Carpenter Technology Inc.
101 Bern Street • Reading, PA 19601

PENTOXSD SIMULATION
For the Carpenter Technology Site Reading, PA

Date: October 25, 2010

Report Prepared By:

Malcolm Pirnie, Inc.

640 Freedom Business Center Drive
Suite 310
King of Prussia, PA 19406
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0432005

MALCOLM PIRNIE

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1. Introduction

Malcolm Pirnie, Inc. (Malcolm Pirnie) was tasked by Carpenter Technology (Carpenter) to perform an analysis of diffuse groundwater flow to the Schuylkill River per the Pennsylvania Department of Environmental Protection (PADEP) Land Recycling Act 25PaCode 250.406(c). The purpose for performing the analysis was to evaluate the potential in-stream concentration of constituents of concern for comparison with United States Environmental Protection Agency (USEPA) National Recommended Water Quality Criteria (2009).

Carpenter provided Malcolm Pirnie with a summary of analytical data from April 2005 through October 2009. This data was provided to Malcolm Pirnie in the form of a letter transmitting the data to USEPA data November 2009 (Attachment 1). The data summary (Attachment 1) includes the following constituents of concern (COCs) for the following groundwater monitoring wells:

> **COCs:** 1,1,1-Trichloroethane (TCA), 1,2 Dichloroethylene (DCE), cis 1,2 Dichloroethylene (cis DCE), Perchloroethylene (PCE) and Trichloroethylene (TCE)
>
> **Monitoring Wells:** 92-07, 89-01, 89-07, 92-04D, and 92-05D

Table 1 presents s summary of average COC concentrations for each well and an average concentration of COC for all of the wells combined. These values are compared to the water quality criteria for each COC. Averaging point of compliance well concentrations is consistent with performing diffuse groundwater discharge evaluations.

Direct comparison of average COC concentrations to water quality criteria demonstrates that the following COC concentrations attain water quality criteria without performing further evaluation:

> **COC Not Requiring Further Evaluation:** TCA, DCE, cis DCE

Based upon the evaluation of average concentrations, diffuse groundwater discharge analysis is required for TCE and PCE. The method of evaluation used for this task is the PADEP PENTOXSD for Windows Version 2.0c. This is the most recent version of the model available at the time of this evaluation

2. Approach

The average COC concentrations were initially evaluated using the PADEP SWLOAD spreadsheet for evaluation of daily discharge. The following concentrations were utilized for the simulation:

PCE Concentration: 21.3 ug/l
TCE Concentration: 7.4 ug/l

To evaluate the sensitivity of potential daily discharge to variable formation hydraulic conductivities, a range of hydraulic conductivities have been employed as summarized below:

Hydraulic Conductivities Used: 1 ft/day, 10 ft/day and 100 ft/day.

The range of hydraulic conductivities represents the typical range for near-river sediments ranging from silt to sand. The hydraulic gradient used for this analysis was one established for the nearby Hartman Tract which appears to represent a reasonable regional gradient of 0.003.

The SWLOAD outputs for the three hydraulic conductivities and gradient are presented in Attachment 2.

The SWLOAD produces a simulated groundwater concentration as well as a loading concentration. The simulated concentration discharging to the stream is summarized as follows:

PCE: 19.98 ug/l
TCE: 6.94 ug/l

The simulated potential discharge values for PCE and TCE based upon the highest hydraulic conductivity value (100 ft/day) and the highest discharge value are summarized as follows:

PCE – 332.7 mg/day
TCE – 115.6 mg/day

These values were inputted to the PENTOXSD spread sheet. The results of the estimated diffuse discharge simulations are presented in Attachment 3. The output of the PENTOXSD simulation provides a recommendation of discharge limitations. If the recommended discharge limitations are returned as the same value as the output of SWLOAD, then the discharge concentrations are acceptable and the diffuse discharge

meets criteria. Because the PENTOXSD simulated concentrations are the same as the input concentrations, the diffuse groundwater discharge meets water quality criteria.

3. Conclusions

Because the PENTOXSD model output is the same as the inputted concentrations, the simulated diffuse groundwater discharge attains water criteria. No further evaluation is recommended at this time.

Table 1
Carpenter
Reading, PA
2008-2009 Averages
Compared to MSCs/Criteria

Well	89-01	89-07	92-04D	92-05D	92-07	Average	MSC/MCL	Criteria
Parameter	(1)	(1)	(1)	(1)	(1)	(2)	Used Aq (3)	USEPA (4)
TCA (ug/L)	6.25	5	5	16.25	12.5	12.30769	200	z
DCE (ug/L)	6.75	5	5	6.25	14.5	9.269231	70	z
cis DCE (ug/L)	41.5	5	5	16.75	90.25	45.11538	70	z
PCE (ug/L)	30.75	5	5	11	36.25	21.30769	5	z
TCE (ug/L)	8.25	5	7.25	5	10.25	7.442308	5	z

ATTACHMENT 1

CARPENTER
Specialty Alloys

Carpenter Technology Corporation
P.O Box 14662
Reading, PA 19612-4662

Tel: 610 208.2000

November 11, 2009

Mr. Stephen Hon Lee
Environmental Engineer, PA/DC Section
United States Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Subject: **Carpenter Technology Corrective Action Groundwater Status**
RCRA Corrective Action Permit N0. PAD002344315

Dear Mr. Lee,

Carpenter has been implementing the Corrective Measures specified in its RCRA Corrective Action Permit for the past eleven years. Attached is a monitoring data summary for the past five years for the remaining five POCs. Carpenter's permit states that Carpenter may petition EPA to revise the cleanup requirements after three years in the event that the concentration of VOCs in the groundwater have attained steady-state conditions. The permit further states that the cleanup standards may be evaluated and revised based upon current acceptable standards. Based upon the attached documentation, it appears that we have attained steady-state status. In addition, sampling results are achieving or approaching the current MCL clean-up standard.

Since the issuance of the permit, Pennsylvania Department of Environmental Protection (PADEP) has established Media Specific Concentrations (MSC) under the Land Recycling Act that are acceptable cleanup levels. Carpenter believes that the EPA and PADEP have entered a Memorandum of Understanding agreeing that MSCs are acceptable cleanup criteria. All Carpenter well data is below the MSCs for non-use aquifers, which is the case at Carpenter's facility.

At this point in time, Carpenter is not requesting a change in cleanup levels, but would like to discuss the EPA's view on this or other potential avenues for facilitating closure of the project.

Thank you for your cooperation on this matter. I will be contacting you in the near future to discuss.

