

### **3.0 EMISSION INVENTORY**

As previously discussed, four (4) emission scenarios are to be modelled for ABTP, namely:

- Scenario 1** air emissions from the incinerator when it was in full operation (pre 1996) and accounting for air emissions from all other sources within the treatment plant;
- Scenario 2** air emissions from the incinerator when it was in partial operation (2000-2002) and accounting for air emissions from all other sources within the treatment plant;
- Scenario 3** air emissions from the treatment plant after incineration is discontinued (2003-2004)
- Scenario 4** air emissions from the treatment plant after incineration is discontinued and odour control measures have been implemented (by 2010).

The following provides details on the emission inventory, including the methods used to create the inventory as well as sources of the data. Past and current emission scenarios (1-3) are primarily based on existing source testing data. Future emissions (Scenario 4) are based on Zorix (2002d) recommendations. Hydrogen sulphide (H<sub>2</sub>S) is used as an example to demonstrate how the emissions are calculated. Hydrogen sulphide was selected for its abundance at the site and since it can be found at virtually all the processes at the ABTP. The emissions from the other chemicals are calculated in a similar fashion.

#### **3.1 IDENTIFICATION OF POINT SOURCES**

A point source is any stack that exhausts vertically and is above the roofline. This includes capped stacks, roof vents, gooseneck vents, and building ventilation. The inventory of 45 point sources is based on Zorix (2002d) and Project Team site visits. Appendix B presents the stack exit characteristics and building parameters which are used in the modelling.

#### **3.2 IDENTIFICATION OF AREA AND FUGITIVE SOURCES**

Area sources are low level or ground releases (i.e., biofilters and open source). There are 15 area sources at ABTP and their emission characteristics are provided in Appendix B. Fugitive sources are sources including leaks from equipment, doors/windows and cracks.

#### **3.3 EMISSIONS INVENTORY METHODOLOGY**

There are four (4) Emission Estimation Techniques (Its) that can be used to generate facility-wide emissions estimates, namely:

- Sampling or direct measurement;
- Mass balance;
- Fuel analysis or other engineering calculations; and
- Emission factors.

Typically, a facility will use more than one type of EET. For example, a mass balance may be used to estimate fugitive emissions from leaks, direct measurements for stack emissions and emission factors for combustion equipment.

With respect to ABTP, emissions were primarily calculated using direct measurements. In some instances, volume air flowrates were not available and an estimate of the flowrate was required. The generalized emission equation is given in Equation 3-1.

$$E_i = \frac{(C_i \times MW_i \times Q_d)}{[0.024 \times 10^6]} \times \frac{293}{273 + T} \times (1 - Eff) \quad \text{Equation 3-1}$$

Where:

$E_i$	=	emissions of chemical i, g/s
$C_i$	=	pollutant concentration at inlet to pollution control device, ppm <sub>v,d</sub>
ppm <sub>v,d</sub>	=	parts per million, volume dry
$MW_i$	=	molecular weight of the pollutant, g/g-mole
$Q_d$	=	stack gas volumetric flow rate (m <sup>3</sup> /s) at temperature T (dry)
0.024	=	volume occupied by one mole of gas at standard temperature and pressure (20 °C and 101.3 kPa), m <sup>3</sup> /g-mole
T	=	temperature of gas sample, °C
10 <sup>6</sup>	=	conversion factor, ppm·g/g
Eff	=	Control Efficiency

A variation of Equation 3-1 is where the concentration is given as mass per volume (i.e., mg/L or µg/m<sup>3</sup>). Equation 3-1 becomes:

$$E_i = C_i \times Q_d \times \frac{1}{1000} \times \left( \frac{293}{273 + T} \right) \times (1 - Eff) \quad \text{Equation 3-1a}$$

where:

$E_i$	=	emissions of chemicals i, g/s
$C_i$	=	concentration of chemicals i at inlet, mg/m <sup>3</sup> at 20 °C
$Q_d$	=	stack gas volumetric flow rate at temperature T, m <sup>3</sup> /s
T	=	temperature of the gas sample, °C

In addition, combining the inlet concentration with the control efficiency results in the outlet concentration of the control device as

$$C'_i = C_i \times (1 - Eff) \quad \text{Equation 3-1b}$$

where:

$$C'_i = \text{concentration of chemical } i \text{ at the outlet of the APC, ppm}_{v,d} \text{ or mg/m}^3$$

For direct measurements of a surface such as the Primary Clarifiers where a flux chamber was used, the emission equation becomes:

$$E_{Flux_i} = \frac{C_i \times Q_s}{A \times 1,000,000} \times A_T \quad \text{Equation 3-2}$$

where:

$E_{Flux_i}$	=	surface emissions of chemical i, g/m <sup>2</sup> /s
$C_i$	=	concentration of chemical i in the flux chamber, µg/m <sup>3</sup>
$Q_s$	=	Sample flow rate, m <sup>3</sup> /s
$A$	=	Surface area covered by the flux chamber, m <sup>2</sup>
$A_T$	=	Total surface area of source, m <sup>2</sup>

In the above equations,  $C_i$  is the uncontrolled concentration above the surface.

Material balance (also known as mass balance) is a method commonly used for estimating emissions from many source categories. The material balance method can be used where source test data, emission factors, or other developed methods are not available. In fact, a material balance is the only practical method to estimate emissions accurately for some sources.

The general form of the equation is given as:

$$E_i = \frac{Q_i \times (C_{in} - C_{out})}{24 \times 3600 \times 1000000} \times \%Volz \quad \text{Equation 3-3}$$

Where:

$E_i$	=	Total emissions of chemical i, g/s
$C_{in}$	=	Concentration of chemical entering the system (µg/L)
$C_{out}$	=	Concentration of chemical leaving the system (µg/L)
$\Delta C$	=	$C_{in} - C_{out}$ (µg/L)
$Q_i$	=	Flowrate (L/day)
$\% Volz$	=	Volatilization (%)

In the above equation, it is assumed that the difference between the concentration entering the system and leaving the system is volatilized into the atmosphere. For conservatism, it is generally assumed as 100% volatilization. This is a very conservative assumption.

In other cases, EPA emission factors were used to calculate the emissions for sources, which had limited data. Emission factors are generally constructed based on a range of source tests conducted on a typical process under varying operating conditions. From this, a ratio is developed which expresses atmospheric emissions as a function of process activity level (such as production rate, material throughput or full consumption). Emissions can be simply estimated by knowing the applicable activity level.

Emission factors are used to estimate a facility's emissions by the general equation:

$$E_{kpy,i} = A \times EF_i \times \left(1 - \frac{CE_i}{100}\right) \quad \text{Equation 3-4}$$

Where:

$E_{kpy,i}$	=	emission rate of chemical i, kg/yr
A	=	activity rate, t/yr
$EF_i$	=	uncontrolled emission factor of chemical i, kg/t
$CE_i$	=	overall control efficiency of chemical i, %

Activity data are usually directly related to the emitting process. For industrial processes, activity data are generally reported as process weight rates (e.g., kilograms, tons, or litres per month of material used or manufactured). Similarly, for fuel-burning equipment, activity data are reported as fuel consumption rates (e.g., tons, litres, cubic meters, or megajoules per hour or per month). In many instances, conversion factors must be applied to convert reported consumption or production values to units that correspond to the emission factor throughput units (e.g., tons, barrels).

### 3.3.1 SITE-SPECIFIC INFORMATION

The following site-specific reports are used to estimate emissions:

- A. Zorix Comprehensive Odour Reports – Interim Reports (Zorix, 2001, 2002a, 2002b, and 2002c) and Final Reports (Zorix, 2002d);
- B. Bovar-Concord Environmental Report BCE441-3345 (Ciccone et al., 1994);
- C. Annual Reports 1988, 1999, 2000 and 2001 prepared for the City of Toronto (City of Toronto, 1997, 2000, 2001, 2002 and Zenon 1989) and;
- D. Incinerator Emission Test Program Reports (EER Canada, 1994 and 1998).

