Revision of Pinjarra Refinery Health Risk Screening Assessment

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This document is issued to Alcoa of Australia Ltd for the purposes of investigating the potential health risk arising from atmospheric emissions from the Pinjarra Refinery for the proposed increase in the alumina production capacity up to 5 Mtpa. It should not be used for any other purpose.

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Executive Summary

Alcoa of Australia Limited (Alcoa) is proposing to incrementally increase the alumina production capacity of the Pinjarra Refinery from 4.2 million tonnes per annum (Mtpa) up to 5 Mtpa, which would also be associated with an equivalent increase in the residue production rate. Alcoa is seeking approval for this increase pursuant to section 45C of the *Environmental Protection Act 1986*, as a 'non-substantial' change to the Pinjarra Efficiency Upgrade (PEU) project that was granted Ministerial Approval (Ministerial Statement 646) in 2004.

In 2008, ENVIRON Australia Pty Ltd (ENVIRON) conducted a screening assessment of the potential health risks arising from atmospheric emissions from the Upgraded Pinjarra Refinery, operating at a nominal alumina production rate of 4.2 Mtpa, following implementation of the PEU (ENVIRON, 2008). Alcoa commissioned ENVIRON to revise the screening assessment to determine the potential health risks arising from atmospheric emissions associated with the proposed increase up to 5 Mtpa alumina production capacity of the Pinjarra Refinery.

The approach used to conduct the revised screening assessment is broadly consistent with the approach used for the previous (ENVIRON, 2008) screening assessment. Changes to the health protective guidelines that have occurred since 2008 have been identified and incorporated into the revised screening assessment, to ensure the most current guideline values are applied. The approach used previously for the acute exposure assessment was also modified to reduce overly conservative estimates of potential acute non-carcinogenic health risks.

The revised screening assessment of the potential health risk arising from atmospheric emissions from the Pinjarra Refinery has been conducted using emission estimates derived by Alcoa for refinery point sources, fugitive sources including the Residue Storage Area (RSA) and bauxite stockpiles, and also for Alinta Energy Limited's (Alinta) Pinjarra Cogeneration Plant which is located at the Pinjarra Refinery and operated by Alcoa on behalf of Alinta.

A number of different scenarios have been defined by Alcoa to represent emissions from the Pinjarra Refinery for the currently approved alumina production capacity of 4.2 Mtpa, and for the proposed increase in the alumina production capacity up to 5 Mtpa. The basis for the emission estimates derived by Alcoa (i.e. forecast, actual, or predicted) differs between scenarios. The operation of the Alinta Cogeneration Plant at less than full load (part load) has also been included as a 2015 scenario.

The revised screening assessment considered the health risk associated with the same list of compounds that was considered in the previous screening assessment. The list of compounds comprised of 21 individual compounds (or groups of compounds), that can be grouped into the following classes: particulates, products of combustion, metals, ammonia, organic compounds, Polycyclic Aromatic Hydrocarbons (PAHs), and dioxins and furans.

Discrete receptor locations were identified around the Pinjarra Refinery to represent the populations or individual residences that could be potentially exposed to atmospheric emissions. Three of the discrete receptor locations that were included in the previous screening assessment have not been included in the revised screening assessment as they are no longer used as residences.

The potential health effects arising from the predicted short-term (acute) and long-term (chronic) exposure to non-carcinogenic compounds, and potential carcinogenic risks were considered in the screening assessment. The potential health effects were assessed by comparing the predicted exposure concentrations at the discrete receptor locations with health protective guidelines for ambient air developed by reputable authorities such as the National Environment Protection Council (NEPC), World Health Organisation (WHO) and the U.S Environmental Protection Agency (US EPA).

The results of the revised health risk screening assessment for atmospheric emissions from the Pinjarra Refinery indicate that, in relation to the proposed increased in the alumina production capacity of the Pinjarra Refinery up to 5 Mtpa, the potential for emissions to cause acute or chronic non-carcinogenic health effects is low. The results of the screening assessment indicate that the potential for emissions to contribute to the incidence of cancer in the exposed population is also low.

In general, the proposed increase in the alumina production capacity of the Pinjarra Refinery is expected to result in an increase in the quantitative health risk indicators of the order of 10% or less at most of the receptor locations. The increases are not considered significant as they do not affect the outcomes of the previous assessment (ENVIRON, 2008) in terms of potential health effects.

As with any risk evaluation, there are areas of uncertainty in this screening assessment. To ensure that potential risks are not underestimated, uniformly conservative assumptions have been used to characterise exposure and toxicity. Due to the resultant compounding of conservatism, the quantitative risk indicators should be considered as over-estimates of potential health risks associated with emissions from the Pinjarra Refinery.

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Acronyms and Abbreviations

ATSDR:	Agency for Toxic Substances and Disease Registry
CO:	Carbon monoxide
CICAD:	Concise Internal Chemical Assessment Document
GLC:	Ground-level Concentration
HI:	Hazard Index
IRIS:	Integrated Risk Information System
ILO:	International Labour Organisation
IPCS:	International Programme on Chemical Safety
IOMC:	Inter-Organization Programme for the Sound Management of Chemicals
IARC:	International Agency for Research on Cancer
ICR:	Incremental Carcinogenic Risk
Mtpa:	Million tonnes per annum
MRL:	Minimal Risk Levels
NEPC:	National Environment Protection Council
NO_x:	Oxides of nitrogen
NO_2:	Nitrogen dioxide
OEHHA:	Office of Environmental Health Hazarded Assessment
PAH:	Polycyclic Aromatic Hydrocarbon
PM_{10}:	Particulate Matter with an equivalent aerodynamic diameter of 10 µm
$PM_{2.5}$:	Particulate Matter with an equivalent aerodynamic diameter of 2.5 µm
PEU:	Pinjarra Efficiency Upgrade
REL:	Reference Exposure Level
RIVM:	Dutch National Institute of Public Health and the Environment
RSA:	Residue Storage Area
UNEP:	United Nations Environment Programme
US EPA:	U.S. Environmental Protection Agency
UR:	Unit Risk factor
VOC:	Volatile Organic Compound
WHO:	World Health Organisation

1 Introduction

Alcoa of Australia Limited (Alcoa) is proposing to incrementally increase the alumina production capacity of the Pinjarra Refinery from 4.2 million tonnes per annum (Mtpa) up to 5 Mtpa, which would also be associated with an equivalent increase in the residue production rate. Alcoa is seeking approval for this increase pursuant to section 45C of the *Environmental Protection Act 1986*, as a 'non-substantial' change to the Pinjarra Efficiency Upgrade (PEU) project that was granted Ministerial Approval (Ministerial Statement 646) in 2004.

In 2008, ENVIRON Australia Pty Ltd (ENVIRON) conducted a screening assessment of the potential health risks arising from atmospheric emissions from the Upgraded Pinjarra Refinery, operating at an alumina production rate of 4.2 Mtpa, following implementation of the PEU (ENVIRON, 2008). This previous assessment considered atmospheric emissions from the refinery point sources, and fugitive emission sources such as the Residue Storage Area (RSA), and was based on improved emission estimates derived from the results of a comprehensive stack emission monitoring program undertaken by Alcoa, and the findings of studies to evaluate fugitive emissions (Ecowise, 2007) (ENVIRON, 2007).

Alcoa commissioned ENVIRON to revise the screening assessment to determine the potential health risks arising from atmospheric emissions associated with the proposed incremental increase up to 5 Mtpa alumina production capacity of the Pinjarra Refinery. The approach used to conduct the revised screening assessment is broadly consistent with the approach used for the previous (ENVIRON, 2008) screening assessment.

Changes to the health protective guidelines that have occurred since 2008, due to advancement in scientific understanding of the potential health effects of certain compounds have been identified and incorporated into the revised screening assessment, to ensure the most current guideline values are applied. The approach used previously for the acute exposure assessment was also modified to reduce overly conservative estimates of potential acute non-carcinogenic health risks.

This report outlines the approach used to conduct the revised health risk screening assessment, and presents the results of potential acute and chronic non-carcinogenic and carcinogenic health risks arising from atmospheric emissions from the Pinjarra Refinery at discrete receptor locations in the vicinity of the Pinjarra Refinery.

2 Overview of the Screening Assessment Approach

Risk assessment provides a systematic approach for characterising the nature and magnitude of the risks associated with environmental health hazards, and is an important tool for decision-making. The generic steps involved in health risk assessment include:

Exposure Assessment: defines the amount, frequency, duration and routes of exposure to compounds present in environmental media. In this assessment, exposure is estimated as the concentration of a compound that a person may be exposed to over both short- (i.e. acute) and long-term (i.e. chronic) exposure periods;

Toxicity Assessment: identifies the nature and degree of toxicity of chemical compounds, and characterises the relationship between magnitude of exposure and adverse health effects (i.e. the dose-response relationship);

Risk Characterisation: the combining of exposure and toxicity data to estimate the magnitude of potential health risks associated with exposure periods of interest; and

Uncertainty Assessment: identification of potential sources of uncertainty and qualitative discussion of the magnitude of uncertainty and expected effects on risk estimates.

This health risk assessment conducted of the Pinjarra Refinery's emissions is considered to be a screening-level assessment in that it makes generally conservative default assumptions regarding the potential magnitude of exposure and uses conservative toxicity criteria. The quantitative health risk indicators calculated for potential acute and chronic health effects are based on the assumption that the health effects arising from exposure to each of the individual compounds emitted from the Pinjarra Refinery are additive. The additive approach is considered to be appropriate for screening assessment purposes, and is considered to be conservative (i.e. health protective) in most circumstances. It should however be noted that it does not account for potential synergistic effects.

On account of the conservatism of such a screening assessment, the results are considered more likely to over- than under-estimate the potential health risks associated with atmospheric emissions from the Pinjarra Refinery. The results of the screening assessment are able to be used to assess the relative change to potential health risks associated with the proposed increase in the alumina production capacity, and identify the individual sources and compounds exhibiting the highest contribution to potential health risks in order to help define atmospheric emissions management strategies.

3 Exposure Assessment

3.1 Compounds Considered

The same list of compounds that was considered in the previous screening assessment has been included in the revised screening assessment. The list of compounds comprised of 21 individual compounds (or groups of compounds), that can be grouped into the following classes:

- particulates;
- products of combustion;
- metals;
- ammonia;
- organic compounds;
- Polycyclic Aromatic Hydrocarbons (PAHs); and
- dioxins and furans.

This list of compounds was originally derived for a previous health risk assessment conducted for the Pinjarra Refinery in 2003 (Toxikos, 2003) (excluding $PM_{2.5}$) on the basis that the emissions of these compounds represented over 90% of the total mass of emissions previously estimated for the Pinjarra Refinery (ENVIRON, 2003).

It should be noted that this previous health risk assessment (Toxikos, 2003) also considered the health risk associated with $PM_{2.5}$ and a number of additional Volatile Organic Compounds (VOCs). However that assessment found that exposure to $PM_{2.5}$ was a minor contributor to the overall health risk from refinery point sources. In addition, the Pinjarra RSA particulate study (Ecowise, 2007) found that the ambient monitoring results showed that the ratio of $PM_{2.5}$ to PM_{10} was less than 0.1. Therefore, compliance with the PM_{10} 24-hour standard will mean that the $PM_{2.5}$ guideline will also be complied with. As such $PM_{2.5}$ has not been considered in this screening assessment.

A previous health risk assessment (Toxikos, 2003) also estimated the exposure concentrations for a number of additional VOC compounds[1] based on the application of minimum dilution factors, providing a conservative (i.e. overestimate) of the exposure concentration for these VOC compounds. The health risk associated with the exposure to these additional VOC compounds has not been considered in this assessment as emissions data were not available and the results of the previous health risk assessment (Toxikos, 2003) found that the cumulative health risk associated with these additional VOC compounds is likely to be well below levels representing cause for concern.

[1] Methylene chloride (dichloromethane), ethylbenzene, isopropanol, hexane, styrene and acrolein.

3.2 Emission Estimates

Alcoa has derived emission estimates for the 21 individual compounds (or groups of compounds) considered in the screening assessment based on a review of emission monitoring data obtained for the Pinjarra Refinery (Alcoa, 2014). Emission estimates have been derived for refinery point sources, fugitive sources including the RSA and bauxite stockpiles, and also for Alinta Energy Limited's (Alinta) Pinjarra Cogeneration Plant which is located at the Pinjarra Refinery and operated by Alcoa on behalf of Alinta.

A number of different scenarios have been defined by Alcoa to represent emissions from the Pinjarra Refinery for the currently approved alumina production capacity of 4.2 Mtpa, and for the proposed incremental increase in the alumina production capacity up to 5 Mtpa. The operation of the Alinta Cogeneration Plant at less than full load (i.e. part load) has also been included as a 2015 scenario, as this mode of operation will result in increased emissions of carbon monoxide (CO). The basis for the emission estimates derived by Alcoa (i.e. forecast, nominal, or predicted) differs between scenarios, as described in Alcoa (2014).

Table A.1 of Appendix A lists the individual compounds or groups of compounds for which emissions have been quantified, and the corresponding total mass emission rate for each of the scenarios. Tables A.2 to A.9 provide the mass emission rates of each compound from each source modelled. For each scenario, "peak" and "average" emissions have been calculated by Alcoa and applied to the assessment of acute and chronic exposure respectively. Typically peak emissions have been defined using the maximum measured emission concentration and corresponding volumetric flow rate, and the average emissions have been defined using the average of the measured emission concentrations and volumetric flow rates. In the case of combustion sources, there is sufficient stack emission measurement data to define a more realistic peak emission rate for oxides of nitrogen (NO_x), CO and PM_{10} for certain scenarios, based on a statistical analysis of the monitoring data (Alcoa, 2014).

Further details on the approach used by Alcoa to derive the emission estimates applied in this screening assessment are provided in Alcoa (2014).

3.3 Scenarios

The revised screening assessment has considered the potential health risks associated with the scenarios defined by Alcoa for the Pinjarra Refinery, as presented in Table 1. It should be noted that Scenarios 1 and 1A are based on the same set of emission estimates, but using the health protective guidelines applied for the previous screening assessment (ENVIRON, 2008) and the most current health protective guidelines respectively.

Table 1: Scenarios

Scenario	Alumina Production Rate	Emissions	Cogeneration Plant Operation	Health Protective Guidelines
1	4.2 Mtpa	forecast	full load	previous
1A	4.2 Mtpa	forecast	full load	current
2	4.2 Mtpa	nominal (2008-2013 average)	full load	current
3	5.0 Mtpa	predicted	full load	current
4	5.0 Mtpa	predicted	part load	current

3.4 Potential Receptor Locations

Discrete receptor locations were identified around the Pinjarra Refinery to represent the populations or individual residences that could be potentially exposed to atmospheric emissions, as presented in Table 2. The locations of the receptors in relation to the Pinjarra Refinery are presented in Figure 1, overlain on an aerial photograph of the region.

Table 2: Receptor Locations [1]

Receptor	Approximate Number of Individuals for which Receptor Representative	Description of Use
2	15	Fairbridge farm, permanent & short stay accommodation
3	500	Nearest residence in Carcoola town site
4	2,000	Nearest residence in Pinjarra town site
5	4	Residence, farmhouse
6	5	Residence, farmhouse
7	4	Residence, farmhouse
8	4	Residence, farmhouse
9	4	Residence, farmhouse
10	4	Residence, farmhouse
11	4	Residence, farmhouse
12	5	Residence, farmhouse

Notes:

[1] Receptor 1, Receptor 13 and Receptor 14 are no longer used as residences, and therefore have not been included in this screening assessment.

It should be noted that three of the discrete receptor locations that were included in the previous screening assessment (ENVIRON, 2008) have not been included in this screening assessment as they are no longer used as residences, as follows:

- Receptor 1: the farmhouse residence located north east of the Refinery, has since been purchased by Alcoa and is no longer inhabited;
- Receptor 13: the former residence of an Alcoa employee and family, has since been demolished; and
- Receptor 14: a former residence of the Alcoa farmlands manager and family, is no longer occupied, and may be demolished as the building is in poor condition.

For purposes of the screening assessment, all receptors are assumed to be residences, including potentially sensitive subpopulations such as children and the elderly. This assumption is inherent in the health protective guidelines selected (refer to Section 4).

3.5 Potentially Complete Exposure Pathways

Based on previous studies conducted by ENVIRON (2005, 2007) inhalation is expected to represent the most significant exposure route in relation to emissions from the Pinjarra Refinery, and therefore the exposure assessment has been confined to the inhalation pathway.

Further assessment of the potential exposure via alternative exposure routes has not been included in the scope of this assessment as no changes have occurred since the previous assessments that would invalidate the conclusions of the previous studies.

3.6 Estimated Concentrations in Air

Concentrations in the ambient air have been estimated based on the results of air dispersion modelling conducted by Air Assessments (2014), and emission estimates for the Pinjarra Refinery provided by Alcoa. The modelling results were provided on a unit emission rate basis, and then scaled by ENVIRON according to the emission estimates provided by Alcoa, with the exception of the modelling results for PM_{10}, VOCs, and mercury (vapour phase only) from the RSA and bauxite stockpiles which were provided as predicted ground-level concentrations (GLCs) based on actual emission rate estimates.

Concentrations in ambient air representative of acute exposure have been derived using the 1-hour, and rolling 8-hour or 24-hour average GLCs predicted by the air dispersion modelling based on the peak emission estimates for the Pinjarra Refinery. It should be noted that the approach used previously (ENVIRON, 2008) for the acute exposure assessment has been modified to reduce overly conservative estimates of potential acute non-carcinogenic health risks (refer to Section 5.1). Concentrations in ambient air representative of chronic exposure have been derived using the annual average GLCs predicted by the air dispersion modelling using the average emission estimates for the Pinjarra Refinery.

Appendix B presents details of the approach used to post process the modelling files, to derive the concentrations in ambient air.

3.6.1 Chemical Transformation

The air dispersion modelling has assumed that the gaseous emissions do not undergo chemical transformation once released into the atmosphere, except in the case of emissions of NO_x and formaldehyde.

To estimate the amount of nitrogen dioxide (NO_2) that would be formed from NO_x emissions, in the presence of ozone (O_3), ENVIRON has used the Ozone Limiting Method (OLM), as per the previous screening assessment (ENVIRON, 2008) (refer to Appendix B).

To account for the decay of formaldehyde concentrations in ambient air with time, Air Assessments (2014) has assumed a decay rate of 5.7% per hour. The air dispersion modelling results used for the previous screening assessment did not account for the decay of formaldehyde (Air Assessments, 2008). The assumed decay rate did not have a noticeable effect on the predicted GLCs of formaldehyde (Air Assessments, 2014).

4 Toxicity Assessment

The toxicity assessment determines the relationship between the magnitude of exposure to a chemical of interest and the nature and severity of adverse health effects that may result from such exposure. Chemical toxicity is divided into two categories for purposes of risk assessment: carcinogenic and non-carcinogenic. Some chemicals exert both types of effects. Whilst all non-carcinogenic effects are assumed to occur only at exposure levels greater than some threshold at which defence mechanisms are overwhelmed, carcinogens are thought to act via both threshold and non-threshold mechanisms. By convention, exposure to even one molecule of a genotoxic carcinogen is assumed to incur some small but finite risk of causing cancer; hence, the action of such compounds is considered to lack a threshold below which adverse effects are not expected to occur. In contrast, the effects of non-genotoxic carcinogens are thought to be manifested only at exposures in excess of compound-specific thresholds. Potential health risks are calculated differently for threshold and non-threshold effects because their toxicity criteria are based on different mechanistic assumptions and expressed in different units.

A number of national and international regulatory agencies have reviewed the toxicity of environmental chemicals and developed acceptable exposure criteria (herein referred to as 'health protective guidelines') in accordance with both carcinogenic and non-carcinogenic endpoints. Health protective guidelines from the following reputable authorities were considered for use in the screening assessment:

- NEPC (2003, 2004);
- World Health Organisation (WHO) (2000, 2003);
- U.S. Environment Protection Agency's (US EPA) Integrated Risk Information System (IRIS);
- U.S. Agency for Toxic Substances and Disease Registry's (ATSDR);
- Dutch National Institute of Public Health and the Environment (RIVM) (2001);
- Concise Internal Chemical Assessment Document (CICAD) and Environmental Health Criteria reports published under the Inter-Organization Programme for the Sound Management of Chemicals (IOMC) and International Programme on Chemical Safety (IPCS); and
- California Office of Environmental Health Hazard Assessment's (OEHHA).

The health protective guidelines applied for the screening assessment are presented in Table A.10 of Appendix A, and briefly discussed in the following sections. The health protective guidelines that have been applied in this assessment are taken from the same reputable authorities referenced in the previous screening assessment (ENVIRON, 2008), and incorporating revisions to the health protective guidelines that have since occurred to ensure the most current guidelines have been applied (refer to Section 4.5).

4.1 Non-Carcinogenic Effects

A non-carcinogenic effect is defined as any adverse response to a chemical that is not cancer. Any chemical can cause adverse health effects if given at a high enough dose. When the dose is sufficiently low, no adverse effect is observed. Thus, in characterising the non-carcinogenic effects of a chemical, the key parameter is the threshold dose at which an adverse effect first becomes evident. Doses below the threshold are considered to be "safe" (i.e., not associated with adverse effects), while doses above the threshold may cause an adverse effect.

The threshold dose is typically estimated from toxicological or epidemiological data by finding the highest dose level that produces no observable adverse effect (a NOAEL) or the lowest dose level that produces an observable adverse effect (a LOAEL). Where more than one such value is available, preference is given to studies using most sensitive species, strain and sex of experimental animal known, the assumption being that humans are no less sensitive than the most sensitive animal species tested. For the guidelines developed by all the authorities considered, NOAELs or LOAELs are divided by the product of a series of uncertainty factors representing experimental vs. environmental exposure duration, inter- and intra-species variability and the quality and completeness of the toxicological database. This procedure ensures that the resultant health protective guidelines are not higher than (and may be orders of magnitude lower than) the threshold level for adverse effects in the most sensitive potential receptor. Thus, there is a “margin of safety” built into the guideline, and doses equal to or less than that level are nearly certain to be without any adverse effect. The likelihood of an adverse effect at doses higher than the guideline increases, but because of the margin of safety, a greater dose does not mean that such an effect will necessarily occur.

4.2 Short-term (Acute) Exposure

Health protective guidelines for acute non-carcinogenic health effects are expressed as concentrations in air that are not expected to cause any adverse effects as a result of continuous exposure over a defined averaging period (typically 24 hours or less). These guidelines are appropriate for comparison with exposure estimates predicted by the air dispersion modelling for averaging periods of between 1-hour and 24-hours. Although obtained from different organisations/reference sources, the guidelines selected for this assessment are all intended to be protective of continually exposed (i.e. residential) receptors, including potentially sensitive subpopulations.

4.3 Long-term (Chronic) Exposure

Health protective guidelines for chronic non-carcinogenic health effects are expressed as concentrations in air that are not expected to cause any adverse health effects as a result of continuous long-term exposure (a year or more). These guidelines are appropriate for comparison with annual average exposure estimates predicted by the air dispersion modelling.

4.4 Carcinogenic Effects

Cancers are generally defined as diseases of mutation affecting cell growth and differentiation. Although many chemicals are known to cause cancer at high doses in studies with experimental animals, relatively few chemicals have been shown to be carcinogenic in humans at doses likely to be encountered in the ambient environment. Cancers are relatively slow to develop, and usually require prolonged exposure to carcinogenic chemicals. As a result, potential carcinogenic risks are only calculated for long-term exposures.

The International Agency for Research on Cancer (IARC) classifies substances according to their potential for human carcinogenicity as indicated in Table 3.

Table 3: IARC Classification Criteria

Group	Description
1	Carcinogenic to humans (sufficient evidence of carcinogenicity to humans)
2A	Probably carcinogenic to humans (sufficient evidence of carcinogenicity in animals, limited evidence of carcinogenicity in humans)
2B	Possibly carcinogenic to humans (less than sufficient evidence of carcinogenicity in animals, limited evidence of carcinogenicity in humans)
3	Not classifiable as to carcinogenicity in humans (inadequate or limited evidence of carcinogenicity in animals, inadequate evidence of carcinogenicity in humans)
4	Probably not carcinogenic to humans (evidence suggesting lack of carcinogenicity in animals and humans)

Those compounds present in the emissions from the Pinjarra Refinery included in this assessment that are classified by the IARC as Group 1, Group 2A or Group 2B are presented in Table 4.

Table 4: IARC Compound Classifications

Compound Name	IARC Classification
arsenic	1
benzene	1
cadmium	1
chromium (VI)	1
formaldehyde	1
nickel	1 (nickel compounds) 2B (nickel, metallic and alloys)
acetaldehyde	2B

The IARC has classified nickel compounds as a Group 1 carcinogen; and nickel, metallic and alloys as a Group 2B carcinogen. The most recent IARC (2012) evaluation of the carcinogenicity of nickel and nickel compounds found that there is sufficient evidence in humans for the carcinogenicity of mixtures that include nickel compounds and nickel metal. The ultimate carcinogenic species in nickel carcinogenesis is the nickel ion Ni (II). The evidence is strongest for water-soluble nickel compounds and risk for lung cancer, however it is not possible to entirely separate various nickel compounds in dose-response analysis for specific nickel compounds (IARC, 2012).

Health protective guidelines for genotoxic carcinogens are expressed as unit risk (UR) factors. A UR factor is defined as the theoretical upper bound probability of extra cases of cancer occurring in the exposed population assuming lifetime exposure by inhalation to 1 $\mu g/m^3$ of the chemical (hence units are per $\mu g/m^3$) (WHO, 2000). These guidelines are appropriate for comparison with annual average exposure estimates predicted by the air dispersion modelling.

4.4.1 Polycyclic Aromatic Hydrocarbons (PAHs)

Some individual PAHs are clearly carcinogenic and others appear not to cause cancer, but the majority of this large class of chemicals cannot be classified as to potential carcinogenicity due to lack of sufficient data. The relative carcinogenic potency of specific PAHs has been published by the WHO relative to Benzo[a]pyrene (BaP), a widely reported PAH known for its carcinogenic potency.

The complex and variable composition and behaviour of PAH mixtures in the environment hinder attribution of health consequences to specific compounds. As a result, no one risk assessment approach is universally accepted. Three principal approaches reviewed by WHO (1998) are (1) toxicity equivalence factors (TEFs), (2) comparative potency, and (3) use of BaP as a surrogate. WHO used the BaP surrogate approach in its Air Quality Guidelines for Europe (2000); however, as BaP has not been detected in testing for PAH emissions from the Pinjarra Refinery, the TEF approach has been applied for this assessment.

The highest potency (relative to BaP) for individual PAH compounds published in the WHO's Environmental Health Criteria 202: Selected Non-heterocyclic Polycyclic Aromatic Hydrocarbons (1998) has been applied in calculating exposure to the mixture of PAHs emitted from the Pinjarra Refinery. The relative potency applied in this assessment compared to the range of relative potencies published by the WHO is presented in Table 5.

Table 5: Relative Potency of Individual PAH Compounds [1]		
Individual PAH Compound	**Maximum Relative Potency**	**Range of Relative Potencies [1]**
naphthalene	0.001	0.001 [2, 3]
2-methylnaphthalene	0.001 [2]	
phenanthrene	0.001	0 [4] , 0.00064 [6], 0.001 [2, 3]
acenaphthene	0.001	0 [5], 0.001 [2, 3, 4]
fluoranthene	0.01	0.001 [2, 3], 0.01 [4]

Notes:
[1] As published by the WHO (1998).
[2] Nisbelt & LaGoy (1992).
[3] Malcolm & Dobson (1994).
[4] Kalberlah *et al.* (1995)).
[5] US Environmental Protection Agency (1993).
[6] McClure & Schoeny (1995).

To calculate the carcinogenic risk associated with exposure to PAH emissions from the Pinjarra Refinery, the BaP equivalent exposure concentration for each individual PAH has been summed. The WHO's UR factor for benzo[a]pyrene of 8.7 x 10^{-2} per µg/m^3 was then applied for this assessment, which is based on studies in coke-oven workers (WHO, 2000).

4.4.2 Dioxins and Furans

Dioxins (polychlorinated dibenzo-p-dioxins [PCDDs]) and furans (polychlorinated dibenzofurans [PCDFs]) are a group of toxic organic chemicals that remain in the environment for a long time, and can accumulate in the body fat of animals and humans. Low levels of dioxins and furans were detected in emissions from the Oxalate kiln prior to the Pinjarra Efficiency Upgrade (PEU).[2] The Oxalate kiln was found to be the only Pinjarra Refinery emission source with detectable levels of dioxins and furans.

The potential for dioxins and furans to be emitted from Alcoa's refineries has been eliminated by identifying and eliminating the chemical additives that were the precursors to the dioxin and furan emissions detected from the oxalate kiln (Alcoa, 2005). In addition, as part of the PEU the Oxalate kiln was fitted with a High Efficiency Wet Scrubber and Regenerative Thermal Oxidiser (RTO) to treat waste gases from this source, which provide an added level of protection from such emissions. Consistent with this, subsequent monitoring of emissions from the upgraded Oxalate kiln found no detectable levels of dioxins and furans. Therefore, it can be concluded that the combination of the changes to the Refinery inputs and the addition of the RTO has resulted in the elimination of measurable levels of dioxins and furans.

[2] In the 2002 Wagerup Air Emissions Inventory monitoring campaign, as well as other sampling undertaken for Alcoa on selected sources with potential to emit dioxins and furans, trace quantities of polychlorinated dioxins and furans were identified in Wagerup liquor burning (Coffey *et al*. 2002), Kwinana liquor burning (Ioppolo-Armanios and Coffey 2002); Wagerup Calciner 4 (Coffey *et al*. 2002) and Pinjarra oxalate kiln (Ioppolo-Armanios 2002) air emissions (stack analyses). In general, only the non-toxic congeners were detected, however the Pinjarra oxalate kiln stack air contained trace amounts of some toxic 2378-substituted-congeners.

