Air Toxics Emission Inventory

for the

Southeast Chicago Area

John Summerhays
Harriet Croke
Air & Radiation Branch
Region V
U.S. Environmental Protection Agency
July 1987

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[redacted]

level of industrial activity coexists with high population density. Within Region V, perhaps the most serious combination of concentrated industrial activity with high population density is in Southeast Chicago. In particular, the area is one of the foremost locations for integrated steel production and chemical production of the coatings used in Chicago's substantial manufacturing

With respect to source types, this study included all source types for which air toxics emissions could be estimated. The inventory included point sources, area sources, and mobile sources, and further included volatilization from

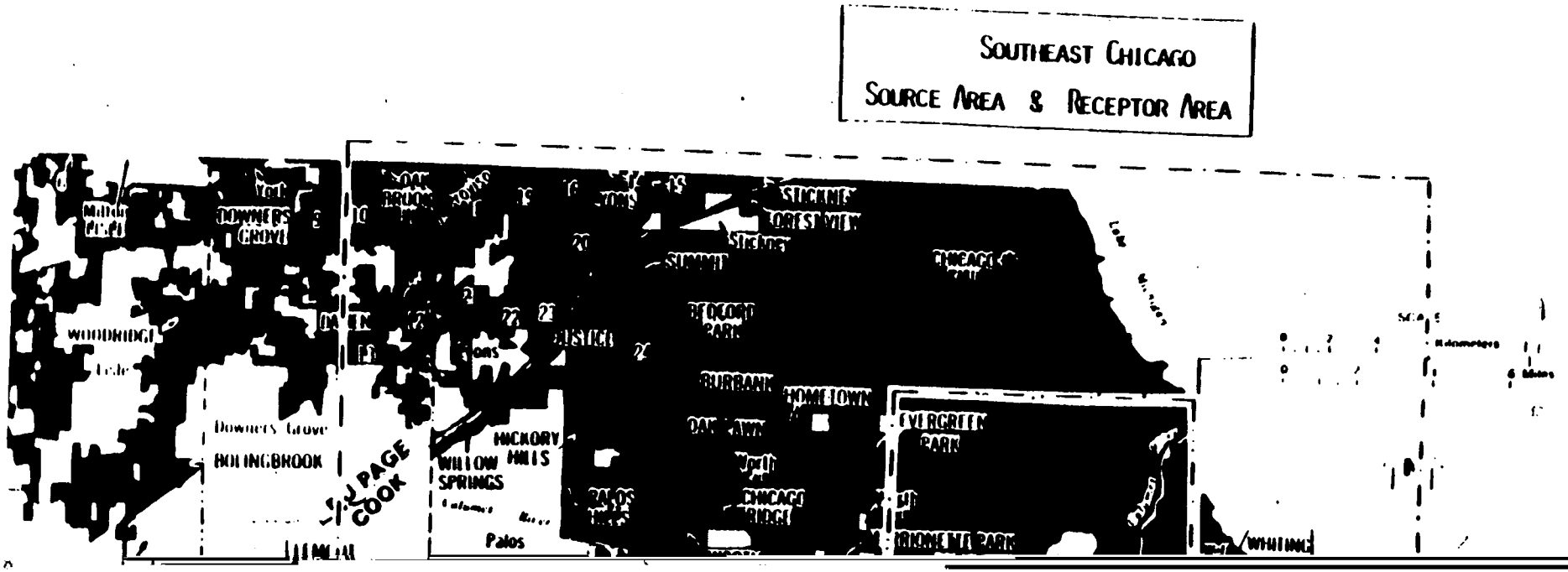
SOUTHEAST CHICAGO
SOURCE AREA & RECEPTOR AREA
WOODRIDGE
Downers Grove
BOLINGBROOK
WILLOW SPRINGS
HICKORY HILLS
Palos
BURBANK
OAK LAWN
EVERGREEN PARK
WHITING
DUPAGE
COOK

Table 1. Substances included in inventory

NON-CHLORINATED VOC (22)	CHLORINATED VOC (17)	INORGANIC (8)
Acrylamide	Allyl Chloride	Arsenic
Acrylonitrile	Benzyl Chloride	Asbestos
Benzene	Carbon Tetrachloride	Beryllium
Butadiene	Chloroform	Cadmium
Coke Oven Emissions	Dioxin	Chromium
Diethanolamine	Epichlorohydrin	Nickel
Dimethylnitrosamine	Ethylene Dibromide*	Titanium Dioxide
Dioctylphthalate	Ethylene Dichloride	Radionuclides
Ethyl Acrylate	Methyl Chloride	
Ethylene	Methylene Chloride	NON-CARCINOGENS (4)
Ethylene Oxide	Pentachlorophenol	
Formaldehyde	Perchloroethylene	Acetone
Gasoline Vapors	PCB's	Mercury
[redacted]	[redacted]	[redacted]
Melamine	Trichloroethylene	Xylene
Nitrobenzene	Vinyl Chloride	
Nitrosomorpholine	Vinylidene Chloride	
Polycyclic Organic Matter		
Propylene Oxide		
Styrene		

