

Appendix G: Ontario Toxic Emissions Inventory

BACKGROUND

The province of Ontario, Canada, has prepared a mobile source air toxic emissions inventory on the target compounds for the Great Lakes Regional Air Toxic Emissions Inventory Project for the 1999 calendar year. Ontario followed the Air Toxic Emissions Inventory Protocol and the emission source methodologies agreed upon by the project's Technical Steering Committee in developing the regional inventory where applicable. Emissions related information was collected from the Ontario Ministry of Transportation for mobile sources. These sources of information were deposited into Ontario's Regional Air Pollution Inventory Development System (RAPIDS Version 2.1) and emissions were compiled using its reference tables and the air toxic emission factors from the Factor Information Retrieval System (FIRE 6.23) and the MOBTOX emission profiles.

MERCURY

As part of the effort to improve the estimates of mercury emissions for the 1999 inventory, Ontario identified major emission source categories of mercury and updated various emission factors based on recent industry source test results and a mercury study (Sang and Lourie, 1996). Ontario was also involved in the stakeholder workgroup which recommended revisions to the mercury reporting requirements for the National Pollution Release Inventory (NPRI) in Canada. However, this revision came into effect for the 2000 reporting year and thus the results of these revisions will not be reflected in the 1999 Ontario inventory.

DATA SOURCES

Mobile Source Emissions

The mobile source inventory included 2 major categories, on-road sources and non-road sources. The 1999 Ontario mobile source inventory included 13 source sectors (7 belonging to the on-road source sectors and 6 belonging to the non-road source sectors). The mobile source sector profile includes emissions data for 48 of the targeted toxics on the GLC substance list (213 substances).

On-road Mobile Sources

The on-road mobile sources include the vehicle categories as defined by the U.S. transportation model MOBILE 5. These are light-duty gasoline vehicles (LDGV), light-duty gasoline trucks (LDGT), heavy-duty gasoline vehicles (HDGV), light-duty diesel vehicles (LDDV), light-duty diesel trucks (LDDT), heavy-duty diesel vehicles (HDDV), and motorcycles (MC).

The Canadian version of the MOBILE model (MOBILE 5C) was used to estimate the

evaporative and exhaust related VOC emissions of on-road vehicles. The PART5 model was used to estimate the particulate matter (PM) emissions. Toxic substance speciation profiles were applied to VOC and PM emissions to obtain the toxic emission values.

Non-road Mobile Sources

Non-road mobile sources include the following categories: i) off-road gasoline engines/vehicles; ii) off-road diesel engines/vehicles; iii) off-road equipment; and iv) locomotives, marine engines, and aviation. The following sections give details on the emission estimation methodologies associated with non-road mobile sources.

Off-road Gasoline Engines/Vehicles

The fuel consumption of off-road gasoline engines/vehicles was obtained from provincial statistics and used to estimate VOC and PM emissions. Corresponding toxic substance speciation profiles were applied to the VOC and PM emissions to obtain the toxic emission values.

Off-road Diesel Engines/Vehicles

The fuel consumption of off-road diesel engines/vehicles was obtained from provincial statistics and used to estimate VOC and PM emissions. Corresponding toxic substance speciation profiles were applied to the VOC and PM emissions to obtain the toxic emission values.

Off-road Equipment

The estimated number of off-road equipment (e.g., lawnmowers) was obtained from a federal Environment Canada field survey and used to estimate VOC and PM emissions. Corresponding toxic substance speciation profiles were applied to the VOC and PM emissions to obtain the toxic emission values.

Locomotives

The fuel consumption of locomotives was obtained from provincial statistics and used to estimate VOC and PM emissions. Corresponding toxic substance speciation profiles were applied to the VOC and PM emissions to obtain the toxic emission values.

Marine Engines

The fuel consumption and the operating statistics (i.e., movement) of marine engines (i.e., vessels) was obtained from provincial statistics, whereas the number of pleasure crafts was estimated via the federal Census. This information was used to estimate VOC and PM emissions. Corresponding toxic substance speciation profiles were applied to the VOC and PM emissions to obtain the toxic emission values.