Sincerely,

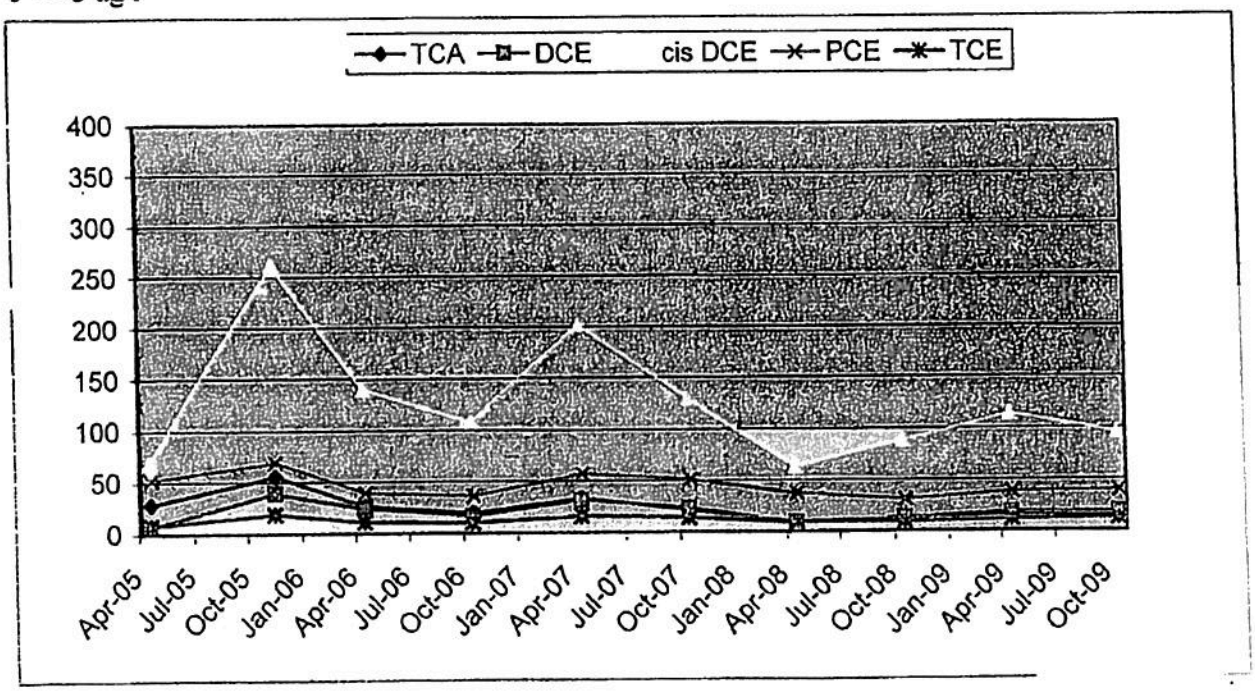
Sean McGowan
Manager – Environmental Affairs
smcgowan@cartech.com
(610) 208-3018

92-07 ug/l

Year	TCA	DCE	cis DCE	PCE	TCE
PADEP MSC*	2000	70	700	50	50
MCL:	200	7	70	5	5
04/15/05	28	6	69	52	8
11/03/05	55	39	261	69	19
04/19/06	26	24	139	39	11
10/25/06	19	16	108	36	10
04/17/07	33	31	202	57	16
10/15/07	21	23	129	51	14
04/11/08	9	9	63	37	9
10/13/08	12	13	88	31	9
04/15/09	16	18	114	38	11
10/06/09	13	18	96	39	12

* non-use aquifer

5 = <5 ug/l

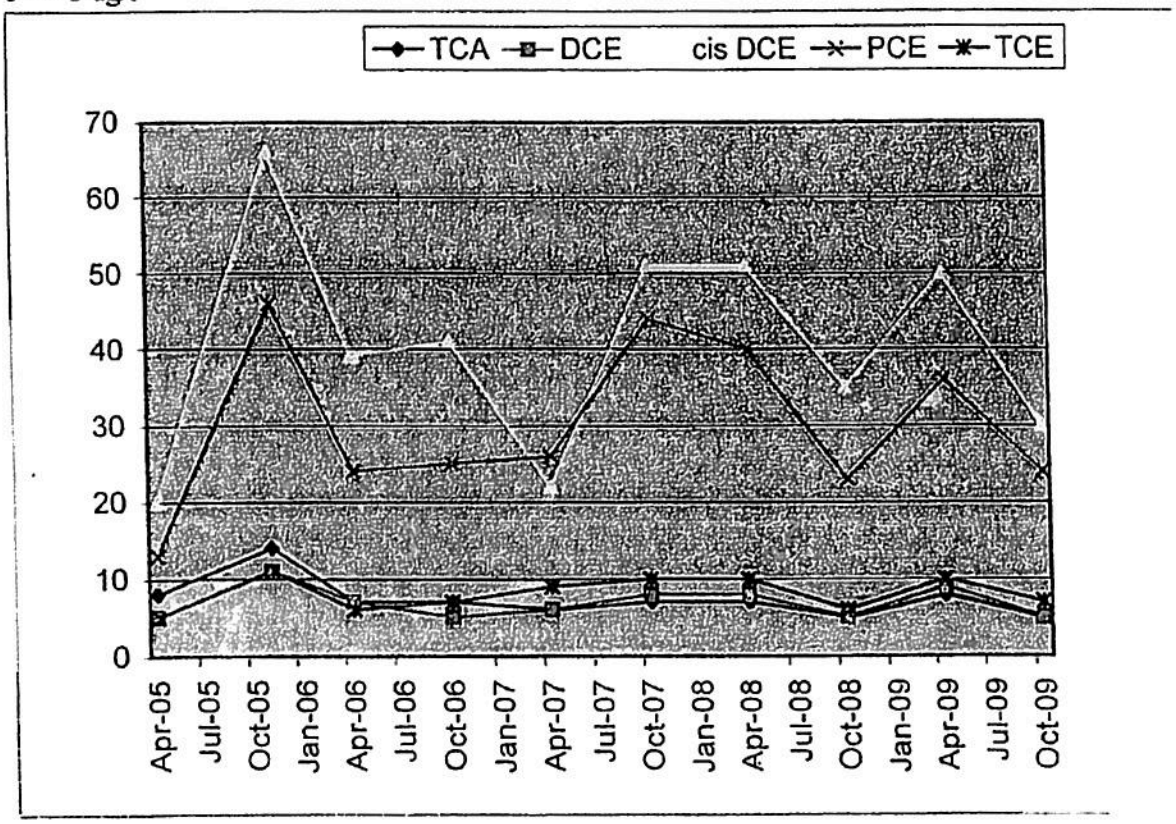


89-01 ug/l

Year	TCA	DCE	cis DCE	PCE	TCE
PADEP MSC*	2000	70	700	50	50
MCL:	200	7	70	5	5
04/15/05	8	5	20	13	5
11/03/05	14	11	66	46	11
04/19/06	7	7	39	24	6
10/25/06	7	5	41	25	7
04/17/07	6	6	22	26	9
10/15/07	7	8	51	44	10
04/11/08	7	8	51	40	10
10/13/08	5	5	35	23	6
04/15/09	8	9	50	36	10
10/06/09	5	5	30	24	7