Where multiple measurements were made of the same source, the highest value measured was used to provide conservative estimates. The 1994 EER Canada source testing report was used for Scenario #1 as

all incinerators were in operation at this time and it was the most representative dataset available. Similarly, the 1998 report was used for Scenario 2 as only two incinerators were in operation and these sets of test are the most representative of the period of interest.

### **3.3.2 ENGINEERING ESTIMATES AND DATA QUALITY**

The emission estimates developed for this application have been assigned a data quality rating based on the estimation methodology and information resources used. The terminology used for describing the emission estimation technique and the resulting data quality were based on the Ontario Ministry of the Environment (MOE) guideline document “Procedure for Preparing an Emission Summary and Dispersion Modelling Report” (MOE, June 1998) and are contained in Table 3-1.

**Table 3-1 Reference Terminology for Data Quality**

<b>Reference</b>	<b>Estimation Method</b>	<b>Data Quality</b>
EC	Engineering Calculation using known data on similar sources or sound engineering judgement	Conservative
EF	Emission Factor published by the USEPA, AP-42 (5th Edition) or other published sources	A, B, C, D or E*
MB	Mass Balance Calculations accounting for the material that enters and leaves a process	Conservative
EE	Engineering Estimate based on scientific principles	Conservative
SM	Source Measurement following the USEPA sampling protocol	Documented

\* A is the highest rating (high confidence in the emission factor) and E is lowest rating (low confidence in the emission factor)

Emission estimates based on source testing refer to measurements which have followed an appropriate protocol and have been witnessed by the MOE. In some cases, measurements by Zorix Consultants were used to estimate emissions of various compounds. These measurements were taken for an overall odour assessment and not to quantify specific emissions. Although Zorix Consultants did not follow standard source testing protocols, they do provide useful information for emission estimates.

Descriptions of emission estimation techniques are presented below as per the process described in the previous section. Fugitive emissions, with the exception of road dust or tail-pipe emissions are included as part of this inventory.

To estimate the emission rates for those compounds deemed below method detection limit, the detection limit was used in the calculations. This occurred for mass balance estimates as well as in source testing measurements.

In the case of sources without source testing data, emission factors and engineering calculations were used. For example, emission factors were used for emissions from boilers and flares while a mass balance approach was used to estimate volatile organic compound (VOC) emissions from wastewater.

### 3.4 EMISSIONS CALCULATIONS FOR ABTP SOURCES

The following sections describe the calculation methods used to calculate hydrogen sulphide (H<sub>2</sub>S) emissions from the various sources using the above EETs. The other chemicals such as VOCs, polycyclic aromatic hydrocarbons (PAHs), were calculated in a similar manner.

#### 3.4.1 PUMPING OR LIFT STATIONS

##### 3.4.1.1 M BUILDING

The M Building has four (4) sources of emissions, namely; the M Building Scrubber Exhaust (#1), M Building Roof Exhausts (#2A and #2B) and New M Building Stack without a Scrubber (#3).

Hydrogen sulphide emissions and the flow rates from the M Building (Sources #1, #2A and #2B) were determined by source testing carried out by Zorix in June/July 2001 (Zorix, 2001). Source #2 is divided into Source #2A and #2B and it is assumed that one-half of the flow rate was assigned to each source. In addition, it was also assumed that the other chemicals (i.e., VOCs) emitted from the T Building Roof Exhaust (Source #5) would also be emitted by Sources #2A and #2B at the same concentration. For Scenarios 1 to 3, in-stack concentrations, flow rates and emission rates do not change from scenario to scenario. In Scenario 4, these sources will be rerouted to a new single tall stack, without a scrubber (Source #3). All the emission rates from Sources #1, #2A and 2B were calculated in the same manner. For Source #1, the hydrogen sulphide emission rate was calculated with the aid of Equation 3-1, where

$$\begin{aligned} C_i &= 0.013 \text{ ppm} \\ Q_d &= 14.66 \text{ m}^3/\text{s at } 20^\circ\text{C.} \\ MW_i &= 34 \text{ g/mol} \end{aligned}$$

Substitution into Equation 3-1 results in the following:

$$E_i = \frac{(0.013 \times 34 \times 14.66)}{[0.024 \times 10^6]} \times \frac{293}{273 + 20} = 2.70 \times 10^{-4} \text{ g / s}$$

The control efficiency of the existing scrubber was integrated into Equation 3-1 with the aid of Equation 3-1b as the measurement was taken after the scrubber.

Source #3 was only included in the future scenario (Scenario 4). The flow rate was calculated by summing the flow rates of Sources #1, 2A and 2B with an additional 1 m<sup>3</sup>/s as the inlet pipe would also be captured in this source. The concentration of hydrogen sulphide from Source #3 was calculated by dividing the total emission rate from Sources #1, 2A and 2B by the flow rate of Sources #1, 2A and 2B. The hydrogen sulphide emission rate is calculated using Equation 3-1. The other chemicals emitted from Sources #2A and 2B would also be emitted by Source #3 in the future scenario with no scrubber (i.e., emission reduction).

### 3.4.1.2 T BUILDING

The T Building has four (4) sources of emissions including the T Building Scrubber Exhaust (#4), T Building Roof Exhaust (#5), Control Gate Monument (#55) and New T Building Biofilter Scrubber (#6).

The concentration and flow rates of the T building scrubber exhaust (Source #4), general building ventilation system roof exhaust (Source #5), and control gates (Monument, Source #55) vents were determined from the Zorix Round 1 source testing (Zorix, 2002) in June/July 2001. In Scenario 4, these sources will no longer vent directly to the atmosphere but will vent through a local Biofilter Scrubber (Source #6).

The emission rates for the first three (3) scenarios are identical. The hydrogen sulphide emission rate from the T Building Scrubber (Source #4) was calculated with the aid of Equation 3-1, where

$$\begin{aligned}C_i &= 0.003 \text{ ppm} \\Q_d &= 2.58 \text{ m}^3/\text{s at } 20^\circ\text{C} \\MW_i &= 34 \text{ g/mol}\end{aligned}$$

Substitution into Equation 3-1 results in the following:

$$E_i = \frac{(0.003 \times 34 \times 2.58)}{[0.024 \times 10^6]} \times \frac{293}{273 + 20} = 1.1 \times 10^{-5} \text{ g / s}$$

The control efficiency of the existing scrubber was integrated into Equation 3-1 with the aid of Equation 3-1b as the measurement was taken after the scrubber.

A future scrubber was added as Source #6. The hydrogen sulphide emission rate for Source #6 was calculated as the sum of emission rates from Sources #4, 5, and 55 with a scrubber efficiency of 95% on hydrogen sulphide. The calculations for hydrogen sulphide for the future scenario only are shown below:

$$\begin{aligned}E &= (E_{Source\#4} + E_{Source\#5} + E_{Source\#55}) \times (1 - Eff) \\&= (1.10 \times 10^{-5} + 1.96 \times 10^{-3} + 7.68 \times 10^{-4}) \times (1 - 95\%) \\&= 1.37 \times 10^{-4} \text{ g / s}\end{aligned}$$

Scrubber removal efficiencies for the other chemicals were also taken as 95%.

### 3.4.2 GRIT TANKS

#### 3.4.2.1 P BUILDING – GRIT TANKS (1-6) BUILDING

The P Building emission sources include the P Building Scrubber Outlet (#10) and P Building Room Air (#11A to #11F).

The P Building (Grit Tanks 7-12) has seven (7) emissions sources, namely: Scrubber Outlet (Source #10) and five (5) room exhausts and one standby (Sources #11A to #11F). All seven (7) sources emit hydrogen sulphide, determined from source testing carried out by Zorix in June/July 2001 (Zorix, 2001).

For the first three (3) scenarios, the flow rate for the scrubber outlet was determined from Zorix's Round 1 source testing (Zorix, 2002a). Under the future scenario, that source will no longer be active and exhaust air will be conveyed to the central biofilter.

The flow rates for P Building Room exhausts (Sources #11A to F) were assumed to be distributed among the operating exhaust fans at one-sixth of the flow rate provided in the Zorix Final Report (Zorix, 2002d). Source #11B is a spare fan so Source #11A was assigned two-sixths of the flow rate. Under the future scenario, these sources will continue to be directly exhausted to the environment without treatment.