Aviation

The pertinent aircraft statistics for each airport were obtained from Transport Canada to derive associated landing-takeoff (LTO) cycles. Corresponding toxic substance speciation profiles were applied to the estimated VOC and PM emissions to determine the toxic air emissions.

QUALITY CHECK ACTIVITIES

During the development of this air toxics inventory, quality check activities, such as technical reviews and accuracy checks, were performed to ensure that the most appropriate emission profiles were used for each source.

UNCERTAINTIES

The emission estimates in this air toxic emissions inventory were based on the best available source information and source emission profiles.

Uncertainties exist when using emission factor tables, which vary in terms of data quality. In preparing this emission inventory, Ontario has further updated some of the RAPIDS emission factor tables with the most recent information from FIRE, AP-42, and specify studies.

INFORMATION

If more information is required about Ontario's emissions inventory, please contact:

Peter Wong
Ontario Ministry of the Environment
Environmental Monitoring and Reporting Branch
125 Resources Road, East Wing
Etobicoke, Ontario
Canada M9P 3V6

(P) 416-235-6130
(F) 416-235-6352
(E) Peter.Wong@ene.gov.on.ca

and

John Georgakopoulos
Ontario Ministry of the Environment
Environmental Monitoring and Reporting Branch
125 Resources Road, East Wing
Etobicoke, Ontario
Canada
M9P 3V6

(T) 416-235-5776
(F) 416-235-6352
(E) John.Georgakopoulos@ene.gov.on.ca

Table G-2: Ontario – Province-wide Summary of Emissions (lb/yr)

Pollutant	Point Sources	Area Sources	On-road Sources	Off-road Sources	Total
1,1,1-TRICHLOROETHANE	43,067.17	4,349,833.16		11.80	4,392,912.13
1,1,2,2-TETRACHLOROETHANE	5.76				5.76
1,1,2-TRICHLOROETHANE	1,830.15				1,830.15
1,1-DICHLOROETHANE	0.10				0.10
1,2-DIBROMOETHANE	10.69	13.34			24.03
1,2-DICHLOROETHANE	39.79	7,075.13			7,114.92
1,3-BUTADIENE	173,290.94		1,167,338.98	563,700.09	1,904,330.00
1,3-DICHLOROPROPENE		1,843,628.32			1,843,628.32
1,4-DICHLOROBENZENE	1.76	897,155.63			897,157.39
1,4-DIOXANE	749.70	346.11			1,095.81
2,2,4-TRIMETHYLPENTANE			0.00		0.00
2,3,7,8-TETRACHLORODIBENZOFURAN	0.06				0.06
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	0.0035				0.00