* non-use aquifer

5 = <5 ug/l



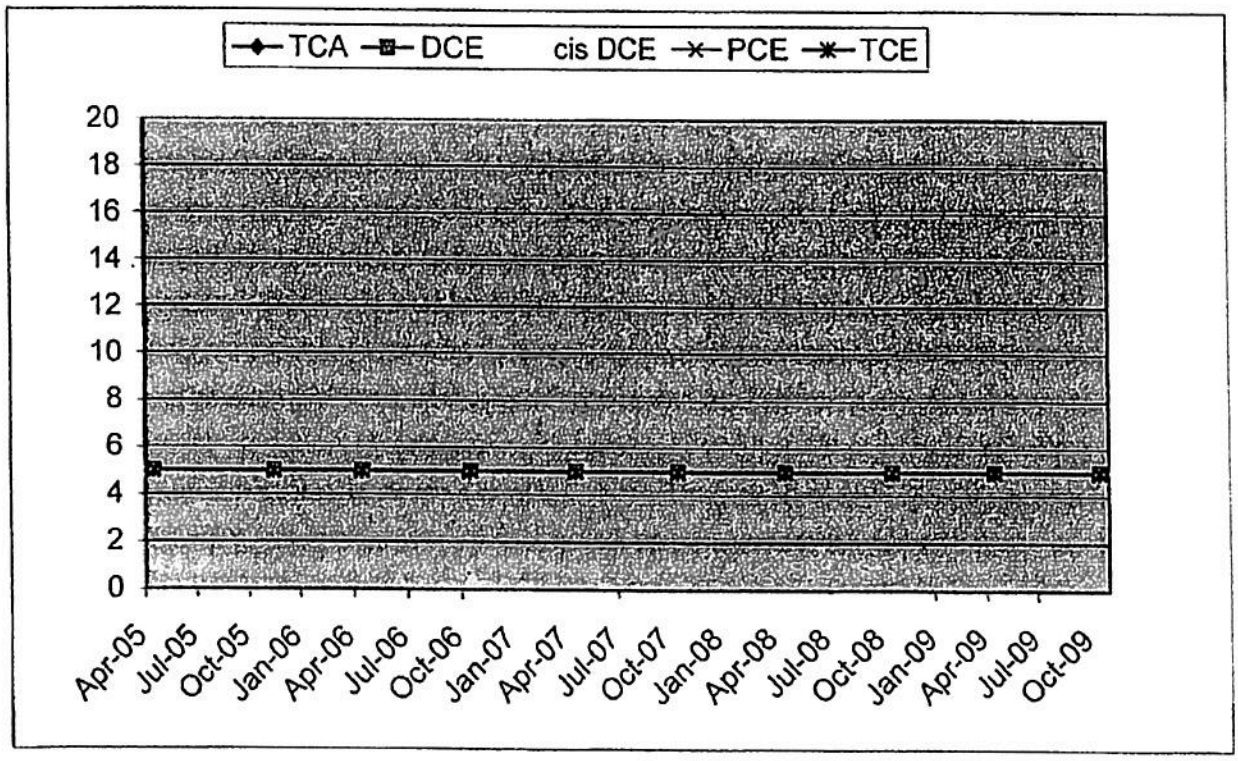
89-07

ug/l

Year	TCA	DCE	cis DCE	PCE	TCE
PADEP MSC*	2000	70	700	50	50
MCL:	200	7	70	5	5
04/15/05	5	5	5	5	5
11/03/05	5	5	5	5	5
04/19/06	5	5	5	5	5
10/25/06	5	5	5	5	5
04/17/07	5	5	5	5	5
10/15/07	5	5	5	5	5
04/11/08	5	5	5	5	5
10/13/08	5	5	5	5	5
04/15/09	5	5	5	5	5
10/06/09	5	5	5	5	5