Under the future scenario, a new ventilation system will be installed to capture the foul air from the new grit processing and storage. The new system exhaust will be captured and conveyed to the central biofilter.

The hydrogen sulphide emission rate from the P Building Scrubber (Source #10) is calculated with the aid of Equation 3-1, where

$$\begin{aligned} C'_i &= 0.447 \text{ ppm} \\ Q_d &= 14.07 \text{ m}^3/\text{s at } 20^\circ\text{C} \\ MW_i &= 34 \text{ g/mol} \end{aligned}$$

Substitution into Equation 3-1 results in the following:

$$E_i = \frac{(0.447 \times 34 \times 14.07)}{[0.024 \times 10^6]} \times \frac{293}{273 + 20} = 8.91 \times 10^{-3} \text{ g / s}$$

The control efficiency of the existing scrubber was integrated into Equation 3-1 with the aid of Equation 3-1b as the measurement was taken after the scrubber.

### **3.4.2.2 GRIT TANKS (7-12) BUILDING**

The Grit Tank (7-12) Building includes two (2) sources, namely; the Screen 7-12 Odour Control (Scrubber) (#122), and the General Building Ventilation (#123).

The above sources are old and the City plans to refurbish the grit tanks and ventilation system. It has been assumed that the emissions have the same characteristics (i.e., chemicals and concentrations) as the P Building. Source #122 is assumed to have the same concentration as Source #10 and a flow rate of 1 m<sup>3</sup>/s. Source #123 is assumed to have a concentration equal to the average concentration of hydrogen sulphide from Sources #11A to 11F and a flow rate of 2.3 m<sup>3</sup>/s.

Under the future scenario, the general building ventilation will be vented directly to the atmosphere without treatment.

For hydrogen sulphide, the emissions for the Screen 7-12 Odour Control (Scrubber) (#122) was calculated with the aid of Equation 3-1, where

$$\begin{aligned} C_i &= 0.447 \text{ ppm} \\ Q_d &= 1.0 \text{ m}^3/\text{s at } 20^\circ\text{C.} \\ MW_i &= 34 \text{ g/mol} \end{aligned}$$

Substitution into Equation 3-1 results in the following:

$$E_i = \frac{(0.447 \times 34 \times 1.0)}{[0.024 \times 10^6]} \times \frac{293}{273 + 20} = 6.33 \times 10^{-4} \text{ g / s}$$

The control efficiency of the existing scrubber was integrated into Equation 3-1 with the aid of Equation 3-1b as the measurement was taken after the scrubber.

### **3.4.2.3 GRIT TANKS (13-16) BUILDING**

The Grit Tank (13-16) Building includes six (6) sources, namely; the D Building Grit Area Exhaust NEF-2 (grit Removal) (#15), D Building Grit Area Exhaust NEF-1 (grit Removal) (#16), and four (4) exhausts fans (#NEF-6, # NEF-7, #NEF-8, and #NEF-9).

The concentration and flow rates of these six (6) sources were determined from the Zorix Round 1 source testing (Zorix, 2002) in June/July 2001. These sources exhaust during all four scenarios.

There are three (3) additional fans NEF-21, NEF-22, and NEF-23 in this building which are not operational under normal operations and are there for emergency purposes only.

The emission rates for the four (4) scenarios are identical. The hydrogen sulphide emission rate from the D Building Grit Area Exhaust NEF-2 (Source #15) was calculated with the aid of Equation 3-1, where

$$\begin{aligned} C_i &= 0.054 \text{ ppm} \\ Q_d &= 16.7 \text{ m}^3/\text{s at } 20^\circ\text{C} \\ MW_i &= 34 \text{ g/mol} \end{aligned}$$

Substitution into Equation 3-1 results in the following:

$$E_i = \frac{(0.054 \times 34 \times 16.7)}{[0.024 \times 10^6]} \times \frac{293}{273 + 20} \times (1 - 0) = 1.3 \times 10^{-3} \text{ g / s}$$

There is no emission control for this source.

### **3.4.3 PRIMARY CLARIFIERS**

There are 12 Primary Clarifiers at ABTP, of which three are open area sources (7 to 9) while the other nine are within enclosed buildings.

#### **3.4.3.1 PRIMARY CLARIFIERS (1 TO 6)**

Emissions associated with the Primary Clarifiers include the Primary Clarifier Three Scum Tanks (#23A, B, and C)

The hydrogen sulphide emissions and flowrates from the Primary Clarifier (1 to 6) and three (3) Scum Tanks (Sources #23A, 23B and 23C) were determined from source testing carried out by Zorix in June/July 2001 (Zorix, 2001). Under the future scenario, these sources will no longer vent directly into the atmosphere via vents but the exhaust air will be conveyed to the central biofilter.

The hydrogen sulphide emission rate for source #23A was calculated with the aid of Equation 3-1, where:

$$\begin{aligned} C_i &= 0.137 \text{ ppm} \\ Q_d &= 0.93 \text{ m}^3/\text{s at } 20^\circ\text{C}. \\ MW_i &= 34 \text{ g/mol} \end{aligned}$$

Substitution into Equation 3-1 results in the following;

$$E_i = \frac{(0.137 \times 34 \times 0.93)}{[0.024 \times 10^6]} \times \frac{293}{273 + 20} \times (1 - 0) = 1.81 \times 10^{-4} \text{ g / s}$$

There is no emission control for this source.

### 3.4.3.2 PRIMARY CLARIFIERS (7 TO 9)

Primary Clarifiers 7-9 include Scum Tanks between Primary Tanks 7-8 (#13A to #13C), Primary Tanks 7-9 Distribution Channels (#19A to #19C), Primary Tank 7 (#20A), Primary Tank 8 (#20B), Primary Tank 9 (#20C), Weirs on Primary Tank 7 (#21A), Weirs on Primary Tank 8 (#21B) and Weirs on Primary Tank 9 (#21C).

The Primary Clarifiers consist of three (3) units (7, 8 and 9). Each clarifier has a scum tank (Sources #13A to 13C), a distribution channel (Sources #19A to 19C), the primary tank itself (Sources #20A to 20C) and the Weirs (Sources #21A to 21C). The hydrogen sulphide emissions from these sources were determined from source testing carried out by Zorix in June/July 2001 (Zorix, 2001).

The flow rates from the Scum Tanks (sources #13A to C) were calculated from the Bovar-Concord Environmental Report BCE441-3345 (Ciccone et al., 1994). For Sources #13A to 13C, each was assigned one-third of the flow rate (i.e., 1/3 of 1.5 m<sup>3</sup>/s).

These sources will no longer exhaust into the atmosphere under the future scenario, as a new building will cover Primary Clarifiers 7 to 9 and the exhaust will be conveyed to the biofilter.

The hydrogen sulphide emission rates for each scenario were calculated with the aid of Equation 3-1 as follows for Source #13A, where

$$\begin{aligned} C_i &= 0.110 \text{ ppm} \\ Q_d &= 0.5 \text{ m}^3/\text{s at } 20^\circ\text{C} \\ MW_i &= 34 \text{ g/mol} \end{aligned}$$

Substitution into Equation 3-1 results in the following:

$$E_i = \frac{(0.110 \times 34 \times 0.5)}{[0.024 \times 10^6]} \times \frac{293}{273 + 20} \times (1 - 0) = 7.79 \times 10^{-5} \text{ g / s}$$

There is no emission control for this source.

