.17***
	45	ND/ND[a]
	55	0.06
	60	ND
	65	ND
	70	ND
	80	ND
BB-7	15	ND
	25	0.06/0.08[a]
	35	***0.51***
	45	ND
	55	ND
	60	ND
	65	ND
	70	ND
BB-8	15	ND
	25	***0.89***
	35	0.06
	45	0.22/0.25[a]
	55	ND
	60	ND
	65	ND
	70	ND
Detection Limits[b]		0.05
BB-9	5	ND
	15	0.01
	25	0.03
	35	0.09/0.08[a]

TABLE 5

SUMMARY OF ONSITE MOBILE LABORATORY SUBSURFACE SOIL ANALYTICAL RESULTS

Boring	Depth (ft)	Detected Volatile Organic Compound (mg/kg)
		Perchloroethylene (PCE)
BB-9 (cont.)	45	0.04
	55	ND
	60	ND
BB-10	5	ND
	15	ND
	25	0.03
	35	0.05/ND[a]
	45	ND
	55	0.03
	62	ND
BB-11	5	ND
	15	ND
	25	ND
	35	0.02
	45	0.07
	55	0.08/0.07[a]
	60	0.06
BB-12	5	ND
	15	0.03
	25	0.01
	35	0.08
	45	*0.54*
	55[c]	0.39
	60	0.42
	65	0.25
	70	0.26/0.44[a]
	77	0.07
	80	ND
	85	ND
	90	0.03
BB-13	5	ND
	15	ND
	25	ND
	35	ND
	45	ND

TABLE 5

SUMMARY OF ONSITE MOBILE LABORATORY SUBSURFACE SOIL ANALYTICAL RESULTS

Boring	Depth (ft)	Detected Volatile Organic Compound (mg/kg)
		Perchloroethylene (PCE)
BB-13 (cont.)	55	0.04
	60	0.22
	70	*0.61/0.67*[a]
	80	0.07
	85	ND
	90	ND
BB-14	5	ND
	15	ND
	25	ND/ND[a]
	35	0.03
	45	ND
	55	ND
	60	ND
BB-15	15[d]	4,180
	25	6.96
	35	0.99
	45	0.20
	55	0.07
	65	0.39
	70	0.02
	75	0.07
	80	0.03
	85	0.03
	90	0.04
	95	0.02/0.02[a]
	100	0.02
BB-16	5	ND
	15	ND
	25	0.01/0.01[a]
	35	ND
	40	ND
	45	ND
BB-17	5	0.01
	10	0.11
	15	0.08

TABLE 5

SUMMARY OF ONSITE MOBILE LABORATORY SUBSURFACE SOIL ANALYTICAL RESULTS

Boring	Depth (ft)	Detected Volatile Organic Compound (mg/kg)
		Perchloroethylene (PCE)
BB-17 (cont.)	20	ND
BB-18	5	0.07
	10	0.02
	15	ND
	20	0.10
	25	0.01
	30	0.02
	35	ND
STOCK-1	0	0.07
STOCK-2	0	0.02
STOCK-3	0	0.01
STOCK-4	0	ND
STOCK-5	0	0.02
STOCK-6	0	0.03/0.03[c]
DECON1	NA	<1.0 µg/L
DECON2	NA	<1.0 µg/L
DECON10	NA	30 µg/L
DECON11	NA	33 µg/L
Detection Limits		0.01
MTCA Method A Cleanup Levels[e]		0.50

Notes:

All samples were analyzed for selected chlorinated solvents using modified EPA Method 8021. Only compounds detected are reported.

(a) Laboratory duplicate sample results.
(b) Detection limits for borings BB-1 through BB-8.
(c) Trichloroethene was also detected in this sample at a concentration of 0.06 mg/kg.
(d) Other compounds detected in this sample include trichloroethene (0.11 mg/kg), 1,1,1-trichloroethane (0.04 mg/kg), and 1,1,2-trichloroethane (0.89 mg/kg).
(e) Model Toxics Control Act [WAC 173-340-740(2)].