4.5 Revisions to Health Protective Guidelines

The review of current health protective guidelines revealed that since the previous screening assessment (ENVIRON, 2008), revised guidelines for acute and/or chronic non-carcinogenic health effects have been published for a number of the compounds considered in the screening assessment. The review did not, however, identify any revisions to the health protective guidelines for carcinogenic health effects.

Table 6 presents a summary of the revisions to the health protective guidelines that are relevant to this screening assessment. A brief overview of the rationale for revisions to these health protective guidelines is provided below.

From Table 6 it can be seen that the current guidelines have become more stringent compared with the previous guidelines that were used in the previous screening assessment. This includes the acute non-carcinogenic guideline for arsenic, as the corresponding averaging period for exposure has been shortened to an hour, resulting in a more stringent criterion.

Table 6: Revisions to Health Protective Guidelines

Compound Name	Guideline ($\mu g/m^3$)	Averaging Period	Last Updated	Reference	Guideline ($\mu g/m^3$)	Averaging Period	Reference
	Acute Non-Carcinogenic						
	Current Guideline				**Previous Guideline**		
arsenic	0.2	1-hour	2008	OEHHA (2014)	0.19 [1]	4-hour	OEHHA (1999)
cadmium	0.03	24-hour	2012	ATSDR (2012)	-		
nickel	0.2	1-hour	2012	OEHHA (2014)	6	1-hour	OEHHA (1999)
mercury	0.6	1-hour	2008	OEHHA (2014)	1.8	1-hour	OEHHA (1999)
ammonia	1,290 [2]	24-hour	2004	ATSDR (2004)	3,200	1-hour	OEHHA (1999)
benzene	27	1-hour	2014	OEHHA (2014)	1,300	6-hour	OEHHA (1999)
	Chronic Non-Carcinogenic						
	Current Guideline				**Previous Guideline**		
mercury	0.2	annual	2003	WHO (2003)	1	annual	WHO (2000)
benzene	3	annual	2014	OEHHA (2014)	60	annual	OEHHA (2000)

Notes:
[1] The previous guideline for arsenic published by the OEHHA (1999) was not applied in the previous screening assessment.
[2] The current guideline for ammonia published by the ATSDR (2004) of 1.7 ppm (1,290 $\mu g/m^3$ at 0^oC), supersedes a previous ATSDR (1990) guideline of 0.5 ppm.

The OEHHA has developed guidelines for conducting health risk assessments under California's Air Toxics Hot Spots Program, which include prescribed Reference Exposure Levels (RELs) for acute and chronic exposures. An inhalation REL is an airborne level of a chemical that is not anticipated to present a significant risk of an adverse non-cancer health effect.

In 2008 the OEHHA published a revised Technical Support Document (TSD) for the derivation of non-cancer RELs (OEHHA, 2008), to reflect scientific knowledge and techniques developed since the previous guidelines (OEHHA, 1999) (OEHHA, 2000), and in particular to explicitly include consideration of possible differential effects on the health of infants, children and other sensitive subpopulations. At the same time the OEHHA added acetaldehyde, arsenic, formaldehyde, manganese and mercury to the list of Toxic Air Contaminants that may cause infants and children to be especially susceptible to illness, and the RELs for these compounds were revised. Nickel (OEHHA, 2012) and benzene (OEHHA, 2014a) were also later identified as toxic air contaminants which may disproportionately impact children, and the RELs for these compounds were subsequently revised.

It should be noted that the revised RELs for acetaldehyde, formaldehyde and manganese do not appear in Table 6, as health protective guidelines were obtained from alternative reputable authorities for these compounds (refer to Table A.1 of Appendix A), and were not sourced from the OEHHA.

It should also be noted that the previous screening assessment conducted for the Upgraded Pinjarra Refinery (ENVIRON, 2008) did not consider the potential health impacts associated with acute exposure to arsenic, and hence the superseded acute REL for arsenic (OEHHA, 1999) was not used in the previous assessment, apparently due to an unintended oversight.

The basis for the revised acute and/or chronic RELs for arsenic, nickel, mercury and benzene is outlined in the current version of the Air Toxics Hot Spots Program TSD for the derivation of non-cancer RELs (OEHHA, 2014) that was updated in July 2014 to reflect adoption of additional new or revised RELs.

The ATSDR has developed Minimal Risk Levels (MRLs) for hazardous substances, which are intended to serve as screening levels to identify contaminants and potential health effects that may be of concern at hazardous waste sites. Inhalation MRLs are derived for acute (1-14 days), intermediate (15-365 days) and chronic (365 days and longer) exposure, and are based on non-cancer health effects only. Each MRL is subject to change as new information becomes available concomitant with updating the toxicological profile of a substance.

The acute inhalation MRL for cadmium was published by the ATSDR in 2012, and the basis for the health protective guideline is outlined in the Toxicological Profile for Cadmium (ATSDR, 2012).

The revised acute inhalation MRL for ammonia was published by the ATSDR in 2004, however was not adopted for the previous screening assessment conducted for the Upgraded Pinjarra Refinery (ENVIRON, 2008), presumably to retain consistency with the previous health risk assessment conducted for the Pinjarra Refinery (Toxikos, 2003) which applied the relevant OEHHA health protective guideline for ammonia (OEHHA, 1999). Notwithstanding, the ATSDR's acute health protective guideline for ammonia has been selected for use in this assessment as it is the most conservative (health protective) of the two, after applying an adjustment to account for the difference in the exposure duration averaging periods. The basis for the revised acute MRL for ammonia is outlined in the Toxicological Profile for Ammonia (ATSDR, 2004).

In 2003, the IPCS, a cooperative programme of the WHO, the International Labour Organisation (ILO) and the United Nations Environment Programme (UNEP), published a CICAD for mercury (elemental and inorganic mercury compounds) (WHO, 2003), deriving a tolerable concentration of 0.2 $\mu g/m^3$ for long-term inhalation exposure to elemental mercury vapour. This health protective guideline supersedes the WHO (2000) air quality guideline for inorganic mercury vapour of 1 $\mu g/m^3$ as an annual average.

There is currently no national ambient air quality standards specified for $PM_{2.5}$. The National Environment Protection Council (NEPC) has published an Impact Statement on the Draft Variation to the National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM) (NEPC, 2014), which proposes that the advisory reporting standards for $PM_{2.5}$ could be made performance standards. The recommendations outlined in the Impact Statement are still under review and subject to change, and therefore an ambient air quality standard has not been used for $PM_{2.5}$ in this screening assessment. Further, compliance with the PM_{10} 24-hour standard will mean that the $PM_{2.5}$ advisory reporting standard will also be complied with (refer to Section 3.1).

5 Risk Characterisation

Screening-level quantitative health risk indicators have been calculated for potential acute and chronic non-carcinogenic health effects, and carcinogenic health effects for each of the defined scenarios (refer to Section 3.3).

The quantitative risk indicators are described in Section 5.1, and the findings of the risk characterisation are presented in Sections 5.2 to 5.6. The sections focus on the maximally affected receptors, and the least affected receptors, as this represent the range of quantitative health risk indicators calculated for all of the discrete receptor locations. The calculated health risk indicators at all of the receptor locations and for each compound individually are presented in Table A.11 of Appendix A. Table A.12 of Appendix A presents the percent contribution of individual compounds to the quantitative risk indicators at all of the receptor locations. Figures 3, 4, 6, 8 and 9 present contours of the calculated health risk indicators for selected scenarios, overlain on an aerial photograph of the region.

5.1 Quantitative Risk Indicators

The Hazard Index (HI) is calculated to evaluate the potential for non-carcinogenic adverse health effects from simultaneous exposure to multiple compounds by summing the ratio of the estimated concentration in air to the health protective guidelines for individual compounds. The HI is calculated for acute (Equation 1) and chronic (Equation 2) exposures.

$$HI_{Acute} = \sum \frac{C_{\leq 24h}}{Gdl_{Acute}} \qquad \textbf{Equation 1}$$

$$HI_{Chronic} = \sum \frac{C_{Annual}}{Gdl_{Chronic}} \qquad \textbf{Equation 2}$$

Where:

HI_{Acute} = acute Hazard Index

$C_{\leq 24h}$ = ground level concentration predicted over an averaging period of typically ≤ 24 hours, matching the averaging time of the health protective guideline for compound (µg/m^3)

Gdl_{Acute} = acute health protective guideline for compound (µg/m^3)

$HI_{Chronic}$ = chronic Hazard Index

C_{Annual} = annual average ground level concentration for compound (µg/m^3)

$Gdl_{Chronic}$ = chronic health protective guideline for compound (µg/m^3)

It should be noted that the screening assessment approach used previously (ENVIRON, 2008) to derive the acute HIs has been modified to reduce overly conservative estimates of potential acute non-carcinogenic health risks. For this screening assessment the acute HI for each hour and model receptor has been calculated by summing the individual acute hazard quotients (HQs) derived from the predicted GLCs for each individual compound. The calculated acute HIs for each of the modelled hours was analysed to determine the maximum and 9th highest value, at each modelled grid point and discrete receptor location. Appendix B presents details of the approach used to post process the modelling files, to derive the maximum and 9th highest acute HIs.

The maximum acute HI is predicted to occur once per year under "worst case" meteorological and peak emission conditions from all sources and therefore is still considered to be a conservative (over) estimate of actual acute exposure health risk. Whilst the 9th highest acute HI represents a more realistic, yet still conservative estimate of the risk of potential acute health effects. The CSIRO (2005) state that the 9th highest concentration or robust highest concentration (RHC) is often chosen as the key statistic to represent the extremes, rather than the modelled or observed maximum.

In the previous assessment the acute HI was derived from the maximum GLCs, and also the 99.9 percentile 1-hour and 99.5 percentile 24-hour average GLCs, predicted for each individual compound considered in isolation, regardless of whether they were predicted to occur at the same time. However, this approach was considered to be overly conservative for the assessment of acute exposure health risk, as the maximum predicted GLCs of individual compounds will not necessarily occur at the same time. This is likely to be the case particularly for compounds released mainly from tall point sources compared with compounds released mainly from low-level fugitive sources.

The modified approach used to derived the acute HIs for this assessment has resulted, at least in-part, to some significant changes to the percent contribution predicted for individual compounds at the discrete receptor locations, compared to the previous assessment (refer to Section 5.2). Notwithstanding, the modified approach is considered to provide for a more realistic assessment of potential acute health impacts. The percent contribution of individual compounds also tends to exhibit more variability between receptor locations using the modified approach, as the acute HIs can be predicted to occur under very different meteorological conditions.

There has been no change to the approach used to derived the chronic HI, in that the predicted annual average GLCs have been used to derive the chronic HI at the discrete receptor locations.

The general rule of thumb for interpreting the HI is that:

- values less than one represent no cause for concern;
- values greater than one but less than 10 generally do not represent cause for concern because of the inherent conservatism embedded in the exposure and toxicity assessments; and
- values greater than ten may present some concern with respect to possible health effects (Toxikos, 2003).

The carcinogenic risk provides an indication of the incremental probability that an individual will develop cancer over a lifetime as a direct result of exposure to potential carcinogens, and is expressed as a unitless probability. The incremental carcinogenic risk (ICR) for individual compounds is summed to calculate the potential total ICR from exposure to multiple compounds (Equation 3).

$$Risk = \sum_1^i C_{i\ Annual} \times \frac{EF \times ED}{AT} \times UR_i \qquad \textbf{Equation 3}$$

Where:

$Risk$ = lifetime incremental total cancer risk

C_{Annual} = annual average ground level concentration for compound (µg/m^3)

EF = exposure frequency (365 days/year)

ED = exposure duration (70 years)

AT = averaging time (365 days/year x 70 years, or 25,550 days)

UR_i = Unit Risk factor for compound (per µg/m^3)

The ICR that is considered acceptable varies amongst jurisdictions, typically ranging from one in a million (1x10^{-6}) to one in ten thousand (1x10^{-4}). EnHealth (2012) suggests that in the case of an assessment for multiple chemical exposures, a combined risk of 1x10^{-5} may be considered acceptable by Australian environmental regulatory authorities. The most stringent criterion of one in a million represents the US EPA's *de minimis*, or essentially negligible incremental risk level, and has therefore been adopted for this screening assessment as a conservative (i.e. health protective) indicator of acceptable incremental carcinogenic risk.

5.2 Acute Non-Carcinogenic Effects

Acute HIs have been calculated for each of the defined scenarios based on peak emission estimates for the Pinjarra Refinery. Receptors 2 and 4 exhibit the highest acute HIs, and Receptor 3, 6 and 7 exhibit the lowest acute HIs, thereby representing the range of calculated acute HIs for all the receptor locations. Table 7 presents the range of maximum and 9th highest acute HIs calculated for the defined scenarios.

Table 7: Summary of Acute Hazard Indices

Scenario	Highest			Lowest		
	Acute HI Maximum	Acute HI 9th Highest	Receptor	Acute HI Maximum	Acute HI 9th Highest	Receptor [1]
Scenario 1	0.98	0.96	4	0.25	0.22	3
Scenario 1A	0.99	0.96	4	0.35	0.28	3
Scenario 2	1.01	0.98	4	0.34	0.27	6, 3
Scenario 3	0.65	0.53	2	0.36	0.29	7, 6
Scenario 4	0.65	0.53	2	0.36	0.29	6

Notes:
1 If the maximum HI and the 9th highest HI occur at different receptor locations, then the location of maximum HI appears first, and the location of 9th highest HI appears second.

From Table 7 it can be seen that the acute HI is less than one for all but one of the scenarios and receptor locations considered in the assessment, indicating no cause for concern in terms of potential acute non-carcinogenic health effects.

For Scenario 2, at Receptor 4 (nearest residence in Pinjarra town site), which is located west of the RSA and downwind of the prevailing easterly winds an acute HI of greater than 1 was calculated. However the maximum acute HI (1.01) is only marginally above one, and therefore does not indicate cause for concern. Further, the maximum acute HI at Receptor 4 is predicted to decrease significantly for the proposed Scenarios 3 and 4, down to 0.52. The predicted decrease in the acute HI at Receptor 4 under Scenarios 3 and 4 is due to fugitive dust management measures implemented in the RSA since the commissioning of the PEU, which have resulted in a significant reduction in PM_{10} emissions from this source.

The highest acute HI for Scenarios 3 and 4 is predicted to be 0.65, and occurs at Receptor 2 (Fairbridge farm), located to the north east of the Pinjarra Refinery. The maximum acute HI at Receptor 2 for the proposed Scenarios 3 and 4 is predicted to decrease by approximately 10% compared with Scenarios 1A and 2, providing a further margin of safety in terms of potential acute non-carcinogenic health effects.

Figure 2 presents the maximum acute HI calculated for all of the scenarios to illustrate the change in the acute HI from Scenario 1 to Scenario 1A associated with the use of revised health protective guidelines, and also the change from Scenarios 1A and 2, to Scenarios 3 and 4, that are associated with the proposed increased in alumina production at the Pinjarra Refinery.

From Figure 2 it can be seen that the acute HI for Scenario 1A is higher than for Scenario 1 at each of the receptor locations. The increase is associated with revisions to the acute health protective guidelines for arsenic, cadmium, nickel, mercury, ammonia and benzene (refer to Section 4.5). As the acute HI for Scenario 1A does not increase above a value of one, the revisions to the acute health protective guidelines do not alter the outcome of the previous assessment (ENVIRON, 2008).

The acute HIs for Scenario 1A and Scenario 2 are representative of the Pinjarra Refinery at 4.2 Mtpa alumina production rate,and the acute HIs for Scenario 3 and 4 are representative of an alumina production rate of 5 Mtpa. From Figure 2 it can be seen that at most of the receptor locations, the maximum acute HI is predicted to increase with the proposed increase in the alumina production rate. The increase in the acute HI is predicted to be in the order of 10% or less at most of the receptor locations, with the exception of Receptor 3 and Receptor 10 which exhibit an increase of approximately 25% and 20% respectively.

As the acute HIs for Scenarios 3 and 4 do not increase above a value of one, the proposed increase in the alumina production rate of the Pinjarra Refinery does not indicate cause for concern in terms of potential acute non-carcinogenic health effects.

At Receptors 2, 4 and 5 the acute HI is predicted to decrease with the proposed increase in the alumina production rate, which is associated with fugitive dust management measures implemented in the RSA. The predicted decrease in the acute HI is most significant at Receptor 4 (approx. 50%), and is primarily attributable to reduced PM_{10} impacts arising from fugitive dust emissions from the RSA on that receptor. A decrease in the acute HI represents a significant reduction in the potential for acute non-carcinogenic health effects to occur at these receptor locations.

Figures 3 and 4 present the contours of the maximum acute HIs (Figure 3) and 9th highest acute HIs (Figure 4) for Scenario 2 and Scenario 4, overlain on an aerial photograph of the Pinjarra region, to show the change from the current to the proposed increase in the alumina production rate of the Pinjarra Refinery. The acute HI contours for Scenario 3 and Scenario 4 are not significantly different, except the acute HI contours for Scenario 4 tend to be slightly larger.

From Figures 3 and 4 it can be seen that an increase is evident in the contours of the acute HIs for Scenario 4 compared to Scenario 2, except within the area located to the west of the RSA which shows a significant decrease for Scenario 4. It can also be seen that the highest acute HIs are predicted to occur in the immediate vicinity of the Pinjarra Refinery plant site and the RSA.

The pollutants that contribute most significantly to the acute HI include NO_2, PM_{10}, nickel and mercury, although the relative contribution of these compounds varies for the different scenarios and receptor locations. Table 8 presents a summary of the percent contribution of the compounds of most significance to the maximum acute HI for Scenario 2, and the proposed Scenarios 3 and 4. Table 8 also includes the percent contribution of CO, to present the change due to operation of the Alinta Cogeneration Plant at part load.

Table 8: Contribution of Individual Compounds to Acute HI – Scenarios 2 to 4							
Receptor	Percent Contribution (%)[1]						
	NO_2	CO	PM_{10}	Nickel	Mercury	Other	Acute HI Maximum
	Scenario 2						
2	5.6	0.1	19.6	16.8	52.7	5.1	0.74
3	45.7	0.2	5.2	16.2	23.9	8.8	0.36
4	0.0	0.0	98.2	0.4	0.0	1.3	1.01
5	27.2	0.6	55.1	2.9	3.5	10.8	0.56
6	46.0	0.9	18.2	7.8	7.8	19.3	0.34
7	56.2	0.6	4.6	9.4	10.9	18.3	0.34
8	29.7	0.2	18.4	10.1	35.0	6.5	0.43
9	30.6	0.3	15.3	10.0	36.5	7.2	0.45
10	30.2	0.2	19.4	10.1	33.7	6.5	0.46
11	34.0	0.6	43.8	3.8	4.3	13.4	0.41
12	10.9	0.3	17.0	26.5	39.2	6.2	0.50
	Scenario 3						
2	27.0	0.3	10.8	15.6	41.3	5.0	0.65
3	8.4	0.03	25.3	7.8	55.4	3.1	0.45
4	0.0	0.0	90.3	0.02	9.2	0.5	0.52
5	49.1	0.7	6.7	9.0	11.1	23.4	0.48
6	46.3	0.9	18.3	7.5	7.5	19.5	0.36
7	54.4	0.5	4.6	9.3	12.2	18.9	0.36
8	30.5	0.2	18.1	8.4	36.0	6.8	0.48
9	31.8	0.3	14.9	8.6	37.0	7.4	0.49
10	29.4	0.2	18.1	8.3	37.5	6.5	0.54
11	32.3	0.2	27.6	6.1	28.9	4.9	0.44
12	18.0	0.3	14.0	24.6	36.4	6.7	0.56

Table 8: Contribution of Individual Compounds to Acute HI – Scenarios 2 to 4

Receptor	Percent Contribution (%)[1]						
	NO_2	CO	PM_{10}	Nickel	Mercury	Other	Acute HI Maximum
	Scenario 4						
2	27.1	0.4	10.8	15.6	41.2	5.0	0.65
3	8.6	0.06	25.2	7.8	55.2	3.1	0.45
4	0.0	0.0	90.3	0.02	9.2	0.5	0.52
5	34.7	2.3	42.9	3.3	4.0	12.7	0.50
6	45.9	1.8	18.1	7.5	7.4	19.4	0.36
7	54.2	1.6	4.5	9.1	12.0	18.5	0.36
8	31.2	0.5	17.8	8.3	35.5	6.7	0.49
9	32.7	0.5	14.6	8.5	36.4	7.3	0.50
10	30.2	0.4	17.8	8.2	36.9	6.4	0.55
11	32.8	0.7	27.2	6.0	28.5	4.8	0.45
12	17.6	1.0	14.0	24.5	36.3	6.7	0.56

Notes:
1 Values that appear shaded represent the largest individual pollutant contribution for the given receptor location.

From Table 8 it can be seen that the maximum acute HI for the proposed Scenarios 3 and 4 is attributable largely to mercury emissions at many of the receptor locations. The relative contribution of mercury has increased compared to the previous screening assessment (ENVIRON, 2008), due to the revision of the acute health protective guideline for mercury which is a factor of three times more stringent.

At Receptor 4 the maximum acute HI is attributable largely to PM_{10} emissions, and to NO_x emissions at Receptor 6, 7 and 11, for both Scenarios 3 and 4. At Receptor 5 the maximum acute HI is attributable largely to NO_x emissions for Scenario 3, and to PM_{10} emissions for Scenario 4. Analysis of the 9th highest acute HI indicates similar trends in terms of the most significant pollutants, although the relative contribution of NO_x emissions tends to be more significant overall.

The same pollutants also contribute most significantly to the acute HI for Scenario 2, although at some of the receptor locations (Receptors 3 and 11) a notable increase in the relative contribution of mercury is predicted to occur for the proposed Scenarios 3 and 4.

The percent contribution of CO to the maximum acute HI is higher for Scenario 5 compared to Scenario 3, due to the increase in CO emissions associated with part load operation of the Alinta Cogeneration Plant. However, CO is not predicted to contribute significantly to the maximum Acute HI at the discrete receptor locations, and therefore the increase in the CO emissions does not affect the outcomes of the screening assessment in terms of risk of potential health effects.

The modified approach used to derive the acute HIs for this assessment (refer to Section 5.1) has resulted, at least in-part, to some significant changes to the percent contribution predicted for individual compounds at the discrete receptor locations, compared to the previous assessment. For example, for Scenario 1[3] the previous assessment indicated that the percent contribution of PM_{10} to the maximum acute HI at Receptor 4 (69.6%) is somewhat lower compared to that predicted for this assessment (99.6%). The previous assessment also indicated that NO_2 was a significant contributor (21%) to the maximum acute HI at Receptor 4, whilst for this assessment the contribution of NO_2 is predicted to be zero at this same receptor location. Such variations in the results are related to the different meteorological conditions that the acute HIs have been predicted to occur under.

5.3 Chronic Non-Carcinogenic Effects

Chronic HIs have been calculated for each of the defined scenarios based on average emission estimates for the Pinjarra Refinery. Receptor 2 exhibits the highest chronic HI, and Receptor 6 exhibits the lowest Chronic HI, thereby representing the range of calculated chronic HIs for all the receptor locations. Table 9 presents the range of chronic HIs calculated for the defined scenarios.

Table 9: Summary of Chronic Hazard Indices

Scenario	Highest		Lowest	
	Chronic HI	Receptor	Chronic HI	Receptor
Scenario 1	0.039	Receptor 2	0.011	Receptor 6
Scenario 1A	0.050	Receptor 2	0.014	Receptor 6
Scenario 2	0.055	Receptor 2	0.016	Receptor 6
Scenario 3	0.065	Receptor 2	0.016	Receptor 6
Scenario 4	0.065	Receptor 2	0.016	Receptor 6

From Table 9 it can be seen that the chronic HI is comfortably less than one for all of the scenarios and at all of the receptor locations considered in the assessment, indicating no cause for concern in terms of potential chronic non-carcinogenic health effects. The highest chronic HI for the proposed Scenarios 3 and 4 is predicted to be equal to 0.065, and occurs at Receptor 2 (Fairbridge farm), located to the north east of the Pinjarra Refinery.

Figure 5 presents the chronic HI calculated for all of the scenarios, at each of the receptor locations considered in the assessment, to illustrate the change in the chronic HI from Scenario 1 to Scenario 1A associated with the use of revised health protective guidelines, and also the change from Scenarios 1A and 2, to Scenarios 3 and 4, that are associated with the proposed increased in alumina production at the Pinjarra Refinery.

[3] Scenario 1 is very similar to the Upgraded Refinery scenario referred to in the previous assessment (ENVIRON, 2008), in that they are both representative of emissions from the Pinjarra Refinery operating at an alumina production rate of 4.2 Mtpa, following implementation of PEU.

From Figure 5 it can be seen that the chronic HI for Scenario 1A is higher than Scenario 1 at each of the receptor locations. The increase is associated with revisions to the chronic health protective guidelines for mercury and benzene (refer to Section 4.5). As the chronic HI for Scenario 1A remains well below one, the revision to the chronic health protective guidelines do not alter the outcome of the assessment.

The chronic HIs for Scenario 1A and Scenario 2 are representative of the Pinjarra Refinery at 4.2Mtpa alumina production rate, and the chronic HIs for Scenario 3 and 4 are representative of an alumina production rate of Mtpa. From Figure 5 it can be seen that the chronic HI is predicted to increase with the proposed increase in the alumina production rate at all of the receptor locations. The increase in the chronic HI is predicted to be in the order of 10% or less at most of the receptor locations. Exceptions occur at Receptor 2 and Receptor 12 which exhibit an increase of up to approximately 30% and 20% respectively, although the absolute increase in the chronic HI (0.015 or less) is considered trivial.

As the chronic HIs for Scenarios 3 and 4 do not increase above a value of one, the proposed increase in the alumina production rate of the Pinjarra Refinery does not indicate cause for concern in terms of potential chronic non-carcinogenic health effects.

Figure 6 present the contours of the Chronic HIs for Scenario 2 and Scenario 4, overlain on an aerial photograph of the Pinjarra region, to show the change from the current to the proposed increase in the alumina production rate of the Pinjarra Refinery. The chronic HI contours for Scenario 3 and Scenario 4 are not significantly different.

From Figure 6 it can be seen that a small increase is evident in the contours of the chronic HIs for Scenario 4 compared to Scenario 2, most evident to the north of the Pinjarra Refinery plant site. It can also be seen that the highest chronic HIs are predicted to occur in the immediate vicinity of the Pinjarra Refinery plant site.

The pollutants that contribute most significantly to the chronic HI include NO_2 and mercury, and to a lesser extent cadmium, acetaldehyde and formaldehyde, although the relative contribution of these pollutants varies for the different scenarios and receptor locations. Table 10 presents a summary of the percent contribution of the compounds of most significance to the chronic HI for Scenario 2, and the proposed Scenarios 3 and 4.

Table 10: Contribution of Individual Compounds to Chronic HI – Scenarios 2 to 4							
Receptor	Percent Contribution (%) [1]						
	NO_2	Cadmium	Mercury	Acetaldehyde	Formaldehyde	Other	Chronic HI
	Scenario 2						
2	41.4	5.9	28.1	5.6	6.7	12.2	0.05
3	34.4	5.5	36.7	5.3	7.0	11.1	0.02
4	40.9	6.9	25.9	5.1	8.4	12.8	0.03
5	52.6	7.8	18.2	3.7	7.5	10.2	0.04
6	34.1	7.2	31.9	5.8	8.4	12.6	0.02
7	35.9	7.6	29.7	5.6	8.6	12.6	0.02
8	48.0	10.3	15.8	4.5	9.1	12.2	0.02
9	45.1	10.4	17.5	5.0	9.3	12.7	0.02
10	47.5	10.3	16.0	4.7	9.2	12.4	0.02
11	50.8	9.4	15.0	4.3	8.5	12.0	0.02
12	48.6	7.0	19.7	5.5	7.0	12.1	0.03
	Scenario 3						
2	36.1	4.9	38.2	4.9	5.5	10.4	0.07
3	34.1	5.5	37.8	5.2	6.8	10.6	0.02
4	41.5	7.1	27.0	4.8	8.1	11.4	0.03
5	52.9	8.3	18.3	3.5	7.2	9.8	0.04
6	35.8	7.5	31.8	5.4	7.9	11.6	0.02
7	36.3	7.7	31.6	5.1	7.9	11.5	0.02
8	47.0	10.1	18.8	4.3	8.1	11.7	0.02
9	44.0	10.0	20.8	4.7	8.3	12.0	0.02
10	46.2	10.0	19.4	4.4	8.1	11.8	0.02
11	49.6	9.3	17.9	4.1	7.6	11.5	0.02
12	44.8	6.7	25.7	5.1	6.3	11.3	0.03

Table 10: Contribution of Individual Compounds to Chronic HI – Scenarios 2 to 4							
Receptor	**Percent Contribution (%) [1]**						
	NO_2	**Cadmium**	**Mercury**	**Acetaldehyde**	**Formaldehyde**	**Other**	**Chronic HI**
	Scenario 4						
2	36.2	4.9	38.4	5.0	5.5	10.0	0.07
3	34.4	5.5	37.9	5.2	6.8	10.3	0.02
4	41.8	7.1	27.1	4.8	8.0	11.2	0.03
5	53.3	8.3	18.3	3.5	7.1	9.6	0.04
6	36.0	7.5	31.9	5.4	7.9	11.3	0.02
7	36.6	7.7	31.6	5.1	7.8	11.2	0.02
8	47.3	10.1	18.8	4.3	8.0	11.5	0.02
9	44.3	10.1	20.9	4.8	8.2	11.7	0.02
10	46.4	10.0	19.5	4.5	8.0	11.6	0.02
11	49.9	9.3	17.9	4.1	7.5	11.3	0.02
12	45.1	6.8	25.8	5.1	6.2	11.0	0.03

Notes:
Values that appear shaded represent the largest individual pollutant contribution for the given receptor location.