The amount of hydrogen sulphide released from the Primary Tanks 7-9 Distribution Channel (Sources #19A to C), the primary tanks (Sources #20A to C) and the Weirs (Sources #21 A to C) were calculated with the aid of Equation 3-2, where a flux chamber was used to measure the quantity of hydrogen sulphide leaving the surface of the Primaries. In the following example, the total area for each primary clarifier distribution channel (i.e., 19A, B and C) is divided into three (3) equal sections of 129 m<sup>2</sup>. The variables for Equation 3-2 are given as

$$\begin{aligned} C_i &= 198.4 \text{ } \mu\text{g}/\text{m}^3 \\ Q_s &= 0.25 \text{ m}^3/\text{s} \\ A &= 0.38 \text{ m}^2 \end{aligned}$$

$$A_T = 129 \text{ m}^2$$

Substitution into Equation 3-2 results in:

$$E_{Flux_i} = \frac{198.4 \times 0.25}{0.38 \times 1,000,000} \times 129 = 1.68 \times 10^{-2} \text{ g / s}$$

Volatile compounds are expected to volatilize into the atmosphere when the wastewater is rapidly mixed with air at the Primary Clarifiers (Source #19A, B and C). The list of chemicals includes VOCs, semi-volatile organic compounds and mercury and was developed from the water sampling data in the Annual reports between 1988 and 2001 (Zenon, 1989 and City of Toronto, 1999, 2000, 2001, 2002). The emission rates of the volatile compounds were estimated by determining the difference in the concentration of each volatile compound in the water entering ABTP (influent) and the concentration in the water released from ABTP (effluent). The emissions were calculated using this difference for each compound in a representative annual report (Table 3-3) times the flow of wastewater and assuming that 100% of the compound is volatilized.

**Table 3-3 Representative Annual Report for VOCs in the Water Analysis**

Scenario #	Scenario	Scenario Year	Representative Annual Report (Year)
Scenario 1	incinerator in full operation (pre 1996)	1995 & earlier	1988
Scenario 2	incinerator in partial operation (2000-2002)	2000	2000
Scenario 3	incineration discontinued (2003-2004)	2003	2001
Scenario 4	incineration discontinued and odour control measures implemented.	2010	2001

It is assumed that all the compounds that will volatilize out of the water will do so early in the process. For simplicity, it was assumed that all of the VOCs in the wastewater are emitted from the primary clarifiers only. This is a very conservative assumption as heavier VOCs will likely be found in the biosolids or released in other locations. Also, a significant portion of the VOCs are biodegraded in the secondary treatment process. Pesticides were not assumed to be released from the wastewater due to their low vapour pressure.

The emission rates are based on the average flow of water entering the plant each day. Since the average amount of wastewater entering the plant (not including heavy rain days) does not have a large variance from year to year, a flow rate of 700,000 m<sup>3</sup>/day was used for all scenarios ([http://www.city.toronto.on.ca/water/wastewater\\_treatment/treatment\\_plants/ashbridges\\_bay.htm](http://www.city.toronto.on.ca/water/wastewater_treatment/treatment_plants/ashbridges_bay.htm)). It is also assumed that Primary Clarifiers 7-9 handle 50% of the wastewater flow and the remaining wastewater is sent to the covered Primary Clarifiers 10-12.

As an example, the methylene chloride emissions from Primary Clarifiers 7, 8 and 9 (Source #19A, B and C) were calculated with the aid of Equation 3-3, where

$$\begin{aligned}\Delta C &= 23.07 \text{ } \mu\text{g/L (Methylene Chloride)} \\ C_{in} &= 35 \text{ } \mu\text{g/L (Methylene Chloride in the Influent (1988))} \\ C_{out} &= 11.93 \text{ } \mu\text{g/L (Methylene Chloride in the Effluent (1988))} \\ Q_i &= 350,000,000 \text{ L/day} \\ \% \text{ Volz} &= 100\%\end{aligned}$$

$$E_i = \frac{350,000,000 \times (23.07)}{24 \times 3600 \times 1000000} \times 100\% = 0.093 \text{ g / s}$$

These emissions are evenly distributed across the three (3) Primary Clarifiers (7 to 9). As mentioned above, these are very conservative assumptions with respect to 100% volatilization and location. It should be expected that most of the heavier VOCs with low vapour pressure would be found in the sludge. The rest of the wastewater VOCs would be emitted from the other Clarifiers in the D Bldg.

In the future scenario, the above emissions will be captured and conveyed to the central biofilter for emission control.

### **3.4.3.3 D BUILDING – PRIMARY CLARIFIERS (10-12)**

The remaining sources at the “D” Building – Grit Tanks 13-16, Screenings and Primary Clarifier 10-12 are ventilated and exhausted in the distribution channel of the Aeration Tanks. All the wastewater VOCs will be accounted for at the Aeration Tanks.

In the future scenario the D Building primary clarifier exhaust will be conveyed directly to the biofilter for emission control.

### **3.4.4 AERATION TANKS ODOUR CONTROL BUILDING**

#### **3.4.4.1 QUAD SCRUBBER OUTLET #10 (#25) AND #11 (#27)**

The emissions (concentration and flowrate) from Quad Scrubber #10 and #11 were determined from source testing carried out by Zorix in June/July 2001 (Zorix, 2001). It is expected that the emissions released from Quad Scrubber #10 are the same as Quad Scrubber #11. These sources will no longer be in operation under the future scenario, as exhaust air will be conveyed to the central biofilter.

The hydrogen sulphide emission rate (Scrubber #10) was calculated with the aid of Equation 3-1, Where

$$\begin{aligned}C'_i &= 0.48 \text{ ppm} \\ Q_d &= 16.7 \text{ m}^3/\text{s at } 20^\circ\text{C} \\ MW_i &= 34 \text{ g/mol}\end{aligned}$$

Substitution into Equation 3-1 results in the following:

$$E_i = \frac{(0.48 \times 34 \times 16.7)}{[0.024 \times 10^6]} \times \frac{293}{273 + 20} = 1.14 \times 10^{-2} \text{ g / s}$$

The control efficiency of the existing scrubber was integrated into Equation 3-1 with the aid Equation 3-1b as the measurement was taken after the scrubber.

### 3.4.4.2 AERATION TANKS (1-9) (#56) AND AERATION TANKS (10-11) (#119)

Aeration Tanks 1-9 (Source #56) are separate from Aeration Tanks 10 and 11 (Source #119) as Tanks 10 and 11 are newer tanks with tight seals and no fugitive emissions (i.e., leaks) are expected. The seals around Aeration Tanks 1-9 covers are not as tight resulting in fugitive emissions. The chemicals released from the Aeration Tanks 1-9 are assumed to be of the same concentration as those from Quad Scrubber #10 and #11 (Sources #25 and #27) prior to scrubbing.

The airflow enters the Aeration Tanks 1-9 from the D Building at 42.5 m<sup>3</sup>/s (Zorix, 2002d) and the Blower Building at 138.6 m<sup>3</sup>/s (Zorix 2002d) for a total airflow of 181.1 m<sup>3</sup>/s. From the Aeration Tanks 1-9, air is conveyed to the Incinerator Stack Annular Space (Source #29) with an average flow rate of 27 m<sup>3</sup>/s (Zorix, 2002d). The difference between the flow entering the Aeration Tanks and the Annular Space is assumed to be lost through the split in the seals of the tanks.

The average inlet concentrations to the Quad Scrubbers #10 were used as the concentrations at the Aeration Tanks 1 to 9.

The hydrogen sulphide emission rate from the Aeration Tanks leaks for each scenario was calculated with the aid of Equation 3-1, where

$$\begin{aligned} C'_i &= 0.47 \text{ ppm} \\ Q_d &= 181.1 \text{ m}^3/\text{s} - 27 \text{ m}^3/\text{s} = 154.1 \text{ m}^3/\text{s} \text{ at } 20^\circ\text{C} \\ MW_i &= 34 \text{ g/mol} \end{aligned}$$

Substitution into Equation 3-1 results in the following:

$$E_i = \frac{(0.47 \times 34 \times 154.1)}{[0.024 \times 10^6]} \times \frac{293}{273 + 20} = 1.03 \times 10^{-1} \text{ g / s}$$

The control efficiency of the existing scrubber was integrated into Equation 3-1 with the aid of Equation 3-1b as the measurement was taken after the scrubber.

In addition, the emission from wastewater (i.e., "D" Bldg Primary Clarifiers 10-12) will also be released in the same proportions as the airflow between the fugitives and the Annular Space.

In the future scenario, the Aeration Tanks will be converted to fine bubbling (air flow reduction), “D” Building exhaust will be conveyed directly to the biofilter, Aeration Tanks cover will be repaired and no fugitive emissions will occur, and all above emissions will be captured and conveyed to the biofilter for emission control.