ND Indicates compound not detected at a concentration equal or greater than method detection limit.
Values in bold and italics indicates concentration exceeds MTCA Method A cleanup level.

Attachment B

Boring & Well Construction Log

Boring & Well Construction Log

Kennedy/Jenks Consultants

BORING LOCATION	THE SHOPS AT FIRST STREET PROJECT
DRILLING COMPANY	CASCADE DRILLING, INC.
DRILLER	SCOTT
DRILLING METHOD	HOLLOW STEM AUGER
DRILL BIT(S) SIZE:	6 5/8" O.D.
ISOLATION CASING	N.A. FROM TO FT.
BLANK CASING	N.A. FROM TO FT.
PERFORATED CASING	N.A. FROM TO FT.
SIZE AND TYPE OF FILTER PACK	N.A. FROM TO FT.
SEAL	CONCRETE FROM 0.0 TO 2.0 FT.
GROUT	VOLCLAY FROM 2.0 TO 100.0 FT.

Boring/Well Name	BB-15
Project Name	BENENSON BELLEVUE II
Project Number	946059.00
ELEVATION AND DATUM	TOTAL DEPTH 100.0
DATE STARTED 10/15/1994	DATE COMPLETED 10/15/1994
INITIAL WATER DEPTH (FT)	
LOGGED BY T. MORIN	
SAMPLING METHODS 2" SPOON W/ BRASS	WELL COMPLETION ☐ SURFACE HOUSING ☐ STAND PIPE ____ FT.

SAMPLES TYPE	RECOVERY (FEET)	PENETRATION RESIST (BLOWS/6 IN.)	DEPTH (FEET)	SAMPLE NO.	WELL NOT CONSTRUCTED	OVA	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
G						2.6			**Sandy SILT with gravel; grey, damp,** very dense; mostly silt, some medium to coarse sand, some medium subangular gravel, minor clay; good dry strength, slight to moderate dilatency, very poorly sorted; interpreted as Glacial Till
G			5			2.4			
G			10			12.0			very distinct solvent odor
S	0.5	160	15	BB-15-15.0		320		ML	
S	0.5	100	20	BB-15-20.0		190			
S	0.5	150	25	BB-15-25.0		75			odor significantly decreased

Boring & Well Construction Log

Kennedy/Jenks Consultants

Project Name BENENSON BELLEVUE II **Project Number** 946059.00 **Boring/Well Name** BB-15

SAMPLES TYPE	SAMPLES RECOVERY (FEET)	SAMPLES PENETRATION RESIST (BLOWS/6 IN.)	DEPTH (FEET)	SAMPLE NO.	WELL NOT CONSTRUCTED	OVA	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
S	0.5	90	30	BB-15-30.0		22			
S	0.5	165	35	BB-15-35.0		16			gravelly
S	0.5	120	40	BB-15-40.0		7.4			
S	0.5	130	45	BB-15-45.0		8.50		ML	
S	0.5	110	50	BB-15-50.0		2.5			
S	0.5	100	55	BB-15-55.0		1.30			siltier
S	0.5	200	60	BB-15-60.0					no recovery, cuttings become dark grey
S	0.5	140	65	BB-15-65.0		5.8			

Boring & Well Construction Log

Kennedy/Jenks Consultants

Project Name BENENSON BELLEVUE II **Project Number** 946059.00 **Boring/Well Name** BB-15

SAMPLES TYPE	SAMPLES RECOVERY (FEET)	SAMPLES PENETRATION RESIST (BLOWS/6 IN.)	DEPTH (FEET)	SAMPLE NO.	WELL NOT CONSTRUCTED	OVA	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
S	0.5	120	70	BB-15-70.0		0.2			
									Sandy lean CLAY: tan grey, damp, very
									stiff; mostly clay, 30 to 40% silt, no odor
S	0.5	100	75	BB-15-75.0		0.2			
								CL	
S	0.5	120	80	BB-15-80.0		0.0			becomes sandy with trace of subrounded
									coarse gravel
									Poorly graded SAND: grey, moist, dense;
S	0.5	140	85	BB-15-85.0		0.1		SP	mostly subangular medium to coarse sand,
									minor silt, minor fine gravel
									Sandy SILT with gravel: grey, damp,
S	0.5	110	90	BB-15-90.0		0.2			very dense; same Glacial Till as above
								ML	
S	0.5	150	95	BB-15-95.0		0.2			grey, moist, slight increase in clay content
S	0.5	140	100	BB-15-100.0		0.0			

Notes:

Refusal at 100 feet bgs. Groundwater not encountered to maximum depth of boring.