* non-use aquifer

5 = <5 ug/l



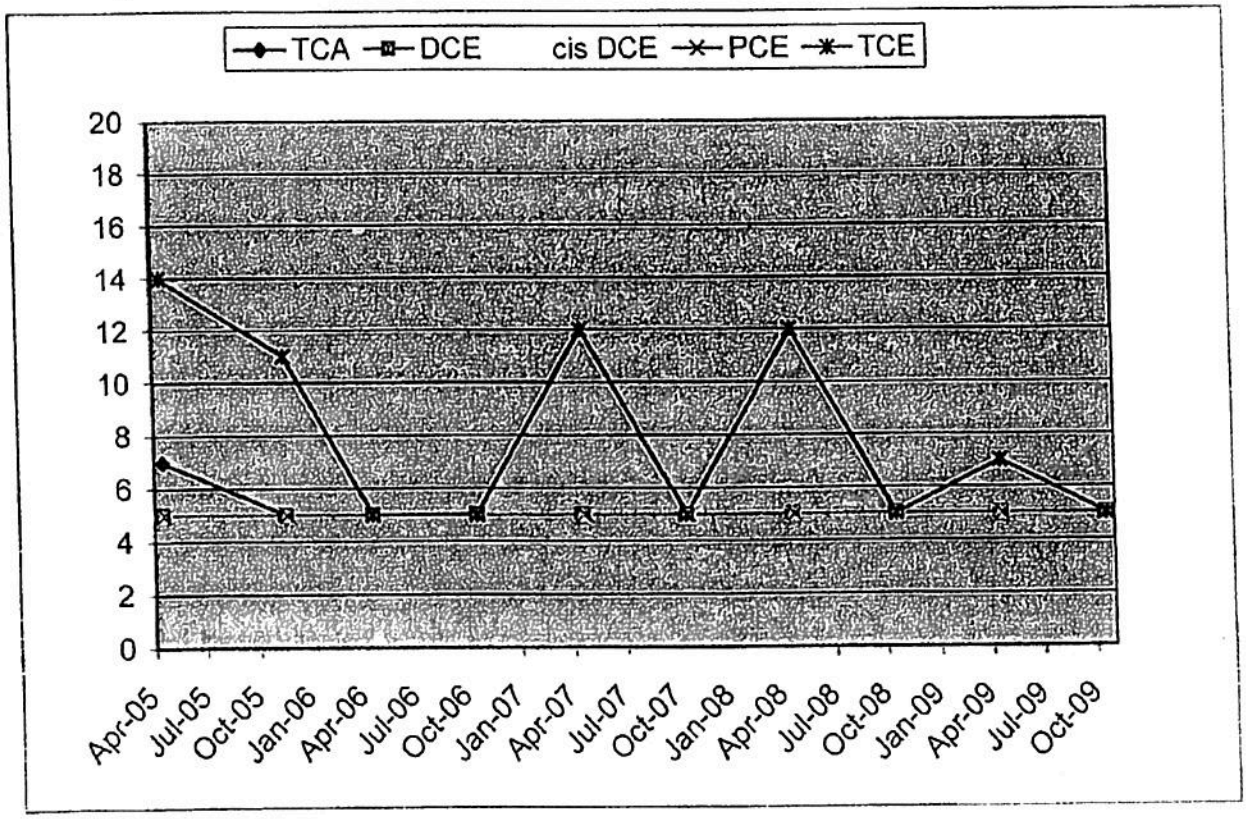
92-04D

ug/l

Year	TCA	DCE	cis DCE	PCE	TCE
PADEP MSC*	2000	70	700	50	50
MCL:	200	7	70	5	5
04/15/05	7	5	5	5	14
11/03/05	5	5	5	5	11
04/19/06	5	5	5	5	5
10/25/06	5	5	5	5	5
04/17/07	5	5	5	5	12
10/15/07	5	5	5	5	5
04/11/08	5	5	5	5	12
10/13/08	5	5	5	5	5
04/15/09	5	5	5	5	7
10/06/09	5	5	5	5	5

* non-use aquifer

5 = <5 ug/l



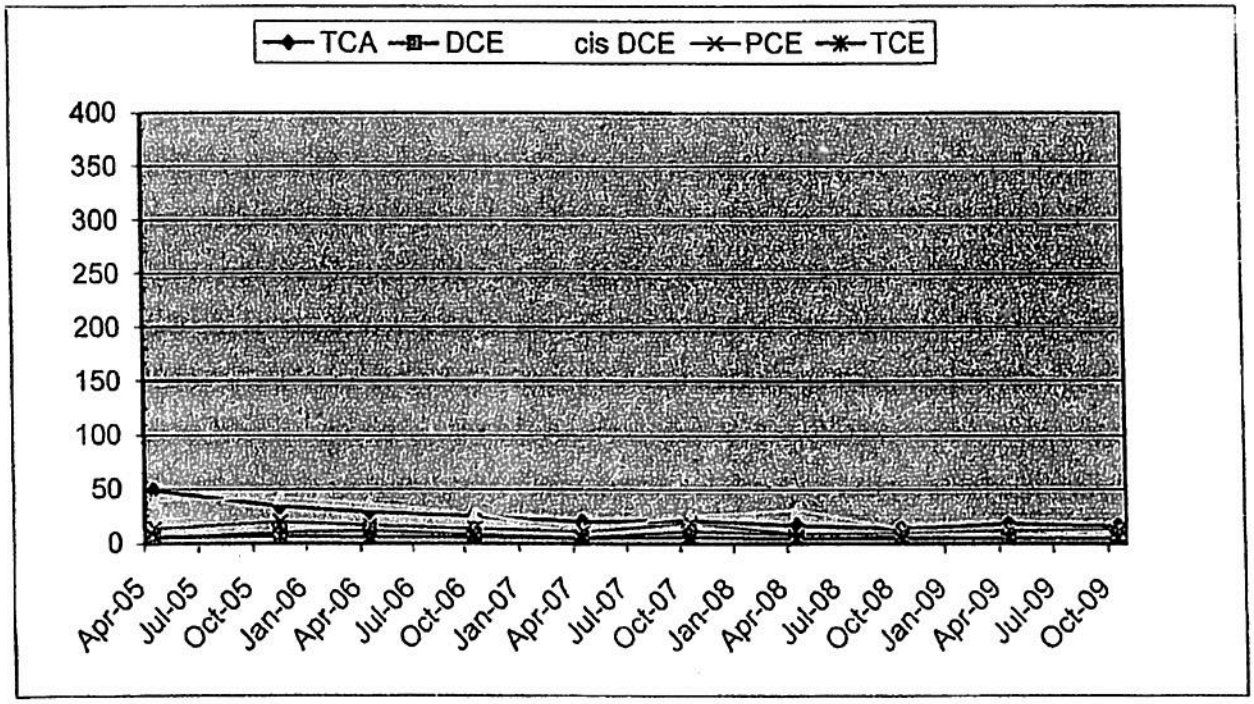
92-05D

ug/l

Year	TCA	DCE	cis DCE	PCE	TCE
PADEP MSC*	2000	70	700	50	50
MCL:	200	7	70	5	5
04/15/05	49	5	39	14	6
11/03/05	34	10	42	20	7
04/19/06	29	12	37	17	6
10/25/06	25	8	27	14	6
04/17/07	20	5	14	11	5
10/15/07	21	11	25	19	6
04/11/08	17	9	31	9	5
10/13/08	14	6	13	10	5
04/15/09	18	5	12	12	5
10/06/09	16	5	11	13	5

* non-use aquifer

5 = <5 ug/l



ATTACHMENT 2

SWLOAD

PCE OUTPUT

SWLOAD5B

PCE
Cartech Reading
1 ft/day

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE
WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

Project:	SWLOAD5B													
Date:	9/6/2010													
Contaminant:	PCE			Prepared by:		BLRWM								
SOURCE CONC (units) mg/l	Ax (ft) >.0001	Ay (ft) >.0001	Az (ft) >=.0001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days)							
0.0213	2000	200	1.00E-04	0.0008	1000	20	1.00E+99							
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm³)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*I/n*R) (ft/day)							
1.00E+00	0.003	0.2	2.5	58	1.00E-03	1.725	0.0086957							
				-93.875	-75.1	-56.325	-37.55	-18.775	0	18.775	37.55	56.325	75.1	93.875
Edge Criterion (mg/l)		0.005	0	0.010828	0.01087	0.010902	0.0109237	0.0109367	0.01094099	0.0109367	0.0109237	0.0109017	0.01087	0.010828
Higest modeled conc.		0.01094	-1.0438	0.010828	0.01087	0.010902	0.0109237	0.0109367	0.01094099	0.0109367	0.0109237	0.0109017	0.01087	0.010828
			-2.0876	0.010828	0.01087	0.010902	0.0109237	0.0109367	0.01094099	0.0109367	0.0109237	0.0109017	0.01087	0.010828
SURFACE WATER LOADING GRID			-3.1314	0.010828	0.01087	0.010902	0.0109237	0.0109367	0.01094099	0.0109367	0.0109237	0.0109017	0.01087	0.010828
Distance to Stream (ft)		100	-4.1752	0.010828	0.01087	0.010902	0.0109237	0.0109367	0.01094099	0.0109367	0.0109237	0.0109017	0.01087	0.010828
Plume View Width (ft)		187.75	-5.219	0.010828	0.01087	0.010902	0.0109237	0.0109367	0.01094099	0.0109367	0.0109237	0.0109017	0.01087	0.010828
Plume View Depth (ft)		10.438	-6.2628	0.010828	0.01087	0.010902	0.0109237	0.0109367	0.01094099	0.0109367	0.0109237	0.0109017	0.01087	0.010828
			-7.3066	0.010828	0.01087	0.010902	0.0109237	0.0109367	0.01094099	0.0109367	0.0109237	0.0109017	0.01087	0.010828
			-8.3504	0.010828	0.01087	0.010902	0.0109237	0.0109367	0.01094099	0.0109367	0.0109237	0.0109017	0.01087	0.010828
PENTOX NEEDED			-9.3942	0.010828	0.01087	0.010902	0.0109237	0.0109367	0.01094099	0.0109367	0.0109237	0.0109017	0.01087	0.010828
			-10.438	0.010828	0.01087	0.010902	0.0109237	0.0109367	0.01094099	0.0109367	0.0109237	0.0109017	0.01087	0.010828
				Average Groundwater Concentration				0.0109	mg/l					
				Plume Flow				0.00007	cfs	4.4E-05	MGD			
				Mass Loading to Stream				1.81	mg/day					

