ISC Modeling Methodology and Results

Emission Source Information

The ISC3 model was used to calculate ambient ground-level vapor concentrations and deposition rates for year 2000 actual C8 emissions from the Washington Works site. Table 1 shows the stack parameters used in the model for each emission point. Table 2 shows the emission rates used. (The stack parameters and emission rates are identical to those submitted under Consent Order GWR-2001-019). Since the C8 emissions are partitioned between the vapor and particle phases, deposition runs were completed by modeling each phase separately. (Modeling runs to determine ground-level concentrations were based on the total emissions.)

Deposition modeling requires particle size distribution information and scavenging coefficients for each phase of emissions (vapor and particle). The size distribution information used in the modeling for the particle phase was obtained from testing at the Washington Works site. The scavenging coefficients used for the particle phase were obtained from Figure 1-11 of the EPA ISC3 User's Guide. The vapor phase scavenging coefficients used were based on calculations by DuPont which were submitted under the Consent Order. This data shows the calculated vapor scavenging coefficient based on rain intensity. Since only one value of the scavenging coefficient can be entered into the ISC3 model, the largest scavenging coefficient was chosen to ensure that the model predictions were conservative. Table 3 shows the gas and particle data used in the model and, additionally, shows the basis for the vapor scavenging coefficient used in the model.

Modeling Methodology

Dispersion and deposition modeling was performed using the Industrial Source Complex 3 Model (ISC3), version 00101, provided by Lakes Environmental. All modeling was done in accordance with the procedures in EPA's Guideline on air Quality Models (40 CFR Part 51, Appendix W). The EPA regulatory default options and rural dispersion coefficients were used in the model.

The C8 emission sources were evaluated for downwash effects from surrounding buildings. The Lakes Environmental BPIP View model was used to provide wind direction specific building parameters. All buildings on the site were evaluated to determine if they could potentially impact the stack by causing building downwash effects. A plot plan showing the location of buildings included in the model is shown in Figure 1. (The buildings included in the model are identical to the list submitted under Consent Order GWR-2001-019).

A 100-meter grid extending out 4,000 meters from the source was used. In addition, discrete receptors with 100-meter spacing were placed on the plant property line. Terrain elevations were imported from electronic files obtained from the U.S. Geological Survey.

An additional receptor grid was used to determine deposition to the watershed for the Little Hocking wells. A USGS topographical map was used to identify the general area of the watershed (Figure 2), and a receptor grid with 100 meter spacing was placed within this watershed (Figure 3).

One year of on-site meteorological data (1996) was analyzed. The data was processed by Trinity consultants, using Wilmington, Ohio for the upper air data. Missing data and measured wind speeds of less than 1 m/s were treated consistent with the recommendations made in EPA's On-site Meteorological Program Guidance for Regulatory Modeling. An anemometer height of 10 meters was used for the modeling.

Modeling Results

An averaging time of one year was used to determine the annual average vapor concentrations and annual deposition rates over the entire receptor grid. A contour plot of the annual average vapor concentrations is shown in Figure 4. Contour plots of the total deposition rates for the particle and vapor phases are shown in Figures 5 and 6. The maximum off-site values predicted by the model were:

Maximum Annual Average Ground-Level Concentration = 2.806 ug/m3

Particle Phase: Maximum Dry Deposition Rate = 0.1345 $g/m^2/yr$
Maximum Wet Deposition Rate = 0.0479 $g/m^2/yr$
Maximum Total Deposition Rate = 0.1824 $g/m^2/yr$

Vapor Phase: Maximum Wet Deposition Rate = 0.0085 $g/m^2/yr$

The maximum ground-level concentration and all of the maximum deposition rates were predicted to occur at the same receptor (442135.47E, 4346899N), which is located on the plant fenceline north of the plant.