may be a more reliable basis for assessing exposure. A third "pollutant",

identified here as polycyclic organic matter, is actually a class of aromatic compounds. Three of the lightest such compounds, namely napthalene (a two ring structure), anthracene (a three ring structure), and phenanthrene (also a three

ring structure), are both among the most highly emitted and among the least toxic of this class of compounds. In order to focus on the more significantly toxic compounds, this inventory includes not only an estimate of total polycyclic organic matter but also an estimate of "heavy" polycyclic organic matter that

matter for each operation of each facility. The second step of the method is to obtain species fractions representing the fractions of the total VOC or the TSP that are emitted as the various individual species. For example, in this study, the fugitive emissions from purging operations at refineries were estimated to be 2.4% benzene. These fractions are then multiplied times the VOC or TSP emissions estimate to obtain estimates of emissions of individual

Species fraction information for formaldehyde from utility fuel combustion and from industrial coal combustion was derived from the formaldehyde "locator document" (Locating and Estimating Air Emissions from Sources of Formaldehyde, ref. P.4e). This document provided emissions factors in units of grams per Joule of heat input, which was multiplied times the heat content of typical locally used fuels and compared against the standard VOC emission factor to derive the formaldehyde species fraction.

Area Source Inventorying Methods

As with point sources, the most commonly used method for developing area source emissions estimates was the species fraction method. The categories information are shown in Table 3. In general, the first piece of necessary information was a county-by-county estimate of emissions from each category being assessed. This information was generally derived by the State from the

Table 2. Particulate Matter Species Fractions
(Taken from Reference P.3. All data in percent)

	Species Fraction*				Applicable SCC
[redacted]					
Coal combustion	.058%	.006%	.054%	.040%	1-01-002-01,-02,-03,-23 1-02-002-01,-02,-04
Oil combustion	.015	.001	.089	1.622	1-01-004-01, 1-02-004-01,-04 1-02-005-01,-04 3-06-001-03***
Steel making:					
[redacted]					

For degreasing, county level emissions estimates were derived from a national study that estimated total usage of each of the compounds, divided the total by the total number of employees in the Standard Industrial Classification (SICs) relevant to the respective compound, and multiplied the resultant emission factor times the number of employees in these classifications employed in the counties in the Southeast Chicago area. County emissions were then distributed according to total manufacturing employment, since spatial distri-

for dry cleaning, national emissions data were distributed to county level estimate using employment data for relevant SICs, which were in turn distributed to grids in the study area using commercial employment data. For comfort

Table 3. Species Fractions used in Area Source Inventory
(except as noted, units are % of VOC emissions)

Category	Pollutants	Fractions	Spatial dbn Parameter	Reference
Gasoline Marketing	Benzene	.63%	Arterial VMT	A.3
	Toluene	.64%		
	Xylene	.18%		
Ship and Barge Transfer	Benzene	.63%	Distributed within port areas	A.3
	Toluene	.64		
	Xylene	.18%		
Architectural Surface Coating	Benzene	.18%	Dwelling units	A.3
	Methyl Chloride	.27%		
	Methylene Chloride	3.37%		
	Toluene	7.60%		
	Xylene	1.36%		
Heating (oil-fired)	Chromium	.047%*	**	P.4
	Nickel	5.36%*		

* Heating fractions are fractions of total suspended particulate emissions.

** Spatial distribution parameter for industrial distillate oil use was manufacturing employment. Parameter for all commercial/institutional

Table 4 Emissions Factors used in Area Source Inventory

Source Category	Pollutant	Emission Factor	Spatial dbn.	Ref.
Heating				
Resid. oil: Comm/Inst*	Formaldehyde	.069 ng/J (10.8 mg/gal)	Population	P.4e
Dist. oil: Industrial	"	.10 ng/J (14.5 mg/gal)	Mfg. emp.	"
Comm/Inst	"	" "	Population	"
Residential	"	" "	Population	"
Gas: Industrial	"	.038 ng/J (41 g/mmcf)	mfg. emp.	"
Comm/Inst	"	.095 ng/J (103 g/mmcf)	Population	"
Residential	"	.43 ng/J (464 g/mmcf)	Population	"
[illegible]	POM	[illegible]	[illegible]	[illegible]
Dist. Oil (all users)	"	9.7 ng/J (1.4 mg/gal)***	population	"
Gas (all users).	"	11.2 ng/J (12 g/mmcf)***	population	"
Per Capita Emissions				
Aerosol Cans	Methylene Chloride	.50 #/capita-yr	population	A.10
Paint Stripping	Methylene Chloride	.59 "	"	A.10
Misc. Products	Formaldehyde	.048 "	"	P.4e

The emission factor is derived from data given in a draft POM "locator document",

very approximate. Nevetheless, the survey suggested that small hospitals are

arbitrarily set at 200 beds.) Also, obviously not all hospitals use ethylene

A similar procedure was used to estimate adjusted county total evaporative

evaporative emissions to arterials, i.e., to reassign emissions to arterials that otherwise would have been assigned to freeways. Since most of these emissions may be assumed to occur at trip ends, this reassignment was intended to provide a more reliable assignment of these emissions to where they actually occur. The results of multiplying the MOBILE3 evaporative emissions estimates times the respective traffic volumes indicate that freeway evaporative emissions

of fractions used here include national average gasoline benzene content (1.34%) and aromatic content (32.5%) and an approximate North Central annual average reid vapor pressure (12.6).