SWLOAD5B

PCE
Cartech Reading
10 ft/day

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE
WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

Project:	SWLOAD5B						
Date:	9/6/2010						
Contaminant:	PCE			Prepared by:		BLRWM	
SOURCE							
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE	
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)
0.0213	2000	200	1.00E-04	0.0008	1000	20	1.00E+99
Hydraulic	Hydraulic		Soil Bulk		Frac.	Retard-	V
Cond	Gradient	Porosity	Density	KOC	Org. Carb.	ation	(=K*I/n*R)
(ft/day)	(ft/ft)	(dec. frac.)	(g/cm³)			(R)	(ft/day)
1.00E+01	0.003	0.2	2.5	58	1.00E-03	1.725	0.0869565

			-93.875	-75.1	-56.325	-37.55	-18.775	0	18.775	37.55	56.325	75.1	93.875
Edge Criterion (mg/l)	0.005	0	0.017199	0.0172665	0.017317	0.0173519	0.01737252	0.01737933	0.0173725	0.0173519	0.0173169	0.017266	0.017199
Higest modeled conc.	0.01738	-1.0438	0.017199	0.0172665	0.017317	0.0173519	0.01737252	0.01737933	0.0173725	0.0173519	0.0173169	0.017266	0.017199
		-2.0876	0.017199	0.0172665	0.017317	0.0173519	0.01737252	0.01737933	0.0173725	0.0173519	0.0173169	0.017266	0.017199
SURFACE WATER LOADING GRID		-3.1314	0.017199	0.0172665	0.017317	0.0173519	0.01737252	0.01737933	0.0173725	0.0173519	0.0173169	0.017266	0.017199
Distance to Stream (ft)	100	-4.1752	0.017199	0.0172665	0.017317	0.0173519	0.01737252	0.01737933	0.0173725	0.0173519	0.0173169	0.017266	0.017199
Plume View Width (ft)	187.75	-5.219	0.017199	0.0172665	0.017317	0.0173519	0.01737252	0.01737933	0.0173725	0.0173519	0.0173169	0.017266	0.017199
Plume View Depth (ft)	10.438	-6.2628	0.017199	0.0172665	0.017317	0.0173519	0.01737252	0.01737933	0.0173725	0.0173519	0.0173169	0.017266	0.017199
		-7.3066	0.017199	0.0172665	0.017317	0.0173519	0.01737252	0.01737933	0.0173725	0.0173519	0.0173169	0.017266	0.017199
		-8.3504	0.017199	0.0172665	0.017317	0.0173519	0.01737252	0.01737933	0.0173725	0.0173519	0.0173169	0.017266	0.017199
PENTOX NEEDED		-9.3942	0.017199	0.0172665	0.017317	0.0173519	0.01737252	0.01737933	0.0173725	0.0173519	0.0173169	0.017266	0.017199
		-10.438	0.017199	0.0172665	0.017317	0.0173519	0.01737252	0.01737933	0.0173725	0.0173519	0.0173169	0.017266	0.017199

Average Groundwater Concentration	0.01731	mg/l		
Plume Flow	0.00068	cfs	0.00044	MGD
Mass Loading to Stream	28.82	mg/day		

SWLOAD5B

PCE
Cartech Reading
100 ft/day

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER

Project: SWLOAD5B
Date: 9/6/2010
Contaminant: PCE
Prepared by: BLRWM

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE
WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

SOURCE CONC (units) mg/l	Ax (ft) >.0001	Ay (ft) >.0001	Az (ft) >=.0001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days)
0.0213	2000	200	1.00E-04	0.0008	1000	20	1.00E+99

Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm³)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
1.00E+02	0.003	0.2	2.5	58	1.00E-03	1.725	0.8695652

			-93.875	-75.1	-56.325	-37.55	-18.775	0	18.775	37.55	56.325	75.1	93.875
Edge Criterion (mg/l)	0.005	0	0.019856	0.0199337	0.019992	0.0200323	0.02005611	0.02006397	0.0200561	0.0200323	0.0199919	0.019934	0.019856
Higest modeled conc.	0.02006	-1.0438	0.019856	0.0199337	0.019992	0.0200323	0.02005611	0.02006397	0.0200561	0.0200323	0.0199919	0.019934	0.019856
		-2.0876	0.019856	0.0199337	0.019992	0.0200323	0.02005611	0.02006397	0.0200561	0.0200323	0.0199919	0.019934	0.019856
SURFACE WATER LOADING GRID		-3.1314	0.019856	0.0199337	0.019992	0.0200323	0.02005611	0.02006397	0.0200561	0.0200323	0.0199919	0.019934	0.019856
Distance to Stream (ft)	100	-4.1752	0.019856	0.0199337	0.019992	0.0200323	0.02005611	0.02006397	0.0200561	0.0200323	0.0199919	0.019934	0.019856
Plume View Width (ft)	187.75	-5.219	0.019856	0.0199337	0.019992	0.0200323	0.02005611	0.02006397	0.0200561	0.0200323	0.0199919	0.019934	0.019856
Plume View Depth (ft)	10.438	-6.2628	0.019856	0.0199337	0.019992	0.0200323	0.02005611	0.02006397	0.0200561	0.0200323	0.0199919	0.019934	0.019856
		-7.3066	0.019856	0.0199337	0.019992	0.0200323	0.02005611	0.02006397	0.0200561	0.0200323	0.0199919	0.019934	0.019856
		-8.3504	0.019856	0.0199337	0.019992	0.0200323	0.02005611	0.02006397	0.0200561	0.0200323	0.0199919	0.019934	0.019856
PENTOX NEEDED		-9.3942	0.019856	0.0199337	0.019992	0.0200323	0.02005611	0.02006397	0.0200561	0.0200323	0.0199919	0.019934	0.019856
		-10.438	0.019856	0.0199337	0.019992	0.0200323	0.02005611	0.02006397	0.0200561	0.0200323	0.0199919	0.019934	0.019856