From Table 10 it can be seen that the chronic HI is attributable largely to NO_x emissions, which account for approximately half of the chronic HI at many of the receptor locations. At Receptors 2 and 3 however, the chronic HI is attributable largely to mercury emissions for both Scenarios 3 and 4. The higher contribution of mercury emissions at Receptors 2 and 3 is likely to be because these receptors are located closer to the RSA which is assigned as the single largest source of mercury emissions, and further away from the NO_x emission sources located within the Pinjarra Refinery plant site. It should however be noted that the mercury emissions assigned to the RSA includes the unaccountable mercury estimated from the refinery mass balance (Alcoa, 2014), and therefore is likely to be an overestimate of actual mercury emissions from this source.

NO_x emissions also contribute most significantly to the chronic HI at most of the receptor locations for Scenario 2, although at Receptor 2 a notable increase in the relative contribution of mercury is predicted to occur for the proposed Scenarios 3 and 4.

5.4 Carcinogenic Effects

The ICR has been calculated for each of the defined scenarios based on average emission estimates for the Pinjarra Refinery. Receptor 2 exhibits the highest ICR, and Receptor 6 exhibits the lowest ICR, thereby representing the range of ICR values calculated for all the receptor locations. Table 11 presents the range of ICR values calculated for the defined scenarios.

Table 11: Summary of Incremental Carcinogenic Risk

Scenario	Highest		Lowest	
	ICR	Receptor	ICR	Receptor
Scenario 1	1.33×10^{-6}	Receptor 2	3.47×10^{-7}	Receptor 6
Scenario 1A	1.33×10^{-6}	Receptor 2	3.47×10^{-7}	Receptor 6
Scenario 2	1.41×10^{-6}	Receptor 2	3.90×10^{-7}	Receptor 6
Scenario 3	1.40×10^{-6}	Receptor 2	3.66×10^{-7}	Receptor 6
Scenario 4	1.39×10^{-6}	Receptor 2	3.64×10^{-7}	Receptor 6

The ICR values presented in Table 11 are best explained by way of example, with the incremental carcinogenic risk calculated for Scenario 1 at Receptor 2 of 1.33×10^{-6} (0.00000133 or 0.000133%) which can also be interpreted as a risk of 1 more person in 751,880 people developing cancer as a result of a lifetime of continuous exposure.

From Table 11 it can be seen that the highest ICR values, predicted to occur at Receptor 2 (Fairbridge farm), are only marginally above the *de minimis* threshold of one in a million. EnHealth (2012) suggests that in the case of an assessment for multiple chemical exposures, a combined risk of one in one hundred thousand (1×10^{-5}) may be considered acceptable by Australia environmental regulatory authorities, and all the predicted ICR values comply with this target risk level. The ICR values predicted to occur at the other receptor locations comply with the *de minimis* threshold for all of the scenarios considered in the assessment. The potential for emissions from the Pinjarra Refinery to contribute to the incidence of cancer in the exposed population is therefore considered to be low.

Figure 7 presents the ICR calculated for all of the scenarios, at each of the receptor locations considered in the assessment, to illustrate the change in the ICR from Scenarios 1A and 2, to Scenarios 3 and 4, that is associated with the proposed increased in alumina production at the Pinjarra Refinery. It should be noted that no change occurs in the ICR for Scenario 1 to Scenario 1A as this assessment did not identify any necessary revisions to the health protective guidelines for carcinogenic effects.

The ICR for Scenario 1A and Scenario 2 is representative of the Pinjarra Refinery at 4.2 Mtpa alumina production capacity, and the ICR for Scenario 3 and 4 is representative of an increase in the alumina production rate to5 Mtpa. From Figure 7 it can be seen that the ICR is not predicted to change significantly with the proposed increase in the alumina production capacity. The ICR for Scenarios 3 and 4 is generally predicted to be marginally higher compared to the forecast emission estimates (Scenario 1A), and marginally lower compared to the actual emission estimates (Scenario 2). The increase in the ICR is predicted to be in the order of 10% or less at all of the receptor locations.

Figures 8 and 9 present the contours of the IRC for Scenario 4 compared with Scenario 1A (Figure 8) and Scenario 2 (Figure 9), overlain on an aerial photograph of the Pinjarra region, to show the change from the current to the proposed increase in the alumina production capacity of the Pinjarra Refinery. From Figure 8 it can be seen that a minor increase is evident in the contours of ICR for Scenario 4 compared to Scenario 1A. Figure 9, however, shows a minor decrease in the contours of ICR for Scenario 4 compared to Scenario 2, which is particularly evident in the area to the west of the RSA. It can also be seen from Figures 8 and 9 that the highest ICR is predicted to occur in the immediate vicinity of the Pinjarra Refinery plant site and the RSA.

The pollutants that contribute most significantly to the ICR include formaldehyde and chromium (VI), and to a lesser extent arsenic, PAHs and acetaldehyde, although the relative contribution of these pollutants varies for the different scenarios and receptor locations. Table 12 presents a summary of the percent contribution of the compounds of most significance to the ICR for Scenario 2, and the proposed Scenarios 3 and 4.

Table 12: Contribution of Individual Compounds to ICR – Scenarios 2 - 4

Receptor	Percent Contribution (%) [1]						
	Arsenic	Chromium (VI)	PAHs	Acetaldehyde	Formaldehyde	Other	ICR
	Scenario 2						
2	9.9	26.6	10.2	9.9	36.6	6.8	1.41×10^{-6}
3	10.3	21.7	9.9	10.0	40.9	7.2	5.42×10^{-7}
4	13.7	23.4	7.2	7.8	40.5	7.3	9.38×10^{-7}
5	12.3	16.8	6.3	7.7	48.4	8.4	8.03×10^{-7}
6	10.1	13.3	10.5	10.5	47.2	8.4	3.90×10^{-7}
7	10.4	13.2	10.0	10.1	47.9	8.4	4.32×10^{-7}
8	12.2	15.4	6.6	7.9	49.5	8.3	5.72×10^{-7}
9	11.8	13.6	7.3	8.7	50.2	8.4	5.75×10^{-7}
10	12.1	15.2	6.8	8.1	49.4	8.3	5.98×10^{-7}
11	12.2	18.5	6.8	7.7	46.8	8.0	5.54×10^{-7}
12	10.0	22.0	12.1	9.9	38.8	7.2	6.86×10^{-7}

Table 12: Contribution of Individual Compounds to ICR – Scenarios 2 - 4							
Receptor	**Percent Contribution (%) [1]**						
	Arsenic	**Chromium (VI)**	**PAHs**	**Acetaldehyde**	**Formaldehyde**	**Other**	**ICR**
	Scenario 3						
2	9.5	26.3	10.6	10.4	36.1	7.0	1.40×10^{-6}
3	10.5	21.7	9.6	10.1	41.0	7.1	5.54×10^{-7}
4	12.4	19.7	7.3	8.5	44.4	7.7	8.42×10^{-7}
5	13.1	16.1	5.6	7.6	49.0	8.7	7.76×10^{-7}
6	10.9	13.8	9.5	10.4	47.3	8.2	3.66×10^{-7}
7	11.1	13.6	9.1	10.0	47.8	8.4	4.08×10^{-7}
8	12.8	15.6	6.6	8.2	48.1	8.8	5.61×10^{-7}
9	12.4	13.9	7.3	9.0	48.6	8.8	5.57×10^{-7}
10	12.7	15.4	6.9	8.4	47.8	8.7	5.86×10^{-7}
11	12.8	18.5	6.7	7.9	45.6	8.5	5.51×10^{-7}
12	10.3	21.2	12.0	10.2	38.7	7.6	7.06×10^{-7}
	Scenario 4						
2	9.6	26.4	10.7	10.4	35.8	7.1	1.39×10^{-6}
3	10.6	21.8	9.7	10.1	40.7	7.1	5.52×10^{-7}
4	12.5	19.8	7.5	8.6	44.0	7.7	8.39×10^{-7}
5	13.1	16.1	5.8	7.7	48.5	8.7	7.72×10^{-7}
6	10.9	13.9	9.7	10.4	46.8	8.2	3.64×10^{-7}
7	11.2	13.7	9.3	10.0	47.3	8.4	4.06×10^{-7}
8	12.9	15.7	6.9	8.2	47.5	8.8	5.58×10^{-7}
9	12.4	14.0	7.6	9.0	48.1	8.9	5.54×10^{-7}
10	12.7	15.5	7.2	8.5	47.3	8.8	5.82×10^{-7}
11	12.9	18.6	7.0	7.9	45.1	8.5	5.48×10^{-7}
12	10.4	21.3	12.3	10.2	38.2	7.7	7.03×10^{-7}

Notes:
Values that appear shaded represent the largest individual pollutant contribution for the given receptor location.

From Table 12 it can be seen that emissions of formaldehyde account for nearly half of the ICR at many of the receptor locations, with emissions of chromium (VI) the next most significant contributor to the ICR for the proposed Scenarios 3 and 4. Formaldehyde emissions also contribute most significantly to the ICR at all of the receptor locations for Scenario 2.

5.5 Irritancy

For the purposes of this screening assessment irritancy refers to a direct physiological response arising from short-term exposure to a compound that may result in mild, transient adverse health effects that are reversible upon cessation of exposure. The likelihood that exposure to a compound will result in sensory irritation can be assessed by comparison of the exposure concentration to the irritancy threshold. Acute health protective guidelines are designed to be more stringent (i.e. health protective) than irritancy thresholds, therefore exposure concentrations that are below the acute health protective guidelines implicitly are also below the irritancy thresholds and hence do not represent a cause for concern with respect to irritancy. As the acute HI for the proposed Scenarios 3 and 4 are predicted to be less than one at all of the receptor locations, it can be concluded that the potential for emissions from the Pinjarra Refinery to cause irritation is very low.

5.6 Uncertainties Associated with Calculated Risks

The risk assessment process relies on a set of assumptions and estimates with varying degrees of certainty and variability. Major sources of uncertainty in risk assessment include:

- natural variability (e.g., differences in body weight in a population);
- lack of knowledge about basic physical, chemical, and biological properties and processes;
- assumptions in the models used to estimate key inputs (e.g., air dispersion modelling, dose response models); and
- measurement error (e.g. in characterising emissions).

Perhaps the greatest single source of uncertainty in risk assessment is in the dose-response relationships for chemicals, particularly in relation to carcinogenic unit risks.

For this screening assessment, uniformly conservative assumptions have been used to ensure that potential exposures and associated health risks are over- rather than under-estimated. As a result of the compounding of conservatism, the quantitative risk indicators are considered to be upper-bound estimates, with the actual risk likely to be lower.

5.6.1 Emissions Characterisation and Quantification Uncertainty

There is uncertainty associated with the identification and quantification of atmospheric emissions from the Pinjarra Refinery. The emission estimates were based on emissions testing results obtained by independent NATA accredited sampling contractors and analytical laboratories using appropriate techniques including quality control and quality assurance procedures. Alcoa believes that the uncertainty in emission rates associated with process variation is expected to be lower now than at the time of the original PEU HRA, since the emissions monitoring database is now significantly larger and more representative of current refinery operations, due to five years of operating post PEU commissioning. This results in lower inherent statistical uncertainty for several emissions sources – in particular the regularly monitored combustion sources. Significant uncertainty still remains however for sources where monitoring data remains sparse and/or highly variable as per the original 2008 HRA (Patrick Coffey *pers comm.* 4 December 2014).

5.6.2 Estimation of Exposure Concentration Uncertainty

The air dispersion modelling was completed by Air Assessments. The assumptions used in the modelling are discussed in Air Assessment (2014) and have not been reviewed as part of this screening assessment.

The maximum and 9th highest acute HIs were calculated based on 1-hour, and rolling 8-hour and 24-hour average, predicted GLCs. The maximum acute HI is predicted to occur once per year under the "worst-case" meteorological conditions and therefore provides the most conservative estimate of exposure concentrations. The 9th highest acute HI is predicted to occur for only 0.1% of the time at any given receptor location. Therefore, for the vast majority of the year, the potential acute health effects are expected to be less significant than the calculated acute HIs suggest.

5.6.3 Exposure Assumptions Uncertainty

To calculate the incremental carcinogenic risk it has been assumed that residences located at the key receptor locations spend every hour of every day outdoors at that location for 70 years. Clearly, these exposure conditions are unlikely to be realised, because the actual exposure concentrations (of substances originating at the refinery) in the indoor environment are reasonably expected to be lower than experienced in the outdoor air, and the exposure frequency (i.e. days per year) and exposure duration (years) likely to be considerably lower as people move about.

The screening assessment has been confined to exposure via the inhalation pathway, raising the possibility that the total exposure to specific compounds may have been underestimated. Notwithstanding, inhalation is expected to represent the most significant exposure route (refer to Section 3.5).

5.6.4 Toxicity Assessment Uncertainty

The primary uncertainties associated with the toxicity assessment are related to the derivation of the health protective guidelines. Health protective guidelines published by reputable authorities have been applied for this assessment, and these have been derived by applying various conservative (i.e. health protective) assumptions. The extrapolation of animal bioassay results or occupational exposure studies to human risk at much lower levels of exposure involves a number of assumptions regarding effect threshold, interspecies extrapolation, high- to low-dose extrapolation, and route-to-route extrapolation. The scientific validity of these assumptions is uncertain; because each of the individual extrapolations are intended to prevent underestimation of risk, in concert they result in unquantifiable but potentially very significant overestimation of risk.

5.6.5 Risk Characterisation Uncertainty

It should be noted that the summing of the quantitative risk indicators for individual compounds to calculate the overall risk from exposure to multiple compounds does not take into account that different compounds can target different organs and therefore the potential health risk arising from exposure to multiple compounds is not necessarily additive, nor does it account for potential antagonistic or synergistic effects. However, the additive approach is considered to be appropriate for screening assessment purposes, and is considered to be conservative (i.e. health protective) in most circumstances.

6 Summary

ENVIRON has revised the screening assessment of the potential health risks arising from atmospheric emissions from the Pinjarra Refinery, to determine the potential risks associated with the proposed incremental increase in alumina production capacity to 5 Mtpa at the Pinjarra Refinery.

The approach used to conduct the revised health risk screening assessment is broadly consistent with the approach used for the previous screening assessment (ENVIRON, 2008), although the method used for the acute exposure assessment has been modified to reduce overly conservative estimates of potential acute non-carcinogenic health risk. Changes to the health protective guidelines that have occurred since 2008 have been identified and incorporated into the screening assessment, to ensure the most current guideline values are applied.

The revised assessment has been based on emission estimates derived by Alcoa for refinery point sources, fugitive sources including the RSA and bauxite stockpiles, and the Alinta Cogeneration Plant, for a number of different scenarios (Table 1) that represent the currently approved alumina production capacity of 4.2 Mtpa, and the proposed incremental increase in the alumina production capacity up to 5 Mtpa.

Quantitative health risk indicators were calculated for exposure via the inhalation pathway to atmospheric emissions from the Pinjarra Refinery in isolation, and therefore did not take into account the alternative exposure pathways (e.g. ingestion, dermal absorption), nor other sources of atmospheric emissions of these compounds. The quantitative health risk indicators that were calculated for discrete receptors located in the vicinity of the Pinjarra Refinery include:

- acute HI: for the assessment of potential acute (short-term) non-carcinogenic health effects;
- chronic HI: for the assessment of potential chronic (long-term) non-carcinogenic health effects; and
- ICR: for the assessment of potential incremental carcinogenic risk.

Based upon the results of the screening assessment it can be concluded that, in relation to the proposed increased in the alumina production capacity of the Pinjarra Refinery to 5 Mtpa, the potential for emissions to cause acute or chronic non-carcinogenic health effects is low. The results of the screening assessment indicate that the potential for emissions to contribute to the incidence of cancer in the exposed population is also low.

In general, production at the higher alumina production rate of 5Mtpa at the Pinjarra Refinery is expected to result in an increase in the quantitative health risk indicators of the order of 10% or less at most of the receptor locations. The increases are not considered significant as they do not affect the outcomes of the previous assessment (ENVIRON, 2008) in terms of risk of potential health effects.

At a number of the receptor locations the acute HI is predicted to decrease with the proposed increase in the alumina production capacity. This predicted change in acute HI is due to fugitive dust management measures implemented in the RSA since the commissioning of the PEU, which have resulted in the significant reduction in fugitive dust impacts from this source. The reduction in the acute HI is predicted to be most significant at the nearest residence in the Pinjarra town site (Receptor 4) which is located west of the RSA and downwind of the prevailing easterly winds. A reduction in the acute HI provides a further margin of safety in terms of potential acute non-carcinogenic health effects.

The acute HI is mainly attributable to emissions of mercury, PM_{10}, NO_x and nickel. Although the relative contribution of these compounds varies for the different scenarios and receptor locations considered in the assessment, the maximum acute HI is attributable largely to mercury emissions at many of the receptor locations. The relative contribution of mercury has increased compared to the previous screening assessment (ENVIRON, 2008), due to the revision of the acute health protective guideline for mercury which is now a factor of three times more stringent.

The increased emissions of CO during part load operation of the Alinta Cogeneration Plant are predicted to only marginally increase the maximum acute HI at the discrete receptor locations considered, and therefore does not affect the outcomes of the screening assessment in terms of risk of potential health effects.

The chronic HI is mainly attributable to emissions of NO_x and mercury, and to a lesser extent cadmium, acetaldehyde and formaldehyde. NO_x emissions account for approximately half of the chronic HI at many of the receptor locations.

The ICR is mainly attributable to emissions of formaldehyde and chromium (VI), and to a lesser extent arsenic, PAHs and acetaldehyde. Formaldehyde emissions account for nearly half of the ICR at many of the receptor locations.

As with any risk evaluation, there are areas of uncertainty in this screening assessment. To ensure that potential risks are not underestimated, uniformly conservative assumptions have been used to characterise exposure and toxicity. Due to the resultant compounding of conservatism, the quantitative risk indicators should be considered as over-estimates of potential health risks associated with emissions from the Pinjarra Refinery.

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8 Limitations

ENVIRON Australia prepared this report in accordance with the scope of work as outlined in our proposal to Alcoa of Australia Ltd dated 29 October 2014 and in accordance with our understanding and interpretation of current regulatory standards.

The conclusions presented in this report represent ENVIRON's professional judgment based on information made available during the course of this assignment and are true and correct to the best of ENVIRON's knowledge as at the date of the assessment.

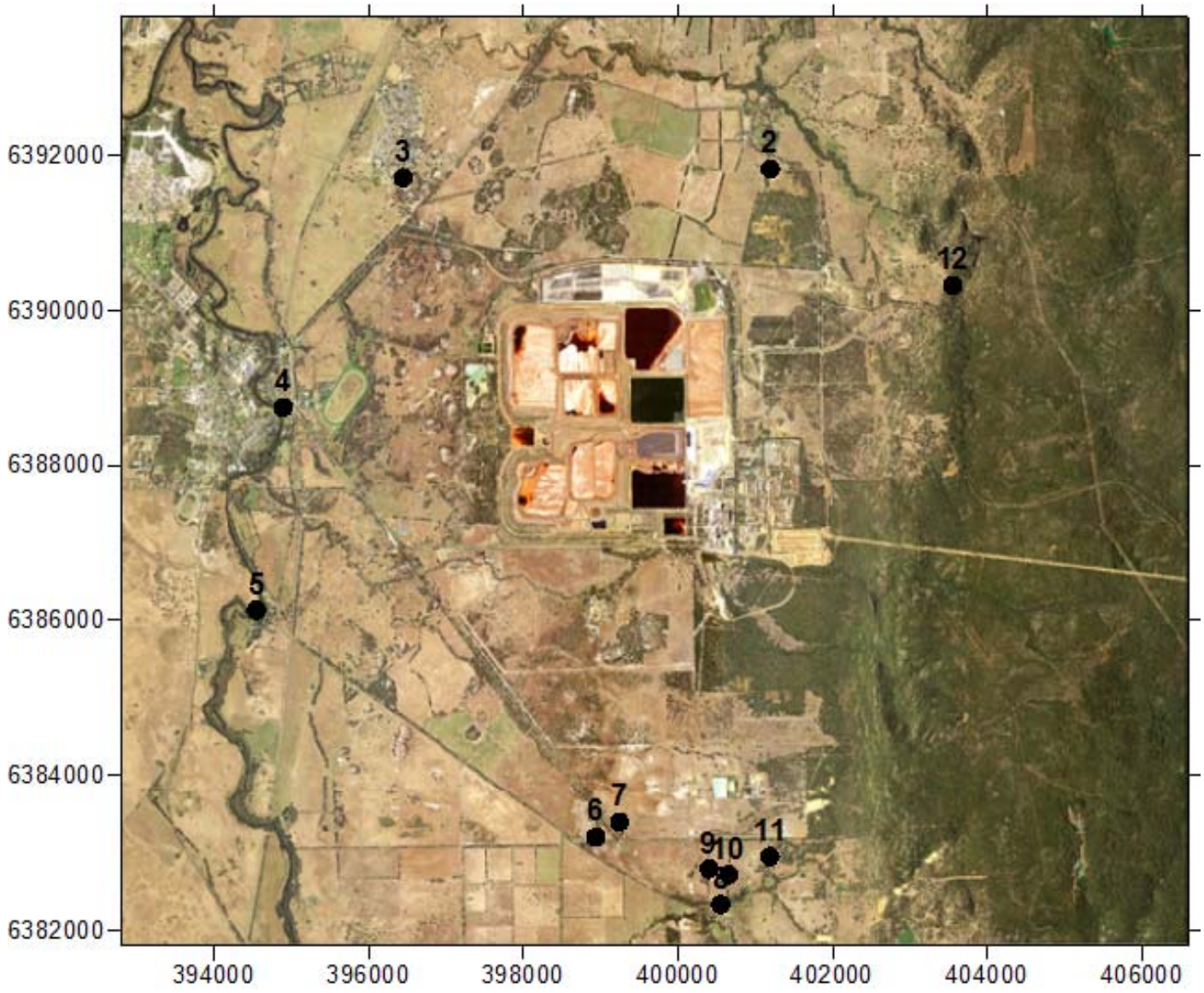
ENVIRON did not independently verify all of the written or oral information provided to ENVIRON during the course of this investigation. While ENVIRON has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided to ENVIRON was itself complete and accurate.

This report does not purport to give legal advice. This advice can only be given by qualified legal advisors.

8.1 User Reliance

This report has been prepared exclusively for Alcoa of Australia Ltd and may not be relied upon by any other person or entity without ENVIRON's express written permission.

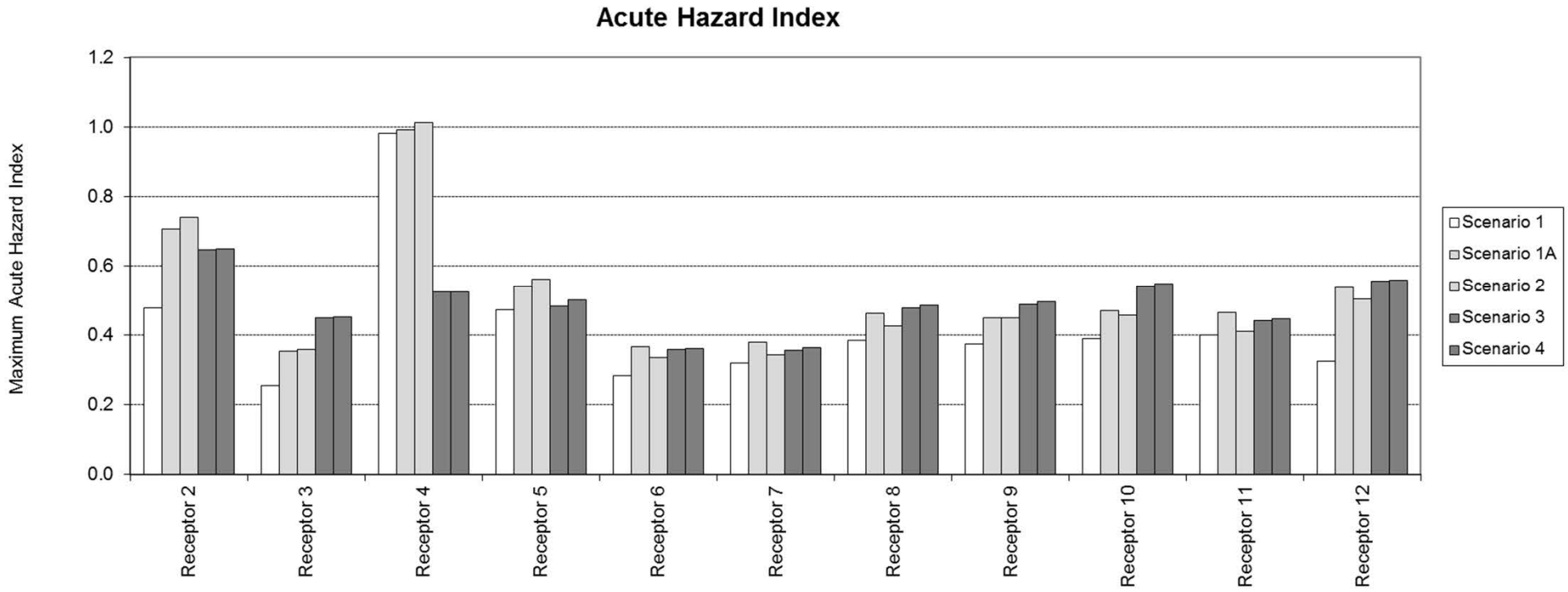
Figures



Revision of Pinjarra Refinery Health Risk Screening Assessment

Location of Receptors in Relation to the Pinjarra Refinery

ENVIRON JOB NO: AS110754 DATE: December 2014 FIGURE 1



Revision of Pinjarra Refinery Health Risk Screening Assessment

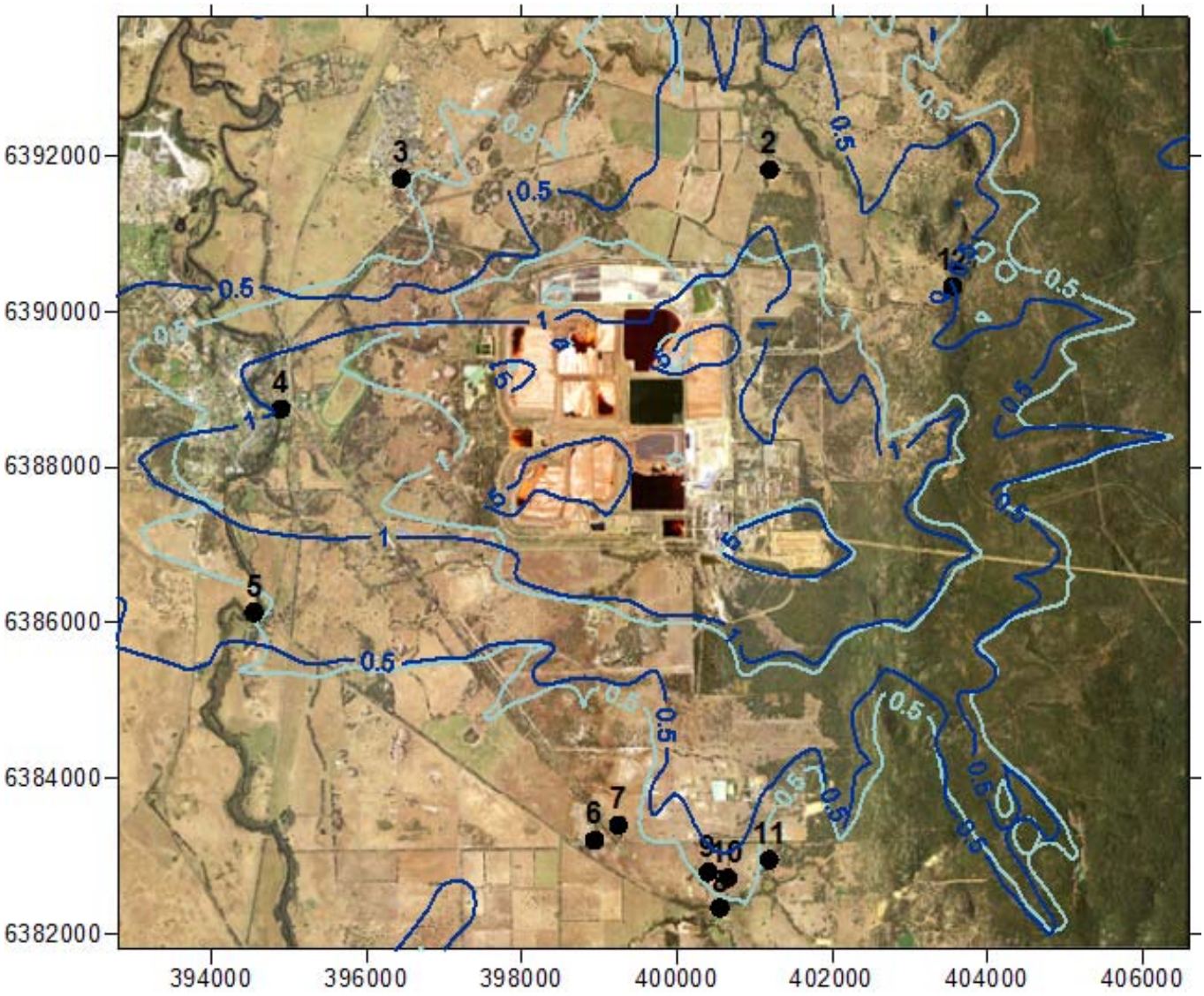
Maximum Acute Hazard Index for Scenarios 1 - 4