Ethylene dibromide fractions were calculated from results reported by John

Table 5. Highway vehicle species fractions

Pollutant	Species Fraction (in %) Exhaust	Evaporative
Benzene	3.14%	1.09%
Butadiene	.0345%	0
Ethylene dibromide	.0025%/.0018%*	.0017%
Formaldehyde	.763%	0
Ethylene	7.15%	0
Toluene	6.59%	6.3
Xylene	5.84%	3.8
Acetone	.072%	0
Benzo(a)Pyrene	.040%/.061%*	0

* Separate figures are for arterial/freeway exhaust emissions. The differences result from the differences in vehicle mix.

[redacted]

the Indiana vehicle mix, translating to an emission factor of .652 tpy/1000 daily miles. The same adjustments as in Illinois were made to reflect possible undermeasurement of exhaust emissions and undercalculation of evaporative

[redacted]

Inventory Methods for Hazardous Waste Treatment Storage and Disposal Facilities

Emission estimates for this source category are being developed by a contractor [redacted]

the methods to be used have not yet been selected. Emission estimates for this category will be included in the inventory as soon as they are available.

Summary of Results

A summary of the emissions from all categories of emissions is provided in [redacted]

Table 6. Summary of Emissions from all Source Types

Pollutant	Point	Area	Mobile	STP	Total
Benzene	4860.0	43.9	1113.4	2.0	6019.3
Methylene chloride	7.6	1490.3		23.6	1521.5
[redacted]	[redacted]	[redacted]		[redacted]	[redacted]
Formaldehyde	29.6	122.4	229.5		381.5
Vinyl chloride	.1				.1
Vinylidene chloride				.03	.03
Ethylene	568.8		2137.7		2706.5
Ethylene dichloride	.2			2.0	2.2
Ethylene dibromide			1.0		1.0
Butadiene	12.2		91.3		103.5
Ethylene oxide	16.1	12.3			28.4
Methyl chloride	.3	12.0		.2	12.5
Benzyl chloride	.05			3.7	3.8
Styrene	4.2			6.6	10.8
Gasoline vapors		5221.8	20396.5		25618.3
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 7. Area Source Emissions Totals

Category	Pollutant	emissions (tons/year) Total	Cook	DuPage	Will	Lake, In.
Gasoline Marketing	benzene	32.9	30.1	.2	1.4	1.2
	toluene	33.4	30.5	.2	1.5	1.2
	xylene	9.4	8.6	.05	.4	.3
	gasoline vapors	5221.8	4771.6	30.8	230.0	189.4
Ship & Barge Transfer	benzene	3.0	1.4	0	.1	1.5
	toluene	3.1	1.4	0	.1	1.5
	xylene	.9	.4	0	.04	.4
Degreasing	perchloroethylene	242.2	194.2	1.2	3.1	43.7
	trichloroethylene	401.4	332.4	2.3	4.7	62.1
	methylene chloride	295.4	277.8	2.0	3.3	12.2
Architectural sfc. coating	benzene	8.0	6.7	.04	.2	1.1
	methyl chloride	12.0	10.1	.06	.3	1.6
	methylene chloride	150.2	126.3	.7	3.4	19.8
	toluene	338.8	284.8	1.6	7.7	44.7
	xylene	60.6	51.0	.3	1.4	8.0
Aerosol cans	methylene chloride	590.3	502.2	12.5	15.4	60.2
Paint stripping	methylene chloride	454.4	364.7	9.8	9.4	70.5

Table 8. Highway Vehicle Emissions Totals (in tons/year)

Pollutant	Arterial Exhaust	Freeway Exhaust	Evaporative	Total
Benzene	823.6	116.7	173.1	1113.4
[illegible]				
Gasoline vapors	-----	-----	20396.5	20396.5
Ethylene	1871.7	266.0	-----	2137.7
Formaldehyde	201.2	28.3	-----	229.5
Ethylene dibromide	.7	.07	.3	1.0
[illegible]				
Toluene	1731.4	240.2	1006.1	2977.6
Xylene	1520.8	214.5	608.3	2343.6
[illegible]				

Table 9. Wastewater Treatment Plant Emissions Estimates

Pollutant	Calumet	West-Southwest
Benzene	1.7	.3
Methylene chloride	3.3*	20.3*
Perchloroethylene	1.4	15.0*
Trichloroethylene	.8	4.4*
Chloroform	.7*	1.3*
Vinylidene chloride	.03	--
Ethylene dichloride	.4	1.6
Methyl chloride	.2	--
Styrene	4.6	2.0
Chlorobenzene	.7	3.0*
Toluene	12.0	6.9
Xylene	8.7	34.6
Acetone	301.0	206.3

*Because contaminant quantities in the treated effluent are a significant fraction of the quantities in the raw influent (suggesting limited volatilization), these amounts represent the difference between influent and effluent quantities.