### **3.4.5 DEWATERING BUILDING**

The Dewatering Building includes eight (8) sources of emissions, namely; Day Tank #1 Scrubber Outlet (#35A), Day Tank #3 Scrubber Outlet (#35B), Dewatering Building EF1 exhaust Fan (#38), Dewatering Building EF16 exhaust Fan (#39), Dewatering Building EF4 exhaust Fan (#40), Dewatering Building EF5 exhaust Fan (#103), Dewatering Building EF2 exhaust Fan (#104) and Dewatering Building EF3 exhaust Fan (#105).

The emissions for sources from the Day Tanks (#35A and #35B) and the Dewatering Building Exhaust Fans EF1, EF16, EF4, EF3 and EF 5 (Sources #38, #39, #40, #103 and #105) were calculated from source testing carried out by Zorix in June/July 2001 (Zorix, 2001). It was assumed that the concentrations from Source #35B and Source #35A are the same. The flow rates for these sources were taken from the Zorix Final Report (Zorix, 2002d). The additional exhaust on the Dewatering Building (Exhaust Fan EF2 (Source #104)) was added to the emissions inventory. It was assumed that Source #104 has the same flow rate and hydrogen sulphide concentration as Source #43. The emission rates were calculated using Equation 3-1 as above. Sources #103, #104 and #105 were assumed to have the same emission rates for all four (4) scenarios.

Under the future scenario, Sources #35A, #35B, #38, #39, #40 exhaust will be redirected to the inlet of the blower building, the air will be used in the Aeration Tanks. Source #103, 104 and 105 will be exhausting directly to the atmosphere without treatment. Day Tanks # 35A, 35B and 35C (new) will be ventilated through a dedicated scrubber (activated carbon) and exhaust directly to the incinerator stack.

The hydrogen sulphide emission rate for Source #35A was calculated with the aid of Equation 3-1, where

$$\begin{aligned} C'_i &= 0.111 \text{ ppm} \\ Q_d &= 0.05 \text{ m}^3/\text{s at } 20^\circ\text{C} \\ MW_i &= 34 \text{ g/mol} \end{aligned}$$

Substitution into Equation 3-1 results in the following:

$$E_i = \frac{(0.111 \times 34 \times 0.05)}{[0.024 \times 10^6]} \times \frac{293}{273 + 20} = 7.86 \times 10^{-6} \text{ g / s}$$

The control efficiency of the existing scrubber was integrated into Equation 3-1 with the aid of Equation 3-1b as the measurement was taken after the scrubber.

### 3.4.6 FINAL CLARIFIERS

The Final Clarifiers source includes the Final Clarifiers Distribution Channels (#30A to K) and Final Clarifiers (#31). There is some question with respect to the validity of the measurements which seem to be exceptionally high for these sources. The Study Team decided to exclude these emissions from the emissions inventory, as they are not representative.

### 3.4.7 BIOSOLID BIOFILTERS

As of 2003, there are four (4) Biofilters (#54A to D) at ABTP and emissions were calculated from source testing carried out by Zorix in June/July 2001 (Zorix, 2001). The flowrates for these sources were taken from Zorix "Drawing 1 Design".

The Biosolid Biofilter was built in 2000 but prior to its erection foul air was treated by incineration. For the future scenario the Biosolid Biofilter will be covered and the exhaust will be conveyed to the incinerator stack annular space.

For Scenarios 2 and 3, the emission rates were calculated with the aid of Equation 3-1 (example shows hydrogen sulphide emissions from Source #54A for Scenario 2). The hydrogen sulphide emissions for scenarios 2 and 3 from all four Biosolid Biofilters are identical.

Given:

$$\begin{aligned}C_i &= 0.015 \text{ ppm} \\Q_d &= 5 \text{ m}^3/\text{s at } 20 \text{ }^\circ\text{C} \\MW_i &= 34 \text{ g/mol}\end{aligned}$$

Substitution into Equation 3-1 results in the following:

$$E_i = \frac{(0.015 \times 34 \times 5)}{[0.024 \times 10^6]} \times \frac{293}{273 + 20} = 1.06 \times 10^{-4} \text{ g/s}$$

Here, the control efficiency of the biofilter is integrated with the concentration, as the measurement was taken at the outlet of the system.

### 3.4.8 OLD BIOSOLIDS TRUCK LOADING BUILDING

Emissions from the Old Truck Loading Building (#120A and B) occur only under Scenario 1 (Pre 1996) since its operation was discontinued in late 1999 to early 2000. The air flowrate and the hydrogen sulphide concentration were estimated to be 3.3 m<sup>3</sup>/s and 0.01 ppm respectively. The hydrogen sulphide emission rate for Source #120A was estimated with the aid of Equation 3-1, where

$$\begin{aligned}C_i &= 0.01 \text{ ppm} \\Q_d &= 3.3 \text{ m}^3/\text{s at } 20 \text{ }^\circ\text{C} \\MW_i &= 34 \text{ g/mol}\end{aligned}$$

Substitution into Equation 3-1 results in the following:

$$E_i = \frac{(0.01 \times 34 \times 3.3)}{[0.024 \times 10^6]} \times \frac{293}{273 + 20} \times (1 - 0) = 4.68 \times 10^{-5} \text{ g / s}$$

There is no emission control for this source.

### 3.4.9 PELLETIZER BUILDING

Sources at the Pelletizer Building include the Pelletizer Building Reactor Vent (#112), Pelletizer Building Reactor Vent (#113), Pelletizer Building Process Vent (#116), Pelletizer Building Ventilation (#117) and Pelletizer Building Carbon System Vents (#107 to 111).

Hydrogen Sulphide emissions are negligible from the Pelletizer building but combustion emissions (NO<sub>x</sub>, SO<sub>2</sub>, CO and particulate) from the natural gas heaters have been accounted for.

### 3.4.10 INCINERATOR

#### 3.4.10.1 ANNULAR SPACE

The emissions (concentration and flowrate) from the Annular Space (#29) were determined from source testing carried out by Zorix in June/July 2001 (Zorix, 2001). Under the first three (3) scenarios the emissions do not change. The hydrogen sulphide emissions from the Annular Space was calculated with the aid of Equation 3-1, where

$$\begin{aligned} C_i &= 0.103 \text{ ppm} \\ Q_d &= 27 \text{ m}^3/\text{s at } 20^\circ\text{C} \\ MW_i &= 34 \text{ g/mol} \end{aligned}$$

Substitution into Equation 3-1 results in the following:

$$E_i = \frac{(0.103 \times 34 \times 27)}{[0.024 \times 10^6]} \times \frac{293}{273 + 20} \times (1 - 0) = 3.95 \times 10^{-3} \text{ g / s}$$

There is no emission control for this source.

Under the future scenario the Annular Space exhaust will be comprised of:

- Dewatering Day Tanks Scrubber (0.15 m<sup>3</sup>/s);
- Biosolid Biofilter (20 m<sup>3</sup>/s); and
- New Biofilter (217 m<sup>3</sup>/s)

The New Biofilter will treat the air from:

- P Building Scrubber Outlet (20.1 m<sup>3</sup>/s);
- Screens 7-12 Building (3.0 m<sup>3</sup>/s);
- Primary Clarifier Tanks (1-6) Scum Scrubber (2.8 m<sup>3</sup>/s);
- Primary Clarifier 7-9 (33.9 m<sup>3</sup>/s);
- “D” Building (43.5 m<sup>3</sup>/s); and
- Aeration Tanks (111.8 m<sup>3</sup>/s)

Emission rates were calculated as the sum of each source and applying a removal efficiency of 95% to sulphur bearing compounds (i.e., hydrogen sulphide and mercaptans) for the biofilter. For other compounds, a conservative 40% removal efficiency was assumed. If a source had a control device, the emissions were adjusted to account for the device (i.e., the emissions were converted to uncontrolled before passing to the biofilter).

### **3.4.10.2 INCINERATOR BUILDING**

The Incinerator Building Exhaust (#43A to D) can be separated into four (4) sources. Sources #43A and 43B are existing building exhausts while 43C and 43D are old exhausts (decommissioned in 2000). The only chemical emitted from these sources is hydrogen sulphide. Emissions were calculated from source testing carried out by Zorix in June/July 2001 (Zorix, 2001, 2002d). It was assumed that the hydrogen sulphide concentration remains the same in each exhaust.