Average Groundwater Concentration	0.01998	mg/l	
Plume Flow	0.00679	cfs	0.00439 MGD
Mass Loading to Stream	332.70	mg/day	

SWLOAD

TCE OUTPUT

SWLOAD5B

TCE
Cartech Reading
1 ft/day

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER

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Project:	SWLOAD5B													
Date:	9/6/2010													
Contaminant:	TCE			Prepared by:		BLRWM								
SOURCE														
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE								
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time							
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)							
0.0074	2000	200	1.00E-04	0.0008	1000	20	1.00E+99							
Hydraulic	Hydraulic		Soil Bulk		Frac.	Retard-	V							
Cond	Gradient	Porosity	Density	KOC	Org. Carb.	ation	(=K*i/n*R)							
(ft/day)	(ft/ft)	(dec. frac.)	(g/cm³)			(R)	(ft/day)							
1.00E+00	0.003	0.2	2.5	58	1.00E-03	1.725	0.0086957							
				-93.875	-75.1	-56.325	-37.55	-18.775	0	18.775	37.55	56.325	75.1	93.875
Edge Criterion (mg/l)		0.005	0	0.003762	0.0037764	0.003787	0.0037951	0.00379961	0.0038011	0.0037996	0.0037951	0.0037874	0.003776	0.003762
Higest modeled conc.		0.0038	-1.0438	0.003762	0.0037764	0.003787	0.0037951	0.00379961	0.0038011	0.0037996	0.0037951	0.0037874	0.003776	0.003762
			-2.0876	0.003762	0.0037764	0.003787	0.0037951	0.00379961	0.0038011	0.0037996	0.0037951	0.0037874	0.003776	0.003762
SURFACE WATER LOADING GRID			-3.1314	0.003762	0.0037764	0.003787	0.0037951	0.00379961	0.0038011	0.0037996	0.0037951	0.0037874	0.003776	0.003762
Distance to Stream (ft)		100	-4.1752	0.003762	0.0037764	0.003787	0.0037951	0.00379961	0.0038011	0.0037996	0.0037951	0.0037874	0.003776	0.003762
Plume View Width (ft)		187.75	-5.219	0.003762	0.0037764	0.003787	0.0037951	0.00379961	0.0038011	0.0037996	0.0037951	0.0037874	0.003776	0.003762
Plume View Depth (ft)		10.438	-6.2628	0.003762	0.0037764	0.003787	0.0037951	0.00379961	0.0038011	0.0037996	0.0037951	0.0037874	0.003776	0.003762
			-7.3066	0.003762	0.0037764	0.003787	0.0037951	0.00379961	0.0038011	0.0037996	0.0037951	0.0037874	0.003776	0.003762
			-8.3504	0.003762	0.0037764	0.003787	0.0037951	0.00379961	0.0038011	0.0037996	0.0037951	0.0037874	0.003776	0.003762
PENTOX NOT NEEDED			-9.3942	0.003762	0.0037764	0.003787	0.0037951	0.00379961	0.0038011	0.0037996	0.0037951	0.0037874	0.003776	0.003762
			-10.438	0.003762	0.0037764	0.003787	0.0037951	0.00379961	0.0038011	0.0037996	0.0037951	0.0037874	0.003776	0.003762
				Average Groundwater Concentration				0.00379	mg/l					
				Plume Flow				0.00007	cfs	4.4E-05	MGD			
				Mass Loading to Stream				0.63	mg/day					

SWLOAD5B

TCE
Cartech Reading
10 ft/day

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE
WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

Project:	SWLOAD5B													
Date:	9/6/2010													
Contaminant:	TCE			Prepared by:		BLRWM								
SOURCE CONC (units)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH	SOURCE THICKNESS	Time							
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)							
0.0074	2000	200	1.00E-04	0.0008	1000	20	1.00E+99							
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm³)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*I/n*R) (ft/day)							
1.00E+01	0.003	0.2	2.5	58	1.00E-03	1.725	0.0869565							
				-93.875	-75.1	-56.325	-37.55	-18.775	0	18.775	37.55	56.325	75.1	93.875
Edge Criterion (mg/l)		0.005	0	0.005975	0.0059987	0.006016	0.0060284	0.00603552	0.00603789	0.0060355	0.0060284	0.0060162	0.005999	0.005975
Higest modeled conc.		0.00604	-1.0438	0.005975	0.0059987	0.006016	0.0060284	0.00603552	0.00603789	0.0060355	0.0060284	0.0060162	0.005999	0.005975
			-2.0876	0.005975	0.0059987	0.006016	0.0060284	0.00603552	0.00603789	0.0060355	0.0060284	0.0060162	0.005999	0.005975
SURFACE WATER LOADING GRID			-3.1314	0.005975	0.0059987	0.006016	0.0060284	0.00603552	0.00603789	0.0060355	0.0060284	0.0060162	0.005999	0.005975
Distance to Stream (ft)		100	-4.1752	0.005975	0.0059987	0.006016	0.0060284	0.00603552	0.00603789	0.0060355	0.0060284	0.0060162	0.005999	0.005975
Plume View Width (ft)		187.75	-5.219	0.005975	0.0059987	0.006016	0.0060284	0.00603552	0.00603789	0.0060355	0.0060284	0.0060162	0.005999	0.005975
Plume View Depth (ft)		10.438	-6.2628	0.005975	0.0059987	0.006016	0.0060284	0.00603552	0.00603789	0.0060355	0.0060284	0.0060162	0.005999	0.005975
			-7.3066	0.005975	0.0059987	0.006016	0.0060284	0.00603552	0.00603789	0.0060355	0.0060284	0.0060162	0.005999	0.005975
			-8.3504	0.005975	0.0059987	0.006016	0.0060284	0.00603552	0.00603789	0.0060355	0.0060284	0.0060162	0.005999	0.005975
PENTOX NEEDED			-9.3942	0.005975	0.0059987	0.006016	0.0060284	0.00603552	0.00603789	0.0060355	0.0060284	0.0060162	0.005999	0.005975
			-10.438	0.005975	0.0059987	0.006016	0.0060284	0.00603552	0.00603789	0.0060355	0.0060284	0.0060162	0.005999	0.005975
				Average Groundwater Concentration				0.00601	mg/l					
				Plume Flow				0.00068	cfs	0.00044	MGD			
				Mass Loading to Stream				10.01	mg/day					

SWLOAD5B

TCE
Cartesian Reading
100 ft/day

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE
WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

Project:	SWLOAD5B						
Date:	9/6/2010						
Contaminant:	TCE			Prepared by:		BLRWM	
SOURCE CONC (units)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH	SOURCE THICKNESS	Time
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)
0.0074	2000	200	1.00E-04	0.0008	1000	20	1.00E+99
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm³)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
1.00E+02	0.003	0.2	2.5	58	1.00E-03	1.725	0.8695652