Table 10. Emissions Estimates for Facilities Receiving Questionnaires

Nalco Chemical		PMC	
Methyl chloride	.0016 tpy	Formaldehyde	.0015 tpy
Benzyl chloride	.048	Toluene	.91
Diethanolamine	.065		
Pentachlorophenol	.003	Trichloroethylene	6.55
		Methylene Chloride	5.68
Desoto		Benzene	1.09
Titanium dioxide	.20 tpy	Toluene	3.09
Acrylamide	.025	Xylene	1.45
Ethylacrylate	.375	Acetone	1.17
Melamine	.25		
Propylene oxide	.075	Clark Oil	
Styrene	1.95	Benzene	15. tpy
Formaldehyde	.080		
Toluene	2.7	McKesson Chemical	
Xylene	2.1	Trichloroethylene	2.9 tpy

Table 11. Emissions from coking operations
(All data in tons per year)

	Coke Ovens*	Byproduct Plants		
[redacted]				
Interlake	68.61 tpy	474.4 tpy	75.2 tpy	26.2 tpy
LTV Steel (Chicago)	23.27	225.8	35.8	12.5
Inland Steel	406.14	1303.4	206.8	71.9
U.S. Steel	242.83	2666.8	423.0	147.1
Total	740.85 tons/year	4670.4 tpy	740.8 tpy	257.7 tpy

*These are total emissions of "coke oven emissions" (benzene soluble organics) that are emitted from charging and leaks at the coke ovens.

TABLE 1?. POINT SOURCE EMISSIONS ESTIMATES BASED ON ORGANIC SPECIES FRACTIONS

CNTY	PLTD	PLANT NAME	(EMISSIONS IN TONS/YEAR) ETH	13BUT	HCHO	ACE	CTC	PR.O	ACN	MCL	EDC	PERC	VCL	XYL	BENZ	TOL	STYR
[illegible]																	
1540	3	VAN LEER CONTAINERS	11.8	.0	.0	27.3	.0	.0	.0	.0	.0	.0	.0	50.0	.0	123.4	.0
1540	5	H P SMITH PAPER CO	1.8	.0	.2	10.3	.0	.0	.0	.0	.0	9.7	.0	3.9	.0	4.3	.0
1540	6	MILES LABORATORIES -	24.1	.4	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	17.4	.8	.0
1540	8	SHELL OIL COMPANY ,	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	11.4	2.1	8.2	.0
1540	10	CONTINENTAL CAN COMP	5.8	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1540	11	CORN PRODUCTS-ARGO P	1.4	.0	.3	.2	.0	.0	.0	.0	.0	.0	.0	.8	.0	3.4	.0
1540	12	GATX TERMINALS CORP.	.0	.0	.1	6.9	.0	.0	.0	.0	.0	5.6	.0	.0	1.6	5.8	.0
1540	17	C W ELECTRIC SPECIAL	.0	.0	.0	27.9	.0	.0	.0	.0	.0	27.9	.0	11.2	.0	11.2	.0
1540	18	CHICAGO FINISHED MET	.0	.0	.0	12.6	.0	.0	.0	.0	.0	12.6	.0	5.0	.0	5.0	.0

(EMISSIONS IN TONS/YEAR)

CNTY	PLID	PLANT NAME	ETH	13BUT	HCHO	ACE	ETO	PR.O	ACN	MCL	EDC	PERC	VCL	XYL	BENZ	TOL	STYR
2360	52	THERMARK CORP 650 W	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]																	
2360	117	NIPSCO DEAN H MITCHE	.0	.0	.7	.0	.0	.0	.0	.0	.0	.0	.0	2.1	.0	1.3	.0
[redacted]																	
2360	120	U.S.STEEL CORP. GARY	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.3	.2	.0
2360	121	U.S.STEEL CORP. GARY	108.3	.0	.4	.0	.0	.0	.0	.0	.0	.0	.0	.4	.5	.7	.0
2360	202	AMERICAN CAN COMPANY	7.8	.0	.0	3.9	.0	.0	.0	.0	.0	3.9	.0	1.6	.0	1.6	.0
2360	207	AMERICAN MAIZE-PRODU	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0	.0
2360	219	COMMONWEALTH EDISON	.0	.0	1.2	.0	.0	.0	.0	.0	.0	.0	.0	2.3	.0	1.5	.0
2360	229	LEVER BROTHERS COMPA	.0	.0	.2	.1	.0	.0	.0	.0	.0	.0	.0	.0	.1	.1	.0
2360	231	MARATHON OIL COMPANY	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	4.7	.8	3.4	.0
[redacted]																	
2360	309	EAST CHICAGO MUNICIP	39.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	34.6	[illegible]	.0
2360	310	E.I. DUPONT DE NEMOUR	6.3	.0	.6	.0	.9	.3	.6	.2	.0	.0	.1	.3	2.0	.8	.7