Attachment C

Phase I Excavation Area Data

```
|-------------------------------------------------------------|
|                VLEACH (Version 2.2a, 1996)                  |
|                                                             |
|                           By:                               |
|        Varadhan Ravi and Jeffrey A. Johnson                 |
|                  (USEPA Contractors)                        |
|        Center for Subsurface Modeling Support               |
|        Robert S. Kerr Environmental Research Laboratory     |
|        U.S. Environmental Protection Agency                 |
|        P.O. Box 1198                                        |
|        Ada, OK 74820                                        |
|                                                             |
|        Based on the original VLEACH (version 1.0)           |
|        developed by CH2M Hill, Redding, California          |
|        for USEPA Region IX                                  |
|-------------------------------------------------------------|
```

THE SHOPS AT FIRST ST, BELLVUE, WA. PHASE 1 EXCAVATION AREA.BORING BB-3 DATA.
1 polygons.
Timestep = 0.10 years. Simulation length = 100.00 years.
Printout every 2.00 years. Vertical profile stored every 2.00 years.
Koc = 400.00 ml/g, 0.14126E-01cu.ft./g
Kh = 0.70000 (dimensionless).
Aqueous solubility = 140.00 mg/l, 3.9644 g/cu.ft
Free air diffusion coefficient = .62000 sq. m/day, 2436.0 sq.ft./yr

Polygon 1
REMEDIAL EXCAVATION AREA
Polygon area = 1.0000 sq. ft.
40 cells, each cell 2.500 ft. thick.
Soil Properties:
Bulk density = 1.4700 g/ml, 41626. g/cu.ft.
Porosity = 0.3700 Volumetric water content = 0.1000
Organic carbon content = 0.00100000
Recharge Rate = 0.00000000 ft/yr
Conc. in recharge water = 0.00000 mg/l, 0.00000 g/cu.ft
Atmospheric concentration = 0.00000 mg/l, 0.00000 g/cu.ft
Water table has a fixed concentration of 0.00000 mg/l, 0.00000 g/cu.ft.
with respect to gas diffusion.

THE SHOPS AT FIRST ST, BELLVUE, WA. PHASE 1 EXCAVATION AREA.BORING BB-3 DATA.
1

0.10	100.	2.	2.0			
400	.7	140	.62			

REMEDIAL EXCAVATION AREA

1.	2.5	0.00	1.47	.37	.1	.001
0.0	0.	0.				