2,4,5-TRICHLOROPHENOL	4.99				4.99
2,4,6-TRICHLOROPHENOL	276.59				276.59
2,4-DINITROPHENOL	6.70				6.70
2-CHLOROACETOPHENONE	0.40				0.40
2-NITROPROPANE		22.40			22.40
4,4-METHYLENEDIPHENYL DIISOCYANATE	4,851.00				4,851.00
4-NITROPHENOL	0.25				0.25
ACENAPHTHENE	18.97	7,245.53		1.06	7,265.55
ACENAPHTHYLENE	125.62	145,501.38		0.01	145,627.02
ACETALDEHYDE	398,274.57		1,723,229.91	2,082,701.09	4,204,205.56
ACETAMIDE		1.40			1.40
ACETONITRILE	17,632.56				17,632.56
ACETOPHENONE	4.81	98.29			103.10
ACROLEIN	1,349.30		241,130.07	186,257.33	428,736.70
ACRYLAMIDE	595.35				595.35
ACRYLIC ACID	882.00	0.04			882.04
ACRYLONITRILE	16,904.91				16,904.91
ANILINE	815.85				815.85
ANTHRACENE	2,075.45	9,958.35		0.06	12,033.87
ANTIMONY	2,667.48	16.51		262.57	2,946.56
ARSENIC	154,541.74	196.40	16.53	67.33	154,822.00
BENZ(A)ANTHRACENE	599.72	14,215.71		0.35	14,815.77
BENZENE	1,964,754.38	1,807,423.65	9,035,010.79	3,470,658.72	16,277,847.55
BENZO(A)PYRENE	1,153.77	3,018.15		0.29	4,172.21
BENZO(B)FLUORANTHENE	0.47	4,291.16			4,291.63
BENZO(G,H,I)PERYLENE	0.80	3,437.83		0.11	3,438.75
BENZO(K)FLUORANTHENE	0.58	1,440.39			1,440.97
BENZYL CHLORIDE	22.05				22.05
BERYLLIUM	201.28	102.98		1.39	305.65
BIPHENYL	20,969.55	759.28			21,728.83
BROMOFORM	12.56				12.56
BROMOMETHANE	15.60	2,558,034.29			2,558,049.90
CADMIUM	10,972.73	446.51		19.91	11,439.14
CARBON DISULFIDE	261,920.57				261,920.57
CARBON TETRACHLORIDE	34.42	4,873.27			4,907.69
CARBONYL SULFIDE	34,713.32				34,713.32
CHLORDANE	0.47				0.47
CHLORINE	726,718.04	2,246,741.52	21,180.20	1,650.12	2,996,289.89
CHLOROENZENE	210.93	825,254.13			825,465.05
CHLOROETHANE	137,330.86				137,330.86
CHLOROFORM	23,565.90	37,754.80			61,320.69
CHROMIUM	39,887.79	521.27	431.31	1,592.78	42,433.15
CHROMIUM (VI)	570.29	0.78		12.40	583.47
CHRYSENE	819.48	8,714.34		0.83	9,534.65
COBALT	11,057.90	44.09		301.08	11,403.06
COPPER	1,005,771.34	470.31	53,356.69	271.37	1,059,869.71
CRESOL- MIXED ISOMERS	45,423.00				45,423.00
CUMENE	2,599.61		18,632.74		21,232.35
CYANIDE	2,007.65				2,007.65
DIBENZO(A,H)ANTHRACENE	0.60	201.90		0.08	202.58
DIBENZOFURAN		85.27			85.27
DIBUTYL PHTHALATE	2,624.79	72,420.02			75,044.82
DIETHANOLAMINE	12,546.45				12,546.45
DIETHYLHEXYL PHTHALATE	2,315.25				2,315.25