Additionally, a smaller receptor grid was used to determine the annual deposition rate to the Little Hocking well watershed. The model was run to calculate vapor and particle phase deposition rates for each receptor, which were then imported into a spreadsheet. An average deposition rate was calculated for all of the receptors and multiplied by the receptor grid area (2.57 km^2) to get a total deposition per year over the entire watershed. The deposition amounts calculated were:

Particle Phase: Total Dry Deposition = 6,966 g/yr
Total Wet Deposition = 12,484 g/yr
Total Deposition = 19,450 g/yr

Vapor Phase: Total Wet Deposition = 1642 g/yr

Table 1

Stack Parameters

Permit Number	Permit Vent ID	Reg. [illegible] Vent ID	Zone 17 UTM E	UTM N	Stack Height (ft)	Stack Diameter (ft)	Stack Flow ([illegible])	Stack Velocity (ft/s)	Stack Temperature (F)
1823A	T7IME	662	442025	4346847	150	1.33	3,349	40.2	172
815D	T6IFCE	644	442084	4346835	59	1.5	18,000	169.8	111
815D	T6IZCE	699	442091	4346836	63	18 -1 ft	18000[a]	21.2[b]	111
1353A	164-5E	652	441920	4346767	70	1.96	9,800	54.1	200
Pre-Existing	164-2E	658	441923	4346756	68	1.63	2,800	22.4	300
614A	163-E-26	231	441952	4346776	93	0.67	500	23.6	130
614A	163-E-11	232	441953	4346766	81	0.67	600	28.4	130
781	163-E-33	216	441960	4346788	60	1.3	2,750	34.5	158
1953	242	242	441954	4346741	114.5	0.5	1,250	106.1	200
2365A	C1FSE	274	441787	4346744	110	0.69	1,000	44.6	255
Semiworks Application	RO22EEF6		442086	4346624	47	2.5	8836	30.0	80
Semiworks Application	RO22EEF86		442069	4346627	49	2.0	7540	40.0	80
Semiworks Application	RO22EEF87		442058	4346634	49	2.0	1885	10.0	80
Semiworks Application	RO22EEF89		442063	4346635	49	2.0	3770	20.0	80

[a]Vent ID T61ZCE consists of 18 one-foot diameter vents. The flow rate given is the total for all 18 vents.

[b]The velocity listed is the velocity calculated for one individual vent.

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Table 2
Emission Information

Permit Vent ID	Reg 29 Vent ID	Particle Mass Fraction	Vapor Mass Fraction	Year 2000 Actual CS Emissions (lb/yr)	Year 2000 Actual CS Emissions (g/s)	2000 Actual Particle Phase Emission Rate (g/s)	2000 Actual Vapor Phase Emission Rate (g/s)
T7IME	662	0	1	0	0	0	0
T6IFCE	644	0.54	0.46	13,977	0.2010	0.1086	0.0925
T6IZCE	699	0.9	0.1	0	0	0	0
164-5E	652	0.9	0.1	33	0.0005	4.27E-04	4.75E-05
164-2E	658	0.9	0.1	79	0.0011	0.00102	1.14E-04
163-E-26	231	0.11	0.89	3,541	0.0509	0.00560	0.0453
163-E-11	232	0.09	0.91	4,680	0.0673	0.00606	0.0613
163-E-33	216	0	1	0	0	0	0
242	242	0.9	0.1	3,510	0.0505	0.0454	0.00505
C1FSE	274	0.03	0.97	5,414	0.0779	0.00234	0.0755
RO22EEF6		1	0	12	1.73E-04	1.73E-04	0
RO22EEF86		1	0	0.3	4.32E-06	4.32E-06	0
RO22EEF87		1	0	3	4.32E-05	4.32E-05	0
RO22EEF89		1	0	0.6	8.63E-06	8.63E-06	0

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Table 3
Gas & Particle Data

Particle Phase:

Particle Diameter (microns)	Mass Fraction	Particle Density (g/cm^3)	Scavenging Coefficients Liquid Precipitation ($s^{-1}/mm\text{-}h^{-1}$)	Frozen Precipitation ($s^{-1}/mm\text{-}h^{-1}$)
0.2	0.538	2.2	$1.2x10^{-4}$	$4x10^{-5}$
0.4	0.267	2.2	$5x10^{-5}$	$1.67x10^{-5}$
0.75	0.035	2.2	$4x10^{-5}$	$1.33x10^{-5}$
2.0	0.127	2.2	$1.3x10^{-4}$	$4.33x10^{-5}$
4.0	0.033	2.2	$2.8x10^{-4}$	$9.33x10^{-5}$