TABLE 13. POINT SOURCE EMISSION ESTIMATES BASED ON PARTICULATE MATTER SPECIES EMISSIONS

CNTY	PLID	PLANT NAME	EMISSIONS IN TONS AS	CD	CR	NI	HG
[redacted]							
[redacted]							
1540	11	COTN PRODUCTS-ARGO P	.019	.002	.017	.012	.00(
[redacted]							
1540	60	GENERAL MOTORS - TLS	.053	.005	.049	.036	.00(
1540	66	VULCAN MATLS-LIME PL	.000	.000	.030	.000	.00(
[redacted]							

Discussion of Results

[redacted]

TABLE 14. POINT SOURCE EMISSIONS ESTIMATES SORTED BY STANDARD CLASSIFICATION CODE (SCC)

A. ORGANICS

SCC	VOC SM	ETH.	13BUT	FORM	ACETONE	ETO	PRO	ACN	CHCL3	EDC	PERC	VINYLCL	XYL.	BENZENE	TOL	STYR.
10100201	72.000	.0	.0	2.2	.0	.0	.0	.0	.0	.0	.0	.0	6.2	.0	4.0	.0
10100202	23.885	.0	.0	.7	.0	.0	.0	.0	.0	.0	.0	.0	2.1	.0	1.3	.0
10100203	23.000	.0	.0	.7	.0	.0	.0	.0	.0	.0	.0	.0	2.0	.0	1.3	.0
10100223	26.000	.0	.0	.8	.0	.0	.0	.0	.0	.0	.0	.0	2.3	.0	1.5	.0
10100601	10.000	.0	.0	.8	.0	.0	.0	.0	.0	.0	.0	.0	.0	.4	.2	.0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10200204	30.145	.0	.0	.9	.0	.0	.0	.0	.0	.0	.0	.0	2.6	.0	1.7	.0
10200601	30.255	.0	.0	2.6	8.5	.0	.0	.0	.0	.0	.0	.0	.8	.0	.0	.0
10200701	1.000	.0	.0	.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10200501	31.393	.0	.0	4.9	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.5	1.2	.0
10200502	6.000	.0	.0	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.4	.2	.0
10200704	101.000	.0	.0	7.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10500106	1.000	.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]	165.000	.0	.0	.0	16.6	.0	.0	.0	.0	.0	16.6	.0	6.5	.0	6.6	.0
[illegible]	5.000	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.5	.0
[illegible]	426.000	.0	.0	.0	30.2	.0	.0	.0	.0	.0	.0	.0	20.9	.0	16.6	.0
[illegible]	56.000	.0	.0	.0	3.8	.0	.0	.0	.0	.0	.0	.0	2.5	.0	2.1	.0
[illegible]	17.000	.0	.0	.0	1.2	.0	.0	.0	.0	.0	.0	.0	.8	.0	.7	.0
[illegible]	201.000	.0	.0	.0	20.1	.0	.0	.0	.0	.0	20.1	.0	8.0	.0	8.0	.0
[illegible]	57.000	.0	.0	.0	4.0	.0	.0	.0	.0	.0	.0	.0	2.8	.0	2.2	.0
[illegible]	2.000	.0	.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	.1	.0	.1	.0
[illegible]	637.000	.0	.0	.0	63.7	.0	.0	.0	.0	.0	63.7	.0	25.5	.0	25.5	.0
40299999	1.000	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0	.1	.0
40201001	20.000	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.7	.5	1.9	.0
[illegible]	[illegible]															

[illegible]	46.000	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	6.2	1.1	4.5	.0
[illegible]	122.000	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	16.5	2.9	11.8	.0
[illegible]	[illegible]															

[illegible]	11.000	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.2	.2	.3	.0
[illegible]	1.000	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0	.1	.0
[illegible]	217.000	.0	.0	.1	15.5	.0	.0	.0	.0	.1	12.7	.0	.0	3.6	13.1	.0
[illegible]	14.000	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.9	.3	1.4	.0
[illegible]	644.000	83.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
[illegible]	3369.000	.0	.0	.0	26.9	.0	.0	.0	.0	.0	.0	.0	.0	.0	404.2	.0
[illegible]	145.[illegible]	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	19.7	3.5	14.1	.0
[illegible]	17.000	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
[illegible]	31.000	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
[illegible]	72.000	1.7	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	3.5	.0
50100102	449.000	39.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	34.6	.0	.0

