State of New Jersey

CHRIS CHRISTIE
Governor

DEPARTMENT of ENVIRONMENTAL PROTECTION

BOB MARTIN
Commissioner

Division of Air Quality
Bureau of Technical Services
Air Quality Evaluation
401 E. State Street, 2nd floor, P.O. Box 27
Trenton, NJ 08625-0027

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M E M O R A N D U M

TO: Frank Faranca, CHMM, Site Remediation Technical Specialist
Bureau of Case Management

FROM: Greg John, Research Scientist
Bureau of Technical Services

SUBJECT: Pompton Lakes PCE/TCE Air Dispersion Modeling and Risk Assessment

The Bureau of Technical Services has completed air dispersion modeling and risk assessment of Tetrachloroethylene (PCE) and Trichloroethylene (TCE) emissions from the treatment of contaminated groundwater at and surrounding the Pompton Lakes DuPont Facility. The air dispersion modeling and risk assessment show negligible inhalation cancer and non-cancer risks for both PCE and TCE at Pompton Lakes. A summary of the air dispersion modeling and risk assessment is attached. If there are any questions regarding the air dispersion modeling and risk assessment, please contact me at (609) 633-1106.

Attachment

c: Joel Leon
Alan Dresser
Len Romino
Steve Maybury
John Boyer
Bob Kelly - EPA

Tetrachloroethylene (PCE) and Trichloroethylene (TCE)
Air Dispersion Modeling and Risk Assessment
Pompton Lakes, Passaic County
April 2010

CONCLUSION

Air dispersion modeling and risk assessment shows that the cancer and non-cancer risks related to Tetrachloroethylene (PCE) and Trichloroethylene (TCE) emissions from the DuPont Air Stripper, Sub-Slab Depressurization Systems, and soil evaporation are negligible for the Pompton Lakes area. The maximum predicted annual concentration for PCE of 0.078 $\mu g/m^3$ results in an incremental risk of 4.6 in ten million and hazard quotient of 0.002. The maximum predicted 1-hour PCE concentration of 6.74 $\mu g/m^3$ is well below the short-term reference concentration of 22,000 $\mu g/m^3$. The maximum predicted annual concentration for TCE of 0.025 $\mu g/m^3$ results in an incremental risk of 5 in a hundred million and hazard quotient of 0.00004. Cancer risks less than 1 in a million and a hazard quotients less than 1 are considered negligible.

PROJECT DESCRIPTION

A groundwater plume of PCE and TCE contamination at and south of the Pompton Lakes DuPont Facility is undergoing treatment through the use of a permitted air stripper (Permit # PCP990001). In addition, Sub-Slab Depressurization Systems have been installed at local residences to reduce the indoor impacts from the groundwater contaminants. The air quality impacts and inhalation risks from these sources and soil evaporation of PCE and TCE were evaluated for the effected area.

EMISSION RATES AND STACK PARAMETERS

Three types of PCE and TCE emission sources were modeled. 1) The primary source of PCE and TCE emissions within the Pompton Lakes Valley is the permitted air stripper at the DuPont Facility. Air dispersion modeling included the allowable PCE and TCE emissions set in the air permit. The air stripper stack parameters and emission rates modeled are provided in Table 1. 2) Data from 335 samples taken at surrounding homes in Pompton Lakes were included in the evaluation. Samples from only eight residences show either PCE or TCE concentrations above non-detect levels (0.2 ppb). Assuming that these concentrations are emitted to the air by Sub-Slab Depressurization Systems (SSDS), they were modeled as point sources. While flow rates from the SSDS fans vary depending on the sub-slab material porosity, a generic flow rate of 120 acfm was modeled for each system. The maximum flow rates of model of SSDS fans used at Pompton Lakes are as follows: HP-220 – 344 acfm, GP-501 – 95 acfm, HS-5000 – 53 acfm, and FR-250 – 649 acfm. The location and parameters for each SSDS modeled are listed in Table 2. And, 3) the air dispersion modeling included an estimate of the soil evaporation of PCE and TCE above the delineated groundwater plume. The following equation (1) was used to estimate the soil evaporation rate:

Equation 1)

$$E = \frac{\left(\frac{R_n - S}{1+\beta}\right)}{V_h}$$

Footnote 1

Where:

Soil Evaporation Rate (E) = 6.84 * 10^{-5} kg/m^2/s

Net Radiation (R_n) = 300 W/m^2 Footnote 2

Soil Heat Flux (S) = 30 W/m^2 Footnote 2

Bowen Ratio (β) = 0.79 (NJDEP Default)

Latent heat of the vaporization of water (V_h) = 2.45 * 10^6 kg/m^2/s Footnote 1

Footnote 1 Watt, Jacqueline, Adam Pirie, and Nathan Odgers, 2004, Narrabri Soil Physics Study, University of Sydney.