Vapor Phase:

Liquid Scavenging Coefficient ($s^{-1}/mm\text{-}h^{-1}$) = $6.4x10^{-6}$
Frozen Scavenging Coefficient ($s^{-1}/mm\text{-}h^{-1}$) = $6.4x10^{-6}$

Calculations of Vapor Scavenging Coefficient:

- vapor scavenging coefficients are presented in the consent order submittal as a list of values for different rainfall intensities
- the vapor scavenging coefficient that is entered into the ISC model is in units of $s^{-1}/mm\text{-}h^{-1}$, therefore the scavenging coefficients shown in the consent order must be adjusted to the proper units and then divided by the rainfall intensity
- to ensure that model predictions would be conservative, the scavenging coefficient based on a 1 mm/hr rain intensity was used, as this gives the largest value for input into the model

$$2.311x10^{-2}\frac{1}{hr}\times\frac{hr}{3600s}\times\frac{hr}{1mm}=6.4x10^{-6}\frac{hr}{s\cdot mm}=6.4x10^{-6}\frac{s^{-1}}{mm\cdot hr^{-1}}$$

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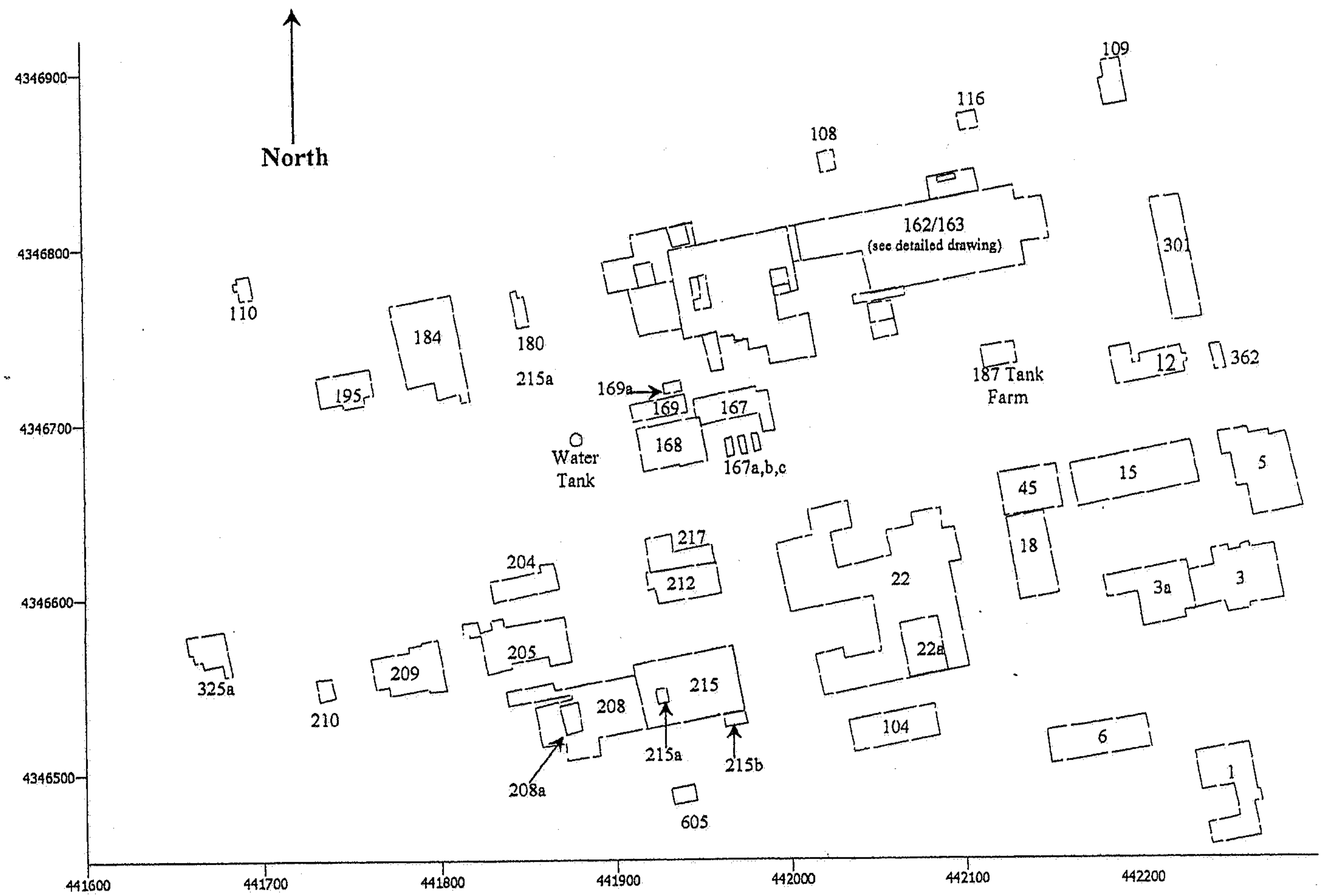