ENVIRON

JOB NO: AS110754

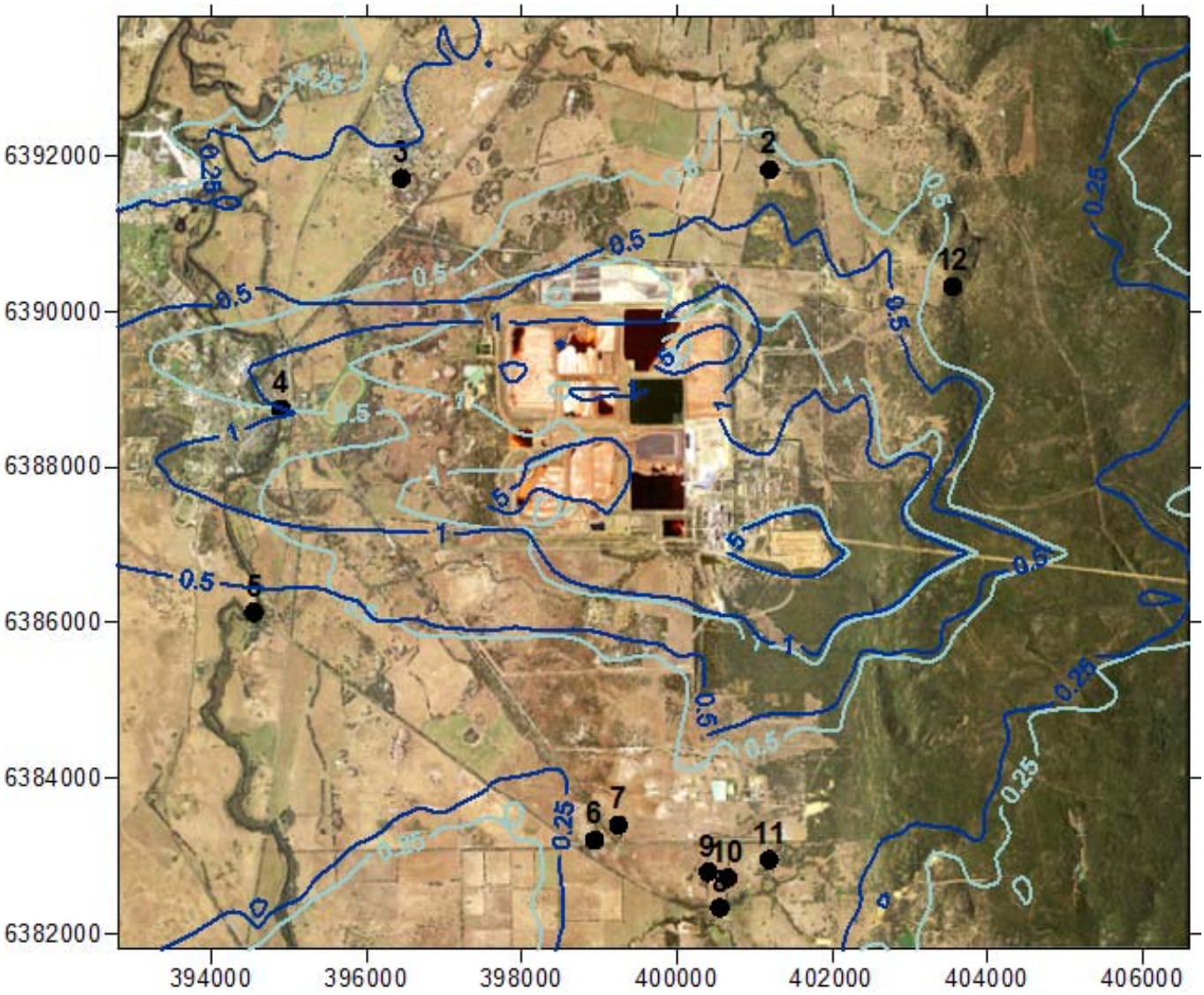
DATE: December 2014

FIGURE 2



Contours of the Maximum Acute Hazard Index for Scenarios 2 and 4

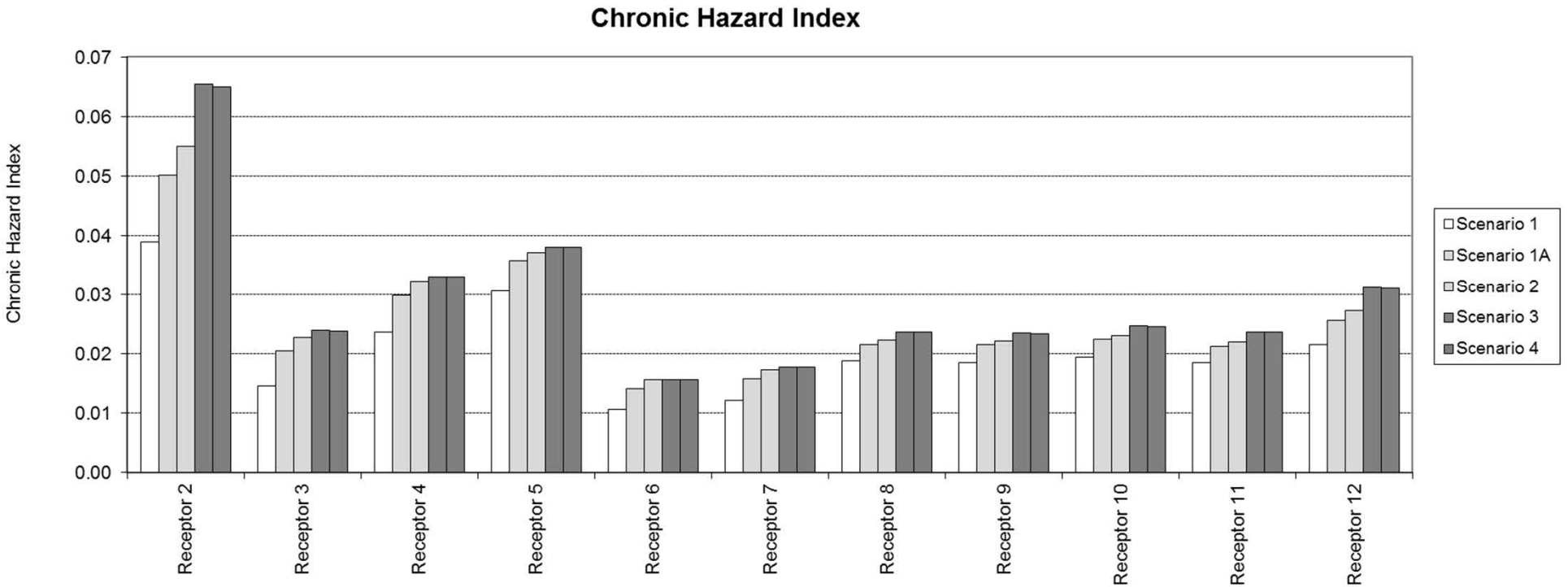
Revision of Pinjarra Refinery Health Risk Screening Assessment



Contours of the 9th Highest Acute Hazard Index for Scenarios 2 and 4

Revision of Pinjarra Refinery Health Risk Screening Assessment

ENVIRON JOB NO: AS110754 DATE: December 2014 FIGURE 4



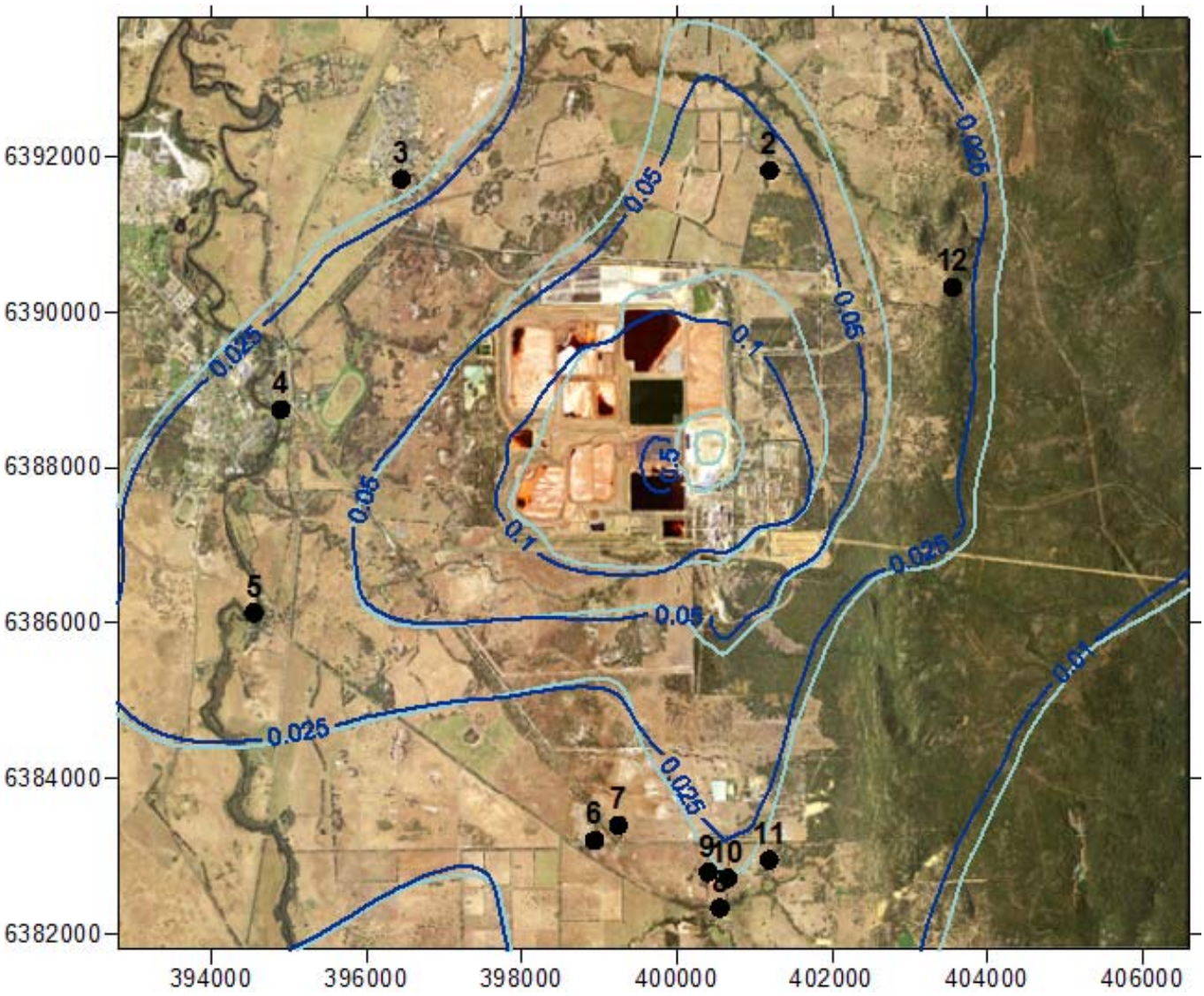
Revision of Pinjarra Refinery Health Risk Screening Assessment	Chronic Hazard Index for Scenarios 1 - 4

ENVIRON

JOB NO: AS110754

DATE: December 2014

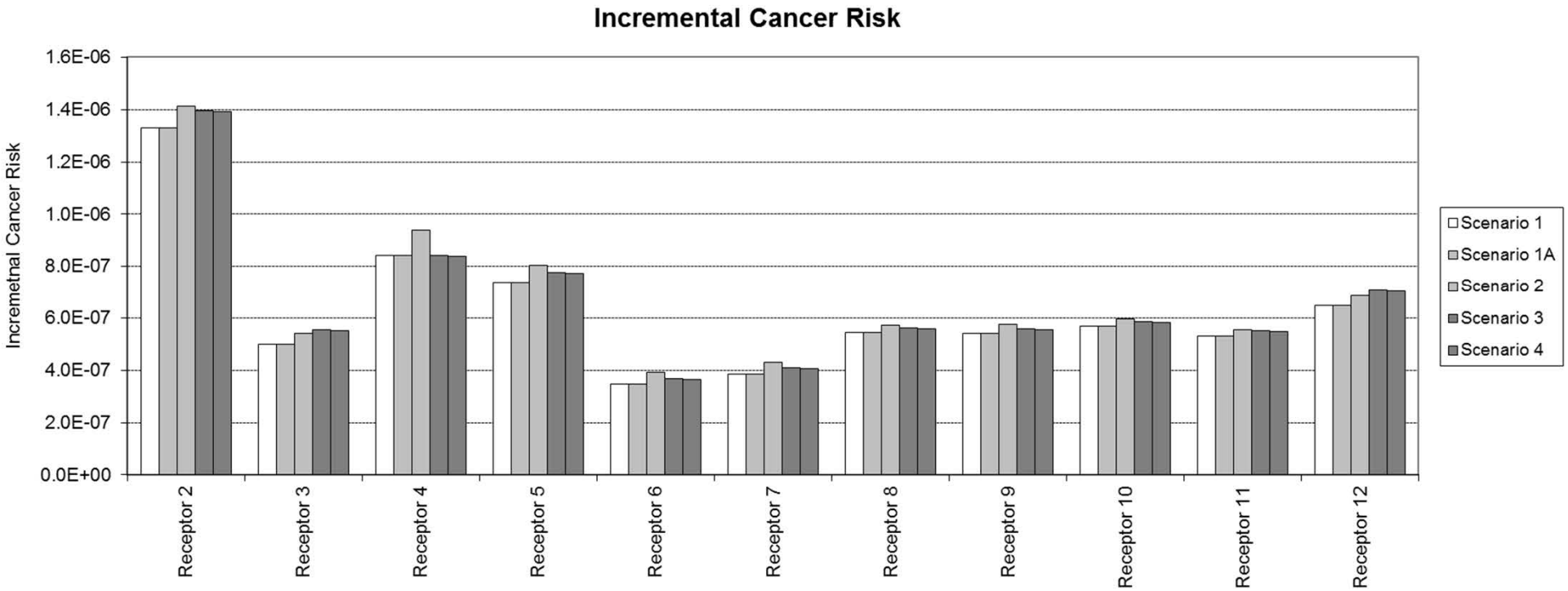
FIGURE 5



Contours of the Chronic Hazard Index for Scenarios 2 and 4

Revision of Pinjarra Refinery Health Risk Screening Assessment

ENVIRON JOB NO: AS110754 DATE: December 2014 FIGURE 6



Revision of Pinjarra Refinery Health Risk Screening Assessment

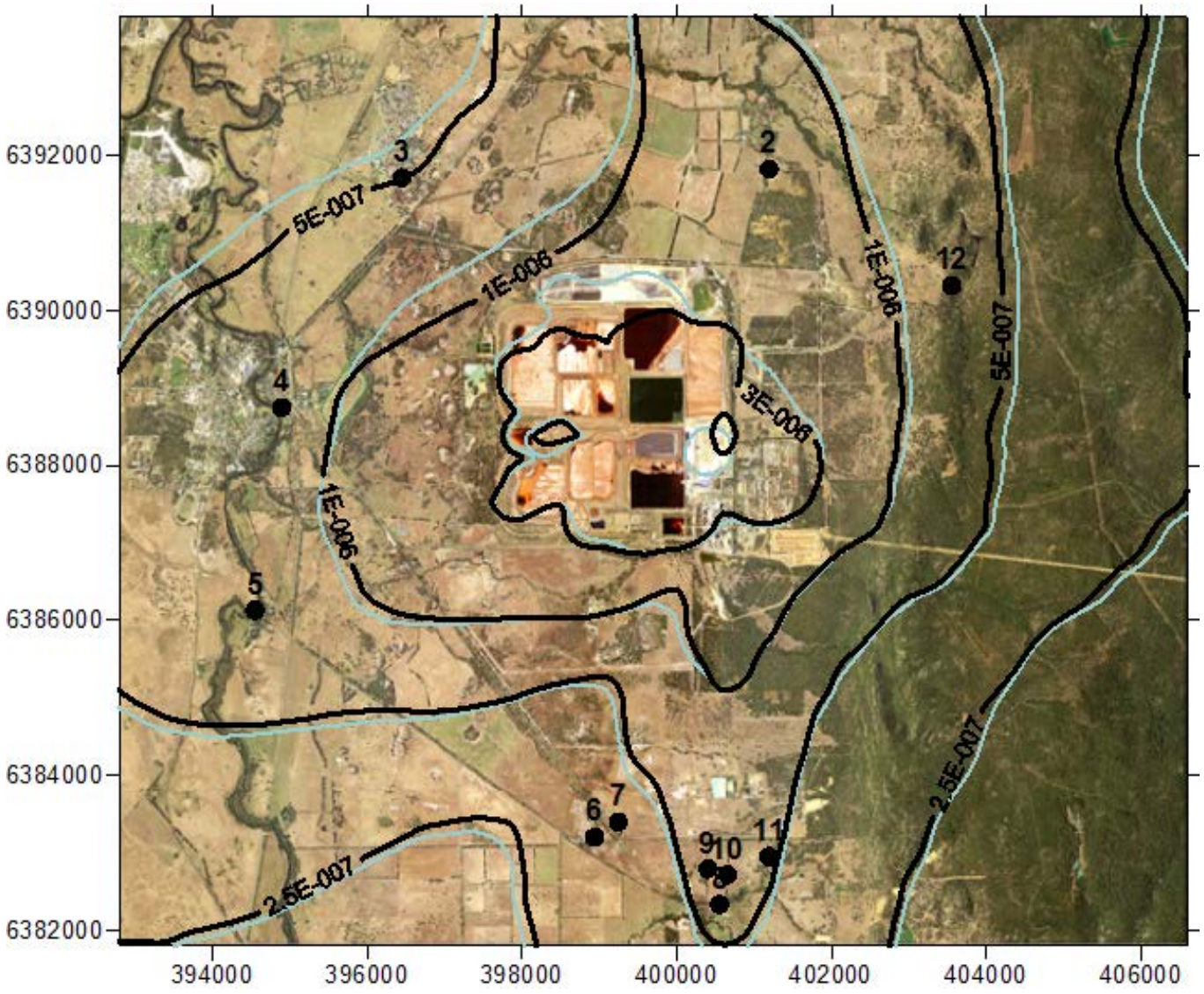
Incremental Carcinogenic Risk for Scenarios 1 - 4

ENVIRON

JOB NO: AS110754

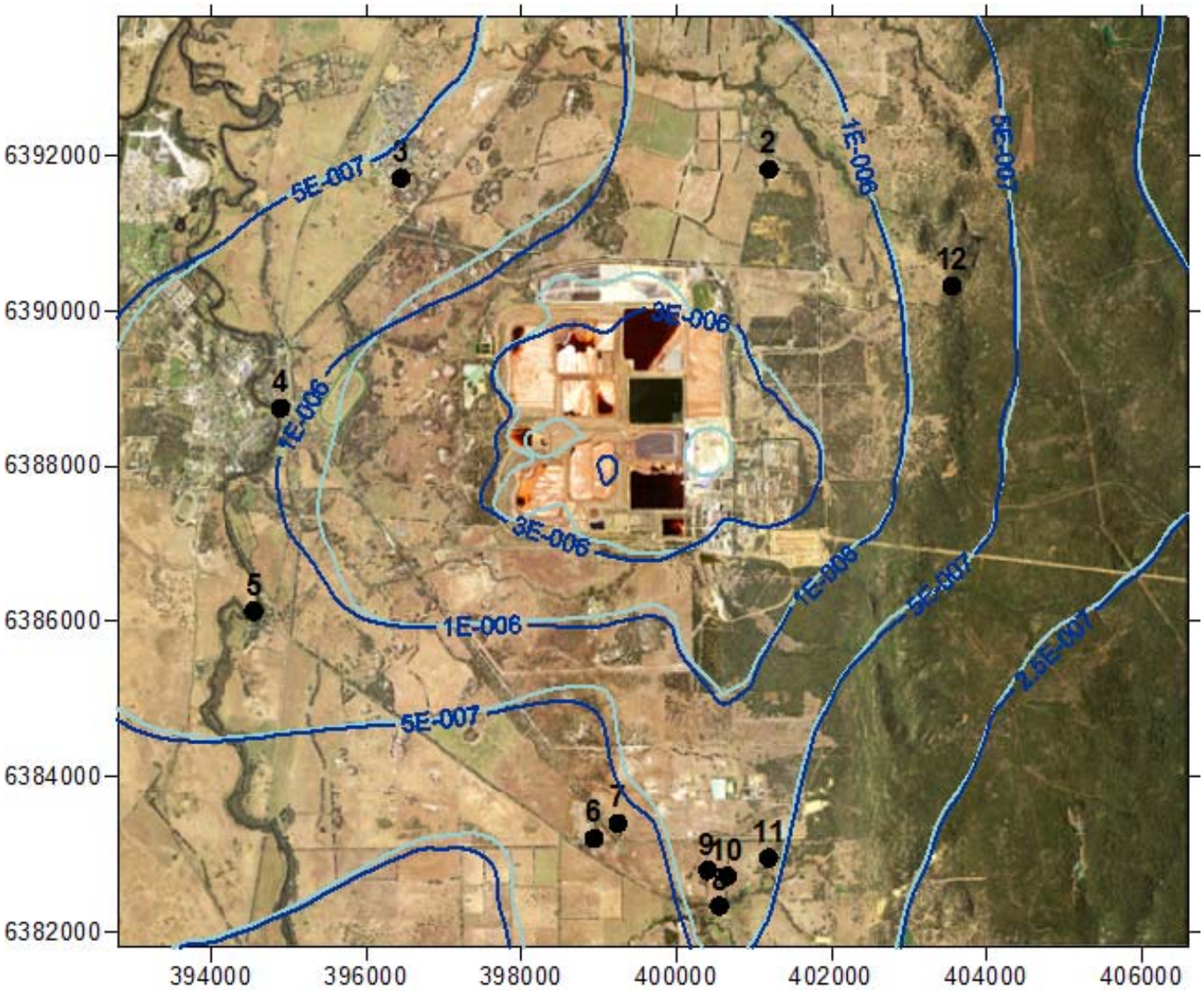
DATE: December 2014

FIGURE 7



Revision of Pinjarra Refinery Health Risk Screening Assessment	Contours of Incremental Carcinogenic Risk for Scenarios 1A and 4

ENVIRON | JOB NO: AS110754 | DATE: December 2014 | FIGURE 8



Revision of Pinjarra Refinery Health Risk Screening Assessment

Contours of Incremental Carcinogenic Risk for Scenarios 2 and 4

Appendix A

Tabulated Data and Results

TABLE A.1: COMPOUND LIST AND TOTAL MASS EMISSION ESTIMATES [1]

No.	CAS No. or Code	Compound Name	Scenario 1 and 1A (g/s)		Scenario 2		Scenario 3		Scenario 4	
			Average Case	Peak Case	Average Case	Peak Case	Average Case	Peak Case	Average Case	Peak Case
1	10102-44-0	Oxides of Nitrogen	6.30E+01	1.20E+02	5.88E+01	8.79E+01	5.79E+01	9.09E+01	5.86E+01	8.82E+01
2	630-08-0	Carbon monoxide	3.52E+01	1.53E+02	2.63E+01	1.17E+02	3.20E+01	1.27E+02	2.20E+02	7.52E+02
3	7446-09-5	Sulphur dioxide	1.31E+00	7.39E+00	9.64E-01	3.66E+00	1.10E+00	4.27E+00	1.10E+00	4.26E+00
4	PM10	Particulate matter <10 µm	2.58E+01	3.22E+01	2.68E+01	3.02E+01	2.49E+01	3.09E+01	2.49E+01	2.85E+01
5	7440-38-2	Arsenic	1.90E-03	5.36E-03	2.10E-03	5.83E-03	2.34E-03	6.44E-03	2.34E-03	6.44E-03
6	7782-49-2	Selenium	3.75E-04	6.84E-04	3.92E-04	7.35E-04	4.05E-04	7.46E-04	4.05E-04	7.46E-04
7	7439-96-5	Manganese	3.50E-03	1.15E-02	3.94E-03	1.29E-02	4.47E-03	1.43E-02	4.47E-03	1.43E-02
8	7440-43-9	Cadmium	4.42E-04	1.19E-03	4.97E-04	1.40E-03	5.72E-04	1.52E-03	5.72E-04	1.52E-03
9	18540-29-9	Chromium (VI)	8.11E-05	2.87E-04	7.91E-05	2.87E-04	7.40E-05	2.82E-04	7.40E-05	2.82E-04
10	7440-02-0	Nickel	1.43E-03	4.57E-03	1.54E-03	4.83E-03	1.69E-03	5.04E-03	1.69E-03	5.04E-03
11	7439-97-6	Mercury	1.36E-02	1.89E-02	1.53E-02	2.12E-02	1.73E-02	2.32E-02	1.73E-02	2.32E-02
12	7664-41-7	Ammonia	6.47E-01	1.03E+00	7.07E-01	1.03E+00	7.08E-01	1.03E+00	6.46E-01	1.03E+00
13	PAHs	PAHs (BaP Equivalents) [2]	4.37E-06	8.68E-06	9.14E-06	1.31E-05	7.82E-06	1.27E-05	8.65E-06	1.27E-05
14	67-64-1	Acetone	1.87E+00	5.13E+00	1.63E+00	5.68E+00	1.60E+00	5.95E+00	1.60E+00	5.96E+00
15	75-07-0	Acetaldehyde	1.52E+00	2.45E+00	1.38E+00	2.83E+00	1.38E+00	2.98E+00	1.38E+00	2.98E+00
16	50-00-0	Formaldehyde	9.59E-01	2.51E+00	1.01E+00	2.91E+00	1.02E+00	3.17E+00	1.02E+00	3.18E+00
17	78-93-3	2-Butanone	1.90E-01	3.11E-01	2.01E-01	4.51E-01	1.97E-01	4.58E-01	1.97E-01	4.58E-01
18	71-43-2	Benzene	5.26E-02	1.63E-01	8.65E-02	2.16E-01	8.36E-02	2.29E-01	8.36E-02	2.29E-01
19	108-88-3	Toluene	4.31E-02	1.13E-01	6.23E-02	1.41E-01	6.10E-02	1.46E-01	6.11E-02	1.46E-01
20	1330-20-7	Xylenes	7.45E-03	1.68E-02	9.01E-03	1.78E-02	8.85E-03	1.79E-02	8.85E-03	1.79E-02

Notes
(1) Polycyclic Aromatic Hydrocarbons (PAHs) reported as Benzo[a]pyrene (BaP) Equivalents.