The first scenario (Pre 1996) has all four (4) sources operating (#43A to D) while scenarios 2 (2000-2002), 3 (2003-2004) and 4 (2010) only have Sources #43A and 43B operating and #43C and 43D are exhausted into the incinerator stack. The hydrogen sulphide emission rate from each exhaust was calculated with the aid of Equation 3-1, where

$$\begin{aligned} C_i &= 0.001 \text{ ppm} \\ Q_d &= 23.25 \text{ m}^3/\text{s at } 20 \text{ }^\circ\text{C} \\ MW_i &= 34 \text{ g/mol} \end{aligned}$$

Substitution into Equation 3-1 results in the following;

$$E_i = \frac{(0.001 \times 34 \times 23.25)}{[0.024 \times 10^6]} \times \frac{293}{273 + 20} \times (1 - 0) = 3.29 \times 10^{-5} \text{ g / s}$$

There is no emission control for this source.

### 3.4.10.3 INCINERATOR STACK

The emissions from the Incinerator Stack (#58) change from scenario to scenario (Table 3-5). Scenario 1 (Pre 1996) is based on three incinerators operating; Scenario 2 (2000) is based on two incinerators operating with a third incinerator on standby; while the current and future scenarios assume that the incinerators are not operating. The emission rates were obtained from the 1994 Incinerator Emission Test Program (EER Canada, 1994) for the first scenario and the 1998 Incinerator Emission Test Program (EER Canada, 1998) for the second.

**Table 3-5 Incinerator Operating Schedule for All Four Emission Scenarios**

Scenario		# of Incinerators Operating	# of Incinerators on Standby	Flow Rate (m <sup>3</sup> /s)
Scenario 1	Incinerator in full operation (pre 1996)	3	0	63.3
Scenario 2	Incinerator in partial operation (2000-2002)	2	1	42.2
Scenario 3	Incineration discontinued (2003-2004)	0	0	--
Scenario 4	Incineration discontinued and odour control measures implemented	0	0	--

### 3.4.11 BOILER STACK

The emissions from the natural gas boiler (#121) change for each scenario. There are four (4) large ('new') boilers, eighteen (18) small ('old') boilers and two (2) medium sized ('old') boilers. Table 3-7 shows which boilers were operating during the different scenarios. The older boilers do not have low-NO<sub>x</sub> burners. The new boilers have low-NO<sub>x</sub> burners so the appropriate emission factor for the size of the boilers was used, as per U.S. EPA AP 42.

**Table 3-7 Boiler Operations for Each Emissions Scenario**

Boiler Type	Scenario			
	Scenario #1	Scenario #2	Scenario #3	Scenario #4
NG Fired Boiler - (4 Large Boilers)	Not Operating	50%	Full Operation	Full Operation
NG Fired Boiler - (2 Medium Sized Boilers)	Full Operation	50%	Not Operating	Not Operating
NG Fired Boiler - (18 Small Boilers)	Full Operation	50%	Not Operating	Not Operating

Scenario 1 incinerator in full operation (pre 1996)  
 Scenario 2 incinerator in partial operation (2000-2002)  
 Scenario 3 incineration discontinued (2003-2004)  
 Scenario 4 incineration discontinued and odour control measures implemented.

The emission calculations for the boilers were completed based on the thermal rating (Btu/hr) or the natural gas consumption of each boiler. Using the natural gas heat content of 1012 Btu/ft<sup>3</sup>, the emissions were calculated with the aid of Equation 3-5, where

$$\begin{aligned} A &= \text{Rate of Natural Gas consumed} \\ EF_i &= \text{uncontrolled emission factor of NO}_x = 0.068 \text{ lb}/10^6 \text{ Btu} \\ CE_i &= \text{overall control efficiency } 0\% \end{aligned}$$

Substitution into Equation 3-5 results in the following:

$$E = A \times 1012 \times 0.068 \times 454 \times \left(1 - \frac{CE_i}{100}\right)$$

In the above, CE<sub>i</sub> was assumed to be negligible.

### 3.4.12 FLARES

The emissions from the Digester Flares (#118A to C) are based on U.S. EPA AP-42 Emission Factors for Industrial Flares (Section 13.5). It is assumed that the digester gas has a British thermal unit (Btu) rating of 1012 Btu/ft<sup>3</sup>. The only chemicals calculated for the flares are nitrogen oxides (NO<sub>x</sub>) and SO<sub>2</sub>. The emissions are calculated with the aid of Equation 3-5, where

$$\begin{aligned} A &= \text{Rate of digester gas consumed} \\ EF_i &= \text{uncontrolled emission factor of NO}_x = 0.068 \text{ lb}/10^6 \text{ Btu} \\ CE_i &= \text{overall control efficiency } 0\% \end{aligned}$$

Substitution into Equation 3-4

$$E = A \times 1012 \times 0.068 \times 454 \times \left(1 - \frac{CE_i}{100}\right)$$

In the above, CE<sub>i</sub> is assumed to be negligible. The flares are for emergency situations only. Under normal operations all digested gases will be consumed at the boilers and there are no emissions from the flares for all four (4) scenarios.

### 3.4.13 NEGLIGIBLE OR TRACE EMISSIONS

Emergency Diesel Generators will be included as part of the emissions inventory but will not be modelled since many other processes are not operating when the generators are in use. In addition, tail-pipe emissions from vehicles and road dust arising from the vehicular traffic on the ABTP property are not included, as these sources represent insignificant sources at the ABTP.

### 3.5 SUMMARY OF EMISSIONS

Application of the emission estimation techniques discussed above, resulted in an emission inventory of 186 chemicals from the ABTP. Emissions from the facility include

- Criteria Air Contaminants (Sulphur Dioxide (SO<sub>2</sub>), Nitrogen Oxides (NO<sub>x</sub>), Carbon Monoxide (CO), Particulate Matter (PM), Particulate Matter less than 10 microns (PM<sub>10</sub>) and Particulate Matter less than 2.5 microns (PM<sub>2.5</sub>);
- Sulphur Bearing Compounds (Hydrogen Sulphide (H<sub>2</sub>S) & Mercaptans);
- Volatile Organic Compounds (VOCs);
- Dioxin and Furans;
- Polycyclic Aromatic Hydrocarbons (PAHs);
- Chlorobenzenes;
- Polychlorinated Biphenyls (PCBs);
- Chlorophenols; and
- Metals

An overall summary of the frequency of estimation technique used to develop the ABTP emissions inventory is presented in Table 3-9. As illustrated, Zorix source testing was used for a majority of the emission estimations followed by Mass Balance calculations.

The potential emissions from each chemical per scenario are summarized in Table 3-11. All of the emissions are attached in Appendix B (in a CD). Appendix B includes a summary of estimation techniques by chemical.