Figure 1 – Building Plot Plan

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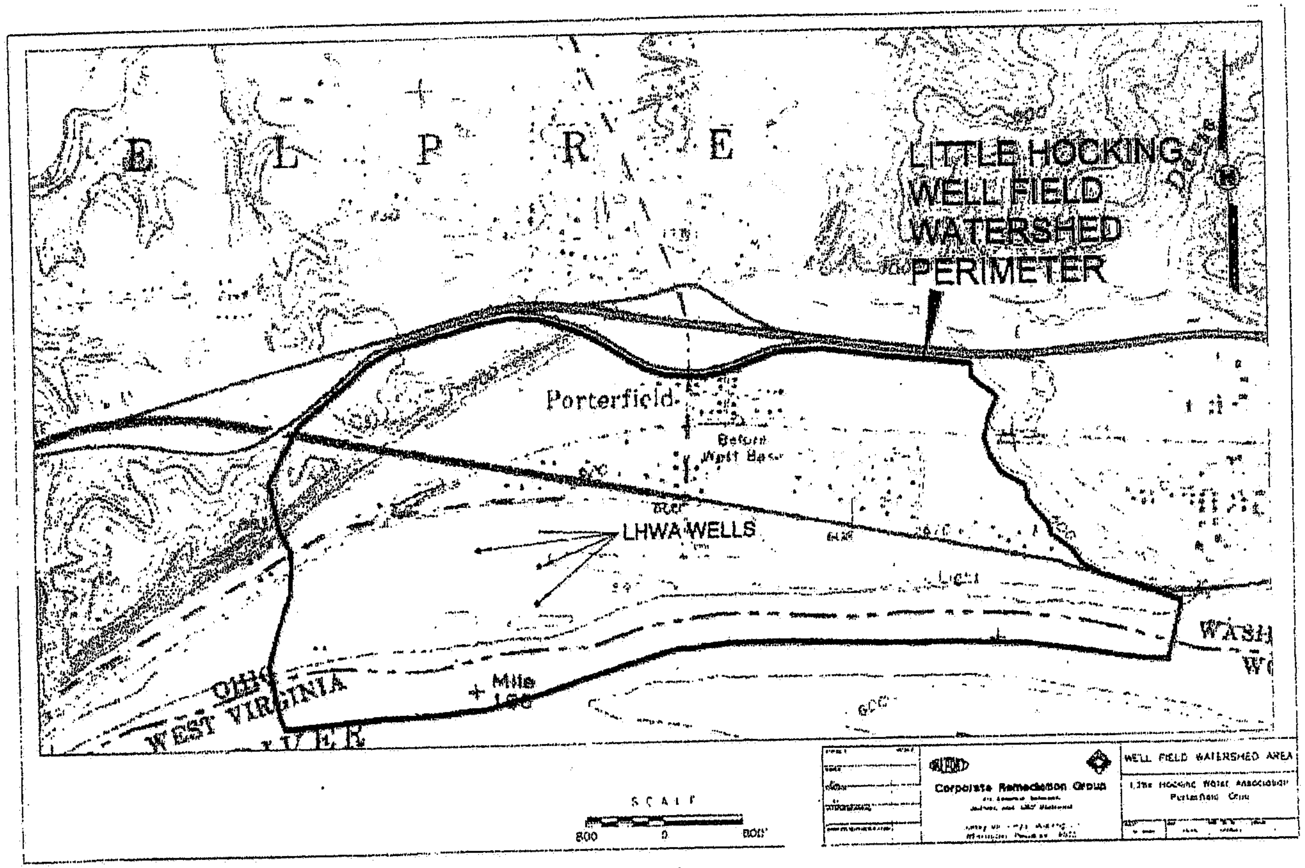