Pollutant	Point Sources	Area Sources	On-road Sources	Off-road Sources	Total
DIMETHYL SULFATE	22.05				22.05
DIMETHYLFORMAMIDE, N,N-		362.73			362.73
DIOCTYL PHTHALATE (DEHP)	3,101.05				3,101.05
ETHYLBENZENE	1,249,873.28	1,241,094.11	3,855,099.80	2,024,240.41	8,370,307.60
ETHYLENE GLYCOL	144,625.95	1,720,135.13			1,864,761.08
ETHYLENE OXIDE	27,628.65	173,992.42			201,621.07
FLUORANTHENE	3,014.17	14,077.36		8.78	17,100.31
FLUORENE	56.77	17,030.86		0.22	17,087.86
FORMALDEHYDE	952,748.43	210,026.70	4,630,104.61	4,706,783.79	10,499,663.53
GLYCOL ETHERS (MISC.)		1,157,201.27			1,157,201.27
HEXACHLOROBENZENE	0.0021				0.00
HYDRAZINE	396.90				396.90
HYDROCHLORIC ACID	18,110,817.50	17.96			18,110,835.46
HYDROGEN CYANIDE	108,993.15				108,993.15
HYDROGEN FLUORIDE	957,291.64	148.76			957,440.40
HYDROGEN SULFIDE	6,195,657.26				6,195,657.26
INDENO(1,2,3-C,D)PYRENE	0.58	817.78		0.11	818.47
ISOPHORONE	33.40	10,911.98			10,945.37
LEAD	292,569.25	452.64	19,814.63	2,092.34	314,928.86
LINDANE, (ALL ISOMERS)	0.16				0.16
MALEIC ANHYDRIDE	1,962.45				1,962.45
MANGANESE	123,872.40	447.63	798.93	1,971.74	127,090.70
M-CRESOL	4,564.35				4,564.35
MERCURY	490.80	177.48	325.38	485.75	1,479.41
METHANOL	13,364,427.60	7,398,376.74	16,296,495.93		37,059,300.28
METHYL CHLORIDE	790,724.33				790,724.33
METHYL ETHYL KETONE	9,859,557.10	7,797,700.70	293,033.58		17,950,291.39
METHYL HYDRAZINE	9.79				9.79
METHYL IODIDE	0.56				0.56
METHYL ISOBUTYL KETONE	1,480,679.55	6,998,623.62			8,479,303.17
METHYL METHACRYLATE	40,086.90				40,086.90
METHYL TERT BUTYL ETHER		247.51	2,988,048.84	2,460,865.96	5,449,162.31
METHYLENE CHLORIDE	3,824,382.28	1,281,616.74			5,105,999.02
M-XYLENE	86.00	183,271.17	7,553,068.76		7,736,425.93
NAPHTHALENE	93,296.53	945,120.38	572,584.05	1,418.42	1,612,419.38
N-HEXANE	3,226,538.78	1,429,641.96	2,734,001.53	1,203,809.84	8,593,992.11
NICKEL	575,942.09	1,003.36	530.30	5,112.98	582,588.73
O-XYLENE	66.02	212,385.20	4,084,997.97	483.24	4,297,932.42
P-CRESOL	2,535.75				2,535.75
PENTACHLOROPHENOL (PCP)	0.23				0.23
PHENANTHRENE	30.80	71,936.73		0.53	71,968.06
PHENOL	294,491.23	34.51		587.78	295,113.52
PHOSPHORUS (YELLOW OR WHITE)	3,062.21	29.74	20,343.14	3,076.65	26,511.74
PHTHALIC ANHYDRIDE	1,499.40				1,499.40
POLYCHLORINATED BIPHENYLS (PCBS)	3.86				3.86
POLYCHLORINATED DIBENZODIOXINS, TOTAL	1.22				1.22
POLYCHLORINATED DIBENZOFURANS, TOTAL	3.86				3.86
PROPIONALDEHYDE			323,949.13	343,238.31	667,187.44
PROPYLENE DICHLORIDE	25.57				25.57
PROPYLENE OXIDE	23,266.26				23,266.26
P-XYLENE	7.98	70,950.96			70,958.94
PYRENE	5.25	16,697.41		0.21	16,702.87
QUINOLINE	441.00				441.00
QUINONE	1,039.60				1,039.60
SELENIUM	16,858.53	505.86	608.70	180.84	18,153.92
STYRENE	766,222.64	12,149.29	2,110,346.46	140,312.23	3,029,030.61
TETRACHLOROETHYLENE	314,632.31	4,560,613.32			4,875,245.63
TOLUENE	11,648,081.17	28,765,607.90	26,363,557.99	8,055,299.84	74,832,546.90
TRICHLOROETHYLENE	1,418,205.35	22,157.63			1,440,362.99
TRIETHYLAMINE	142,751.70	9,667.53			152,419.23
VINYL ACETATE	5,115.60	0.52			5,116.12
VINYL CHLORIDE	23,476.49	81,962.67			105,439.17
VINYLDENE CHLORIDE	2,936.39	5,303.47			8,239.85
XYLENES (MIXED ISOMERS)	10,934,105.38	22,965,762.70	14,933,871.04	8,367,912.89	57,201,652.02