3. METAL SPECIES

SCC	TSP EM	ARSENIC	CADMIUM	CHROMIUM	NICKEL	MERCURY
10100201	922.000	.477	.049	.444	.329	.000
10100202	221.996	.135	.014	.125	.093	.000
10100203	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10100222	1091.000	.633	.065	.589	.435	.000
10200202	197.996	.109	.011	.102	.075	.000
10200204	591.031	.343	.035	.319	.235	.000
10200601	315.950	.047	.003	.281	5.125	.000
10200604	5.000	.001	.000	.004	.081	.000
10200501	1.000	.000	.000	.001	.016	.000
30300801	401.000	2.205	2.205	12.030	.000	.000
30300802	533.000	2.931	2.931	15.990	.000	.000
30300808	69.000	.374	.374	2.040	.000	.000
30300809	122.000	.671	.671	3.660	.000	.000
30300811	11.000	.060	.060	.330	.000	.000
30300812	90.000	.495	.495	2.700	.000	.000
30300813	1528.704	8.463	8.463	46.161	.000	.000
30300814	95.556	.551	.551	3.005	.000	.000
30300821	195.000	1.072	1.072	5.850	.000	.000
30300822	[illegible]	.011	.011	.060	.000	.000
30300824	70.000	.385	.385	2.100	.000	.000
30300825	122.000	.671	.671	3.660	.000	.000
30300899	18.000	.099	.099	.540	.000	.000
30300904	176.000	.099	.088	.352	.000	.000
30300910	2.000	.001	.001	.004	.000	.000
30300911	29.000	.014	.014	.058	.000	.000
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30300913	943.000	.471	.471	1.886	.000	.000
30300914	1045.000	.522	.522	2.090	.000	.000
30300915	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30300931	25.000	.012	.012	.050	.000	.000
30300932	43.000	.021	.021	.086	.000	.000

One finding from a review of emissions and dose-response data is ironically and unfortunately that the compounds that appear most significant are associated with sme of the greatest uncertainties. Polycyclic organic matter may be the

Table 15. Organic Species Fraction-Based Estimates

CNTY	PLID	PLANT NAME	(EMISSIONS IN TONS/YEAR) ETH	13BUT	HCHO	ACE	ETO	PR.O	ACN	MCL	EDC	PERC	VCL	XYL	BENZ	TOL	STYR
1540	2	TRUMBULL ASPHALT CO.	.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.8	.3	.8	.0
1540	7	NALCO CHEMICAL CO.-	24.6	.0	2.1	.1	5.2	1.6	3.4	1.0	.0	.0	.7	1.5	11.3	5.5	3.8
1540	9	3M COMPANY - INDUSTR	351.8	.0	.0	54.0	.0	.0	.0	.0	.0	53.7	.0	21.5	.0	25.8	.0
1540	10	SYCAMORE CORP	4.3	.0	.0	84.9	.0	.0	.0	.0	.0	.0	.0	.0	28.1	13.3	.0
1540	20	STAUFFER CHEMICAL CO	.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.3	.0	.2	.0
1540	62	MOTOR OIL REFINING C	.0	.0	.1	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1540	95	KOPPERS COMPANY INC.	11.4	.0	1.3	14.2	2.4	.7	1.6	.5	.0	.9	.3	.7	5.5	3.5	1.8
1540	98	FORD MOTOR COMPANY	2.1	.0	.0	595.5	.1	.0	.1	.0	.0	2.9	.0	84.8	150.1	126.3	.1
1540	99	SHERWIN-WILLIAMS CO	3.2	.0	.3	.8	.7	.2	.4	.1	.0	.0	.1	.2	1.5	.6	.5
1540	110	FORD MOTOR COMPANY C	.0	.0	.0	22.9	.0	.0	.0	.0	.0	.0	.0	41.9	.0	103.6	.0
[illegible]																	
9220	1	MOBIL CHEMICAL CO-PL	105.4	.0	7.4	1.6	20.1	6.1	13.1	3.9	.0	.0	2.6	5.7	43.6	41.3	14.8
9220	3	UNION OIL CO. - CHIC	.0	.0	22.9	.0	.0	.0	.0	.0	.0	.0	.0	3.0	7.9	7.6	.0
9220	20	TEXACO REFINING AND	.0	.0	11.1	2.8	.0	.0	.0	.0	.0	.0	.0	237.7	54.8	196.9	.0
9260	3	AMER OIL CO 2831 IND	.2	.0	27.1	3.9	.0	.0	.0	.0	.0	.0	.0	30.0	23.4	29.6	.0

TABLE 16. PARTICULATE MATTER SPECIES FRACTION-BASED ESTIMATES FOR FACILITIES RECEIVING QUESTIONNAIRES

CNTY	PLID	PLANT NAME	EMISSIONS IN TONS ARSENIC	CADMIUM	CHROMIUM	NICKEL	MERCURY
1540	3	TRUMBULL ASPHALT CO.	.000	.000	.055	.000	.000
1540	22	STAUFFER CHEMICAL CO	.006	.001	.035	.004	.000
1540	42	MOTOR OIL REFINING C	.001	.000	.006	.114	.000
[redacted]							
1540	123	CLARK OIL REFINING	.000	.007	1.672	1.982	.002
[redacted]							
8320	20	TEXACO REFINING AND	.006	.011	.278	1.367	.003
2360	3	AMER OIL CO 2831 IND	.125	.033	.883	14.783	.008