Figure 2

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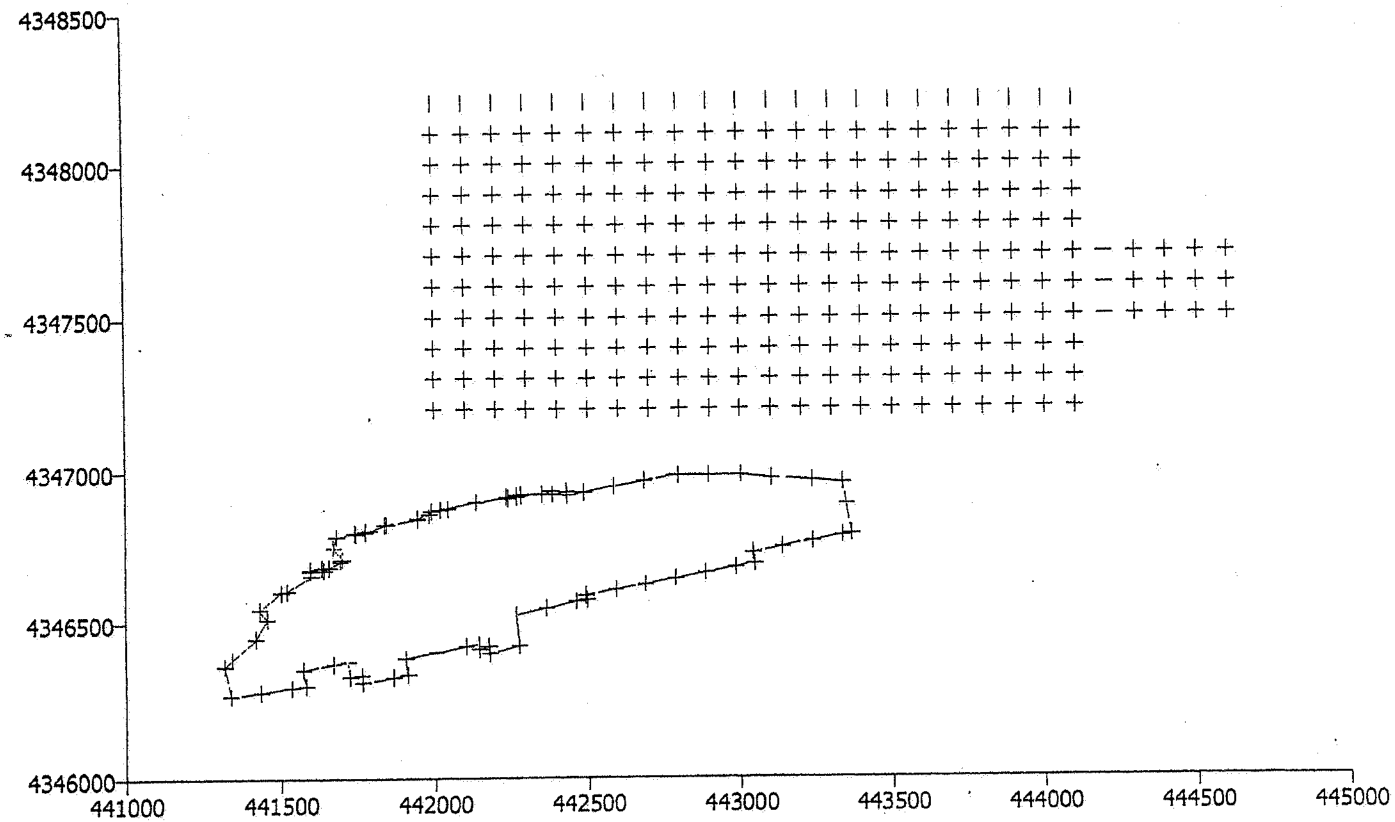