Ontario – Pollutant Codes

Code	Pollutant	CAS Number
TCE, 111	1,1,1-TRICHLOROETHANE	71-55-6
TETCLET, 1122	1,1,2,2-TETRACHLOROETHANE	79-34-5
TRICLETH, 112	1,1,2-TRICHLOROETHANE	79-00-5
DICLETH, 11-	1,1-DICHLOROETHANE	75-34-3
DIBROMOET, 12	1,2-DIBROMOETHANE	106-93-4
DICHLORETH12	1,2-DICHLOROETHANE	107-06-2
BUTADIENE, 13	1,3-BUTADIENE	106-99-0
DICLPROPE, 13	1,3-DICHLOROPROPENE	542-75-6
DICLBENZ, 14	1,4-DICHLOROBENZENE	106-46-7
DIOXANE	1,4-DIOXANE	123-91-1
TCDF, 2378	2,3,7,8-TETRACHLORODIBENZOFURAN	51207-31-9
TCDD, 2378	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	1746-01-6
TRICLPHN, 245	2,4,5-TRICHLOROPHENOL	95-95-4
TRICLPHN, 246	2,4,6-TRICHLOROPHENOL	88-06-2
DINITROPH, 24	2,4-DINITROPHENOL	51-28-5
CLACETOPHE, 2	2-CHLOROACETOPHENONE	532-27-4
NITROPROPA, 2	2-NITROPROPANE	79-46-9
METHENE (B) 4-	4,4-METHYLENEDIPHENYL DIISOCYANATE	101-68-8
NITROPHENL, 4	4-NITROPHENOL	100-02-7
ACENAPHTHEN	ACENAPHTHENE	83-32-9
ACENAPHTHYL	ACENAPHTHYLENE	208-96-8
ACETALDEHYDE	ACETALDEHYDE	75-07-0
ACETAMIDE	ACETAMIDE	60-35-5
ACETONITRILE	ACETONITRILE	75-05-8
ACETOPHENONE	ACETOPHENONE	98-86-2
ACROLEIN	ACROLEIN	107-02-8
ACRYLAMIDE	ACRYLAMIDE	79-06-1
ACRYLIC ACID	ACRYLIC ACID	79-10-7
ACRYLONITRIL	ACRYLONITRILE	107-13-1
ANILINE	ANILINE	62-53-3
ANTHRACENE	ANTHRACENE	120-12-7
ANTIMONY	ANTIMONY	7440-36-0
ARSENIC	ARSENIC	7440-38-2
BENZ (A) ANTHR	BENZ (A) ANTHRACENE	56-55-3
BENZENE	BENZENE	71-43-2
BENZO (A) PYRE	BENZO (A) PYRENE	50-32-8
BENZO (B) FLUO	BENZO (B) FLUORANTHENE	205-99-2
BENZ (GHI) PE	BENZO (G, H, I) PERYLENE	191-24-2
BENZO (K) FLUO	BENZO (K) FLUORANTHENE	207-08-9
BENZYL CHLOR	BENZYL CHLORIDE	100-44-7
BERYLLIUM	BERYLLIUM	7440-41-7
BIPHENYL	BIPHENYL	92-52-4
BROMOFORM	BROMOFORM	75-25-2
BROMOMETH	BROMOMETHANE	74-83-9
CADMIUM	CADMIUM	7440-43-9
CARBON DISUL	CARBON DISULFIDE	75-15-0
CARBON TETRA	CARBON TETRACHLORIDE	56-23-5
CARBONYL SUL	CARBONYL SULFIDE	463-58-1
CHLORDANE	CHLORDANE	57-74-9
CHLORINE	CHLORINE	7782-50-5
CHLOROENZ	CHLOROENZENE	108-90-7
CHLOROETHANE	CHLOROETHANE	75-00-3
CHLOROFORM	CHLOROFORM	67-66-3
CHROMIUM	CHROMIUM	7440-47-3
CHROMIUM III	CHROMIUM (III)	16065-83-1
CHROMIUM VI	CHROMIUM (VI)	18540-29-9
CHROMIUM CMP	CHROMIUM COMPOUNDS	
CHRYSENE	CHRYSENE	218-01-9
COBALT	COBALT	7440-48-4
COPPER	COPPER	7440-50-8
CRESOL MX IS	CRESOL- MIXED ISOMERS	1319-77-3
CUMENE	CUMENE	98-82-8
CYANIDE	CYANIDE	57-12-5
DIBENZAHAN	DIBENZO (A, H) ANTHRACENE	
DIBENZOFURAN	DIBENZOFURAN	
DIBUTYL PHTH	DIBUTYL PHTHALATE	84-74-2