Footnote 2 Stull, Roland B., 1988, An Introduction to Boundary Layer Meteorology, Kluwer Academic Publishers.

Table 1. Air Stripper Emissions and Stack Parameters

Parameter	**Air Stripper PT17**	
PCE Emissions	0.003871 g/s (0.13459 TPY)	
TCE Emissions	0.0012318 g/s (0.04282 TPY)	
UTM Coordinates	560558 m E	4540607 m N
Elevation	70 m	
Stack Height	15.24 m	
Stack Diameter	0.4 m	
Exit Temperature	65 ◦F	
Flow Rate	1800 acfm	

Table 2. SSDS Emissions and Parameters Modeled

Location	UTM Coordinates		Elevation (m)	PCE Emissions (g/s)	TCE Emissions (g/s)	Stack Height (m)	Stack Diameter (m)	Exit Temp. (◦F)	Flow Rate (acfm)
	East (m)	North (m)							
Residence 1	560562.43	4540327.96	66	7.68E-07	--	6	0.51	68	120
Residence 2	560517.01	4540013.74	67	3.84E-07	--	6	0.51	68	120
Residence 3	560729.36	4540276.48	67	--	6.09E-07	6	0.51	68	120
Residence 4	560534.29	4539702.77	60	7.68E-07	--	6	0.51	68	120
Residence 5	560837.51	4539959.8	65	--	9.13E-07	6	0.51	68	120
Residence 6	560577.85	4540282.18	66	7.68E-07	--	6	0.51	68	120
Residence 7	560595.96	4539944.69	67	2.69E-06	--	6	0.51	68	120
Residence 8	560968.4	4540305.14	66	3.84E-07	--	6	0.51	68	120

Table 3. Area Source Soil Evaporation

Parameter	**Soil Evaporation Flux**	
PCE Emissions	0.000616 g/s	
TCE Emissions	0.000296 g/s	
Soil Evaporation Rate	$6.84 * 10^{-5}$ kg/m^2/s	
UTM Coordinate (SW corner)	5604777.6 m E	4539660.3 m N
Elevation	66 m	
Release Height	0 m	
Dimensions	600 m x 600 m	

MODELING METHODOLOGY

The AERMOD Air Dispersion Model (version 09292) was used to model the three types of PCE/TCE sources. Five years of surface observations (1990-1994) from Newark International Airport and concurrent upper air data from Atlantic City International Airport (Note: upper air measurements were concluded in September 1994 data; the remaining upper data during 1994 is from Brookhaven, New York). A profile base elevation of 7 meters was used. Rural dispersion coefficients were assumed.

A total of 900 receptors were modeled. A Cartesian Grid of receptors with 100-meter spacing out to approximately 1.5 kilometers in each primary direction from the air stripper was modeled. Terrain elevations were modeled by incorporating DEM data.

MODELING RESULTS

The air dispersion modeling and risk assessment shows that the cancer and health risks related to PCE and TCE emissions from the DuPont Air Stripper, Sub-Slab Depressurization Systems, and soil evaporation are negligible. The maximum predicted annual concentration of PCE (0.078 $\mu g/m^3$) was calculated with 1990 meteorological data. Figure 1 shows that the maximum PCE impact concentration occurs on DuPont property about 100 meters north of the air stripper. Among the PCE/TCE emission sources modeled, the air stripper is the dominant source. The maximum predicted 1-hour PCE concentration of 6.74 $\mu g/m^3$ is well below the short-term reference concentration of 22,000 $\mu g/m^3$.

The maximum predicted annual concentration of TCE is 0.025 $\mu g/m^3$. Figure 2 shows that maximum TCE impact concentration is just north of the air stripper. Table 4 shows the maximum predicted annual concentration and cancer and non-cancer risks calculated for each contaminant.