TABLE A.2: SCENARIO 1 AND 1A AVERAGE EMISSION RATES (G/S)

Source	NOx	CO	SO2	Dust	Arsenic	Selenium	Manganese	Cadmium	Chromium VI	Nickel	Mercury	Ammonia	PAHs	Acetone
Oxalate Kiln/RTO	2.05E-01	2.45E-01	1.01E-02	1.45E-02	1.80E-04	7.55E-05			9.05E-06	4.41E-05	9.85E-04			2.91E-03
Bldg 30 RTO (Operating)	4.80E-01	8.06E-02			2.46E-05	3.82E-05	6.55E-05	1.23E-05	4.99E-05	3.71E-04	4.18E-03	3.53E-02		2.95E-03
Bldg 30 RTO (Bypassed)														5.41E-03
Calciner U1&2	1.30E+00	7.85E+00	3.96E-01	1.30E+00	5.14E-04	3.47E-05	8.86E-04	7.73E-05		2.43E-04	6.12E-04		2.02E-07	1.50E-01
Calciner U3&4	2.61E+00	4.76E+00	2.82E-01	4.38E-01	4.65E-04	3.14E-05	8.02E-04	7.00E-05		2.20E-04	5.54E-04		1.83E-07	1.36E-01
Calciner U5&6	3.48E+00	7.48E+00	4.40E-01	5.57E-01	4.58E-04	3.09E-05	7.90E-04	6.89E-05		2.17E-04	5.45E-04		1.80E-07	1.34E-01
Calciner U7	4.94E+00	3.42E+00	1.04E-01	1.89E-01	6.83E-05	7.65E-05	6.64E-04	2.10E-04		2.32E-04	1.23E-03		1.93E-07	1.43E-01
Boiler 2	3.19E+00	1.48E-01	5.82E-03		0.00E+00		2.97E-09	1.12E-09	7.22E-10	8.50E-10	6.02E-10			5.27E-03
Boiler 3 & 4	1.79E+00	3.95E-02	6.19E-03		0.00E+00		1.39E-09	5.26E-10	3.38E-10	3.98E-10	2.82E-10			8.98E-03
Boiler 5, 6, & 7	6.98E+00	1.04E+00	1.51E-02		0.00E+00		6.84E-09	2.58E-09	1.66E-09	1.95E-09	1.38E-09			1.54E-02
Cogen 1	1.79E+01	3.19E+00	2.76E-02				2.13E-08	8.05E-09	3.30E-08	6.09E-09	4.32E-09			
Cogen 2	2.01E+01	6.94E+00	2.72E-02				2.03E-08	7.69E-09	3.15E-08	5.81E-09	4.12E-09			
OBF Vac Pump Stack						3.21E-06								4.52E-02
Calciner Vac Pump Stack														2.09E-01
45T Cooling Tower											6.74E-05			
Bldg 44 Vac Pump Stack														6.59E-02
Powerhouse Deaerator											1.41E-05		1.63E-09	3.42E-03
Mills Product Hopper												3.36E-01		1.24E-01
25A/C Vapour Droppers														2.31E-02
Excess BO, PRT & CT Vents					2.14E-07	3.93E-07	2.56E-06				2.28E-04	2.76E-01		1.69E-02
B34 A-Rake Vents														5.81E-03
35F Tank Vents													2.82E-07	3.17E-02
35D Tank Vents													1.96E-06	3.13E-02
35A Tank Vents													7.16E-07	2.97E-02
35R & 35S Tank Vents														9.17E-03
35J Tank Vents														9.34E-03
35C Tank Vents - Banks 1&2													2.59E-08	3.04E-03
35C Tank Vents - Banks 3-5 & 35H													3.31E-07	4.10E-02
Bauxite Stockpiles				9.50E+00	9.50E-06	4.75E-06	5.70E-05	7.60E-07	0.00E+00	2.28E-05	8.55E-07			
Residue Areas (all)				1.38E+01	1.78E-04	7.99E-05	2.34E-04	2.89E-06	2.20E-05	7.72E-05	5.23E-03		2.95E-07	6.27E-01

TABLE A.2: SCENARIO 1 AND 1A AVERAGE EMISSION RATES (G/S)

Source	NOx	CO	Acetaldehyde	Formaldehyde	2-Butanone (MEK)	Benzene	Toluene	Xylenes
Oxalate Kiln/RTO	2.05E-01	2.45E-01				1.53E-04	1.34E-04	
Bldg 30 RTO (Operating)	4.80E-01	8.06E-02	1.22E-03				4.84E-04	
Bldg 30 RTO (Bypassed)			1.96E-03		7.78E-04	4.47E-05	5.91E-04	1.44E-04
Calciner U1&2	1.30E+00	7.85E+00	2.23E-01	2.35E-01	8.36E-03	1.09E-02	3.88E-03	3.80E-04
Calciner U3&4	2.61E+00	4.76E+00	2.02E-01	2.13E-01	7.57E-03	9.87E-03	3.51E-03	3.44E-04
Calciner U5&6	3.48E+00	7.48E+00	1.99E-01	2.10E-01	7.45E-03	9.72E-03	3.46E-03	3.39E-04
Calciner U7	4.94E+00	3.42E+00	2.12E-01	1.55E-01	7.96E-03	1.04E-02	3.70E-03	3.62E-04
Boiler 2	3.19E+00	1.48E-01		6.63E-03		4.82E-05		
Boiler 3 & 4	1.79E+00	3.95E-02		7.36E-03	3.28E-04	2.26E-05	2.12E-05	
Boiler 5, 6, & 7	6.98E+00	1.04E+00		1.74E-02	1.64E-04	1.11E-04	1.06E-05	
Cogen 1	1.79E+01	3.19E+00						
Cogen 2	2.01E+01	6.94E+00						
OBF Vac Pump Stack			2.45E-03		2.43E-03		2.21E-04	3.04E-04
Calciner Vac Pump Stack			8.23E-02	6.20E-04	3.03E-02			
45T Cooling Tower								
Bldg 44 Vac Pump Stack			1.50E-02					
Powerhouse Deaerator			4.06E-03		1.47E-03	7.00E-05	1.20E-05	6.18E-06
Mills Product Hopper			8.65E-02		9.03E-03			
25A/C Vapour Droppers			1.26E-02		3.36E-03		6.94E-04	3.33E-05
Excess BO, PRT & CT Vents			7.18E-03		2.62E-03	4.44E-05	5.36E-04	5.00E-05
B34 A-Rake Vents			2.47E-03		9.01E-04	1.91E-05	1.84E-04	1.91E-05
35F Tank Vents			9.49E-03	1.75E-04	5.50E-03	1.14E-04	1.48E-03	9.63E-04
35D Tank Vents			1.85E-02	4.00E-05	8.02E-03	6.63E-05	3.31E-03	1.41E-03
35A Tank Vents			2.51E-02		8.29E-03		4.42E-03	6.32E-04
35R & 35S Tank Vents			3.50E-03		1.03E-03		5.03E-05	6.39E-05
35J Tank Vents			9.17E-03	2.06E-05	1.40E-03			
35C Tank Vents - Banks 1&2			1.31E-03	9.78E-06	3.27E-04		8.99E-05	1.59E-05
35C Tank Vents - Banks 3-5 & 35H			1.02E-02	2.93E-05	6.77E-03		1.21E-03	3.86E-04
Bauxite Stockpiles								
Residue Areas (all)			3.90E-01	1.14E-01	7.69E-02	1.11E-02	1.57E-02	2.14E-03

TABLE A.3: SCENARIO 1 AND 1A PEAK EMISSION RATES (G/S)

Source	NOx	CO	SO2	Dust	Arsenic	Selenium	Manganese	Cadmium	Chromium VI	Nickel	Mercury	Ammonia	PAHs	Acetone
Oxalate Kiln/RTO	4.52E-01	2.07E+00	7.37E-02	3.65E-02	4.12E-04	2.08E-04			2.17E-05	1.17E-04	1.40E-03			9.33E-03
Bldg 30 RTO (Operating)	8.51E-01	1.50E-01	0.00E+00	0.00E+00	8.88E-05	1.17E-04	2.62E-04	7.52E-05	2.43E-04	2.53E-03	7.49E-03	5.42E-02		
Bldg 30 RTO (Bypassed)														1.54E-01
Calciner U1&2	6.48E+00	2.70E+01	1.84E+00	5.80E+00	1.48E-03	3.96E-05	2.77E-03	1.78E-04		4.29E-04	7.59E-04		5.94E-07	7.46E-01
Calciner U3&4	9.26E+00	2.24E+01	1.89E+00	9.24E-01	1.55E-03	4.14E-05	2.90E-03	1.86E-04		4.49E-04	7.94E-04		6.21E-07	7.80E-01
Calciner U5&6	1.01E+01	2.95E+01	2.92E+00	1.78E+00	1.47E-03	3.92E-05	2.74E-03	1.76E-04		4.24E-04	7.51E-04		5.87E-07	7.38E-01
Calciner U7	1.17E+01	1.30E+01	5.74E-01	4.32E-01	1.72E-04	1.44E-04	2.50E-03	5.74E-04		5.17E-04	2.18E-03		5.17E-07	6.50E-01
Boiler 2	5.00E+00	1.13E+00	6.46E-03		0.00E+00		1.38E-08	3.06E-09	1.22E-09	2.87E-09	2.29E-09			1.88E-02
Boiler 3 & 4	2.56E+00	3.00E-01	6.88E-03		0.00E+00		6.44E-09	1.43E-09	5.69E-10	1.34E-09	1.07E-09			1.84E-02
Boiler 5, 6, & 7	1.05E+01	1.19E+01	1.67E-02		0.00E+00		3.16E-08	7.03E-09	2.79E-09	6.59E-09	5.27E-09			4.80E-02
Cogen 1	2.39E+01	9.40E+00	3.06E-02				9.87E-08	2.19E-08	3.57E-08	2.06E-08	2.68E-08			
Cogen 2	3.92E+01	3.59E+01	3.02E-02				9.42E-08	2.09E-08	3.41E-08	1.96E-08	2.56E-08			
OBF Vac Pump Stack						8.89E-06								8.89E-02
Calciner Vac Pump Stack														4.25E-01
45T Cooling Tower											6.74E-05			
Bldg 44 Vac Pump Stack														2.14E-01
Powerhouse Deaerator											1.41E-05		1.75E-09	4.26E-03
Mills Product Hopper												4.34E-01		2.66E-01
25A/C Vapour Droppers														3.21E-02
Excess BO, PRT & CT Vents					5.03E-07	1.04E-06	6.94E-06				2.28E-04	5.38E-01		5.61E-02
B34 A-Rake Vents														6.88E-03
35F Tank Vents													8.98E-07	5.74E-02
35D Tank Vents													3.32E-06	6.48E-02
35A Tank Vents													1.24E-06	3.69E-02
35R & 35S Tank Vents														2.67E-02
35J Tank Vents					1.00E-06	5.00E-07	6.00E-06	8.00E-08	0.00E+00	2.40E-06	9.00E-08			1.08E-02
35C Tank Vents - Banks 1&2					1.29E-05	5.80E-06	1.70E-05	2.10E-07	1.60E-06	5.60E-06	3.80E-04		5.79E-08	4.13E-03
35C Tank Vents - Banks 3-5 & 35H													5.51E-07	4.76E-02
Bauxite Stockpiles				9.50E+00	9.50E-06	4.75E-06	5.70E-05	7.60E-07	0.00E+00	2.28E-05	8.55E-07			
Residue Areas (all)				1.38E+01	1.78E-04	7.99E-05	2.34E-04	2.89E-06	2.20E-05	7.72E-05	5.23E-03		2.95E-07	6.27E-01

TABLE A.3: SCENARIO 1 AND 1A PEAK EMISSION RATES (G/S)

Source	NOx	CO	Acetaldehyde	Formaldehyde	2-Butanone (MEK)	Benzene	Toluene	Xylenes
Oxalate Kiln/RTO	4.52E-01	2.07E+00				3.58E-04	3.58E-04	
Bldg 30 RTO (Operating)	8.51E-01	1.50E-01						
Bldg 30 RTO (Bypassed)			5.28E-02		2.31E-02	2.50E-03	2.10E-02	5.50E-03
Calciner U1&2	6.48E+00	2.70E+01	3.72E-01	5.94E-01	1.85E-02	3.79E-02	1.42E-02	8.58E-04
Calciner U3&4	9.26E+00	2.24E+01	3.89E-01	6.21E-01	1.93E-02	3.96E-02	1.48E-02	8.97E-04
Calciner U5&6	1.01E+01	2.95E+01	3.68E-01	5.87E-01	1.83E-02	3.75E-02	1.40E-02	8.48E-04
Calciner U7	1.17E+01	1.30E+01	3.24E-01	5.17E-01	1.61E-02	3.30E-02	1.23E-02	7.47E-04
Boiler 2	5.00E+00	1.13E+00		1.41E-02		6.37E-05	6.37E-05	
Boiler 3 & 4	2.56E+00	3.00E-01		1.49E-02		2.98E-05	2.98E-05	
Boiler 5, 6, & 7	1.05E+01	1.19E+01		3.65E-02		1.46E-04	1.46E-04	
Cogen 1	2.39E+01	9.40E+00						
Cogen 2	3.92E+01	3.59E+01						
OBF Vac Pump Stack			4.30E-03		4.30E-03		3.30E-04	8.60E-04
Calciner Vac Pump Stack			1.58E-01	1.34E-03	5.75E-02			
45T Cooling Tower								
Bldg 44 Vac Pump Stack			4.25E-02	1.45E-02				
Powerhouse Deaerator			5.74E-03	0.00E+00	1.91E-03	7.93E-05	1.24E-05	6.30E-06
Mills Product Hopper			1.82E-01		1.70E-02			
25A/C Vapour Droppers			1.31E-02		3.39E-03		7.78E-04	6.67E-05
Excess BO, PRT & CT Vents			1.75E-02		7.12E-03	1.74E-04	1.91E-03	1.74E-04
B34 A-Rake Vents			3.09E-03		1.25E-03	3.06E-05	3.36E-04	3.06E-05
35F Tank Vents			1.41E-02	3.02E-04	9.87E-03	1.80E-04	2.44E-03	1.38E-03
35D Tank Vents			4.56E-02	7.66E-05	1.30E-02	7.11E-05	5.00E-03	1.78E-03
35A Tank Vents			3.33E-02		1.16E-02		7.72E-03	9.65E-04
35R & 35S Tank Vents			8.70E-03		2.07E-03	1.68E-04	8.40E-05	8.40E-05
35J Tank Vents			1.29E-02	2.08E-05	1.69E-03			
35C Tank Vents - Banks 1&2			1.93E-03	1.90E-05	5.49E-04		1.38E-04	1.55E-05
35C Tank Vents - Banks 3-5 & 35H			1.23E-02	5.71E-05	7.63E-03		1.39E-03	4.11E-04
Bauxite Stockpiles								
Residue Areas (all)			3.90E-01	1.14E-01	7.69E-02	1.11E-02	1.57E-02	2.14E-03

TABLE A.4: SCENARIO 2 AVERAGE EMISSION RATES (G/S

Source	NOx	CO	SO2	Dust	Arsenic	Selenium	Manganese	Cadmium	Chromium VI	Nickel	Mercury	Ammonia	PAHs
Oxalate Kiln/RTO	2.18E-01	1.83E-01	1.07E-02	1.05E-02	1.63E-04	6.86E-05			8.23E-06	4.01E-05	8.95E-04		
Bldg 30 RTO (Operating)	5.93E-01	3.25E-02	7.26E-02		2.39E-05	3.71E-05	6.37E-05	1.20E-05	4.85E-05	3.61E-04	4.06E-03	3.43E-02	
Bldg 30 RTO (Bypassed)													
Calciner U1&2	1.43E+00	5.52E+00	3.06E-01	7.43E-01	5.77E-04	3.89E-05	9.95E-04	8.68E-05		2.73E-04	6.87E-04		2.14E-07
Calciner U3&4	2.51E+00	5.03E+00	1.50E-01	3.26E-01	5.43E-04	3.66E-05	9.35E-04	8.16E-05		2.56E-04	6.46E-04		2.04E-07
Calciner U5&6	3.08E+00	5.51E+00	2.25E-01	3.58E-01	5.21E-04	3.51E-05	8.98E-04	7.83E-05		2.46E-04	6.19E-04		2.10E-07
Calciner U7	2.94E+00	5.50E+00	1.17E-01	3.20E-01	7.62E-05	8.53E-05	7.41E-04	2.35E-04		2.59E-04	1.38E-03		1.99E-07
Boiler 2	2.43E+00	7.49E-02	5.82E-03		0.00E+00		2.48E-09	1.31E-09	6.02E-10	7.09E-10	5.02E-10		
Boiler 3 & 4	3.08E+00	3.06E-01	6.19E-03		0.00E+00		2.52E-09	1.33E-09	6.13E-10	7.21E-10	5.11E-10		
Boiler 5, 6, & 7	6.52E+00	1.29E+00	1.51E-02		0.00E+00		6.79E-09	3.58E-09	1.65E-09	1.94E-09	1.38E-09		
Cogen 1	1.86E+01	1.96E+00	2.76E-02				1.83E-08	9.61E-09	2.83E-08	5.22E-09	3.70E-09		
Cogen 2	1.74E+01	8.54E-01	2.72E-02				1.80E-08	9.46E-09	2.78E-08	5.13E-09	3.64E-09		
OBF Vac Pump Stack						3.21E-06							
Calciner Vac Pump Stack													
45T Cooling Tower											6.74E-05		
Bldg 44 Vac Pump Stack													
Powerhouse Deaerator											1.41E-05		1.63E-09
Mills Product Hopper												3.98E-01	
25A/C Vapour Droppers													
Excess BO, PRT & CT Vents					2.14E-07	3.93E-07	2.56E-06				2.28E-04	2.76E-01	
B34 A-Rake Vents													
35F Tank Vents													2.94E-07
35D Tank Vents													1.67E-06
35A Tank Vents													7.03E-07
35R & 35S Tank Vents													
35J Tank Vents													
35C Tank Vents - Banks 1&2													2.51E-08
35C Tank Vents - Banks 3-5 & 35H													3.29E-07
Bauxite Stockpiles				1.10E+01	1.10E-05	5.51E-06	6.61E-05	8.82E-07	0.00E+00	2.64E-05	9.92E-07		
Residue Areas (all)				1.40E+01	1.80E-04	8.11E-05	2.38E-04	2.94E-06	2.24E-05	7.83E-05	6.73E-03		5.30E-06

TABLE A.4: SCENARIO 2 AVERAGE EMISSION RATES (G/S

Source	NOx	Acetone	Acetaldehyde	Formaldehyde	2-Butanone (MEK)	Benzene	Toluene	Xylenes
Oxalate Kiln/RTO	2.18E-01	2.64E-03				1.39E-04	1.22E-04	
Bldg 30 RTO (Operating)	5.93E-01	2.87E-03	1.19E-03				4.71E-04	
Bldg 30 RTO (Bypassed)		9.73E-03	3.52E-03		1.40E-03	8.03E-05	1.06E-03	2.60E-04
Calciner U1&2	1.43E+00	7.22E-02	1.68E-01	2.15E-01	6.91E-03	1.15E-02	3.92E-03	6.37E-04
Calciner U3&4	2.51E+00	6.89E-02	1.60E-01	2.05E-01	6.59E-03	1.10E-02	3.74E-03	6.07E-04
Calciner U5&6	3.08E+00	7.07E-02	1.64E-01	2.10E-01	6.77E-03	1.13E-02	3.84E-03	6.24E-04
Calciner U7	2.94E+00	6.70E-02	1.56E-01	1.99E-01	6.41E-03	1.07E-02	3.64E-03	5.91E-04
Boiler 2	2.43E+00	5.94E-03		6.20E-03		4.02E-05	3.77E-05	
Boiler 3 & 4	3.08E+00	1.63E-02		1.33E-02	5.94E-04	4.09E-05	3.84E-05	
Boiler 5, 6, & 7	6.52E+00	2.17E-02		2.07E-02	3.14E-04	1.10E-04	1.03E-04	
Cogen 1	1.86E+01							
Cogen 2	1.74E+01							
OBF Vac Pump Stack		4.52E-02	2.45E-03		2.43E-03			3.03E-04
Calciner Vac Pump Stack		1.99E-01	7.83E-02	1.31E-04	2.90E-02		3.35E-04	3.05E-04
45T Cooling Tower								
Bldg 44 Vac Pump Stack		7.84E-02	1.47E-02	5.59E-03	1.51E-02		3.16E-03	
Powerhouse Deaerator		3.42E-03	4.06E-03		1.47E-03	7.00E-05	1.20E-05	6.18E-06
Mills Product Hopper		1.42E-01	9.91E-02		1.04E-02			
25A/C Vapour Droppers		2.31E-02	1.26E-02		3.36E-03		6.94E-04	
Excess BO, PRT & CT Vents		1.69E-02	7.17E-03		2.62E-03	5.33E-05	5.33E-04	5.33E-05
B34 A-Rake Vents		5.80E-03	2.47E-03		9.01E-04	1.83E-05	1.83E-04	1.83E-05
35F Tank Vents		2.95E-02	9.01E-03	1.69E-04	5.10E-03	1.08E-04	1.42E-03	9.36E-04
35D Tank Vents		3.10E-02	1.86E-02	4.04E-05	7.84E-03	6.70E-05	3.27E-03	1.43E-03
35A Tank Vents		2.86E-02	2.43E-02		7.96E-03		4.54E-03	6.42E-04
35R & 35S Tank Vents		8.68E-03	3.33E-03		9.84E-04		5.35E-05	5.99E-05
35J Tank Vents		9.34E-03	9.17E-03	2.06E-05	1.40E-03			
35C Tank Vents - Banks 1&2		2.95E-03	1.26E-03	9.77E-06	3.18E-04		8.72E-05	1.54E-05
35C Tank Vents - Banks 3-5 & 35H		4.07E-02	1.01E-02	2.93E-05	6.74E-03		1.20E-03	3.84E-04
Bauxite Stockpiles								
Residue Areas (all)		6.26E-01	4.31E-01	1.31E-01	7.69E-02	4.12E-02	2.98E-02	2.14E-03

TABLE A.5: SCENARIO 2 PEAK EMISSION RATES (G/S)

Source	NOx	CO	SO2	Dust	Arsenic	Selenium	Manganese	Cadmium	Chromium VI	Nickel	Mercury	Ammonia	PAHs
Oxalate Kiln/RTO	1.62E-01	6.17E-01	7.10E-03	7.83E-03	4.12E-04	2.08E-04			2.17E-05	1.17E-04	1.40E-03		
Bldg 30 RTO (Operating)	3.70E-01	9.24E-02	3.35E-02		8.88E-05	1.17E-04	2.62E-04	7.52E-05	2.43E-04	2.53E-03	7.49E-03	5.42E-02	
Bldg 30 RTO (Bypassed)													
Calciner U1&2	3.98E+00	1.96E+01	1.17E+00	2.12E+00	1.78E-03	4.74E-05	3.32E-03	2.13E-04		5.14E-04	9.09E-04		2.65E-07
Calciner U3&4	5.42E+00	1.96E+01	5.79E-01	7.62E-01	1.64E-03	4.36E-05	3.05E-03	1.96E-04		4.72E-04	8.36E-04		2.44E-07
Calciner U5&6	6.31E+00	2.12E+01	8.84E-01	1.15E+00	1.51E-03	4.02E-05	2.81E-03	1.81E-04		4.35E-04	7.70E-04		2.44E-07
Calciner U7	7.19E+00	2.81E+01	8.95E-01	1.15E+00	2.19E-04	1.83E-04	3.18E-03	7.31E-04		6.58E-04	2.78E-03		2.46E-07
Boiler 2	3.47E+00	8.69E-01	6.46E-03		0.00E+00		1.18E-08	2.62E-09	1.04E-09	2.45E-09	2.18E-09		
Boiler 3 & 4	4.64E+00	6.01E+00	6.88E-03		0.00E+00		1.20E-08	2.66E-09	1.06E-09	2.50E-09	2.03E-09		
Boiler 5, 6, & 7	1.03E+01	1.43E+01	1.67E-02		0.00E+00		3.23E-08	7.17E-09	2.85E-09	6.72E-09	5.49E-09		
Cogen 1	2.31E+01	5.16E+00	3.06E-02				8.67E-08	1.93E-08	3.14E-08	1.81E-08	2.29E-08		
Cogen 2	2.30E+01	1.49E+00	3.02E-02				8.53E-08	1.90E-08	3.09E-08	1.78E-08	2.29E-08		
OBF Vac Pump Stack						8.89E-06							
Calciner Vac Pump Stack													
45T Cooling Tower											6.74E-05		
Bldg 44 Vac Pump Stack													
Powerhouse Deaerator											1.41E-05		1.87E-09
Mills Product Hopper												4.34E-01	
25A/C Vapour Droppers													
Excess BO, PRT & CT Vents					5.03E-07	1.04E-06	6.94E-06				2.28E-04	5.38E-01	
B34 A-Rake Vents													
35F Tank Vents													9.56E-07
35D Tank Vents													3.68E-06
35A Tank Vents													1.57E-06
35R & 35S Tank Vents													
35J Tank Vents													
35C Tank Vents - Banks 1&2													6.51E-08
35C Tank Vents - Banks 3-5 & 35H													5.72E-07
Bauxite Stockpiles				1.10E+01	1.10E-05	5.51E-06	6.61E-05	8.82E-07	0.00E+00	2.64E-05	9.92E-07		
Residue Areas (all)				1.40E+01	1.80E-04	8.11E-05	2.38E-04	2.94E-06	2.24E-05	7.83E-05	6.73E-03		5.30E-06

TABLE A.5: SCENARIO 2 PEAK EMISSION RATES (G/S)

Source	NOx	Acetone	Acetaldehyde	Formaldehyde	2-Butanone (MEK)	Benzene	Toluene	Xylenes
Oxalate Kiln/RTO	1.62E-01	9.30E-03		3.16E-03		1.31E-04	7.75E-05	
Bldg 30 RTO (Operating)	3.70E-01							
Bldg 30 RTO (Bypassed)		1.59E-01	5.44E-02		2.36E-02	2.58E-03	2.16E-02	5.66E-03
Calciner U1&2	3.98E+00	8.80E-01	4.46E-01	7.11E-01	3.55E-02	4.54E-02	1.70E-02	7.90E-04
Calciner U3&4	5.42E+00	8.10E-01	4.10E-01	6.54E-01	3.27E-02	4.18E-02	1.56E-02	7.26E-04
Calciner U5&6	6.31E+00	8.08E-01	4.09E-01	6.52E-01	3.26E-02	4.17E-02	1.56E-02	7.25E-04
Calciner U7	7.19E+00	8.15E-01	4.13E-01	6.58E-01	3.29E-02	4.20E-02	1.57E-02	7.31E-04
Boiler 2	3.47E+00	1.61E-02	1.20E-02	1.15E-02		4.46E-05	4.18E-05	
Boiler 3 & 4	4.64E+00	3.42E-02		2.77E-02	6.59E-04	4.54E-05	4.26E-05	
Boiler 5, 6, & 7	1.03E+01	5.34E-02	2.65E-02	3.99E-02	3.49E-04	1.22E-04	1.15E-04	
Cogen 1	2.31E+01							
Cogen 2	2.30E+01							
OBF Vac Pump Stack		7.40E-02	3.58E-03		3.58E-03			7.16E-04
Calciner Vac Pump Stack		4.73E-01	1.76E-01	1.36E-03	6.42E-02		1.45E-03	9.68E-04
45T Cooling Tower								
Bldg 44 Vac Pump Stack		2.60E-01	5.04E-02	1.76E-02	6.30E-02		4.20E-03	
Powerhouse Deaerator		3.42E-03	5.73E-03	0.00E+00	1.91E-03	7.93E-05	6.06E-05	6.30E-06
Mills Product Hopper		3.23E-01	2.21E-01		2.04E-02			
25A/C Vapour Droppers		3.21E-02	1.31E-02		3.39E-03		7.77E-04	
Excess BO, PRT & CT Vents		3.90E-02	1.40E-02		7.11E-03	1.73E-04	1.91E-03	1.73E-04
B34 A-Rake Vents		6.87E-03	2.47E-03		1.25E-03	0.00E+00	0.00E+00	0.00E+00
35F Tank Vents		6.11E-02	1.50E-02	3.22E-04	1.05E-02	1.91E-04	2.60E-03	1.47E-03
35D Tank Vents		7.18E-02	5.05E-02	8.84E-05	1.44E-02	7.87E-05	5.54E-03	1.97E-03
35A Tank Vents		4.66E-02	4.21E-02		1.46E-02		6.93E-03	1.17E-03
35R & 35S Tank Vents		1.46E-02	5.24E-03		1.43E-03		1.22E-04	1.24E-04
35J Tank Vents		1.12E-02	1.31E-02	2.08E-05	1.77E-03			
35C Tank Vents - Banks 1&2		4.65E-03	2.17E-03	2.06E-05	5.35E-04		1.56E-04	1.77E-05
35C Tank Vents - Banks 3-5 & 35H		4.92E-02	1.30E-02	6.17E-05	7.58E-03		1.44E-03	4.17E-04
Bauxite Stockpiles								
Residue Areas (all)		6.26E-01	4.31E-01	1.31E-01	7.69E-02	4.12E-02	2.98E-02	2.14E-03

TABLE A.6: SCENARIO 3 AVERAGE EMISSION RATES (G/S

Source	NOx	CO	SO2	Dust	Arsenic	Selenium	Manganese	Cadmium	Chromium VI	Nickel	Mercury	Ammonia	PAHs
Oxalate Kiln/RTO	2.18E-01	1.83E-01	1.07E-02	1.00E-02	1.63E-04	6.86E-05	0.00E+00	0.00E+00	8.23E-06	4.01E-05	8.95E-04		
Bldg 30 RTO (Operating)	5.93E-01	3.25E-02	7.26E-02		2.39E-05	3.71E-05	6.37E-05	1.20E-05	4.85E-05	3.61E-04	4.06E-03	3.43E-02	
Bldg 30 RTO (Bypassed)													
Calciner U1&2	1.73E+00	6.66E+00	3.69E-01	8.98E-01	6.98E-04	4.71E-05	1.20E-03	1.05E-04		3.30E-04	8.31E-04		
Calciner U3&4	2.78E+00	5.72E+00	1.69E-01	3.65E-01	6.11E-04	4.12E-05	1.05E-03	9.19E-05		2.89E-04	7.27E-04		
Calciner U5&6	3.57E+00	6.36E+00	2.61E-01	4.22E-01	6.08E-04	4.10E-05	1.05E-03	9.14E-05		2.87E-04	7.23E-04		
Calciner U7	3.35E+00	6.28E+00	1.34E-01	3.66E-01	8.71E-05	9.75E-05	8.47E-04	2.68E-04		2.96E-04	1.57E-03		
Boiler 2	2.88E+00	8.87E-02	6.90E-03				2.94E-09	1.55E-09	7.14E-10	8.40E-10	5.95E-10		
Boiler 3 & 4	3.27E+00	3.15E-01	6.72E-03				2.74E-09	1.44E-09	6.65E-10	7.82E-10	5.54E-10		
Boiler 5, 6, & 7	7.05E+00	1.41E+00	1.64E-02				7.40E-09	3.89E-09	1.80E-09	2.11E-09	1.50E-09		
Cogen 1	1.67E+01	2.96E+00	2.47E-02				1.63E-08	8.60E-09	2.53E-08	4.67E-09	3.31E-09		
Cogen 2	1.58E+01	1.99E+00	2.48E-02				1.63E-08	8.59E-09	2.53E-08	4.66E-09	3.31E-09		
OBF Vac Pump Stack						3.21E-06							
Calciner Vac Pump Stack													
45T Cooling Tower											6.74E-05		
Bldg 44 Vac Pump Stack													
Powerhouse Deaerator											1.41E-05		1.63E-09
Mills Product Hopper												3.98E-01	
25A/C Vapour Droppers													
Excess BO, PRT & CT Vents					2.14E-07	3.93E-07	2.56E-06				2.28E-04	2.76E-01	
B34 A-Rake Vents													
35F Tank Vents													2.94E-07
35D Tank Vents													1.67E-06
35A Tank Vents													7.03E-07
35R & 35S Tank Vents													
35J Tank Vents													
35C Tank Vents - Banks 1&2													2.51E-08
35C Tank Vents - Banks 3-5 & 35H													3.29E-07
Bauxite Stockpiles				1.20E+01	1.20E-05	5.99E-06	7.19E-05	9.58E-07	0.00E+00	2.88E-05	1.08E-06		
Residue Areas (all)				1.08E+01	1.39E-04	6.27E-05	1.84E-04	2.27E-06	1.73E-05	6.05E-05	8.22E-03		4.80E-06