Figure 3
Little Hocking Well Watershed Receptors Modeled

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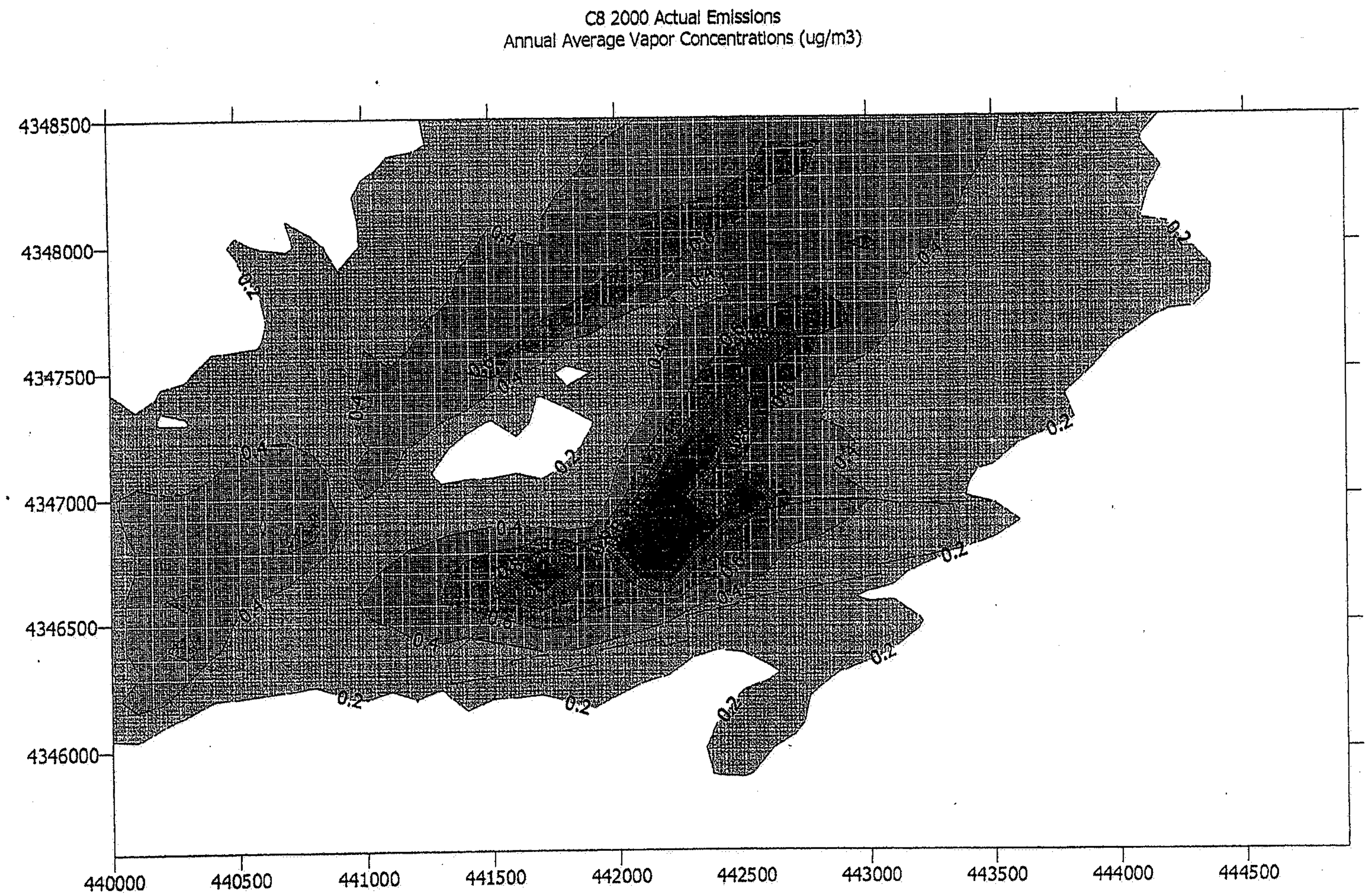