				-93.875	-75.1	-56.325	-37.55	-18.775	0	18.775	37.55	56.325	75.1	93.875
Edge Criterion (mg/l)		0.005	0	0.006898	0.0069253	0.006946	0.0069596	0.00696785	0.00697058	0.0069678	0.0069596	0.0069455	0.006925	0.006898
Higest modeled conc.		0.00697	-1.0438	0.006898	0.0069253	0.006946	0.0069596	0.00696785	0.00697058	0.0069678	0.0069596	0.0069455	0.006925	0.006898
			-2.0876	0.006898	0.0069253	0.006946	0.0069596	0.00696785	0.00697058	0.0069678	0.0069596	0.0069455	0.006925	0.006898
SURFACE WATER LOADING GRID			-3.1314	0.006898	0.0069253	0.006946	0.0069596	0.00696785	0.00697058	0.0069678	0.0069596	0.0069455	0.006925	0.006898
Distance to Stream (ft)		100	-4.1752	0.006898	0.0069253	0.006946	0.0069596	0.00696785	0.00697058	0.0069678	0.0069596	0.0069455	0.006925	0.006898
Plume View Width (ft)		187.75	-5.219	0.006898	0.0069253	0.006946	0.0069596	0.00696785	0.00697058	0.0069678	0.0069596	0.0069455	0.006925	0.006898
Plume View Depth (ft)		10.438	-6.2628	0.006898	0.0069253	0.006946	0.0069596	0.00696785	0.00697058	0.0069678	0.0069596	0.0069455	0.006925	0.006898
			-7.3066	0.006898	0.0069253	0.006946	0.0069596	0.00696785	0.00697058	0.0069678	0.0069596	0.0069455	0.006925	0.006898
			-8.3504	0.006898	0.0069253	0.006946	0.0069596	0.00696785	0.00697058	0.0069678	0.0069596	0.0069455	0.006925	0.006898
PENTOX NEEDED			-9.3942	0.006898	0.0069253	0.006946	0.0069596	0.00696785	0.00697058	0.0069678	0.0069596	0.0069455	0.006925	0.006898
			-10.438	0.006898	0.0069253	0.006946	0.0069596	0.00696785	0.00697058	0.0069678	0.0069596	0.0069455	0.006925	0.006898

Average Groundwater Concentration	0.00694	mg/l		
Plume Flow	0.00679	cfs	0.00439	MGD
Mass Loading to Stream	115.59	mg/day		

Attachment 3

PENNTOXSD

PCE OUTPUT

PENTOXSD

Modeling Input Data

Stream Code	RMI	Elevation (ft)	Drainage Area (sq mi)	Slope	PWS With (mgd)	Apply FC
833	80.00	310.65	355.00	0.00000	0.00	☑

Stream Data

	LFY (cfsm)	Trib Flow (cfs)	Stream Flow (cfs)	WD Ratio	Rch Width (ft)	Rch Depth (ft)	Rch Velocity (fps)	Rch Trav Time (days)	Tributary Hard (mg/L)	Tributary pH	Stream Hard (mg/L)	Stream pH	Analysis Hard (mg/L)	Analysis pH
Q7-10	0.1	0	117	0	0	0	0	0	100	7	0	0	0	0
Qh		0	0	0	0	0	0	0	100	7	0	0	0	0

Discharge Data

Name	Permit Number	Existing Disc Flow (mgd)	Permitted Disc Flow (mgd)	Design Disc Flow (mgd)	Reserve Factor	AFC PMF	CFC PMF	THH PMF	CRL PMF	Disc Hard (mg/L)	Disc pH
	Act 2	0	0	0.00439	0	0	0	0	0	100	7

Parameter Data

Parameter Name	Disc Conc (µg/L)	Trib Conc (µg/L)	Disc Daily CV	Disc Hourly CV	Steam Conc (µg/L)	Stream CV	Fate Coef	FOS	Crit Mod	Max Disc Conc (µg/L)
TETRACHLOROETHYL-ENE	19.98	0	0.5	0.5	0	0	0	0	1	0

Stream Code	RMI	Elevation (ft)	Drainage Area (sq mi)	Slope	PWS With (mgd)	Apply FC
833	74.00	185.50	880.00	0.00000	0.00	☑

Stream Data

	LFY (cfsm)	Trib Flow (cfs)	Stream Flow (cfs)	WD Ratio	Rch Width (ft)	Rch Depth (ft)	Rch Velocity (fps)	Rch Trav Time (days)	Tributary Hard (mg/L)	Tributary pH	Stream Hard (mg/L)	Stream pH	Analysis Hard (mg/L)	Analysis pH
Q7-10	0.1	0	0	0	0	0	0	0	100	7	0	0	0	0
Qh		0	0	0	0	0	0	0	100	7	0	0	0	0

Discharge Data

Name	Permit Number	Existing Disc Flow (mgd)	Permitted Disc Flow (mgd)	Design Disc Flow (mgd)	Reserve Factor	AFC PMF	CFC PMF	THH PMF	CRL PMF	Disc Hard (mg/L)	Disc pH
		0	0	0	0	0	0	0	0	100	7

Parameter Data

Parameter Name	Disc Conc (µg/L)	Trib Conc (µg/L)	Disc Daily CV	Disc Hourly CV	Steam Conc (µg/L)	Stream CV	Fate Coef	FOS	Crit Mod	Max Disc Conc (µg/L)
TETRACHLOROETHYL-ENE	0	0	0.5	0.5	0	0	0	0	1	0

PENTOXSD Analysis Results

Hydrodynamics

SWP Basin	Stream Code:	Stream Name:
03F	833	SCHUYLKILL RIVER

RMI	Stream Flow (cfs)	PWS With (cfs)	Net Stream Flow (cfs)	Disc Analysis Flow (cfs)	Reach Slope	Depth (ft)	Width (ft)	WD Ratio	Velocity (fps)	Reach Trav Time (days)	CMT (min)
Q7-10 Hydrodynamics											
80.000	117	0	117	0.00679	0.004	1.0184	141.00	138.46	0.8148	0.45	421.834
74.000	169.5	0	169.5	NA	0	0	0	0	0	0	NA
Qh Hydrodynamics											
80.000	477.07	0	477.07	0.00679	0.004	1.8901	141.00	74.602	1.7901	0.2048	166.851
74.000	659.60	0	659.60	NA	0	0	0	0	0	0	NA

PENTOXSD Analysis Results

Wasteload Allocations

RMI	Name	Permit Number
80.00		Act 2

AFC

Q7-10: CCT (min) 15 PMF 0.188 Analysis pH 7 Analysis Hardness 100

Parameter	Stream Conc (µg/L)	Stream CV	Trib Conc (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
TETRACHLOROETHYL-ENE	0	0	0	0	700	700	2270000

CFC

Q7-10: CCT (min) 421.834 PMF 1 Analysis pH 7 Analysis Hardness 100

Parameter	Stream Conc. (µg/L)	Stream CV	Trib Conc. (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
TETRACHLOROETHYL-ENE	0	0	0	0	140	140	2410000