TABLE A.6: SCENARIO 3 AVERAGE EMISSION RATES (G/S

Source	NOx	Acetone	Acetaldehyde	Formaldehyde	2-Butanone (MEK)	Benzene	Toluene	Xylenes
Oxalate Kiln/RTO	2.18E-01	2.64E-03				1.39E-04		
Bldg 30 RTO (Operating)	5.93E-01	2.87E-03	1.19E-03				4.71E-04	
Bldg 30 RTO (Bypassed)		9.73E-03	3.52E-03		1.40E-03	8.03E-05	1.06E-03	2.60E-04
Calciner U1&2	1.73E+00	7.22E-02	1.68E-01	2.15E-01	6.91E-03	1.15E-02	3.92E-03	6.37E-04
Calciner U3&4	2.78E+00	6.89E-02	1.60E-01	2.05E-01	6.59E-03	1.10E-02	3.74E-03	6.07E-04
Calciner U5&6	3.57E+00	7.07E-02	1.64E-01	2.10E-01	6.77E-03	1.13E-02	3.84E-03	6.24E-04
Calciner U7	3.35E+00	6.70E-02	1.56E-01	1.99E-01	6.41E-03	1.07E-02	3.64E-03	5.91E-04
Boiler 2	2.88E+00	7.04E-03		7.35E-03	0.00E+00	4.76E-05	4.47E-05	
Boiler 3 & 4	3.27E+00	1.76E-02		1.45E-02	6.44E-04	4.43E-05	4.16E-05	
Boiler 5, 6, & 7	7.05E+00	2.29E-02		2.21E-02	3.03E-04	1.20E-04	1.12E-04	
Cogen 1	1.67E+01							
Cogen 2	1.58E+01							
OBF Vac Pump Stack		4.52E-02	2.45E-03		2.43E-03			3.03E-04
Calciner Vac Pump Stack		1.99E-01	7.83E-02	1.31E-04	2.90E-02		3.35E-04	3.05E-04
45T Cooling Tower								
Bldg 44 Vac Pump Stack		7.84E-02	1.47E-02	5.59E-03	1.51E-02		3.16E-03	
Powerhouse Deaerator		3.42E-03	4.06E-03		1.47E-03	7.00E-05	1.20E-05	6.18E-06
Mills Product Hopper		1.60E-01	1.12E-01		1.16E-02			
25A/C Vapour Droppers		2.31E-02	1.26E-02		3.36E-03		6.94E-04	
Excess BO, PRT & CT Vents		1.69E-02	7.17E-03		2.62E-03	5.33E-05	5.33E-04	5.33E-05
B34 A-Rake Vents		5.80E-03	2.47E-03		9.01E-04	0.00E+00	0.00E+00	0.00E+00
35F Tank Vents		2.95E-02	9.01E-03	1.69E-04	5.10E-03	1.08E-04	1.42E-03	9.36E-04
35D Tank Vents		3.10E-02	1.86E-02	4.04E-05	7.84E-03	6.70E-05	3.27E-03	1.43E-03
35A Tank Vents		2.86E-02	2.43E-02		7.96E-03		4.54E-03	6.42E-04
35R & 35S Tank Vents		8.68E-03	3.33E-03		9.84E-04		5.35E-05	5.99E-05
35J Tank Vents		9.34E-03	9.17E-03	2.06E-05	1.40E-03			
35C Tank Vents - Banks 1&2		2.95E-03	1.26E-03	9.77E-06	3.18E-04		8.72E-05	1.54E-05
35C Tank Vents - Banks 3-5 & 35H		4.07E-02	1.01E-02	2.93E-05	6.74E-03		1.20E-03	3.84E-04
Bauxite Stockpiles								
Residue Areas (all)		5.72E-01	4.15E-01	1.42E-01	7.09E-02	3.84E-02	2.88E-02	2.00E-03

TABLE A.7: SCENARIO 3 PEAK EMISSION RATES (G/S)

Source	NOx	CO	SO2	Dust	Arsenic	Selenium	Manganese	Cadmium	Chromium VI	Nickel	Mercury	Ammonia	PAHs
Oxalate Kiln/RTO	4.62E-01	6.15E-01	4.94E-02	3.56E-02	4.12E-04	2.08E-04	0.00E+00	0.00E+00	2.17E-05	1.17E-04	1.40E-03		
Bldg 30 RTO (Operating)	1.32E+00	1.77E-01	2.72E-01		8.88E-05	1.17E-04	2.62E-04	7.52E-05	2.43E-04	2.53E-03	7.49E-03	5.42E-02	
Bldg 30 RTO (Bypassed)													
Calciner U1&2	4.31E+00	2.15E+01	1.28E+00	2.30E+00	1.93E-03	5.15E-05	3.60E-03	2.32E-04		5.58E-04	9.87E-04		2.88E-07
Calciner U3&4	6.11E+00	2.28E+01	6.72E-01	8.66E-01	1.89E-03	5.04E-05	3.53E-03	2.27E-04		5.46E-04	9.66E-04		2.82E-07
Calciner U5&6	6.77E+00	2.28E+01	9.48E-01	1.24E+00	1.73E-03	4.62E-05	3.23E-03	2.08E-04		5.00E-04	8.85E-04		2.61E-07
Calciner U7	7.67E+00	3.00E+01	9.54E-01	1.23E+00	2.34E-04	1.95E-04	3.39E-03	7.80E-04		7.02E-04	2.96E-03		2.62E-07
Boiler 2	3.85E+00	9.66E-01	7.18E-03		0.00E+00		1.31E-08	2.91E-09	1.61E-09	2.73E-09	3.05E-09		
Boiler 3 & 4	4.63E+00	5.74E+00	7.00E-03		0.00E+00		1.22E-08	2.71E-09	1.50E-09	2.54E-09	2.85E-09		
Boiler 5, 6, & 7	1.05E+01	1.47E+01	1.70E-02		0.00E+00		3.29E-08	7.32E-09	4.05E-09	6.86E-09	7.69E-09		
Cogen 1	2.18E+01	4.87E+00	2.89E-02				8.45E-08	1.88E-08	3.06E-08	1.76E-08	1.48E-08		
Cogen 2	2.36E+01	3.26E+00	3.09E-02				8.43E-08	1.87E-08	3.05E-08	1.76E-08	1.46E-08		
OBF Vac Pump Stack						8.89E-06							
Calciner Vac Pump Stack													
45T Cooling Tower											6.74E-05		
Bldg 44 Vac Pump Stack													
Powerhouse Deaerator											1.41E-05		1.87E-09
Mills Product Hopper												4.34E-01	
25A/C Vapour Droppers													
Excess BO, PRT & CT Vents					5.03E-07	1.04E-06	6.94E-06				2.28E-04	5.38E-01	
B34 A-Rake Vents													
35F Tank Vents													9.56E-07
35D Tank Vents													3.68E-06
35A Tank Vents													1.57E-06
35R & 35S Tank Vents													
35J Tank Vents													
35C Tank Vents - Banks 1&2													6.51E-08
35C Tank Vents - Banks 3-5 & 35H													5.72E-07
Bauxite Stockpiles				1.20E+01	1.20E-05	5.99E-06	7.19E-05	9.58E-07	0.00E+00	2.88E-05	1.08E-06		
Residue Areas (all)				1.08E+01	1.39E-04	6.27E-05	1.84E-04	2.27E-06	1.73E-05	6.05E-05	8.22E-03		4.80E-06

TABLE A.7: SCENARIO 3 PEAK EMISSION RATES (G/S)

Source	NOx	Acetone	Acetaldehyde	Formaldehyde	2-Butanone (MEK)	Benzene	Toluene	Xylenes
Oxalate Kiln/RTO	4.62E-01	9.30E-03		3.16E-03		1.31E-04	7.75E-05	
Bldg 30 RTO (Operating)	1.32E+00							
Bldg 30 RTO (Bypassed)		1.59E-01	5.44E-02		2.36E-02	2.58E-03	2.16E-02	5.66E-03
Calciner U1&2	4.31E+00	9.56E-01	4.84E-01	7.72E-01	3.86E-02	4.93E-02	1.84E-02	8.57E-04
Calciner U3&4	6.11E+00	9.36E-01	4.74E-01	7.55E-01	3.78E-02	4.82E-02	1.80E-02	8.39E-04
Calciner U5&6	6.77E+00	8.67E-01	4.39E-01	7.00E-01	3.50E-02	4.47E-02	1.67E-02	7.78E-04
Calciner U7	7.67E+00	8.69E-01	4.40E-01	7.01E-01	3.51E-02	4.48E-02	1.68E-02	7.79E-04
Boiler 2	3.85E+00	1.79E-02	1.34E-02	1.28E-02		4.95E-05	4.65E-05	
Boiler 3 & 4	4.63E+00	3.47E-02		2.82E-02	6.71E-04	4.61E-05	4.33E-05	
Boiler 5, 6, & 7	1.05E+01	5.35E-02	2.78E-02	3.98E-02	3.16E-04	1.25E-04	1.17E-04	
Cogen 1	2.18E+01							
Cogen 2	2.36E+01							
OBF Vac Pump Stack		7.40E-02	3.58E-03	0.00E+00	3.58E-03	0.00E+00		7.16E-04
Calciner Vac Pump Stack		4.73E-01	1.76E-01	1.36E-03	6.42E-02	0.00E+00	1.45E-03	9.68E-04
45T Cooling Tower		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bldg 44 Vac Pump Stack		2.60E-01	5.04E-02	1.76E-02	6.30E-02	0.00E+00	4.20E-03	0.00E+00
Powerhouse Deaerator		3.42E-03	5.73E-03	0.00E+00	1.91E-03	7.93E-05	6.06E-05	6.30E-06
Mills Product Hopper		3.23E-01	2.21E-01		2.04E-02			
25A/C Vapour Droppers		3.21E-02	1.31E-02		3.39E-03		7.77E-04	
Excess BO, PRT & CT Vents		3.90E-02	1.40E-02		7.11E-03	1.73E-04	1.91E-03	1.73E-04
B34 A-Rake Vents		6.87E-03	2.47E-03		1.25E-03	0.00E+00	0.00E+00	0.00E+00
35F Tank Vents		6.11E-02	1.50E-02	3.22E-04	1.05E-02	1.91E-04	2.60E-03	1.47E-03
35D Tank Vents		7.18E-02	5.05E-02	8.84E-05	1.44E-02	7.87E-05	5.54E-03	1.97E-03
35A Tank Vents		4.66E-02	4.21E-02		1.46E-02		6.93E-03	1.17E-03
35R & 35S Tank Vents		1.46E-02	5.24E-03		1.43E-03	0.00E+00	1.22E-04	1.24E-04
35J Tank Vents		1.12E-02	1.31E-02	2.08E-05	1.77E-03			
35C Tank Vents - Banks 1&2		4.65E-03	2.17E-03	2.06E-05	5.35E-04		1.56E-04	1.77E-05
35C Tank Vents - Banks 3-5 & 35H		4.92E-02	1.30E-02	6.17E-05	7.58E-03		1.44E-03	4.17E-04
Bauxite Stockpiles								
Residue Areas (all)		5.72E-01	4.15E-01	1.42E-01	7.09E-02	3.84E-02	2.88E-02	2.00E-03

TABLE A.8: SCENARIO 4 AVERAGE EMISSION RATES (G/S

Source	NOx	CO	SO2	Dust	Arsenic	Selenium	Manganese	Cadmium	Chromium VI	Nickel	Mercury	Ammonia	PAHs
Oxalate Kiln/RTO	2.18E-01	1.83E-01	1.07E-02	1.05E-02	1.63E-04	6.86E-05			8.23E-06	4.01E-05	8.95E-04		
Bldg 30 RTO (Operating)	5.93E-01	3.25E-02	7.26E-02		2.39E-05	3.71E-05	6.37E-05	1.20E-05	4.85E-05	3.61E-04	4.06E-03	3.43E-02	
Bldg 30 RTO (Bypassed)													
Calciner U1&2	1.73E+00	6.66E+00	3.69E-01	8.98E-01	6.98E-04	4.71E-05	1.20E-03	1.05E-04		3.30E-04	8.31E-04		2.14E-07
Calciner U3&4	2.78E+00	5.72E+00	1.69E-01	3.65E-01	6.11E-04	4.12E-05	1.05E-03	9.19E-05		2.89E-04	7.27E-04		2.04E-07
Calciner U5&6	3.57E+00	6.36E+00	2.61E-01	4.22E-01	6.08E-04	4.10E-05	1.05E-03	9.14E-05		2.87E-04	7.23E-04		2.10E-07
Calciner U7	3.35E+00	6.28E+00	1.34E-01	3.66E-01	8.71E-05	9.75E-05	8.47E-04	2.68E-04		2.96E-04	1.57E-03		1.99E-07
Boiler 2	2.79E+00	8.60E-02	6.69E-03				2.86E-09	1.50E-09	6.94E-10	8.17E-10	5.79E-10		
Boiler 3 & 4	3.17E+00	3.05E-01	6.52E-03				2.66E-09	1.40E-09	6.46E-10	7.61E-10	5.39E-10		
Boiler 5, 6, & 7	6.84E+00	1.37E+00	1.59E-02				7.19E-09	3.79E-09	1.75E-09	2.06E-09	1.46E-09		
Cogen 1	1.62E+01	9.86E+01	2.46E-02				1.63E-08	8.57E-09	2.52E-08	4.65E-09	3.30E-09		
Cogen 2	1.74E+01	9.44E+01	2.49E-02				1.64E-08	8.64E-09	2.54E-08	4.69E-09	3.32E-09		
OBF Vac Pump Stack						3.21E-06							
Calciner Vac Pump Stack													
45T Cooling Tower											6.74E-05		
Bldg 44 Vac Pump Stack													
Powerhouse Deaerator											1.41E-05		1.63E-09
Mills Product Hopper												3.36E-01	
25A/C Vapour Droppers													
Excess BO, PRT & CT Vents					2.14E-07	3.93E-07	2.56E-06				2.28E-04	2.76E-01	
B34 A-Rake Vents													
35F Tank Vents													2.94E-07
35D Tank Vents													1.67E-06
35A Tank Vents													7.03E-07
35R & 35S Tank Vents													
35J Tank Vents													
35C Tank Vents - Banks 1&2													2.51E-08
35C Tank Vents - Banks 3-5 & 35H													3.29E-07
Bauxite Stockpiles				1.20E+01	1.20E-05	5.99E-06	7.19E-05	9.58E-07	0.00E+00	2.88E-05	1.08E-06		
Residue Areas (all)				1.08E+01	1.39E-04	6.27E-05	1.84E-04	2.27E-06	1.73E-05	6.05E-05	8.22E-03		4.80E-06

TABLE A.8: SCENARIO 4 AVERAGE EMISSION RATES (G/S

Source	NOx	Acetone	Acetaldehyde	Formaldehyde	2-Butanone (MEK)	Benzene	Toluene	Xylenes
Oxalate Kiln/RTO	2.18E-01	2.64E-03				1.39E-04	1.22E-04	
Bldg 30 RTO (Operating)	5.93E-01	2.87E-03	1.19E-03				4.71E-04	
Bldg 30 RTO (Bypassed)		9.73E-03	3.52E-03		1.40E-03	8.03E-05	1.06E-03	2.60E-04
Calciner U1&2	1.73E+00	7.22E-02	1.68E-01	2.15E-01	6.91E-03	1.15E-02	3.92E-03	6.37E-04
Calciner U3&4	2.78E+00	6.89E-02	1.60E-01	2.05E-01	6.59E-03	1.10E-02	3.74E-03	6.07E-04
Calciner U5&6	3.57E+00	7.07E-02	1.64E-01	2.10E-01	6.77E-03	1.13E-02	3.84E-03	6.24E-04
Calciner U7	3.35E+00	6.70E-02	1.56E-01	1.99E-01	6.41E-03	1.07E-02	3.64E-03	5.91E-04
Boiler 2	2.79E+00	6.85E-03		7.15E-03	0.00E+00	4.63E-05	4.34E-05	
Boiler 3 & 4	3.17E+00	1.72E-02		1.41E-02	6.27E-04	4.31E-05	4.05E-05	
Boiler 5, 6, & 7	6.84E+00	2.23E-02		2.15E-02	2.95E-04	1.17E-04	1.09E-04	
Cogen 1	1.62E+01							
Cogen 2	1.74E+01							
OBF Vac Pump Stack		4.52E-02	2.45E-03		2.43E-03			3.03E-04
Calciner Vac Pump Stack		1.99E-01	7.83E-02	1.31E-04	2.90E-02		3.35E-04	3.05E-04
45T Cooling Tower								
Bldg 44 Vac Pump Stack		7.84E-02	1.47E-02	5.59E-03	1.51E-02		3.16E-03	
Powerhouse Deaerator		3.42E-03	4.06E-03		1.47E-03	7.00E-05	1.20E-05	6.18E-06
Mills Product Hopper		1.61E-01	1.12E-01		1.17E-02			
25A/C Vapour Droppers		2.31E-02	1.26E-02		3.36E-03		6.94E-04	
Excess BO, PRT & CT Vents		1.69E-02	7.17E-03		2.62E-03	5.33E-05	5.33E-04	5.33E-05
B34 A-Rake Vents		5.80E-03	2.47E-03		9.01E-04	0.00E+00	0.00E+00	0.00E+00
35F Tank Vents		2.95E-02	9.01E-03	1.69E-04	5.10E-03	1.08E-04	1.42E-03	9.36E-04
35D Tank Vents		3.10E-02	1.86E-02	4.04E-05	7.84E-03	6.70E-05	3.27E-03	1.43E-03
35A Tank Vents		2.86E-02	2.43E-02		7.96E-03		4.54E-03	6.42E-04
35R & 35S Tank Vents		8.68E-03	3.33E-03		9.84E-04		5.35E-05	5.99E-05
35J Tank Vents		9.34E-03	9.17E-03	2.06E-05	1.40E-03			
35C Tank Vents - Banks 1&2		2.95E-03	1.26E-03	9.77E-06	3.18E-04		8.72E-05	1.54E-05
35C Tank Vents - Banks 3-5 & 35H		4.07E-02	1.01E-02	2.93E-05	6.74E-03		1.20E-03	3.84E-04
Bauxite Stockpiles								
Residue Areas (all)		5.72E-01	4.15E-01	1.42E-01	7.09E-02	3.84E-02	2.88E-02	2.00E-03

TABLE A.9: SCENARIO 4 PEAK EMISSION RATES (G/S)

Source	NOx	CO	SO2	Dust	Arsenic	Selenium	Manganese	Cadmium	Chromium VI	Nickel	Mercury	Ammonia	PAHs
Oxalate Kiln/RTO	4.62E-01	6.15E-01	4.94E-02	3.56E-02	4.12E-04	2.08E-04	0.00E+00	0.00E+00	2.17E-05	1.17E-04	1.40E-03	0.00E+00	
Bldg 30 RTO (Operating)	1.32E+00	1.77E-01	2.72E-01		8.88E-05	1.17E-04	2.62E-04	7.52E-05	2.43E-04	2.53E-03	7.49E-03	5.42E-02	
Bldg 30 RTO (Bypassed)													
Calciner U1&2	4.31E+00	2.15E+01	1.28E+00	2.30E+00	1.93E-03	5.15E-05	3.60E-03	2.32E-04		5.58E-04	9.87E-04		2.88E-07
Calciner U3&4	6.11E+00	2.28E+01	6.72E-01	8.66E-01	1.89E-03	5.04E-05	3.53E-03	2.27E-04		5.46E-04	9.66E-04		2.82E-07
Calciner U5&6	6.77E+00	2.28E+01	9.48E-01	1.24E+00	1.73E-03	4.62E-05	3.23E-03	2.08E-04		5.00E-04	8.85E-04		2.61E-07
Calciner U7	7.67E+00	3.00E+01	9.54E-01	1.23E+00	2.34E-04	1.95E-04	3.39E-03	7.80E-04		7.02E-04	2.96E-03		2.62E-07
Boiler 2	4.31E+00	1.08E+00	8.04E-03		0.00E+00		1.47E-08	3.26E-09	1.80E-09	3.05E-09			
Boiler 3 & 4	5.18E+00	6.43E+00	7.84E-03		0.00E+00		1.37E-08	3.04E-09	1.68E-09	2.85E-09			
Boiler 5, 6, & 7	1.17E+01	1.64E+01	1.91E-02		0.00E+00		3.69E-08	8.20E-09	4.54E-09	7.69E-09			
Cogen 1	2.01E+01	3.36E+02	2.50E-02				7.09E-08	1.58E-08	2.57E-08	1.48E-08			
Cogen 2	2.02E+01	2.94E+02	2.48E-02				7.00E-08	1.56E-08	2.53E-08	1.46E-08			
OBF Vac Pump Stack						8.89E-06							
Calciner Vac Pump Stack													
45T Cooling Tower											6.74E-05		
Bldg 44 Vac Pump Stack													
Powerhouse Deaerator											1.41E-05		1.87E-09
Mills Product Hopper												4.34E-01	
25A/C Vapour Droppers													
Excess BO, PRT & CT Vents					5.03E-07	1.04E-06	6.94E-06				2.28E-04	5.38E-01	
B34 A-Rake Vents													
35F Tank Vents													9.56E-07
35D Tank Vents													3.68E-06
35A Tank Vents													1.57E-06
35R & 35S Tank Vents													
35J Tank Vents													
35C Tank Vents - Banks 1&2													6.51E-08
35C Tank Vents - Banks 3-5 & 35H													5.72E-07
Bauxite Stockpiles				1.20E+01	1.20E-05	5.99E-06	7.19E-05	9.58E-07	0.00E+00	2.88E-05	1.08E-06		
Residue Areas (all)				1.08E+01	1.39E-04	6.27E-05	1.84E-04	2.27E-06	1.73E-05	6.05E-05	8.22E-03		4.80E-06

TABLE A.9: SCENARIO 4 PEAK EMISSION RATES (G/S)

Source	NOx	Acetone	Acetaldehyde	Formaldehyde	2-Butanone (MEK)	Benzene	Toluene	Xylenes
Oxalate Kiln/RTO	4.62E-01	9.30E-03		3.16E-03		1.31E-04	7.75E-05	
Bldg 30 RTO (Operating)	1.32E+00							
Bldg 30 RTO (Bypassed)		1.59E-01	5.44E-02		2.36E-02	2.58E-03	2.16E-02	5.66E-03
Calciner U1&2	4.31E+00	9.56E-01	4.84E-01	7.72E-01	3.86E-02	4.93E-02	1.84E-02	8.57E-04
Calciner U3&4	6.11E+00	9.36E-01	4.74E-01	7.55E-01	3.78E-02	4.82E-02	1.80E-02	8.39E-04
Calciner U5&6	6.77E+00	8.67E-01	4.39E-01	7.00E-01	3.50E-02	4.47E-02	1.67E-02	7.78E-04
Calciner U7	7.67E+00	8.69E-01	4.40E-01	7.01E-01	3.51E-02	4.48E-02	1.68E-02	7.79E-04
Boiler 2	4.31E+00	2.00E-02	1.50E-02	1.43E-02		5.55E-05	5.21E-05	
Boiler 3 & 4	5.18E+00	3.89E-02		3.16E-02	7.51E-04	5.17E-05	4.85E-05	
Boiler 5, 6, & 7	1.17E+01	5.99E-02	3.12E-02	4.46E-02	3.54E-04	1.40E-04	1.31E-04	
Cogen 1	2.01E+01							
Cogen 2	2.02E+01							
OBF Vac Pump Stack		7.40E-02	3.58E-03		3.58E-03			7.16E-04
Calciner Vac Pump Stack		4.73E-01	1.76E-01	1.36E-03	6.42E-02		1.45E-03	9.68E-04
45T Cooling Tower								
Bldg 44 Vac Pump Stack		2.60E-01	5.04E-02	1.76E-02	6.30E-02		4.20E-03	
Powerhouse Deaerator		3.42E-03	5.73E-03		1.91E-03	7.93E-05	6.06E-05	6.30E-06
Mills Product Hopper		3.23E-01	2.21E-01		2.04E-02			
25A/C Vapour Droppers		3.21E-02	1.31E-02		3.39E-03		7.77E-04	
Excess BO, PRT & CT Vents		3.90E-02	1.40E-02		7.11E-03	1.73E-04	1.91E-03	1.73E-04
B34 A-Rake Vents		6.87E-03	2.47E-03		1.25E-03	0.00E+00	0.00E+00	0.00E+00
35F Tank Vents		6.11E-02	1.50E-02	3.22E-04	1.05E-02	1.91E-04	2.60E-03	1.47E-03
35D Tank Vents		7.18E-02	5.05E-02	8.84E-05	1.44E-02	7.87E-05	5.54E-03	1.97E-03
35A Tank Vents		4.66E-02	4.21E-02		1.46E-02		6.93E-03	1.17E-03
35R & 35S Tank Vents		1.46E-02	5.24E-03		1.43E-03	0.00E+00	1.22E-04	1.24E-04
35J Tank Vents		1.12E-02	1.31E-02	2.08E-05	1.77E-03			
35C Tank Vents - Banks 1&2		4.65E-03	2.17E-03	2.06E-05	5.35E-04		1.56E-04	1.77E-05
35C Tank Vents - Banks 3-5 & 35H		4.92E-02	1.30E-02	6.17E-05	7.58E-03		1.44E-03	4.17E-04
Bauxite Stockpiles								
Residue Areas (all)		5.72E-01	4.15E-01	1.42E-01	7.09E-02	3.84E-02	2.88E-02	2.00E-03

TABLE A.10: HEALTH PROTECTIVE GUIDELINES [(1)]

			Acute Health Effects								Chronic He			
			Scenario 1				Scenarios 1A, 2, 3 and 4				Scenario 1			
No	**CAS # / ID**	**Compound Name**	Guideline	Units	Averaging Period	Reference	Guideline	Units	Averaging Period	Reference	Guideline	Units	Averaging Period	Reference
1	10102-44-0	Oxides of Nitrogen	246	µg/m^3	1	NEPC	246	µg/m^3	1	NEPC	62	µg/m^3	Annual	NEPC
2	630-08-0	Carbon monoxide	11,250	µg/m^3	8	NEPC	11,250	µg/m^3	8	NEPC				
3	7446-09-5	Sulphur dioxide	571	µg/m^3	1	NEPC	571	µg/m^3	1	NEPC	57	µg/m^3	Annual	NEPC
4	PM10	Particulate matter <10 µm	50	µg/m^3	24	NEPC	50	µg/m^3	24	NEPC				
5	7440-38-2	Arsenic					0.2	µg/m^3	1	OEHHA	1	µg/m^3	Annual	RIVM
6	7782-49-2	Selenium									20	µg/m^3	Annual	OEHHA
7	7439-96-5	Manganese									0.15	µg/m^3	Annual	WHO
8	7440-43-9	Cadmium					0.03	µg/m^3	24	ATSDR	0.005	µg/m^3	Annual	WHO
9	18540-29-9	Chromium (VI)									0.1	µg/m^3	Annual	IRIS
10	7440-02-0	Nickel	6	µg/m^3	1	OEHHA	0.2	µg/m^3	1	OEHHA	0.09	µg/m^3	Annual	ATSDR
11	7439-97-6	Mercury	1.8	µg/m^3	1	OEHHA	0.6	µg/m^3	1	OEHHA	1	µg/m^3	Annual	WHO
12	7664-41-7	Ammonia	3,200	µg/m^3	1	OEHHA	1293	µg/m^3	24	ATSDR	100	µg/m^3	Annual	IRIS
13	PAHs	Polycyclic Aromatic Hydrocarbons												
14	67-64-1	Acetone	67,414	µg/m^3	24	ATSDR	67,414	µg/m^3	24	ATSDR	33,707	µg/m^3	Annual	ATSDR
15	75-07-0	Acetaldehyde	2,000	µg/m^3	24	WHOa	2,000	µg/m^3	24	WHO (1995)	50	µg/m^3	Annual	WHO
16	50-00-0	Formaldehyde	54	µg/m^3	24	NEPC (AT)	54	µg/m^3	24	NEPC (AT)	11	µg/m^3	Annual	ATSDR
17	78-93-3	2-Butanone	13,000	µg/m^3	1	OEHHA	13,000	µg/m^3	1	OEHHA	5,000	µg/m^3	Annual	IRIS
18	71-43-2	Benzene	1,300	µg/m^3	6	OEHHA	27	µg/m^3	1	OEHHA	60	µg/m^3	Annual	OEHHA
19	108-88-3	Toluene	4,113	µg/m^3	24	NEPC (AT)	4,113	µg/m^3	24	NEPC (AT)	411	µg/m^3	Annual	NEPC (AT)
20	1330-20-7	Xylenes	1,183	µg/m^3	24	NEPC (AT)	1,183	µg/m^3	24	NEPC (AT)	946	µg/m^3	Annual	NEPC (AT)

TABLE A.10: HEALTH PROTECTIVE GUIDELINES [(1)]

			alth Effects					Carcinogenic Health Effects		
				Scenarios 1A, 2, 3 and 4				Scenarios 1, 1A, 2, 3 and 4		
No	**CAS # / ID**	**Compound Name**	Guideline	Guideline	Units	Averaging Period	Reference	Guideline	Units	Reference
1	10102-44-0	Oxides of Nitrogen	246	62	µg/m^3	Annual	NEPC			
2	630-08-0	Carbon monoxide	11,250							
3	7446-09-5	Sulphur dioxide	571	57	µg/m^3	Annual	NEPC			
4	PM10	Particulate matter <10 µm	50							
5	7440-38-2	Arsenic		1	µg/m^3	Annual	RIVM	1.50E-03	per µg/m^3	WHO
6	7782-49-2	Selenium		20	µg/m^3	Annual	OEHHA			
7	7439-96-5	Manganese		0.15	µg/m^3	Annual	WHO			
8	7440-43-9	Cadmium		0.005	µg/m^3	Annual	WHO	1.80E-03	per µg/m^3	IRIS
9	18540-29-9	Chromium (VI)		0.1	µg/m^3	Annual	IRIS	4.00E-02	per µg/m^3	WHO
10	7440-02-0	Nickel	6	0.09	µg/m^3	Annual	ATSDR	3.80E-04	per µg/m^3	WHO
11	7439-97-6	Mercury	1.8	0.2	µg/m3	Annual	WHO (2003)			
12	7664-41-7	Ammonia	3,200	100	µg/m^3	Annual	IRIS			
13	PAHs	Polycyclic Aromatic Hydrocarbons						8.70E-02	per µg/m^3	WHO
14	67-64-1	Acetone	67,414	33,707	µg/m^3	Annual	ATSDR			
15	75-07-0	Acetaldehyde	2,000	50	µg/m^3	Annual	WHO	9.00E-07	per µg/m^3	WHO
16	50-00-0	Formaldehyde	54	11	µg/m^3	Annual	ATSDR	1.30E-05	per µg/m^3	IRIS
17	78-93-3	2-Butanone	13,000	5,000	µg/m^3	Annual	IRIS			
18	71-43-2	Benzene	1,300	3	µg/m^3	Annual	OEHHA	6.00E-06	per µg/m^3	WHO
19	108-88-3	Toluene	4,113	411	µg/m^3	Annual	NEPC (AT)			
20	1330-20-7	Xylenes	1,183	946	µg/m^3	Annual	NEPC (AT)			