**Table 3-9 Frequency of Emission Estimation Techniques Applied at ABTP**

Reference	Description	% Applied
MB	Mass Balance Calculations	12.7%
EF	Emission Factor published by the USEPA	0.4%
ZORIX	Source Testing Conducted by ZORIX	80.8%
EE	Engineering Estimation	0.1%
SM	Source Measurement	6.1%

**Table 3-11 Summary of Annual ABTP Emissions**

	Chemical	CAS #	Scenario 1 (Pre-1996) (kg/day)	Scenario 2 (2000-2002) (kg/day)	Scenario 3 (2003) (kg/day)	Scenario 4 (Future) (kg/day)
1	1,1 - Dichloroethene	75-35-4	0.35	2.03	3.71	1.48
2	1,1,2 - Trichloroethane	79-00-5	0.99	0.52	0.31	0.15
3	1,2 - Dichloroethane	107-06-2	0.87	0.36	0.36	0.16
4	1,1,2,2 - Tetrachloroethane	79-34-5	1.75	0.75	0.75	0.35
5	1,1 Dichloroethane	75-34-3	1.37	1.13	0.89	0.41
6	1,2 - Dibromoethane	106-93-4	0.56	0.45	0.59	0.27
7	1,1,1 - Trichloroethane	71-55-6	1.48	0.44	0.44	0.19
8	1,2 - Dichlorotetrafluoroethane	76-14-2	0.85	0.90	0.90	0.43
9	1,2 - Dichloropropane	78-87-5	1.69	0.66	0.66	0.29
10	1,2,4 - Trimethylbenzene	95-63-6	1.02	1.05	1.05	0.41
11	1,3,5 - Trimethylbenzene	108-67-8	0.60	0.63	0.63	0.27
12	2,4 - Dichlorophenol	120-83-2	1.40	0.35	0.35	0.14
13	Acetic acid	64-19-7	2.31	2.46	2.46	1.16
14	Ammonia	7664-41-7	0.82	5.82	5.82	5.29
15	Benzene	71-43-2	6.60	1.88	1.77	0.67
16	Bis(2-ethylhexyl)phthalate	117-81-7	17.03	3.50	7.70	3.08
17	Bromoethane	74-83-9	0.81	1.97	0.85	0.39
18	Butylbenzyl phthalate	85-68-7	7.09	0.35	0.35	0.14
19	Butyric acid	107-92-6	2.31	2.46	2.46	0.53
20	Carbon disulphide	75-15-0	3.25	3.47	3.47	1.04
21	Carbon Tetrachloride	56-23-5	1.06	1.02	0.56	0.25
22	Chlorobenzenes	108-90-7	0.95	0.47	0.44	0.20
23	Chloroform	67-66-3	4.19	2.89	2.85	1.10
24	Chloromethane	74-87-3	8.50	1.80	0.68	0.31
25	cis-1,2-Dichloroethene	156-59-2	0.44	0.70	0.46	0.20
26	cis-1,3-dichloropropylene	10061-01-5	0.33	4.36	0.34	0.04
27	Dichlorodifluoromethane	75-71-8	1.13	1.16	0.63	0.29
28	Dichloromethane	75-09-2	0.70	0.74	0.74	0.33
29	Diethylphthalate	84-66-2	10.57	0.35	0.35	0.14
30	Dimethyl disulphide	624-92-0	5.03	5.37	5.37	1.62
31	Di-n-butyl phthalate	84-74-2	8.98	2.80	0.35	0.14
32	Di-n-octyl phthalate	117-84-0	0.63	0.14	1.26	0.50
33	Diphenyl ether	101-84-8	9.70	0.35	0.35	0.14
34	Ethyl Benzene	100-41-4	47.97	1.41	0.50	0.22
35	Ethyl Mercaptan/Dimethyl Sulfide	75-08-1	3.32	3.54	3.54	1.07
36	Formic acid	64-18-6	2.31	2.46	2.46	1.16
37	Hexachlorobutadiene	87-68-3	1.26	0.78	0.78	0.35
38	Hydrogen Sulphide	7783-06-4	118.67	119.97	125.54	11.77
39	Hydrogen Sulphide/carbonyl sulphide	7783-06-4	118.67	119.97	125.54	11.77
40	Indole	10075-50-0	0.35	23.45	30.80	12.32
41	Lactic acid	50-21-5	2.31	2.46	2.46	0.53

Chemical	CAS #	Scenario 1 (Pre-1996) (kg/day)	Scenario 2 (2000-2002) (kg/day)	Scenario 3 (2003) (kg/day)	Scenario 4 (Future) (kg/day)
42 Methyl Mercaptan	74-93-1	2.89	3.06	3.06	0.84
43 Methyl phenol	1319-77-3	18.90	0.35	0.35	0.14
44 Nitrobenzene	98-95-3	3.78	0.35	0.35	0.14
45 m-cresol	108-39-4	-	-	-	-
46 p-cresol	106-44-5	0.35	16.45	0.35	0.14
47 Pentachlorophenol	87-86-5	3.50	0.35	0.35	0.14
48 Phenol	108-95-2	30.57	6.09	0.35	0.14
49 Propionic acid	79-09-04	2.31	2.46	2.46	1.16
50 Propyl mercaptan/Methyl Ethyl Sulfide	107-03-9	8.13	8.68	8.68	4.09
51 Styrene	100-42-5	1.50	0.62	0.66	0.30
52 Tellurium	13494-80-9	0.01	0.00	-	-
53 Tetrachloroethene	127-18-4	13.98	15.26	14.39	7.32
54 Toluene	108-88-3	98.82	8.56	3.63	0.47
55 1,2-dichloropropane.		1.69	0.66	0.66	0.29
56 Trichloroethene	79-01-6	0.99	0.48	0.48	0.21
57 Trichlorofluoromethane	75-69-4	3.85	3.93	3.37	1.20
58 Trichlorotrifluoroethane	26523-64-8	2.58	2.75	2.75	1.30
59 Vinyl chloride	75-01-4	1.59	1.75	0.56	0.26
60 Xylene	1330-20-7	53.92	3.02	0.64	0.30
<b>Criteria Air Contaminants</b>					
61 Particulate Matter (as PM <sub>2.5</sub> )	N/A-PM	48.51	60.74	6.87	6.87
62 Carbon Monoxide	630-08-0	-	-	-	-
63 Nitrogen Oxides	10102-44-0	548.12	492.54	163.35	163.35
64 Sulphur Dioxide	7446-09-5	82.38	84.27	29.76	9.33
<b>Dioxins and Furans</b>					
65 2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	3.53E-08	3.76E-08	-	-
66 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1746-01-6	3.14E-08	1.38E-08	-	-
67 1,2,3,7,8-Pentachlorodibenzofuran	--	3.79E-08	6.45E-09	-	-
68 2,3,4,7,8-Pentachlorodibenzofuran	57117-31-4	3.79E-08	1.02E-08	-	-
69 1,2,3,7,8-Pentachlorodibenzo-p-dioxin	--	3.12E-08	5.56E-09	-	-
70 1,2,3,4,6,7,8-Heptachlorodibenzofuran	--	5.26E-08	7.98E-09	-	-
71 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	--	4.37E-08	2.71E-08	-	-
72 1,2,3,4,6,7,8,9-Octachlorodibenzofuran	--	3.70E-08	2.08E-08	-	-
73 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	--	6.96E-08	6.73E-08	-	-
74 1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	2.71E-08	7.09E-09	-	-
75 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	--	4.01E-08	1.81E-08	-	-
76 1,2,3,6,7,8-Hexachlorodibenzofuran	--	1.62E-08	3.99E-09	-	-
77 2,3,4,6,7,8-Hexachlorodibenzofuran	--	2.71E-08	4.64E-09	-	-
78 1,2,3,7,8,9-Hexachlorodibenzofuran	--	3.07E-08	4.75E-09	-	-
79 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	--	2.12E-08	3.47E-09	-	-
80 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	--	3.00E-08	4.15E-09	-	-
81 1,2,3,4,7,8,9-Heptachlorodibenzofuran	--	3.22E-08	7.50E-09	-	-
82 Total Dioxins and Furans (as 2,3,7,8-TCDD eq)	--	9.21E-08	3.09E-08	-	-