CNTY	PLID	PLANT NAME	EMISSIONS IN TONS ARSENIC	CADMIUM	CHROMIUM	NICKEL	MERCURY
		TOTALS	.144	.089	3.806	21.265	.02

The results in Tables 15 and 16 indicate that total emissions according to questionnaire responses in general were found to be substantially lower than total emissions estimates using the species fraction approach. In some cases,

totals for benzene by a factor of 16, for styrene by a factor of 25, and for formaldehyde by a factor of 566. Also, the species fraction approach estimated some emissions of several compounds which were not found in the questionnaires, including ethylene oxide, propylene oxide, acrylonitrile, and vinyl chloride.

surprisingly good correspondence between species fraction results and questionnaire results and sometimes shows firms estimating zero emissions where species fractions indicate substantial emissions. It is possible in some of these latter cases that the firms use solvents for example that are mixtures which, unknown to the firms, contain the compounds of interest.

In summary, the species fraction approach often given reasonable screening estimates of emissions, but the results sometimes differ substantially from the emissions estimates made by the firms themselves. Particularly for chemical plants, the use of national default species fraction cannot be expected to predict what chemicals are used at local facilities. For other facilities, however, the species fraction are generally at least comparable to source estimates, and in fact the species fraction may in some cases be more accurate than the source's own estimation of its emissions mix. In some cases, inaccuracies were a result of inaccurate VOC/TSP emissions data in NEDS. In general, though, in the context that this inventory is intended as a screeening inventory, the species

this purpose.

For mobile sources, substantial literature review was necessary as part of this

project, but the result appears to be a fairly complete and seemingly relatively

relatively complete (with the notable exception that emissions out of sewers

reliance on a handful of influent samples leads to questions about reliability. For treatment, storage and disposal facilities, the estimates here, despite

One surprising aspect of the process of completing this inventory was the effort associated with the questionnaires. Numerous companies misplaced the questionnaire. For some companies, plant personnel were unable to process the questionnaire, and we had to send another copy of the questionnaire to company headquarters. We attached to each questionnaire the NEDS information on the company, thinking this would simplify their response, since the companies could just confirm the accuracy of NEDS. This was a mistake: companies felt obliged to have accurate information on every detail on NEDS, and often needed information to decipher which point of their facility corresponded to which point on NEDS. Finally, substantial follow-up work was necessary, particularly where responses appeared incomplete or where companies did not know the composition of the materials they processed.

This report would not be complete without discussion of needs for further investigation. The goal of this project was to obtain a comprehensive inventory of air toxics emissions, so almost by definition any element of the inventory could be improved through further investigation. Nevertheless, it is possible to identify specific elements of the inventory for which further investigation would particularly improve the overall inventory. Perhaps the most important need identified in this study is the need for improvement of point source species fractions. Part of an investigation of this issue would be a more detailed investigation of the cause of the discrepancy found here between species fraction-based emission estimates and questionnaire responses, which would presumably help identified means of improving the reliability of the species fractions. Even apart from this investigation, it is clear that significant improvement to the inventory could be obtained by performing a broader set of species fraction measurements and doing the collateral work of assessing which operations (e.g., by SCC) can be characterized with which sets of species fractions. A second important need is the development of more area source emission factors (e.g., metals from electroplating and butadiene from home heating) and improvement of existing area source factors (e.g., benzene fractions for various portions of the petroleum/gasoline marketing chain and the composition of coatings used in house painting and auto refinishing).

using methods such as correlations with monitored ozone or photochemical box modeling, which could approximate photochemical formaldehyde formation without requiring long-term formaldehyde monitoring. Fifth, a number of improvements could be made in the inventory of emissions from treatment, storage, and disposal

and in the estimation of the degree of volatilization. Although the emissions from these source types are relatively small, the public interest in this general category translates to an interest in these improvements.

Other needs for further investigation exist in the other source types. For mobile sources, the adjustments, particularly the adjustment to reflect the possibility that standard measurement techniques may only measure 77% of total exhaust, warrant further investigation. For wastewater volatilization, further investigation could address volatilization from sewers, collection of a more

Bibliography

Information on Illinois and Indiana emissions/activity levels

I.1. National Emissions Data System (NEDS) - a computer data base maintained by U.S. EPA containing data on point sources (including operating character-

[redacted]

I.2. 1982 Ozone SIP Revisions by Illinois and Indiana for the Chicago/Northwest Indiana Area - a collective term for numerous submittals most relevantly including a VOC emissions inventory. These submittals were the primary basis for area and mobile source county emissions totals and for various characteristics affecting mobile source emissions. Three specific references included in the SIP are:

I.2. E.M. Sellars, A.M. Kiddio, J.A. Paci, R.J. Perry, D.D. Croce, Development of

[redacted]

the Area Source Emissions Inventory for the 1982 Ozone State Implementation

Point Source References

P.1. Volatile Organic Compound (VOC) Species Data Manual, Office of Air Quality [illegible] EPA Report #EPA-450/4-80-015, July 1980 [illegible]

contains 174 profiles and 134 organic species, including 19 species from this study.