40y 100

1	4	0
5	6	430
7	10	370
11	14	4640
15	18	190
19	22	50
23	40	0

```
|-------------------------------------------------------------|
|                VLEACH (Version 2.2a, 1996)                  |
|                                                             |
|                          By:                                |
|        Varadhan Ravi and Jeffrey A. Johnson                 |
|                  (USEPA Contractors)                        |
|        Center for Subsurface Modeling Support               |
|        Robert S. Kerr Environmental Research Laboratory     |
|        U.S. Environmental Protection Agency                 |
|        P.O. Box 1198                                        |
|        Ada, OK 74820                                        |
|                                                             |
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|        for USEPA Region IX                                  |
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Printout every 2.00 years. Vertical profile stored every 2.00 years.
Koc = 400.00 ml/g, 0.14126E-01cu.ft./g
Kh = 0.70000 (dimensionless).
Aqueous solubility = 140.00 mg/l, 3.9644 g/cu.ft
Free air diffusion coefficient = .62000 sq. m/day, 2436.0 sq.ft./yr

Polygon 1
REMEDIAL EXCAVATION AREA
Polygon area = 1.0000 sq. ft.
40 cells, each cell 2.500 ft. thick.
Soil Properties:
Bulk density = 1.4700 g/ml, 41626. g/cu.ft.
Porosity = 0.3700 Volumetric water content = 0.1000
Organic carbon content = 0.01000000
Recharge Rate = 0.00000000 ft/yr
Conc. in recharge water = 0.00000 mg/l, 0.00000 g/cu.ft
Atmospheric concentration = 0.00000 mg/l, 0.00000 g/cu.ft
Water table has a fixed concentration of 0.00000 mg/l, 0.00000 g/cu.ft.
with respect to gas diffusion.

THE SHOPS AT FIRST ST, BELLVUE, WA. PHASE 1 EXCAVATION AREA.BORING BB-3 DATA.
1

0.10	100.	2.	2.0			
400	.7	140	.62			

REMEDIAL EXCAVATION AREA

1.	2.5	0.00	1.47	.37	.1	.010
0.0	0.	0.				

40y	100	
1	4	0
5	6	430
7	10	370
11	14	4640
15	18	190
19	22	50
23	40	0

```
|-------------------------------------------------------------|
|                VLEACH (Version 2.2a, 1996)                  |
|                                                             |
|                          By:                                |
|        Varadhan Ravi and Jeffrey A. Johnson                 |
|                  (USEPA Contractors)                        |
|        Center for Subsurface Modeling Support               |
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|        P.O. Box 1198                                        |
|        Ada, OK 74820                                        |
|                                                             |
|        Based on the original VLEACH (version 1.0)           |
|        developed by CH2M Hill, Redding, California          |
|        for USEPA Region IX                                  |
|-------------------------------------------------------------|

 BENENSON CAPITAL COMPANY, BELLVUE, WA, STORMWATER MANHOLE AREA.
  1 polygons.
Timestep =   0.10 years.  Simulation length =  100.00 years.
Printout every   2.00 years.  Vertical profile stored every   2.00 years.
Koc =      400.00    ml/g,      0.14126E-01cu.ft./g
Kh =     0.70000     (dimensionless).
Aqueous solubility =     140.00     mg/l,      3.9644     g/cu.ft
Free air diffusion coefficient = .62000     sq. m/day,  2436.0     sq.ft./yr


Polygon   1
STORMWATER MANHOLE
Polygon area =      1.0000    sq. ft.
 40 cells, each cell  2.500 ft. thick.
Soil Properties:
 Bulk density =     1.4700    g/ml,       41626.    g/cu.ft.
 Porosity = 0.3700 Volumetric water content = 0.1000
 Organic carbon content = 0.00100000
Recharge Rate = 0.15000001 ft/yr
Conc. in recharge water =     0.00000    mg/l,      0.00000    g/cu.ft
Atmospheric concentration =     0.00000    mg/l,      0.00000    g/cu.ft
Water table has a fixed concentration of     0.00000    mg/l,      0.00000
g/cu.ft.
   with respect to gas diffusion.
```

```
BENENSON CAPITAL COMPANY, BELLVUE, WA, STORMWATER MANHOLE AREA.
 1
      0.10       100.         2.        2.0
      400.       .700        140       0.62
STORMWATER MANHOLE
         1.        2.5       0.15       1.47        .37        .10    0.001
       0.0         0.         0.
   40y       100.
    1    4          0.
    5    6    4180000.
    7   10       6960
   11   14        990
   15   18        200.
   19   22         70.
   23   26        390.
   27   28         20.
   29   30         70.
   31   34         30.
   35   36         40.
   37   40         20.
```

```
|-------------------------------------------------------------|
|                VLEACH (Version 2.2a, 1996)                  |
|                                                             |
|                          By:                                |
|        Varadhan Ravi and Jeffrey A. Johnson                 |
|                  (USEPA Contractors)                        |
|        Center for Subsurface Modeling Support               |
|        Robert S. Kerr Environmental Research Laboratory     |
|        U.S. Environmental Protection Agency                 |
|        P.O. Box 1198                                        |
|        Ada, OK 74820                                        |
|                                                             |
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Aqueous solubility =     140.00     mg/l,      3.9644     g/cu.ft
Free air diffusion coefficient = .62000     sq. m/day,  2436.0     sq.ft./yr