Table 4. Inhalation Cancer and Non-Cancer Risks from PCE and TCE Groundwater Contamination at Pompton Lakes

Contaminant	Maximum Annual Concentration ($\mu g/m^3$)	Unit Risk Factor $(\mu g/m^3)^{-1}$	Incremental Cancer Risk	Inhalation Reference Concentration ($\mu g/m^3$)	Hazard Quotient
PCE	0.078	5.90E-06	4.6E-07	35	0.002
TCE	0.025	2.00E-06	5.0E-08	600	0.00004

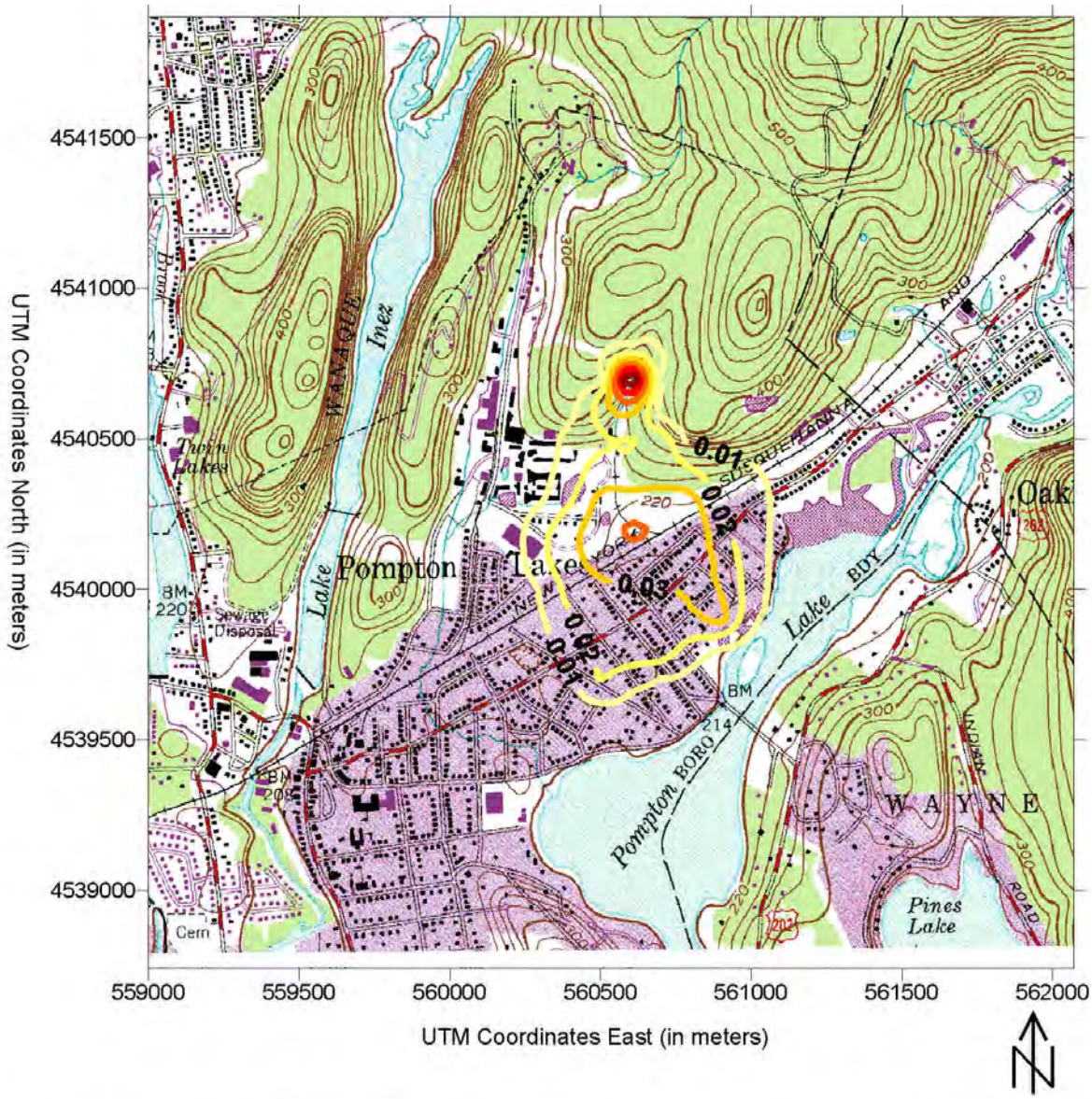

Figure 1. Predicted Annual Tetrachloroethylene (PCE) Concentration (ug/m^3) in Air from Groundwater Treatment Systems and Soil Evaporation at Pompton Lakes