TABLE A.10: HEALTH PROTECTIVE GUIDELINES

Notes:

Blanks in the table indicate that no applicable guideline was able to be identified.
NEPC: National Environment Protection (Ambient Air Quality) Measure (NEPC, 2003)
NEPC (AT): National Environment Protection (Air Toxics) Measure, (NEPC, 2004)
WHO: World Health Organisation (WHO) Air Quality Guidelines for Europe Second Edition (2000)
WHO (1995): EHC 167 Environmental Health Criteria 167 Acetaldehyde, International Programme on Chemical Safety
WHO (2003): CICAD 50 Elemental Mercury and Inorganic Mercury Compounds: Human Health Aspects
OEHHA: California Office of Environmental Health Hazard Assessment's (OEHHA) Toxicity Criteria Database
ATSDR: U.S. Agency for Toxic Substances and Disease Registry's (ATSDR) Minimal Risk Levels (MRLs) for Hazardous Substances
IRIS: U.S. Environment Protection Agency's (USEPA) Integrated Risk Information System (IRIS)
RIVM: Dutch National Institute of Public Health and the Environment (RIVM) human-toxicological Maximum Permissible Risk Levels (2001)

TABLE A.11: QUANTITATIVE HEALTH RISK INDICATORS

			Scenario 1 - Acute												Scenario 1 - Acute									
			Receptor 2		Receptor 3		Receptor 4		Receptor 5		Receptor 6		Receptor 7		Receptor 8		Receptor 9		Receptor 10		Receptor 11		Receptor 12	
No	**CAS # / ID**	**Compound Name**	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest
1	10102-44-0	Nitrogen Dioxide	2.02E-01	9.08E-02	1.84E-01	1.77E-01	7.05E-07	1.52E-05	1.80E-01	2.02E-01	1.69E-01	1.88E-01	1.56E-01	1.65E-01	1.85E-01	1.72E-01	1.88E-01	1.49E-01	1.87E-01	1.81E-01	1.89E-01	1.96E-01	2.37E-01	2.03E-01
2	630-08-0	Carbon monoxide	7.67E-03	9.96E-04	1.15E-03	1.01E-03	1.02E-06	1.01E-06	3.62E-03	3.57E-03	4.84E-03	1.04E-03	4.15E-03	1.75E-03	3.18E-03	4.17E-03	7.13E-03	5.73E-03	3.28E-03	1.48E-03	2.77E-03	1.68E-03	1.58E-03	1.90E-03
3	7446-09-5	Sulphur dioxide	2.66E-02	4.46E-03	9.35E-03	9.10E-03	3.25E-08	5.51E-07	1.36E-02	1.03E-02	9.54E-03	1.06E-02	1.07E-02	1.08E-02	1.26E-02	1.36E-02	1.34E-02	9.04E-03	1.31E-02	9.86E-03	1.29E-02	1.34E-02	9.20E-03	4.20E-03
4	PM10	Particulate matter < 10 µm	2.10E-01	2.22E-01	4.72E-02	2.17E-02	9.78E-01	9.55E-01	2.59E-01	1.28E-01	8.40E-02	2.79E-02	1.29E-01	8.64E-02	1.62E-01	1.16E-01	1.40E-01	1.40E-01	1.65E-01	1.29E-01	1.80E-01	6.45E-02	6.59E-02	6.52E-02
5	7440-38-2	Arsenic	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8	7440-43-9	Cadmium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	7440-02-0	Nickel	7.04E-04	1.73E-04	4.82E-04	6.25E-04	2.90E-05	3.45E-05	5.14E-04	3.16E-04	5.89E-04	7.45E-04	4.50E-04	6.80E-04	4.53E-04	6.31E-04	4.34E-04	6.59E-04	4.44E-04	3.81E-04	5.19E-04	9.30E-04	5.71E-04	4.04E-04
11	7439-97-6	Mercury	1.65E-02	3.29E-03	7.68E-03	9.19E-03	4.00E-05	2.21E-04	6.01E-03	2.82E-03	5.97E-03	9.63E-03	4.45E-03	7.04E-03	4.52E-03	6.54E-03	5.21E-03	6.87E-03	4.40E-03	4.48E-03	5.79E-03	1.33E-02	8.89E-03	7.15E-03
12	7664-41-7	Ammonia	6.79E-06	2.38E-05	2.34E-04	3.01E-04	1.86E-08	3.30E-07	1.01E-04	1.33E-05	2.60E-04	3.51E-04	5.27E-04	6.12E-04	6.47E-04	8.65E-04	1.42E-03	3.36E-04	6.77E-04	1.04E-03	1.29E-03	4.39E-04	2.25E-04	4.00E-04
14	67-64-1	Acetone	3.08E-05	3.18E-05	8.16E-06	4.12E-06	9.06E-06	9.58E-06	1.60E-05	1.54E-05	2.02E-05	5.09E-06	3.12E-05	2.79E-05	3.01E-05	1.36E-05	3.19E-05	1.63E-05	3.21E-05	2.40E-05	1.59E-05	8.78E-06	1.97E-05	1.69E-05
15	75-07-0	Acetaldehyde	4.91E-04	5.06E-04	1.33E-04	6.56E-05	1.63E-04	1.72E-04	2.64E-04	2.49E-04	3.13E-04	7.91E-05	4.87E-04	4.35E-04	4.72E-04	2.13E-04	5.00E-04	2.53E-04	5.03E-04	3.70E-04	2.47E-04	1.38E-04	3.40E-04	2.49E-04
16	50-00-0	Formaldehyde	1.39E-02	1.43E-02	3.70E-03	2.00E-03	3.36E-03	3.50E-03	9.90E-03	1.13E-02	9.70E-03	1.88E-03	1.35E-02	1.09E-02	1.52E-02	8.21E-03	1.88E-02	9.74E-03	1.61E-02	9.94E-03	8.52E-03	2.18E-03	1.96E-03	3.72E-03
17	78-93-3	2-Butanone	2.19E-05	7.05E-06	1.65E-05	1.95E-05	1.14E-06	1.84E-06	1.15E-05	6.05E-06	1.32E-05	2.13E-05	2.55E-05	2.15E-05	2.68E-05	2.26E-05	3.71E-05	1.56E-05	2.80E-05	2.12E-05	3.13E-05	2.75E-05	1.61E-05	1.81E-05
18	71-43-2	Benzene	1.28E-04	1.43E-05	1.85E-05	1.80E-05	2.68E-06	2.76E-06	5.28E-05	4.34E-05	7.04E-05	1.85E-05	6.27E-05	3.39E-05	5.79E-05	7.18E-05	1.17E-04	6.27E-05	6.03E-05	3.17E-05	3.29E-05	2.43E-05	2.02E-05	2.15E-05
19	108-88-3	Toluene	1.31E-05	1.35E-05	3.24E-06	1.51E-06	3.60E-06	3.81E-06	5.51E-06	5.07E-06	7.77E-06	1.96E-06	1.08E-05	8.78E-06	1.09E-05	5.96E-06	1.47E-05	9.11E-06	1.15E-05	1.22E-05	7.96E-06	4.18E-06	9.50E-06	6.05E-06
20	1330-20-7	Xylenes	9.19E-06	9.47E-06	1.91E-06	8.35E-07	1.78E-06	1.95E-06	2.73E-06	2.15E-06	5.21E-06	1.44E-06	7.37E-06	6.01E-06	6.97E-06	3.70E-06	9.45E-06	6.19E-06	7.37E-06	9.26E-06	5.56E-06	3.54E-06	8.59E-06	5.11E-06
		Total	*0.478*	*0.337*	*0.254*	*0.221*	*0.982*	*0.959*	*0.473*	*0.359*	*0.285*	*0.241*	*0.320*	*0.283*	*0.384*	*0.322*	*0.376*	*0.321*	*0.391*	*0.337*	*0.401*	*0.292*	*0.325*	*0.287*

			Scenario 1A - Acute												Scenario 1A - Acute									
			Receptor 2		Receptor 3		Receptor 4		Receptor 5		Receptor 6		Receptor 7		Receptor 8		Receptor 9		Receptor 10		Receptor 11		Receptor 12	
No	**CAS # / ID**	**Compound Name**	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest
1	10102-44-0	Nitrogen Dioxide	1.23E-01	1.55E-01	1.66E-01	1.94E-01	0.00E+00	0.00E+00	1.80E-01	1.60E-01	1.74E-01	1.36E-01	1.56E-01	1.74E-01	1.88E-01	1.72E-01	1.70E-01	1.96E-01	1.89E-01	1.82E-01	1.89E-01	1.79E-01	9.80E-02	8.44E-02
2	630-08-0	Carbon monoxide	7.26E-04	4.60E-04	6.58E-04	1.10E-03	9.64E-07	2.12E-05	3.62E-03	1.51E-03	3.13E-03	5.49E-03	4.15E-03	2.43E-03	2.32E-03	4.17E-03	1.13E-03	1.58E-03	2.42E-03	3.36E-03	2.77E-03	1.39E-03	1.66E-03	2.43E-04
3	7446-09-5	Sulphur dioxide	1.21E-03	1.01E-03	5.78E-03	1.01E-02	0.00E+00	0.00E+00	1.36E-02	7.87E-03	1.64E-02	7.36E-03	1.07E-02	1.44E-02	1.51E-02	1.36E-02	5.62E-03	1.42E-02	1.57E-02	1.17E-02	1.29E-02	1.35E-02	1.18E-03	9.44E-04
4	PM10	Particulate matter < 10 µm	9.15E-02	2.98E-02	1.83E-02	2.02E-02	9.70E-01	9.63E-01	2.59E-01	1.90E-01	6.72E-02	9.06E-02	1.29E-01	7.49E-02	1.54E-01	1.16E-01	6.31E-02	9.93E-02	1.58E-01	8.87E-02	1.80E-01	8.01E-02	7.81E-02	8.23E-02
5	7440-38-2	Arsenic	2.31E-02	1.59E-02	1.95E-02	1.88E-02	2.14E-04	0.00E+00	2.57E-02	1.57E-02	3.39E-02	1.53E-02	2.28E-02	3.03E-02	2.91E-02	2.64E-02	1.69E-02	2.77E-02	2.99E-02	2.63E-02	2.39E-02	2.67E-02	1.78E-02	1.46E-02
8	7440-43-9	Cadmium	2.55E-03	1.43E-03	1.67E-03	1.99E-03	5.41E-04	3.80E-04	8.47E-03	6.92E-03	6.13E-03	9.36E-03	1.11E-02	7.64E-03	1.34E-02	7.46E-03	2.75E-03	1.03E-02	1.40E-02	9.81E-03	7.80E-03	4.16E-03	5.66E-03	1.64E-03
10	7440-02-0	Nickel	1.26E-01	9.27E-02	5.78E-02	1.17E-02	9.25E-05	0.00E+00	1.54E-02	1.52E-02	2.57E-02	1.69E-02	1.35E-02	1.82E-02	1.94E-02	1.89E-02	4.49E-02	1.77E-02	1.88E-02	3.21E-02	1.56E-02	2.23E-02	1.36E-01	6.23E-02
11	7439-97-6	Mercury	3.34E-01	1.63E-01	8.01E-02	1.53E-02	1.91E-02	0.00E+00	1.80E-02	1.64E-02	2.56E-02	1.70E-02	1.34E-02	1.76E-02	1.94E-02	1.96E-02	1.39E-01	1.78E-02	1.87E-02	3.39E-02	1.74E-02	2.31E-02	1.92E-01	1.37E-01
12	7664-41-7	Ammonia	9.25E-04	4.39E-04	1.00E-04	1.69E-05	4.96E-05	1.73E-05	1.62E-04	1.70E-04	2.64E-04	3.45E-04	5.92E-04	2.77E-04	4.95E-04	2.54E-04	5.22E-04	3.48E-04	5.32E-04	3.71E-04	4.19E-04	2.57E-04	7.31E-04	9.67E-04
14	67-64-1	Acetone	3.43E-05	1.98E-05	4.08E-06	3.60E-06	6.06E-06	4.56E-06	1.60E-05	1.31E-05	1.64E-05	2.12E-05	3.12E-05	2.10E-05	2.82E-05	1.36E-05	1.74E-05	2.45E-05	2.99E-05	2.07E-05	1.59E-05	9.73E-06	2.17E-05	3.07E-05
15	75-07-0	Acetaldehyde	5.06E-04	2.79E-04	6.21E-05	5.97E-05	1.14E-04	8.76E-05	2.64E-04	2.12E-04	2.54E-04	3.28E-04	4.87E-04	3.16E-04	4.46E-04	2.13E-04	2.59E-04	3.80E-04	4.73E-04	3.13E-04	2.47E-04	1.47E-04	3.35E-04	4.61E-04
16	50-00-0	Formaldehyde	1.50E-03	9.32E-04	1.61E-03	2.31E-03	1.18E-03	9.54E-04	9.90E-03	7.69E-03	6.88E-03	1.05E-02	1.35E-02	9.01E-03	1.50E-02	8.21E-03	2.39E-03	1.14E-02	1.58E-02	1.08E-02	8.52E-03	4.34E-03	4.77E-03	1.12E-03
17	78-93-3	2-Butanone	1.07E-04	1.26E-04	3.05E-05	9.49E-06	3.20E-06	1.61E-13	1.15E-05	1.19E-05	2.62E-05	1.19E-05	2.55E-05	2.77E-05	2.32E-05	2.26E-05	7.89E-05	2.77E-05	2.48E-05	1.79E-05	3.13E-05	2.21E-05	1.04E-04	4.59E-05
18	71-43-2	Benzene	1.61E-03	1.32E-03	3.02E-03	4.51E-03	1.64E-04	2.00E-11	5.77E-03	3.43E-03	7.10E-03	3.19E-03	4.97E-03	6.52E-03	6.56E-03	5.91E-03	3.17E-03	6.18E-03	6.82E-03	5.12E-03	5.95E-03	6.01E-03	1.36E-03	1.20E-03
19	108-88-3	Toluene	1.35E-05	7.98E-06	2.21E-06	1.29E-06	2.66E-06	2.10E-06	5.51E-06	4.57E-06	6.28E-06	8.30E-06	1.08E-05	7.86E-06	1.04E-05	5.96E-06	6.74E-06	7.06E-06	1.09E-05	9.15E-06	7.96E-06	4.37E-06	9.96E-06	1.40E-05
20	1330-20-7	Xylenes	1.26E-05	7.65E-06	1.67E-06	5.07E-07	1.37E-06	1.00E-06	2.73E-06	2.44E-06	4.41E-06	5.55E-06	7.37E-06	5.56E-06	6.44E-06	3.70E-06	5.88E-06	4.10E-06	6.83E-06	5.97E-06	5.56E-06	3.11E-06	8.60E-06	1.25E-05
		Total	*0.707*	*0.463*	*0.355*	*0.280*	*0.991*	*0.964*	*0.540*	*0.425*	*0.367*	*0.312*	*0.381*	*0.355*	*0.463*	*0.392*	*0.450*	*0.403*	*0.471*	*0.404*	*0.464*	*0.361*	*0.538*	*0.387*

			Scenario 2 - Acute												Scenario 2 - Acute									
			Receptor 2		Receptor 3		Receptor 4		Receptor 5		Receptor 6		Receptor 7		Receptor 8		Receptor 9		Receptor 10		Receptor 11		Receptor 12	
No	**CAS # / ID**	**Compound Name**	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest
1	10102-44-0	Nitrogen Dioxide	4.13E-02	1.39E-01	1.64E-01	1.86E-01	0.00E+00	0.00E+00	1.53E-01	1.19E-01	1.55E-01	1.47E-01	1.93E-01	9.87E-02	1.27E-01	1.61E-01	1.38E-01	1.49E-01	1.38E-01	1.27E-01	1.40E-01	1.72E-01	5.48E-02	1.82E-01
2	630-08-0	Carbon monoxide	1.05E-03	2.88E-03	7.36E-04	8.93E-04	7.99E-06	1.36E-07	3.17E-03	1.42E-03	3.08E-03	1.87E-03	1.98E-03	3.92E-03	1.04E-03	7.93E-04	1.29E-03	3.89E-03	1.12E-03	4.00E-03	2.64E-03	1.53E-03	1.55E-03	1.66E-03
3	7446-09-5	Sulphur dioxide	7.01E-04	6.56E-03	2.86E-03	4.76E-03	0.00E+00	0.00E+00	6.02E-03	3.77E-03	7.24E-03	6.63E-03	7.91E-03	4.45E-03	2.33E-03	4.11E-03	2.93E-03	5.15E-03	2.51E-03	4.51E-03	5.74E-03	6.20E-03	8.44E-04	7.59E-03
4	PM10	Particulate matter < 10 µm	1.45E-01	1.94E-01	1.88E-02	1.66E-02	9.94E-01	9.74E-01	3.10E-01	2.30E-01	6.14E-02	2.11E-02	1.59E-02	1.20E-01	7.85E-02	7.74E-02	6.90E-02	8.36E-02	8.88E-02	1.30E-01	1.80E-01	7.82E-02	8.54E-02	7.85E-02
5	7440-38-2	Arsenic	2.78E-02	2.71E-02	2.10E-02	2.01E-02	9.56E-03	2.08E-07	2.70E-02	1.69E-02	3.53E-02	3.21E-02	3.79E-02	2.27E-02	1.60E-02	2.18E-02	1.83E-02	2.58E-02	1.71E-02	2.09E-02	2.38E-02	2.80E-02	1.56E-02	3.34E-02
8	7440-43-9	Cadmium	2.45E-03	6.83E-03	1.83E-03	2.20E-03	1.49E-03	1.48E-03	9.66E-03	8.01E-03	6.54E-03	3.15E-03	3.99E-03	1.16E-02	2.51E-03	4.25E-03	3.09E-03	7.04E-03	2.71E-03	1.46E-02	8.79E-03	4.66E-03	6.33E-03	3.78E-03
10	7440-02-0	Nickel	1.25E-01	1.50E-02	5.80E-02	1.25E-02	4.14E-03	8.99E-08	1.61E-02	1.59E-02	2.62E-02	2.55E-02	3.22E-02	1.33E-02	4.30E-02	3.40E-02	4.52E-02	2.84E-02	4.61E-02	2.03E-02	1.58E-02	2.30E-02	1.33E-01	1.46E-02
11	7439-97-6	Mercury	3.91E-01	4.56E-02	8.56E-02	1.75E-02	6.23E-05	3.75E-10	1.99E-02	1.74E-02	2.62E-02	2.57E-02	3.76E-02	1.32E-02	1.49E-01	3.88E-02	1.64E-01	2.99E-02	1.54E-01	2.14E-02	1.76E-02	2.47E-02	1.97E-01	3.66E-02
12	7664-41-7	Ammonia	8.99E-04	6.65E-04	1.02E-04	1.72E-05	4.42E-05	4.37E-05	1.62E-04	1.70E-04	2.50E-04	1.13E-04	1.28E-04	5.80E-04	4.99E-04	2.58E-04	5.12E-04	3.01E-04	5.27E-04	8.32E-04	4.24E-04	2.70E-04	6.51E-04	3.43E-04
14	67-64-1	Acetone	3.69E-05	2.32E-05	4.38E-06	3.87E-06	6.25E-06	5.99E-06	1.75E-05	1.45E-05	1.76E-05	8.73E-06	8.53E-06	3.32E-05	1.73E-05	1.01E-05	1.85E-05	1.18E-05	1.84E-05	2.87E-05	1.72E-05	1.05E-05	2.27E-05	1.55E-05
15	75-07-0	Acetaldehyde	5.66E-04	3.84E-04	7.22E-05	6.54E-05	1.28E-04	1.21E-04	2.95E-04	2.38E-04	2.77E-04	1.46E-04	1.37E-04	5.32E-04	2.61E-04	1.59E-04	2.85E-04	1.92E-04	2.80E-04	4.54E-04	2.77E-04	1.65E-04	3.65E-04	2.51E-04
16	50-00-0	Formaldehyde	1.63E-03	7.56E-03	1.81E-03	2.54E-03	2.17E-03	2.05E-03	1.12E-02	8.86E-03	7.60E-03	4.17E-03	4.34E-03	1.42E-02	2.29E-03	4.19E-03	2.78E-03	8.02E-03	2.49E-03	1.53E-02	9.64E-03	4.86E-03	5.59E-03	4.20E-03
17	78-93-3	2-Butanone	1.82E-04	2.42E-05	4.01E-05	1.42E-05	9.91E-07	5.96E-10	1.76E-05	1.85E-05	3.56E-05	3.11E-05	3.72E-05	3.44E-05	1.02E-04	2.30E-05	1.06E-04	2.26E-05	1.08E-04	2.06E-05	3.70E-05	2.78E-05	1.20E-04	7.91E-05
18	71-43-2	Benzene	3.57E-03	8.17E-03	3.80E-03	5.36E-03	2.00E-04	1.17E-07	6.38E-03	4.09E-03	7.59E-03	6.89E-03	8.30E-03	4.93E-03	3.68E-03	4.18E-03	4.50E-03	5.31E-03	3.91E-03	4.77E-03	6.19E-03	6.66E-03	1.63E-03	8.40E-03
19	108-88-3	Toluene	1.61E-05	1.16E-05	2.52E-06	1.70E-06	4.19E-06	3.94E-06	6.74E-06	5.46E-06	7.46E-06	3.63E-06	3.35E-06	1.23E-05	7.68E-06	5.30E-06	7.77E-06	6.31E-06	8.20E-06	1.58E-05	8.70E-06	4.84E-06	1.13E-05	7.25E-06
20	1330-20-7	Xylenes	1.41E-05	9.16E-06	1.73E-06	5.32E-07	1.45E-06	1.41E-06	2.89E-06	2.63E-06	4.78E-06	1.89E-06	2.09E-06	8.09E-06	6.80E-06	4.03E-06	6.62E-06	3.86E-06	7.25E-06	1.12E-05	5.80E-06	3.32E-06	9.21E-06	5.87E-06
		Total	*0.741*	*0.455*	*0.359*	*0.268*	*1.012*	*0.978*	*0.562*	*0.425*	*0.336*	*0.274*	*0.344*	*0.308*	*0.426*	*0.351*	*0.450*	*0.346*	*0.458*	*0.364*	*0.411*	*0.351*	*0.504*	*0.371*

TABLE A.11: QUANTITATIVE HEALTH RISK INDICATORS

			Scenario 3 - Acute												Scenario 3 - Acute									
			Receptor 2		Receptor 3		Receptor 4		Receptor 5		Receptor 6		Receptor 7		Receptor 8		Receptor 9		Receptor 10		Receptor 11		Receptor 12	
No	**CAS # / ID**	**Compound Name**	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest
1	10102-44-0	Nitrogen Dioxide	1.75E-01	1.49E-01	3.77E-02	1.78E-01	0.00E+00	0.00E+00	2.37E-01	1.94E-01	1.66E-01	1.58E-01	1.94E-01	8.70E-02	1.46E-01	1.52E-01	1.55E-01	1.68E-01	1.59E-01	1.28E-01	1.43E-01	1.04E-01	1.00E-01	1.80E-01
2	630-08-0	Carbon monoxide	1.95E-03	5.19E-04	1.52E-04	1.05E-03	4.38E-07	4.55E-07	3.20E-03	3.20E-03	3.17E-03	1.92E-03	1.93E-03	1.01E-03	1.13E-03	4.08E-03	1.34E-03	3.17E-03	1.21E-03	1.94E-03	7.66E-04	2.55E-03	1.63E-03	1.75E-03
3	7446-09-5	Sulphur dioxide	4.46E-03	3.96E-03	1.49E-03	5.27E-03	0.00E+00	0.00E+00	1.60E-02	6.18E-03	8.19E-03	7.56E-03	9.05E-03	2.70E-03	4.13E-03	6.57E-03	4.59E-03	6.39E-03	4.51E-03	5.47E-03	2.70E-03	2.53E-03	5.62E-03	1.06E-02
4	PM10	Particulate matter < 10 µm	6.99E-02	3.74E-02	1.14E-01	5.03E-02	4.74E-01	4.68E-01	3.21E-02	1.22E-01	6.56E-02	1.98E-02	1.65E-02	6.70E-02	8.64E-02	1.19E-01	7.27E-02	7.73E-02	9.77E-02	1.64E-01	1.22E-01	1.91E-01	7.80E-02	8.32E-02
5	7440-38-2	Arsenic	1.87E-02	1.64E-02	7.14E-03	2.23E-02	2.09E-04	4.94E-05	6.90E-02	2.51E-02	3.85E-02	3.49E-02	4.08E-02	1.21E-02	1.83E-02	2.80E-02	1.98E-02	2.85E-02	1.96E-02	2.26E-02	1.14E-02	1.12E-02	1.61E-02	4.86E-02
8	7440-43-9	Cadmium	3.11E-03	1.41E-03	1.12E-03	3.84E-03	3.62E-04	1.38E-03	5.48E-03	1.31E-02	6.73E-03	3.21E-03	4.03E-03	2.53E-03	2.76E-03	8.66E-03	3.24E-03	6.08E-03	2.96E-03	1.52E-02	1.99E-03	7.96E-03	6.72E-03	3.58E-03
10	7440-02-0	Nickel	1.01E-01	9.18E-02	3.53E-02	1.61E-02	9.04E-05	2.14E-05	4.35E-02	1.21E-02	2.71E-02	2.63E-02	3.31E-02	2.30E-02	4.02E-02	2.02E-02	4.20E-02	3.14E-02	4.50E-02	1.35E-02	2.68E-02	2.13E-02	1.36E-01	2.83E-02
11	7439-97-6	Mercury	2.67E-01	2.25E-01	2.49E-01	2.76E-02	4.84E-02	8.92E-08	5.38E-02	1.07E-02	2.68E-02	2.62E-02	4.36E-02	1.24E-01	1.72E-01	2.13E-02	1.81E-01	3.28E-02	2.03E-01	1.43E-02	1.28E-01	2.31E-02	2.02E-01	5.44E-02
12	7664-41-7	Ammonia	5.06E-04	4.29E-04	3.73E-04	1.20E-04	4.95E-05	4.96E-05	2.39E-04	1.16E-04	2.50E-04	1.13E-04	1.28E-04	2.34E-04	4.99E-04	2.58E-04	5.11E-04	2.46E-04	5.26E-04	1.46E-03	3.54E-04	3.79E-04	6.52E-04	1.95E-04
14	67-64-1	Acetone	1.96E-05	2.15E-05	1.40E-05	8.81E-06	5.83E-06	6.61E-06	1.46E-05	1.84E-05	1.79E-05	8.88E-06	8.51E-06	1.19E-05	1.75E-05	1.53E-05	1.85E-05	9.82E-06	1.86E-05	4.01E-05	1.49E-05	1.54E-05	2.36E-05	1.08E-05
15	75-07-0	Acetaldehyde	3.04E-04	3.22E-04	2.23E-04	1.51E-04	1.39E-04	1.50E-04	2.37E-04	3.05E-04	2.84E-04	1.50E-04	1.37E-04	1.79E-04	2.65E-04	2.49E-04	2.84E-04	1.59E-04	2.84E-04	6.49E-04	2.22E-04	2.49E-04	3.86E-04	1.72E-04
16	50-00-0	Formaldehyde	2.76E-03	9.77E-04	1.15E-03	4.54E-03	1.13E-03	2.17E-03	5.56E-03	1.44E-02	7.94E-03	4.30E-03	4.31E-03	2.53E-03	2.55E-03	9.69E-03	2.95E-03	6.85E-03	2.77E-03	1.56E-02	1.90E-03	8.62E-03	6.10E-03	3.97E-03
17	78-93-3	2-Butanone	1.23E-04	2.03E-04	1.09E-04	2.41E-05	3.71E-06	6.87E-07	5.23E-05	1.16E-05	3.64E-05	3.19E-05	3.84E-05	4.16E-05	1.03E-04	2.83E-05	1.06E-04	2.15E-05	1.09E-04	2.84E-05	7.89E-05	1.12E-05	1.19E-04	6.19E-05
18	71-43-2	Benzene	2.25E-03	1.88E-03	2.44E-03	5.51E-03	7.84E-04	1.33E-04	1.64E-02	6.13E-03	8.09E-03	7.34E-03	8.89E-03	2.98E-03	4.12E-03	6.66E-03	4.67E-03	5.76E-03	4.52E-03	5.63E-03	2.79E-03	1.89E-03	1.50E-03	1.07E-02
19	108-88-3	Toluene	8.37E-06	9.77E-06	6.56E-06	4.17E-06	4.35E-06	4.35E-06	5.97E-06	6.28E-06	7.50E-06	3.67E-06	3.34E-06	4.32E-06	7.71E-06	6.79E-06	7.71E-06	5.17E-06	8.24E-06	1.92E-05	7.50E-06	7.86E-06	1.15E-05	4.97E-06
20	1330-20-7	Xylenes	7.10E-06	8.65E-06	5.24E-06	1.97E-06	1.47E-06	1.46E-06	3.90E-06	2.29E-06	4.84E-06	1.94E-06	2.10E-06	3.11E-06	6.80E-06	3.92E-06	6.60E-06	3.06E-06	7.27E-06	1.48E-05	6.81E-06	5.21E-06	9.45E-06	3.88E-06
		Total	*0.647*	*0.529*	*0.450*	*0.315*	*0.525*	*0.472*	*0.483*	*0.407*	*0.358*	*0.290*	*0.357*	*0.325*	*0.478*	*0.377*	*0.488*	*0.366*	*0.541*	*0.388*	*0.441*	*0.375*	*0.556*	*0.425*