P.2. Compiling Air Toxics Emissions Inventories, Office of Air Quality Planning and Standards, EPA Report #450/4-86-006, June 1986 - contains an index of which species profiles to use for which standard Classification Code (SCC), and contains a variety of other useful types of information.

P.3. Receptor Model Source Composition Library, Office of Air Quality Planning and Standards, EPA Report # EPA-450/4-85-002, November 1984 - covers

roughly 80 SCC's and 30 metals, including 6 metals in this study (arsenic, beryllium, cadmium, chromium, mercury and nickel).

P.4. "Locator documents" e.g., Locating and Estimating Air Emissions From Sources of Formaldehyde, EPA Report # EPA-450/4-84-007e, March 1984 - a series of

documents providing emission factor data and, for source types with a modest number of facilities, source location. Such documents are available for

Area Source References

A.1. W.H. Lamason, "Technical Discussion of Per Capita Emission Estimates for Several Area Sources of Volatile Organic Compounds", paper presented at Air Pollution Control Association meeting, June 21-26, 1981 - this is the fundamental source for most of the per capita emission factors.

A.2. End Use of Solvents Containing Volatile Organic Compounds, The Research Corporation of New England (for OAQPS, USEPA), EPA Report # EPA-450/3-79-032, May 1979 - provides additional information for calculating per capita emission factors.

A.3 Improvement of the Emissions Inventory for Reactive Organic Gases and Oxides of Nitrogen in the South Coast Air Basin, Systems Applications, Inc., and Radian Corporation (for California Air Resources Board), May 1985 - provided species profiles for gasoline marketing, architectural surface coating (see especially the main text chapter on "species profile development" and Appendix E).

A.4. "Locator documents" - see reference data and description under point source references. Specific documents from which area source emissions factors were used included the formaldehyde, chloroform, chromium, nickel and draft polycyclic organic matter locator documents.

A.5. Hazardous Air Pollutants: Air Exposure and Preliminary Risk Appraisal for 35 U.S. Counties, Appendix E, "Area Source Emission Factor Documentation," Versar, Inc. and American Management Systems, September 1984 - although the documentation is scant and the reliability of the data are uncertain, this report provides useful species profiles for degreasing; other profiles here were superseded by other references.

A.6. Steam Electric Plant Factors - see reference data under point source references. Again, fuel heat content were used to convert from emissions per Joule to emissions/quantity fuel burned.

A.7. Estimates of U.S. Wood Energy Consumption, 1949-1981, by Applied Management

A.11. Survey of Perchloroethylene Emission Sources. U.S. EPA Report #450/3-85-017.

cleaning.

A.12. Survey of Trichloroethylene Emission Sources. U.S. EPA Report #450/3-85-021

Appendix A

[redacted]

140 West 111th Street
Chicago, Illinois

Gentlemen:

The Illinois EPA and USEPA are engaged in a cooperative effort to compile an inventory of air emissions of selected substances in your area. As authorized

Attachment 3 is a questionnaire which identifies other information needed. In general, this questionnaire seeks emissions estimates for each operation in your facility for each of the listed compounds which you may emit, and some additional information helpful in assessing the possibility of atmospheric releases. Please fill out a questionnaire for each operation or production line in your facility as identified (or as should be identified) in Attachment 2.

Attachment 4 requests additional information on secondary air emissions resulting from plant operations involving wastewater, liquid wastes, and soli

Illinois Environmental Protection Agency · 2200 Churchill Road, Springfield, IL 62706

[redacted]

To Be Inventoried

Acetone
[redacted]

[redacted]

Arsenic
Asbestos
Benzene
Benzyl chloride
Beryllium
1,3 Butadiene
Cadmium
Carbon tetrachloride
Chloroform
Chromium
Coke Oven Emissions
Diethanolamine
Dimethylnitrosamine
Dioctyl phthalate
Dioxin
Epichlorohydrin
Ethyl acrylate
Ethylene
Ethylene dibromide
Ethylene dichloride
Ethylene oxide
Formaldehyde
4,4 Isopropopylidene diphenol
Melamine
Mercury
Methyl chloride
Methylene chloride
4,4 Methylene dianiline
Nickel
Nitrobenzene
Nitrosomorpholine
Pentachl orophenol
Perchloroethylene
PCBs
Polycyclic organic matter
Propylene dichloride
Propylene oxide
Styrene
Terephthalic acid
Titanium dioxide
[redacted]

Attachment 2

[redacted]

ATTACHMENT 3

A. Identify any chemical listed on Attachment A which is used or created by

ATTACHMENT 3 (continued)

During the 1984 calendar year did you have any unscheduled releases resulting in emissions of any of the substances identified in part A?

For each such stream associated with an unscheduled release list for the total calendar year

compound (identified in attachment 1)	quantity emitted to air directly/indirectly

RJW:JS:bjh/sp/1726E/4,5

ATTACHMENT 4

[redacted]