Chemical	CAS #	Scenario 1 (Pre-1996) (kg/day)	Scenario 2 (2000-2002) (kg/day)	Scenario 3 (2003) (kg/day)	Scenario 4 (Future) (kg/day)
<b>PAH's</b>					
83	1-methylnaphthalene	90-12-0	0.35	0.35	0.14
84	1-Methylphenanthrene	832-69-9	0.00016	0.00017	-
85	2-Chloronaphthalene	91-58-7	1.40	0.35	0.14
86	2-Methylanthracene	613-12-7	0.00016	0.00017	-
87	2-Methylnaphthalene	91-57-6	0.35	0.35	0.14
88	3-Methylcholanthrene	56-49-5	0.0031	0.0035	-
89	7, 12-Dimethylbenz[a]anthracene	57-97-6	0.00016	0.00017	-
90	9,10 - Dimethylanthracene	781-43-1	0.00063	0.00069	-
91	9-Methylphenanthrene	883-20-5	0.00016	0.00017	-
92	Acenaphthene	83-32-9	12.32	0.35	0.35
93	Acenaphthylene	208-96-8	2.10	0.35	0.35
94	Anthracene	120-12-7	18.20	0.35	0.35
95	Benzo[a]anthracene	56-55-3	6.58	0.35	0.35
96	Benzo[a]fluorene	238-84-6	0.00016	0.00017	-
97	Benzo[a]pyrene	50-32-8	1.40	0.35	0.35
98	Benzo[b&k]fluoranthene	205-99-2	1.40	0.35	0.35
99	Benzo[b]fluoranthene	205-99-2	1.40	0.35	0.35
100	Benzo[b]fluorene	243-17-4	0.00016	0.00017	-
101	Benzo[e]pyrene	192-97-2	0.00016	0.00017	-
102	Benzo[g,h,i]perylene	191-24-2	3.50	0.35	0.35
103	Benzo[k]fluoranthene	207-08-9	0.35	0.35	0.35
104	Biphenyl	92-52-4	0.35	0.56	0.35
105	Chrysene	218-01-9	2.38	0.35	0.35
106	Coronene	191-07-1	0.00016	0.00017	-
107	Dibenzo[a, l]pyrene	129-00-0	5.57	0.35	0.35
108	Dibenzo[a,h]anthracene	53-70-3	3.50	0.35	0.35
109	Fluoranthene	206-44-0	4.55	0.35	0.35
110	Fluorene	7782-41-4	11.20	0.35	0.35
111	Indeno[1,2,3-c,d]pyrene	193-39-5	1.40	0.35	0.35
112	m-Terphenyl	92-06-8	0.00016	0.00017	-
113	Naphthalene	91-20-3	16.57	0.15	0.35
114	o-Terphenyl	84-15-1	0.00016	0.00017	-
115	Perylene	198-55-0	0.35	0.35	0.35
116	Phenanthrene	85-01-8	6.42	0.35	0.35
117	Picene	213-46-7	0.00016	0.00017	-
118	p-Terphenyl	92-94-4	0.00016	0.00017	-
119	Pyrene	129-00-0	5.57	0.35	0.35
120	Quinoline	91-22-5	0.0002	0.0003	-
121	Tetralin	119-64-2	0.0030	0.0025	-
122	Triphenylene	217-59-4	0.0002	0.0001	-

Chemical	CAS #	Scenario 1 (Pre-1996) (kg/day)	Scenario 2 (2000-2002) (kg/day)	Scenario 3 (2003) (kg/day)	Scenario 4 (Future) (kg/day)	
<b>Chlorobenzenes</b>						
123	1,2 - Dichlorobenzene	95-50-1	2.26	2.22	1.10	0.43
124	1,2,3 - Trichlorobenzene	87-61-6	0.00016	0.00017	-	-
125	1,2,3,4 - Tetrachlorobenzene	634-66-2	0.00016	0.00017	-	-
126	1,2,4 - Trichlorobenzene	120-82-1	1.20	0.71	0.71	0.32
127	1,3 - Dichlorobenzene	541-73-1	0.96	0.94	0.45	0.20
128	1,3,5 - Trichlorobenzene	108-70-3	0.00016	0.00017	-	-
129	1,4 - Dichlorobenzene	106-46-7	1.55	1.19	0.67	0.30
130	Hexachlorobenzene	118-74-1	1.40	0.35	0.35	0.14
131	Pentachlorobenzene	608-93-5	0.00016	0.00017	-	-
<b>PCB's</b>						
132	Chlorobiphenyl	37324-23-5	0.00016	0.00017	-	-
133	Decachlorobiphenyl	2051-24-3	0.00016	0.00017	-	-
134	Dichlorobiphenyl	2050-68-2	0.00016	0.00017	-	-
135	Heptachlorobiphenyl	28655-71-2	0.00016	0.00017	-	-
136	Hexachlorobiphenyl	26601-64-9	0.00016	0.00017	-	-
137	Nonachlorobiphenyl	53742-07-7	0.00016	0.00017	-	-
138	Octachlorobiphenyl	55722-26-4	0.00016	0.00017	-	-
139	Pentachlorobiphenyl	25429-29-2	0.00016	0.00017	-	-
140	Tetrachlorobiphenyl	26914-33-0	0.00016	0.00017	-	-
141	Trichlorobiphenyl		0.00016	0.00017	-	-
<b>Chlorophenols</b>						
142	2,3 - Dichlorophenol	576-24-9	0.00016	0.00017	-	-
143	2,3,4 - Trichlorophenol	15950-66-0	0.35	0.35	0.35	0.14
144	2,3,4,5 - Tetrachlorophenol	4901-51-3	0.35	0.35	0.35	0.14
145	2,3,4,6 - Tetrachlorophenol	58-90-2	0.35	0.35	0.35	0.14
146	2,3,5 - Trichlorophenol	933-78-8	0.00016	0.00017	-	-
147	2,3,5,6 - Tetrachlorophenol	935-95-5	0.35	0.35	0.35	0.14
148	2,3,6 - Trichlorophenol	933-75-5	0.35	0.35	0.35	0.14
149	2,4,5 - Trichlorophenol	95-95-4	3.50	0.35	0.35	0.14
150	2,4,6 - Trichlorophenol	88-06-2	3.50	0.35	0.35	0.14
151	2,6 - dichlorophenol	87-65-0	0.35	0.35	0.35	0.14
152	3,4 - Dichlorophenol	95-77-2	0.00016	0.00017	-	-
153	3,4,5 - Trichlorophenol	609-19-8	0.00016	0.00017	-	-
154	3,5 - Dichlorophenol	591-35-5	0.00016	0.00017	-	-
<b>Metals</b>						
155	Aluminum	7429-90-5	0.70	0.16	-	-
156	Antimony	7440-36-0	0.00	0.01	-	-
157	Arsenic	7440-38-2	0.01	0.03	-	-
158	Barium	7440-39-3	0.04	0.00	-	-
159	Beryllium	7440-41-7	0.0005	0.0003	-	-
160	Bismuth	7440-69-9	0.12	0.22	-	-
161	Boron	7440-42-8	0.01	0.02	-	-

Chemical	CAS #	Scenario 1 (Pre-1996) (kg/day)	Scenario 2 (2000-2002) (kg/day)	Scenario 3 (2003) (kg/day)	Scenario 4 (Future) (kg/day)	
162	Cadmium	7440-43-9	0.18	0.24	-	-
163	Calcium	7440-70-2	1.64	0.32	-	-
164	Chromium	7440-47-3	0.03	0.01	-	-
165	Cobalt	7440-48-4	0.004	0.003	-	-
166	Copper	7440-50-8	0.12	0.12	-	-
167	Iron	15438-31-0	3.22	0.38	-	-
168	Lead	7439-92-1	0.20	0.56	-	-
169	Lithium	7580-67-8	0.0023	0.01	-	-
170	Magnesium	7429-95-4	0.22	0.03	-	-
171	Manganese	7439-96-5	0.03	0.01	-	-
172	Mercury	7439-97-6	0.10	0.39	0.000049	0.000020
173	Molybdenum	7439-98-7	0.03	0.03	-	-
174	Nickel	7440-02-0	0.01	0.00	-	-
175	Phosphorus	7723-14-0	1.26	0.67	-	-
176	Potassium	7440-09-7	0.19	0.26	-	-
177	Selenium	7782-49-2	0.04	0.04	-	-
178	Silicon	7440-21-3	244.8	15.3	-	-
179	Silver	7440-22-4	0.05	0.02	-	-
180	Sodium	7440-23-5	1.33	1.65	-	-
181	Strontium	7440-24-6	0.01	0.0018	-	-
182	Thallium	7440-28-0	-	0.02	-	-
183	Tin	7440-31-5	0.18	0.34	-	-
184	Titanium	7440-32-6	0.07	0.01	-	-
185	Vanadium	7440-62-2	0.00146	0.0019	-	-
186	Zinc	7440-66-6	0.28	0.55	-	-

- Scenario 1 incinerator in full operation (pre 1996)
- Scenario 2 incinerator in partial operation (2000-2002)
- Scenario 3 incineration discontinued (2003-2004)
- Scenario 4 incineration discontinued and odour control measures implemented.