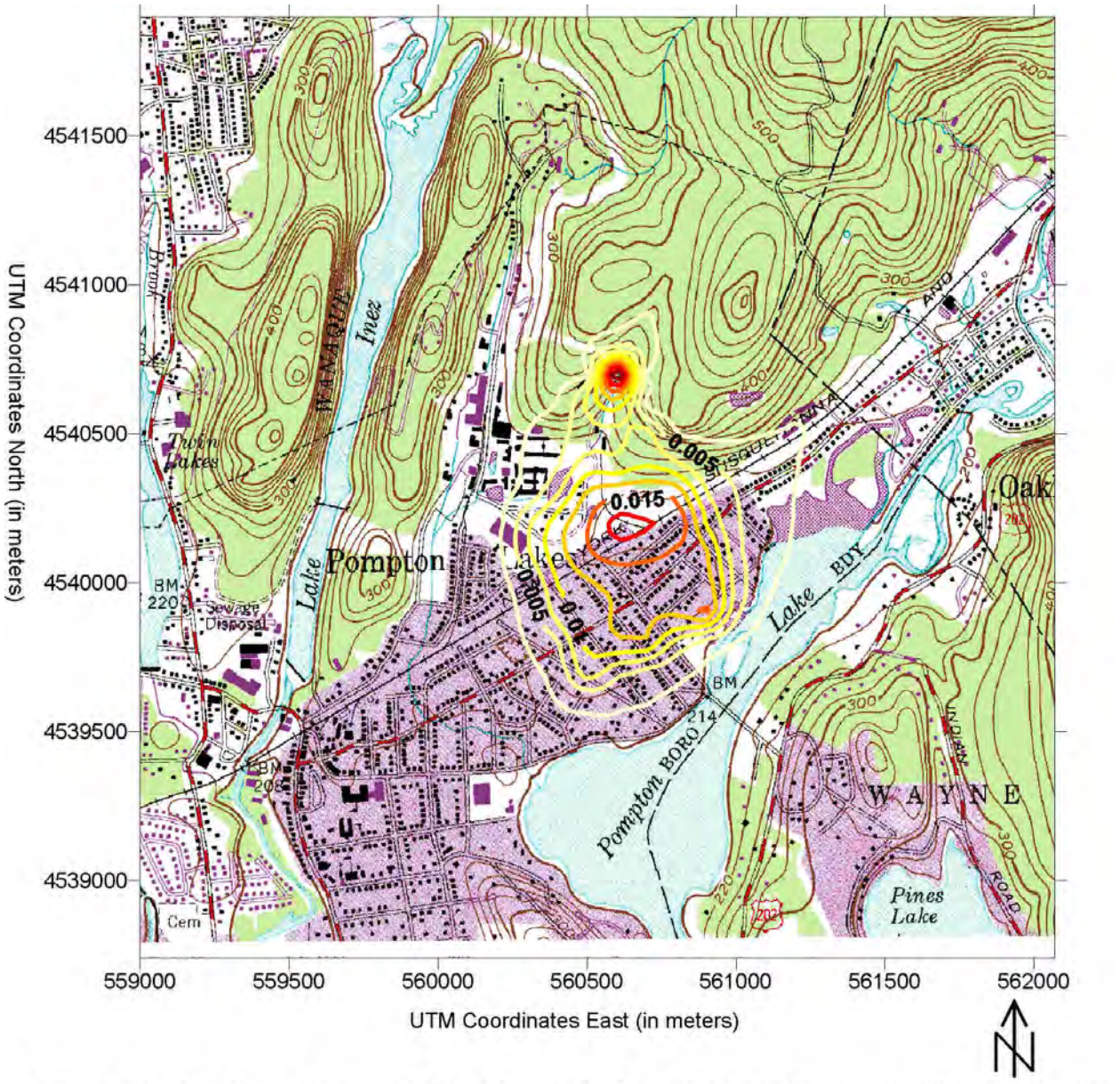

Figure 2. Predicted Annual Trichloroethylene (TCE) Concentration (ug/m^3) in Air from Groundwater Treatment Systems and Soil Evaporation at Pompton Lakes

Concentration Isopleths
- 0.0025 ug/m^3
- 0.005 ug/m^3
- 0.0075 ug/m^3
- 0.01 ug/m^3
- 0.0125 ug/m^3
- 0.015 ug/m^3
- 0.0175 ug/m^3
- 0.02 ug/m^3