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 Organic carbon content = 0.00100000
Recharge Rate = 0.00000000 ft/yr
Conc. in recharge water =     0.00000    mg/l,      0.00000    g/cu.ft
Atmospheric concentration =     0.00000    mg/l,      0.00000    g/cu.ft
Water table has a fixed concentration of     0.00000    mg/l,      0.00000
g/cu.ft.
   with respect to gas diffusion.
```

clay?

```
BENENSON CAPITAL COMPANY, BELLVUE, WA, STORMWATER MANHOLE AREA.
 1
      0.10       100.         2.         2.0
      400.       .700        140        0.62
STORMWATER MANHOLE
         1.        2.5      0.000       1.47        .37        .10    0.001
       0.0         0.         0.
   40y       100.
    1    4         0.
    5    6       990.
    7   10       990
   11   14       990
   15   18       200.
   19   22        70.
   23   26       390.
   27   28        20.
   29   30        70.
   31   34        30.
   35   36        40.
   37   40        20.
```

```
|-------------------------------------------------------------|
|                VLEACH (Version 2.2a, 1996)                  |
|                                                             |
|                          By:                                |
|        Varadhan Ravi and Jeffrey A. Johnson                 |
|                 (USEPA Contractors)                         |
|        Center for Subsurface Modeling Support               |
|        Robert S. Kerr Environmental Research Laboratory     |
|        U.S. Environmental Protection Agency                 |
|        P.O. Box 1198                                        |
|        Ada, OK 74820                                        |
|                                                             |
|        Based on the original VLEACH (version 1.0)           |
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|        for USEPA Region IX                                  |
|-------------------------------------------------------------|

 BENENSON CAPITAL COMPANY, BELLVUE, WA, STORMWATER MANHOLE AREA.
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Atmospheric concentration =     0.00000    mg/l,      0.00000    g/cu.ft
Water table has a fixed concentration of     0.00000    mg/l,      0.00000
g/cu.ft.
   with respect to gas diffusion.
```

```
BENENSON CAPITAL COMPANY, BELLVUE, WA, STORMWATER MANHOLE AREA.
 1
      0.10       100.         2.         2.0
      400.       .700        140        0.62
STORMWATER MANHOLE
         1.        2.5      0.000       1.47        .37        .10    0.001
       0.0         0.         0.
   40y       100.
    1    4         0.
    5    6       500.
    7   10       500
   11   14       500
   15   18       200.
   19   22        70.
   23   26       390.
   27   28        20.
   29   30        70.
   31   34        30.
   35   36        40.
   37   40        20.
```

```
|-------------------------------------------------------------|
|                VLEACH (Version 2.2a, 1996)                  |
|                                                             |
|                          By:                                |
|        Varadhan Ravi and Jeffrey A. Johnson                 |
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 Organic carbon content = 0.01000000
Recharge Rate = 0.00000000 ft/yr
Conc. in recharge water =     0.00000    mg/l,      0.00000    g/cu.ft
Atmospheric concentration =     0.00000    mg/l,      0.00000    g/cu.ft
Water table has a fixed concentration of     0.00000    mg/l,      0.00000
g/cu.ft.
   with respect to gas diffusion.
```

```
BENENSON CAPITAL COMPANY, BELLVUE, WA, STORMWATER MANHOLE AREA.
 1
      0.10       100.         2.         2.0
      400.       .700        140        0.62
STORMWATER MANHOLE
        1.        2.5      0.000       1.47        .37        .10    0.010
       0.0         0.         0.
   40y       100.
    1    4         0.
    5    6       990.
    7   10       990
   11   14       990
   15   18       200.
   19   22        70.
   23   26       390.
   27   28        20.
   29   30        70.
   31   34        30.
   35   36        40.
   37   40        20.
```