Figure 4
Maximum Ground-Level Concentrations

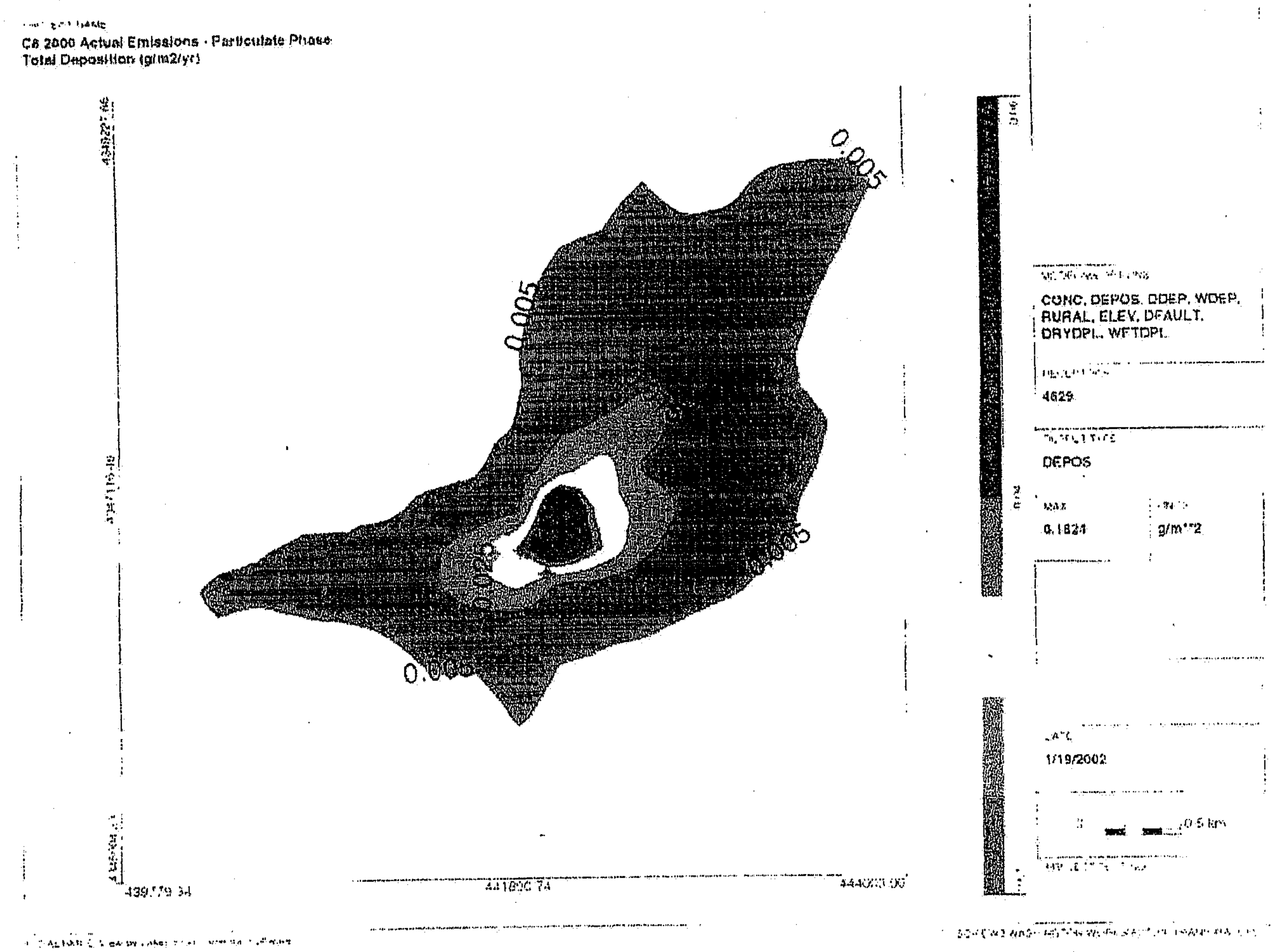

Figure 5 – Particle Phase Total Deposition Rates

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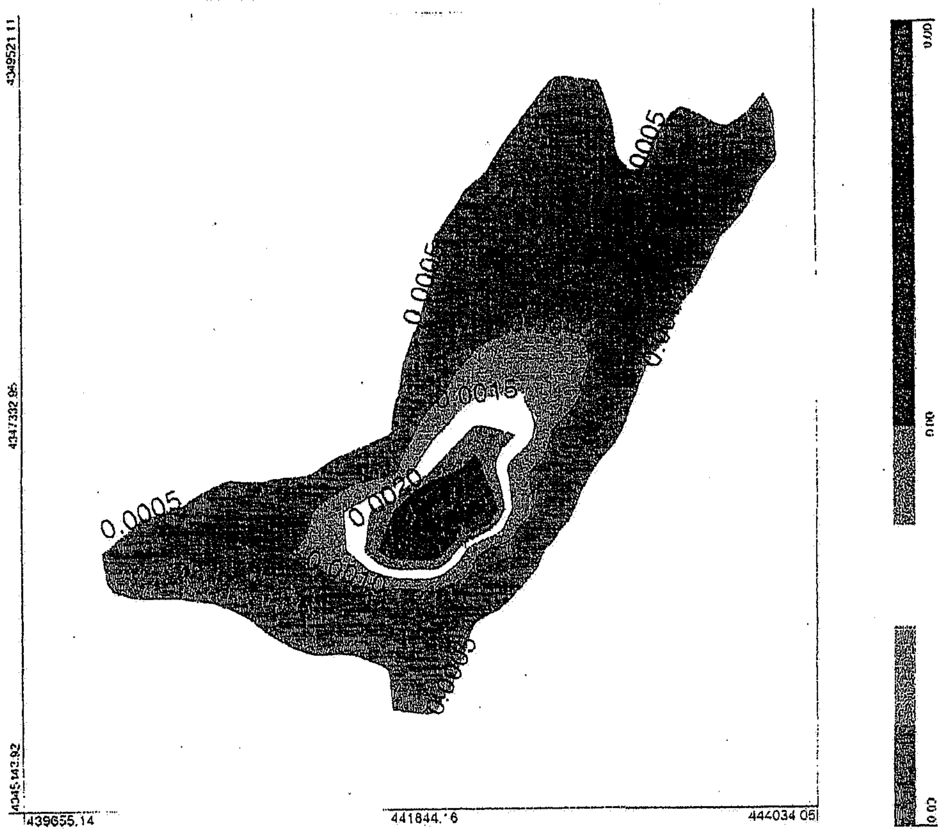
PROJECT NAME

C8 2000 Actual Emissions - Vapor Phase
Wet Deposition (g/m2/yr)



MODELING OPTIONS CONC, WDEP, RURAL, ELEV, DFAULT, WETDPL	
RECEPTORS 4629	
OUTPUT TYPE WDEP	
MAX 0.00845	UNITS g/m**2
DATE 1/19/2002	
0 ___ 0.5 km	
PROJECT/PLOT NO.	

ISC-AERMOD View by Lakes Environmental Software

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Figure 6 – Vapor Phase Wet Deposition Rates