Code	Pollutant	CAS Number
DIETHANOLAMI	DIETHANOLAMINE	111-42-2
DIEYLHEX PHT	DIETHYLHEXYL PHTHALATE	117-81-7
DIMETH SULFA	DIMETHYL SULFATE	77-78-1
DIMETHFORMAM	DIMETHYLFORMAMIDE, N,N-	68-12-2
DIOCTYL PHTH	DIOCTYL PHTHALATE (DEHP)	117-81-7
ETHYLBENZENE	ETHYLBENZENE	100-41-4
ETHYLENE GLY	ETHYLENE GLYCOL	107-21-1
ETHYLENE OXI	ETHYLENE OXIDE	75-21-8
FLUORANTHENE	FLUORANTHENE	206-44-0
FLUORENE	FLUORENE	86-73-7
FORMALDEHYDE	FORMALDEHYDE	50-00-0
GLYCOL ETHRS	GLYCOL ETHERS (MISC.)	
HEXCLBENZENE	HEXACHLOROBENZENE	118-74-1
HYDRAZINE	HYDRAZINE	302-01-2
HCL	HYDROCHLORIC ACID	7647-01-0
HYDROGEN CYA	HYDROGEN CYANIDE	74-90-8
HF	HYDROGEN FLUORIDE	7664-39-3
HYDROGEN SUL	HYDROGEN SULFIDE	7783-06-4
INDN(123CDPY	INDENO(1,2,3-C,D)PYRENE	193-39-5
ISOPHORONE	ISOPHORONE	78-59-1
LEAD	LEAD	7439-92-1
LEAD CMP	LEAD COMPNDS	
LEAD OXIDE	LEAD OXIDE	1317-36-8
LINDANE ISO	LINDANE, (ALL ISOMERS)	58-89-9
MALEIC ANHYD	MALEIC ANHYDRIDE	108-31-6
MANGANESE	MANGANESE	7439-96-5
CRESOL,M	M-CRESOL	108-39-4
MERCURY	MERCURY	7439-97-6
METHANOL	METHANOL	67-56-1
METHYL CHLOR	METHYL CHLORIDE	74-87-3
METH ETH KET	METHYL ETHYL KETONE	78-93-3
METH HYDRAZI	METHYL HYDRAZINE	60-34-4
METH IODIDE	METHYL IODIDE	74-88-4
METH ISOBUT	METHYL ISOBUTYL KETONE	108-10-1
METH METHACR	METHYL METHACRYLATE	80-62-6
METH TERT BU	METHYL TERT BUTYL ETHER	1634-04-4
METHYLENE CL	METHYLENE CHLORIDE	75-09-2
XYLENE,M	M-XYLENE	108-38-3
NAPHTHALENE	NAPHTHALENE	91-20-3
HEXANE	N-HEXANE	110-54-3
NICKEL	NICKEL	7440-02-0
NI(II) OXIDE	NICKEL(II) OXIDE (1:1)	1313-99-1
XYLENE,O	O-XYLENE	95-47-6
CRESOL,P	P-CRESOL	106-44-5
PCP	PENTACHLOROPHENOL (PCP)	87-86-5
PHENANTHRENE	PHENANTHRENE	85-01-8
PHENOL	PHENOL	108-95-2
PHOSPHORUS	PHOSPHORUS (YELLOW OR WHITE)	7723-14-0
PHTHALIC ANH	PHTHALIC ANHYDRIDE	85-44-9
PCBS	POLYCHLORINATED BIPHENYLS (PCBS)	1336-36-3
PCDD	POLYCHLORINATED DIBENZODIOXINS, TOTAL	
PCDF	POLYCHLORINATED DIBENZOFURANS, TOTAL	
PRPLENE DICH	PROPYLENE DICHLORIDE	78-87-5
PRPLENE OXID	PROPYLENE OXIDE	75-56-9
XYLENE,P	P-XYLENE	106-42-3
PYRENE	PYRENE	129-00-0
QUINOLINE	QUINOLINE	91-22-5
QUINONE	QUINONE	106-51-4
SELENIUM	SELENIUM	7782-49-2
STYRENE	STYRENE	100-42-5
PERC	TETRACHLOROETHYLENE	127-18-4
TOLUENE	TOLUENE	108-88-3
TRICHLORETHY	TRICHLOROETHYLENE	79-01-6
TRIETHAMINE	TRIETHYLAMINE	121-44-8
VINYL ACETAT	VINYL ACETATE	108-05-4
VINYL CHLOR	VINYL CHLORIDE	75-01-4
VINLIDENE CL	VINYLDIENE CHLORIDE	75-35-4
XYLENES ISO	XYLENES (MIXED ISOMERS)	1330-20-7