THH

Q7-10: CCT (min) 421.834 PMF NA Analysis pH NA Analysis Hardness NA

Parameter	Stream Conc (µg/L)	Stream CV	Trib Conc (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
TETRACHLOROETHYL-ENE	0	0	0	0	NA	NA	NA

CRL

Qh: CCT (min) 166.851 PMF 1

Parameter	Stream Conc (µg/L)	Stream CV	Trib Conc (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
TETRACHLOROETHYL-ENE	0	0	0	0	0.8	0.8	56198.48

PENTOXSD Analysis Results

Recommended Effluent Limitations

SWP Basin	Stream Code:	Stream Name:
03F	833	SCHUYLKILL RIVER

RMI	Name	Permit Number	Disc Flow (mgd)
80.00		Act 2	0.0044

Parameter	Effluent Limit (µg/L)	Governing Criterion	Max. Daily Limit (µg/L)	Most Stringent WQBEL (µg/L)	Most Stringent WQBEL Criterion
TETRACHLOROETHYL-ENE	19.98	INPUT	31.172	56198.48	CRL

PENTOXSD

TCE OUTPUT

PENTOXSD

Modeling Input Data

Stream Code	RMI	Elevation (ft)	Drainage Area (sq mi)	Slope	PWS With (mgd)	Apply FC
833	80.00	310.65	355.00	0.00000	0.00	☑

Stream Data

	LFY (cfsm)	Trib Flow (cfs)	Stream Flow (cfs)	WD Ratio	Rch Width (ft)	Rch Depth (ft)	Rch Velocity (fps)	Rch Trav Time (days)	Tributary Hard (mg/L)	Tributary pH	Stream Hard (mg/L)	Stream pH	Analysis Hard (mg/L)	Analysis pH
Q7-10	0.1	0	117	0	0	0	0	0	100	7	0	0	0	0
Qh		0	0	0	0	0	0	0	100	7	0	0	0	0

Discharge Data

Name	Permit Number	Existing Disc Flow (mgd)	Permitted Disc Flow (mgd)	Design Disc Flow (mgd)	Reserve Factor	AFC PMF	CFC PMF	THH PMF	CRL PMF	Disc Hard (mg/L)	Disc pH
	Act 2	0	0	0.00439	0	0	0	0	0	100	7

Parameter Data

Parameter Name	Disc Conc (µg/L)	Trib Conc (µg/L)	Disc Daily CV	Disc Hourly CV	Steam Conc (µg/L)	Stream CV	Fate Coef	FOS	Crit Mod	Max Disc Conc (µg/L)
TRICHLOROETHYLENE	6.94	0	0.5	0.5	0	0	0	0	1	0

Stream Code	RMI	Elevation (ft)	Drainage Area (sq mi)	Slope	PWS With (mgd)	Apply FC
833	74.00	185.50	880.00	0.00000	0.00	☑

Stream Data

	LFY (cfsm)	Trib Flow (cfs)	Stream Flow (cfs)	WD Ratio	Rch Width (ft)	Rch Depth (ft)	Rch Velocity (fps)	Rch Trav Time (days)	Tributary Hard (mg/L)	Tributary pH	Stream Hard (mg/L)	Stream pH	Analysis Hard (mg/L)	Analysis pH
Q7-10	0.1	0	0	0	0	0	0	0	100	7	0	0	0	0
Qh		0	0	0	0	0	0	0	100	7	0	0	0	0

Discharge Data

Name	Permit Number	Existing Disc Flow (mgd)	Permitted Disc Flow (mgd)	Design Disc Flow (mgd)	Reserve Factor	AFC PMF	CFC PMF	THH PMF	CRL PMF	Disc Hard (mg/L)	Disc pH
		0	0	0	0	0	0	0	0	100	7

Parameter Data

Parameter Name	Disc Conc (µg/L)	Trib Conc (µg/L)	Disc Daily CV	Disc Hourly CV	Steam Conc (µg/L)	Stream CV	Fate Coef	FOS	Crit Mod	Max Disc Conc (µg/L)
TRICHLOROETHYLENE	0	0	0.5	0.5	0	0	0	0	1	0

PENTOXSD Analysis Results

Hydrodynamics

SWP Basin	Stream Code:	Stream Name:
03F	833	SCHUYLKILL RIVER

RMI	Stream Flow (cfs)	PWS With (cfs)	Net Stream Flow (cfs)	Disc Analysis Flow (cfs)	Reach Slope	Depth (ft)	Width (ft)	WD Ratio	Velocity (fps)	Reach Trav Time (days)	CMT (min)
Q7-10 Hydrodynamics											
80.000	117	0	117	0.00679	0.004	1.0184	141.00	138.46	0.8148	0.45	421.834
74.000	169.5	0	169.5	NA	0	0	0	0	0	0	NA
Qh Hydrodynamics											
80.000	477.07	0	477.07	0.00679	0.004	1.8901	141.00	74.602	1.7901	0.2048	166.851
74.000	659.60	0	659.60	NA	0	0	0	0	0	0	NA

PENTOXSD Analysis Results

Wasteload Allocations

RMI	Name	Permit Number
80.00		Act 2

AFC

Q7-10: CCT (min) 15 PMF 0.188 Analysis pH 7 Analysis Hardness 100

Parameter	Stream Conc (µg/L)	Stream CV	Trib Conc (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
TRICHLOROETHYLENE	0	0	0	0	2300	2300	7470000

CFC

Q7-10: CCT (min) 421.834 PMF 1 Analysis pH 7 Analysis Hardness 100

Parameter	Stream Conc. (µg/L)	Stream CV	Trib Conc. (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
TRICHLOROETHYLENE	0	0	0	0	450	450	7750000

THH

Q7-10: CCT (min) 421.834 PMF NA Analysis pH NA Analysis Hardness NA

Parameter	Stream Conc (µg/L)	Stream CV	Trib Conc (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
TRICHLOROETHYLENE	0	0	0	0	NA	NA	NA

CRL

Qh: CCT (min) 166.851 PMF 1

Parameter	Stream Conc (µg/L)	Stream CV	Trib Conc (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
TRICHLOROETHYLENE	0	0	0	0	2.7	2.7	189669.9

PENTOXSD Analysis Results

Recommended Effluent Limitations

SWP Basin	Stream Code:	Stream Name:
03F	833	SCHUYLKILL RIVER

RMI	Name	Permit Number	Disc Flow (mgd)
80.00		Act 2	0.0044

Parameter	Effluent Limit (µg/L)	Governing Criterion	Max. Daily Limit (µg/L)	Most Stringent WQBEL (µg/L)	Most Stringent WQBEL Criterion
TRICHLOROETHYLENE	6.94	INPUT	10.828	189669.9	CRL