			Scenario 4 - Acute												Scenario 4 - Acute									
			Receptor 2		Receptor 3		Receptor 4		Receptor 5		Receptor 6		Receptor 7		Receptor 8		Receptor 9		Receptor 10		Receptor 11		Receptor 12	
No	**CAS # / ID**	**Compound Name**	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest
1	10102-44-0	Nitrogen Dioxide	1.76E-01	1.74E-01	3.86E-02	1.78E-01	0.00E+00	0.00E+00	1.74E-01	1.53E-01	1.66E-01	1.62E-01	1.97E-01	1.01E-01	1.52E-01	1.53E-01	1.63E-01	1.68E-01	1.66E-01	1.79E-01	1.47E-01	1.82E-01	9.79E-02	1.83E-01
2	630-08-0	Carbon monoxide	2.43E-03	8.07E-03	2.93E-04	4.09E-03	4.50E-07	4.67E-07	1.17E-02	2.40E-03	6.35E-03	2.05E-03	5.92E-03	6.57E-03	2.19E-03	8.02E-03	2.42E-03	4.13E-03	2.43E-03	4.84E-03	2.98E-03	2.02E-03	5.66E-03	2.32E-03
3	7446-09-5	Sulphur dioxide	4.48E-03	1.92E-03	1.49E-03	5.27E-03	0.00E+00	0.00E+00	6.40E-03	4.72E-03	8.20E-03	7.57E-03	9.07E-03	4.64E-03	4.13E-03	6.57E-03	4.59E-03	6.39E-03	4.51E-03	6.70E-03	2.70E-03	7.42E-03	5.62E-03	1.06E-02
4	PM10	Particulate matter < 10 µm	6.99E-02	1.10E-01	1.14E-01	5.03E-02	4.74E-01	4.69E-01	2.16E-01	1.71E-01	6.56E-02	1.98E-02	1.65E-02	1.28E-01	8.64E-02	1.19E-01	7.27E-02	7.73E-02	9.77E-02	6.30E-02	1.22E-01	8.19E-02	7.80E-02	8.32E-02
5	7440-38-2	Arsenic	1.87E-02	8.76E-03	7.14E-03	2.23E-02	2.09E-04	1.28E-04	2.83E-02	1.98E-02	3.85E-02	3.49E-02	4.08E-02	2.10E-02	1.83E-02	2.80E-02	1.98E-02	2.85E-02	1.96E-02	2.99E-02	1.14E-02	3.36E-02	1.61E-02	4.86E-02
8	7440-43-9	Cadmium	3.11E-03	5.90E-03	1.12E-03	3.84E-03	3.62E-04	1.31E-03	1.02E-02	7.86E-03	6.73E-03	3.21E-03	4.03E-03	1.31E-02	2.76E-03	8.66E-03	3.24E-03	6.08E-03	2.96E-03	1.07E-02	1.99E-03	3.30E-03	6.72E-03	3.58E-03
10	7440-02-0	Nickel	1.01E-01	2.75E-02	3.53E-02	1.61E-02	9.04E-05	5.56E-05	1.67E-02	2.42E-02	2.71E-02	2.63E-02	3.31E-02	1.81E-02	4.02E-02	2.02E-02	4.20E-02	3.14E-02	4.50E-02	3.59E-02	2.68E-02	3.21E-02	1.36E-01	2.83E-02
11	7439-97-6	Mercury	2.67E-01	1.86E-01	2.49E-01	2.76E-02	4.84E-02	2.37E-04	2.02E-02	2.67E-02	2.68E-02	2.62E-02	4.36E-02	2.01E-02	1.72E-01	2.13E-02	1.81E-01	3.28E-02	2.03E-01	3.84E-02	1.28E-01	3.36E-02	2.02E-01	5.44E-02
12	7664-41-7	Ammonia	5.06E-04	4.97E-04	3.73E-04	1.20E-04	4.95E-05	4.96E-05	1.62E-04	1.50E-04	2.50E-04	1.13E-04	1.28E-04	5.91E-04	4.99E-04	2.58E-04	5.11E-04	2.46E-04	5.27E-04	3.34E-04	3.54E-04	3.12E-04	6.52E-04	1.95E-04
14	67-64-1	Acetone	1.97E-05	2.35E-05	1.40E-05	8.82E-06	5.83E-06	6.62E-06	1.76E-05	1.36E-05	1.78E-05	8.88E-06	8.53E-06	3.56E-05	1.75E-05	1.53E-05	1.85E-05	9.83E-06	1.86E-05	2.19E-05	1.49E-05	1.25E-05	2.36E-05	1.09E-05
15	75-07-0	Acetaldehyde	3.04E-04	3.49E-04	2.23E-04	1.51E-04	1.39E-04	1.51E-04	2.94E-04	2.22E-04	2.84E-04	1.50E-04	1.37E-04	5.71E-04	2.65E-04	2.49E-04	2.85E-04	1.59E-04	2.84E-04	3.47E-04	2.22E-04	2.05E-04	3.86E-04	1.72E-04
16	50-00-0	Formaldehyde	2.79E-03	6.76E-03	1.15E-03	4.55E-03	1.13E-03	2.14E-03	1.19E-02	8.78E-03	7.92E-03	4.30E-03	4.33E-03	1.60E-02	2.56E-03	9.70E-03	2.95E-03	6.87E-03	2.78E-03	1.18E-02	1.91E-03	3.91E-03	6.11E-03	3.98E-03
17	78-93-3	2-Butanone	1.23E-04	8.99E-05	1.09E-04	2.41E-05	3.72E-06	1.04E-06	1.77E-05	3.02E-05	3.64E-05	3.19E-05	3.84E-05	2.42E-05	1.03E-04	2.83E-05	1.06E-04	2.15E-05	1.09E-04	2.16E-05	7.89E-05	3.50E-05	1.19E-04	6.19E-05
18	71-43-2	Benzene	2.25E-03	3.21E-03	2.44E-03	5.51E-03	7.84E-04	2.02E-04	6.48E-03	4.28E-03	8.10E-03	7.35E-03	8.89E-03	4.67E-03	4.12E-03	6.66E-03	4.67E-03	5.76E-03	4.52E-03	6.08E-03	2.79E-03	6.90E-03	1.50E-03	1.07E-02
19	108-88-3	Toluene	8.37E-06	1.02E-05	6.56E-06	4.17E-06	4.35E-06	4.44E-06	6.57E-06	4.97E-06	7.50E-06	3.67E-06	3.34E-06	1.29E-05	7.71E-06	6.79E-06	7.71E-06	5.17E-06	8.24E-06	9.46E-06	7.50E-06	5.27E-06	1.15E-05	4.97E-06
20	1330-20-7	Xylenes	7.10E-06	7.43E-06	5.24E-06	1.97E-06	1.47E-06	1.46E-06	2.78E-06	2.32E-06	4.84E-06	1.94E-06	2.10E-06	8.33E-06	6.81E-06	3.92E-06	6.60E-06	3.06E-06	7.27E-06	5.63E-06	6.81E-06	4.21E-06	9.45E-06	3.88E-06
		Total	*0.649*	*0.533*	*0.451*	*0.317*	*0.525*	*0.474*	*0.503*	*0.423*	*0.362*	*0.294*	*0.364*	*0.335*	*0.485*	*0.382*	*0.497*	*0.367*	*0.549*	*0.387*	*0.448*	*0.387*	*0.558*	*0.429*

TABLE A.11: QUANTITATIVE HEALTH RISK INDICATORS

			Scenario 1 - Chronic										
No	**CAS # / ID**	**Compound Name**	Receptor 2	Receptor 3	Receptor 4	Receptor 5	Receptor 6	Receptor 7	Receptor 8	Receptor 9	Receptor 10	Receptor 11	Receptor 12
1	10102-44-0	Nitrogen Dioxide	2.19E-02	7.82E-03	1.35E-02	2.03E-02	5.49E-03	6.38E-03	1.10E-02	1.05E-02	1.13E-02	1.13E-02	1.32E-02
3	7446-09-5	Sulphur dioxide	7.25E-04	2.81E-04	4.75E-04	6.54E-04	2.64E-04	3.06E-04	5.09E-04	5.06E-04	5.29E-04	4.75E-04	4.14E-04
5	7440-38-2	Arsenic	8.73E-05	3.43E-05	7.67E-05	5.92E-05	2.39E-05	2.73E-05	4.30E-05	4.19E-05	4.47E-05	4.17E-05	4.24E-05
6	7782-49-2	Selenium	1.39E-06	5.21E-07	1.26E-06	6.76E-07	2.58E-07	2.87E-07	4.50E-07	4.30E-07	4.69E-07	4.61E-07	5.99E-07
7	7439-96-5	Manganese	8.00E-04	3.30E-04	7.80E-04	6.96E-04	2.75E-04	3.18E-04	5.15E-04	5.15E-04	5.37E-04	4.81E-04	4.48E-04
8	7440-43-9	Cadmium	2.99E-03	1.15E-03	2.01E-03	2.60E-03	1.02E-03	1.19E-03	2.07E-03	2.09E-03	2.16E-03	1.86E-03	1.73E-03
9	18540-29-9	Chromium (vi)	9.48E-05	2.93E-05	5.16E-05	3.35E-05	1.31E-05	1.44E-05	2.27E-05	2.01E-05	2.35E-05	2.65E-05	3.87E-05
10	7440-02-0	Nickel	1.07E-03	3.53E-04	6.02E-04	5.66E-04	2.26E-04	2.57E-04	4.18E-04	3.99E-04	4.34E-04	4.29E-04	5.03E-04
11	7439-97-6	Mercury	2.64E-03	1.36E-03	1.38E-03	1.13E-03	8.13E-04	8.38E-04	6.09E-04	6.63E-04	6.42E-04	5.84E-04	9.35E-04
12	7664-41-7	Ammonia	1.96E-03	5.63E-04	5.43E-04	5.70E-04	3.50E-04	3.84E-04	5.36E-04	5.72E-04	5.86E-04	5.76E-04	9.54E-04
14	67-64-1	Acetone	8.30E-06	3.10E-06	3.90E-06	3.28E-06	2.22E-06	2.35E-06	2.46E-06	2.74E-06	2.65E-06	2.33E-06	4.00E-06
15	75-07-0	Acetaldehyde	3.06E-03	1.19E-03	1.61E-03	1.45E-03	9.24E-04	9.89E-04	1.07E-03	1.17E-03	1.15E-03	1.01E-03	1.52E-03
16	50-00-0	Formaldehyde	3.50E-03	1.52E-03	2.60E-03	2.61E-03	1.22E-03	1.37E-03	1.94E-03	1.96E-03	2.02E-03	1.78E-03	1.77E-03
17	78-93-3	2-Butanone	6.94E-06	2.52E-06	3.04E-06	2.55E-06	1.84E-06	1.95E-06	1.94E-06	2.19E-06	2.10E-06	1.86E-06	3.53E-06
18	71-43-2	Benzene	3.95E-05	1.91E-05	3.31E-05	2.99E-05	1.62E-05	1.77E-05	2.03E-05	2.13E-05	2.12E-05	1.84E-05	2.02E-05
19	108-88-3	Toluene	1.59E-05	5.92E-06	7.72E-06	5.86E-06	4.09E-06	4.31E-06	4.44E-06	4.80E-06	4.79E-06	4.45E-06	8.81E-06
20	1330-20-7	Xylenes	1.83E-06	5.86E-07	6.37E-07	5.56E-07	4.23E-07	4.49E-07	4.86E-07	5.25E-07	5.28E-07	5.02E-07	1.10E-06
		Total	*0.039*	*0.015*	*0.024*	*0.031*	*0.011*	*0.012*	*0.019*	*0.019*	*0.020*	*0.019*	*0.022*

			Scenario 1A - Chronic										
No	**CAS # / ID**	**Compound Name**	Receptor 2	Receptor 3	Receptor 4	Receptor 5	Receptor 6	Receptor 7	Receptor 8	Receptor 9	Receptor 10	Receptor 11	Receptor 12
1	10102-44-0	Nitrogen Dioxide	2.19E-02	7.82E-03	1.35E-02	2.03E-02	5.49E-03	6.38E-03	1.10E-02	1.05E-02	1.13E-02	1.13E-02	1.32E-02
3	7446-09-5	Sulphur dioxide	7.25E-04	2.81E-04	4.75E-04	6.54E-04	2.64E-04	3.06E-04	5.09E-04	5.06E-04	5.29E-04	4.75E-04	4.14E-04
5	7440-38-2	Arsenic	8.73E-05	3.43E-05	7.67E-05	5.92E-05	2.39E-05	2.73E-05	4.30E-05	4.19E-05	4.47E-05	4.17E-05	4.24E-05
6	7782-49-2	Selenium	1.39E-06	5.21E-07	1.26E-06	6.76E-07	2.58E-07	2.87E-07	4.50E-07	4.30E-07	4.69E-07	4.61E-07	5.99E-07
7	7439-96-5	Manganese	8.00E-04	3.30E-04	7.80E-04	6.96E-04	2.75E-04	3.18E-04	5.15E-04	5.15E-04	5.37E-04	4.81E-04	4.48E-04
8	7440-43-9	Cadmium	2.99E-03	1.15E-03	2.01E-03	2.60E-03	1.02E-03	1.19E-03	2.07E-03	2.09E-03	2.16E-03	1.86E-03	1.73E-03
9	18540-29-9	Chromium (vi)	9.48E-05	2.93E-05	5.16E-05	3.35E-05	1.31E-05	1.44E-05	2.27E-05	2.01E-05	2.35E-05	2.65E-05	3.87E-05
10	7440-02-0	Nickel	1.07E-03	3.53E-04	6.02E-04	5.66E-04	2.26E-04	2.57E-04	4.18E-04	3.99E-04	4.34E-04	4.29E-04	5.03E-04
11	7439-97-6	Mercury	1.32E-02	6.81E-03	6.88E-03	5.67E-03	4.06E-03	4.19E-03	3.04E-03	3.32E-03	3.21E-03	2.92E-03	4.68E-03
12	7664-41-7	Ammonia	1.96E-03	5.63E-04	5.43E-04	5.70E-04	3.50E-04	3.84E-04	5.36E-04	5.72E-04	5.86E-04	5.76E-04	9.54E-04
14	67-64-1	Acetone	8.30E-06	3.10E-06	3.90E-06	3.28E-06	2.22E-06	2.35E-06	2.46E-06	2.74E-06	2.65E-06	2.33E-06	4.00E-06
15	75-07-0	Acetaldehyde	3.06E-03	1.19E-03	1.61E-03	1.45E-03	9.24E-04	9.89E-04	1.07E-03	1.17E-03	1.15E-03	1.01E-03	1.52E-03
16	50-00-0	Formaldehyde	3.50E-03	1.52E-03	2.60E-03	2.61E-03	1.22E-03	1.37E-03	1.94E-03	1.96E-03	2.02E-03	1.78E-03	1.77E-03
17	78-93-3	2-Butanone	6.94E-06	2.52E-06	3.04E-06	2.55E-06	1.84E-06	1.95E-06	1.94E-06	2.19E-06	2.10E-06	1.86E-06	3.53E-06
18	71-43-2	Benzene	7.89E-04	3.83E-04	6.63E-04	5.97E-04	3.25E-04	3.55E-04	4.06E-04	4.26E-04	4.25E-04	3.68E-04	4.04E-04
19	108-88-3	Toluene	1.59E-05	5.92E-06	7.72E-06	5.86E-06	4.09E-06	4.31E-06	4.44E-06	4.80E-06	4.79E-06	4.45E-06	8.81E-06
20	1330-20-7	Xylenes	1.83E-06	5.86E-07	6.37E-07	5.56E-07	4.23E-07	4.49E-07	4.86E-07	5.25E-07	5.28E-07	5.02E-07	1.10E-06
		Total	*0.050*	*0.020*	*0.030*	*0.036*	*0.014*	*0.016*	*0.022*	*0.022*	*0.022*	*0.021*	*0.026*

			Scenario 2 - Chronic										
No	**CAS # / ID**	**Compound Name**	Receptor 2	Receptor 3	Receptor 4	Receptor 5	Receptor 6	Receptor 7	Receptor 8	Receptor 9	Receptor 10	Receptor 11	Receptor 12
1	10102-44-0	Nitrogen Dioxide	2.27E-02	7.82E-03	1.32E-02	1.96E-02	5.36E-03	6.20E-03	1.07E-02	1.00E-02	1.10E-02	1.12E-02	1.33E-02
3	7446-09-5	Sulphur dioxide	6.70E-04	2.38E-04	3.73E-04	4.99E-04	1.97E-04	2.28E-04	3.79E-04	3.69E-04	3.93E-04	3.67E-04	3.62E-04
5	7440-38-2	Arsenic	9.32E-05	3.72E-05	8.59E-05	6.61E-05	2.62E-05	2.99E-05	4.64E-05	4.53E-05	4.82E-05	4.50E-05	4.57E-05
6	7782-49-2	Selenium	1.46E-06	5.52E-07	1.40E-06	7.36E-07	2.74E-07	3.04E-07	4.65E-07	4.47E-07	4.84E-07	4.72E-07	6.14E-07
7	7439-96-5	Manganese	8.99E-04	3.72E-04	8.86E-04	7.92E-04	3.08E-04	3.56E-04	5.71E-04	5.70E-04	5.94E-04	5.33E-04	5.05E-04
8	7440-43-9	Cadmium	3.24E-03	1.26E-03	2.24E-03	2.90E-03	1.13E-03	1.31E-03	2.29E-03	2.31E-03	2.38E-03	2.06E-03	1.92E-03
9	18540-29-9	Chromium (vi)	9.41E-05	2.94E-05	5.48E-05	3.37E-05	1.30E-05	1.42E-05	2.20E-05	1.95E-05	2.28E-05	2.57E-05	3.78E-05
10	7440-02-0	Nickel	1.10E-03	3.68E-04	6.50E-04	6.06E-04	2.38E-04	2.71E-04	4.39E-04	4.20E-04	4.56E-04	4.48E-04	5.22E-04
11	7439-97-6	Mercury	1.55E-02	8.33E-03	8.37E-03	6.77E-03	5.00E-03	5.14E-03	3.50E-03	3.89E-03	3.70E-03	3.30E-03	5.37E-03
12	7664-41-7	Ammonia	2.13E-03	6.19E-04	5.97E-04	6.26E-04	3.87E-04	4.21E-04	5.86E-04	6.28E-04	6.42E-04	6.26E-04	1.03E-03
14	67-64-1	Acetone	8.21E-06	3.05E-06	3.78E-06	3.10E-06	2.15E-06	2.26E-06	2.31E-06	2.59E-06	2.50E-06	2.20E-06	3.91E-06
15	75-07-0	Acetaldehyde	3.10E-03	1.21E-03	1.63E-03	1.38E-03	9.11E-04	9.69E-04	1.01E-03	1.11E-03	1.08E-03	9.48E-04	1.51E-03
16	50-00-0	Formaldehyde	3.70E-03	1.59E-03	2.72E-03	2.79E-03	1.32E-03	1.48E-03	2.03E-03	2.07E-03	2.12E-03	1.86E-03	1.91E-03
17	78-93-3	2-Butanone	7.63E-06	2.74E-06	3.26E-06	2.78E-06	1.98E-06	2.10E-06	2.12E-06	2.39E-06	2.30E-06	2.02E-06	3.76E-06
18	71-43-2	Benzene	1.67E-03	8.36E-04	1.46E-03	1.15E-03	7.98E-04	8.55E-04	6.69E-04	7.50E-04	7.02E-04	5.90E-04	7.89E-04
19	108-88-3	Toluene	2.12E-05	8.77E-06	1.22E-05	8.42E-06	5.94E-06	6.17E-06	5.79E-06	6.37E-06	6.23E-06	5.63E-06	1.08E-05
20	1330-20-7	Xylenes	1.95E-06	6.26E-07	6.85E-07	6.17E-07	4.50E-07	4.80E-07	5.36E-07	5.78E-07	5.80E-07	5.46E-07	1.14E-06
		Total	*0.055*	*0.023*	*0.032*	*0.037*	*0.016*	*0.017*	*0.022*	*0.022*	*0.023*	*0.022*	*0.027*

TABLE A.11: QUANTITATIVE HEALTH RISK INDICATORS

			Scenario 3 - Chronic										
No	**CAS # / ID**	**Compound Name**	Receptor 2	Receptor 3	Receptor 4	Receptor 5	Receptor 6	Receptor 7	Receptor 8	Receptor 9	Receptor 10	Receptor 11	Receptor 12
1	10102-44-0	Nitrogen Dioxide	2.36E-02	8.15E-03	1.37E-02	2.01E-02	5.59E-03	6.47E-03	1.12E-02	1.03E-02	1.14E-02	1.18E-02	1.40E-02
3	7446-09-5	Sulphur dioxide	6.60E-04	2.44E-04	3.97E-04	5.41E-04	2.03E-04	2.35E-04	3.92E-04	3.75E-04	4.04E-04	3.86E-04	3.91E-04
5	7440-38-2	Arsenic	8.89E-05	3.89E-05	6.98E-05	6.76E-05	2.65E-05	3.03E-05	4.78E-05	4.60E-05	4.94E-05	4.70E-05	4.86E-05
6	7782-49-2	Selenium	1.39E-06	5.80E-07	9.93E-07	6.83E-07	2.69E-07	3.00E-07	4.72E-07	4.48E-07	4.89E-07	4.82E-07	6.23E-07
7	7439-96-5	Manganese	8.62E-04	3.92E-04	7.62E-04	8.33E-04	3.16E-04	3.65E-04	5.94E-04	5.82E-04	6.15E-04	5.66E-04	5.50E-04
8	7440-43-9	Cadmium	3.20E-03	1.31E-03	2.34E-03	3.16E-03	1.17E-03	1.36E-03	2.39E-03	2.36E-03	2.47E-03	2.20E-03	2.11E-03
9	18540-29-9	Chromium (vi)	9.19E-05	3.01E-05	4.15E-05	3.11E-05	1.27E-05	1.39E-05	2.19E-05	1.94E-05	2.26E-05	2.55E-05	3.74E-05
10	7440-02-0	Nickel	1.08E-03	3.79E-04	5.79E-04	6.24E-04	2.42E-04	2.76E-04	4.51E-04	4.26E-04	4.66E-04	4.64E-04	5.44E-04
11	7439-97-6	Mercury	2.50E-02	9.05E-03	8.95E-03	6.96E-03	4.97E-03	5.62E-03	4.46E-03	4.89E-03	4.81E-03	4.25E-03	8.03E-03
12	7664-41-7	Ammonia	2.13E-03	6.18E-04	6.00E-04	6.28E-04	3.88E-04	4.23E-04	5.85E-04	6.28E-04	6.41E-04	6.27E-04	1.03E-03
14	67-64-1	Acetone	8.51E-06	3.14E-06	3.65E-06	2.94E-06	1.98E-06	2.11E-06	2.36E-06	2.62E-06	2.56E-06	2.26E-06	4.09E-06
15	75-07-0	Acetaldehyde	3.22E-03	1.24E-03	1.60E-03	1.31E-03	8.44E-04	9.06E-04	1.02E-03	1.11E-03	1.10E-03	9.67E-04	1.60E-03
16	50-00-0	Formaldehyde	3.62E-03	1.63E-03	2.68E-03	2.73E-03	1.24E-03	1.40E-03	1.93E-03	1.94E-03	2.01E-03	1.80E-03	1.96E-03
17	78-93-3	2-Butanone	7.88E-06	2.78E-06	3.14E-06	2.63E-06	1.82E-06	1.95E-06	2.16E-06	2.42E-06	2.35E-06	2.06E-06	3.91E-06
18	71-43-2	Benzene	1.82E-03	8.18E-04	1.32E-03	9.71E-04	6.20E-04	6.89E-04	6.79E-04	7.39E-04	7.20E-04	6.08E-04	9.10E-04
19	108-88-3	Toluene	2.17E-05	9.46E-06	1.19E-05	7.69E-06	5.35E-06	5.60E-06	5.67E-06	6.18E-06	6.12E-06	5.55E-06	1.10E-05
20	1330-20-7	Xylenes	1.96E-06	6.12E-07	6.58E-07	5.88E-07	4.20E-07	4.52E-07	5.38E-07	5.76E-07	5.84E-07	5.49E-07	1.16E-06
		Total	*0.065*	*0.024*	*0.033*	*0.038*	*0.016*	*0.018*	*0.024*	*0.023*	*0.025*	*0.024*	*0.031*

			Scenario 4 - Chronic										
No	**CAS # / ID**	**Compound Name**	Receptor 2	Receptor 3	Receptor 4	Receptor 5	Receptor 6	Receptor 7	Receptor 8	Receptor 9	Receptor 10	Receptor 11	Receptor 12
1	10102-44-0	Nitrogen Dioxide	2.36E-02	8.19E-03	1.38E-02	2.03E-02	5.61E-03	6.49E-03	1.12E-02	1.04E-02	1.14E-02	1.18E-02	1.40E-02
3	7446-09-5	Sulphur dioxide	6.60E-04	2.44E-04	3.97E-04	5.41E-04	2.03E-04	2.35E-04	3.92E-04	3.75E-04	4.04E-04	3.86E-04	3.90E-04
5	7440-38-2	Arsenic	8.89E-05	3.89E-05	6.98E-05	6.76E-05	2.65E-05	3.03E-05	4.78E-05	4.60E-05	4.94E-05	4.70E-05	4.86E-05
6	7782-49-2	Selenium	1.39E-06	5.80E-07	9.93E-07	6.83E-07	2.68E-07	3.00E-07	4.71E-07	4.48E-07	4.89E-07	4.82E-07	6.23E-07
7	7439-96-5	Manganese	8.61E-04	3.92E-04	7.62E-04	8.33E-04	3.16E-04	3.65E-04	5.94E-04	5.82E-04	6.15E-04	5.66E-04	5.50E-04
8	7440-43-9	Cadmium	3.20E-03	1.31E-03	2.34E-03	3.17E-03	1.17E-03	1.36E-03	2.39E-03	2.36E-03	2.47E-03	2.20E-03	2.11E-03
9	18540-29-9	Chromium (vi)	9.19E-05	3.01E-05	4.15E-05	3.11E-05	1.27E-05	1.39E-05	2.19E-05	1.94E-05	2.26E-05	2.55E-05	3.74E-05
10	7440-02-0	Nickel	1.08E-03	3.79E-04	5.79E-04	6.24E-04	2.42E-04	2.76E-04	4.51E-04	4.26E-04	4.66E-04	4.64E-04	5.44E-04
11	7439-97-6	Mercury	2.50E-02	9.03E-03	8.95E-03	6.95E-03	4.96E-03	5.61E-03	4.45E-03	4.88E-03	4.80E-03	4.24E-03	8.01E-03
12	7664-41-7	Ammonia	1.87E-03	5.32E-04	5.25E-04	5.54E-04	3.29E-04	3.58E-04	5.14E-04	5.40E-04	5.62E-04	5.59E-04	9.06E-04
14	67-64-1	Acetone	8.50E-06	3.13E-06	3.65E-06	2.93E-06	1.98E-06	2.10E-06	2.35E-06	2.62E-06	2.56E-06	2.26E-06	4.08E-06
15	75-07-0	Acetaldehyde	3.22E-03	1.24E-03	1.60E-03	1.31E-03	8.43E-04	9.05E-04	1.02E-03	1.11E-03	1.10E-03	9.67E-04	1.59E-03
16	50-00-0	Formaldehyde	3.58E-03	1.61E-03	2.65E-03	2.68E-03	1.22E-03	1.38E-03	1.90E-03	1.91E-03	1.98E-03	1.77E-03	1.93E-03
17	78-93-3	2-Butanone	7.87E-06	2.77E-06	3.14E-06	2.62E-06	1.82E-06	1.95E-06	2.16E-06	2.41E-06	2.35E-06	2.06E-06	3.90E-06
18	71-43-2	Benzene	1.82E-03	8.17E-04	1.32E-03	9.71E-04	6.20E-04	6.89E-04	6.79E-04	7.39E-04	7.20E-04	6.08E-04	9.10E-04
19	108-88-3	Toluene	2.17E-05	9.46E-06	1.19E-05	7.70E-06	5.35E-06	5.59E-06	5.67E-06	6.17E-06	6.12E-06	5.55E-06	1.10E-05
20	1330-20-7	Xylenes	1.96E-06	6.11E-07	6.58E-07	5.88E-07	4.19E-07	4.51E-07	5.37E-07	5.76E-07	5.83E-07	5.49E-07	1.16E-06
		Total	*0.065*	*0.024*	*0.033*	*0.038*	*0.016*	*0.018*	*0.024*	*0.023*	*0.025*	*0.024*	*0.031*

TABLE A.11: QUANTITATIVE HEALTH RISK INDICATORS

			Scenario 1 - Incremental Carcinogenic Risk										
No	**CAS # / ID**	**Compound Name**	Receptor 2	Receptor 3	Receptor 4	Receptor 5	Receptor 6	Receptor 7	Receptor 8	Receptor 9	Receptor 10	Receptor 11	Receptor 12
5	7440-38-2	Arsenic	1.31E-07	5.15E-08	1.15E-07	8.88E-08	3.59E-08	4.10E-08	6.45E-08	6.29E-08	6.70E-08	6.26E-08	6.37E-08
8	7440-43-9	Cadmium	2.69E-08	1.03E-08	1.81E-08	2.34E-08	9.16E-09	1.07E-08	1.86E-08	1.88E-08	1.94E-08	1.68E-08	1.56E-08
9	18540-29-9	Chromium (vi)	3.79E-07	1.17E-07	2.06E-07	1.34E-07	5.24E-08	5.76E-08	9.10E-08	8.04E-08	9.39E-08	1.06E-07	1.55E-07
10	7440-02-0	Nickel	3.66E-08	1.21E-08	2.06E-08	1.94E-08	7.72E-09	8.78E-09	1.43E-08	1.36E-08	1.49E-08	1.47E-08	1.72E-08
13		BaP Equivalents	1.17E-07	3.52E-08	3.29E-08	3.08E-08	2.38E-08	2.52E-08	3.02E-08	3.23E-08	3.30E-08	3.17E-08	7.38E-08
15	75-07-0	Acetaldehyde	1.37E-07	5.33E-08	7.25E-08	6.54E-08	4.16E-08	4.45E-08	4.83E-08	5.28E-08	5.17E-08	4.52E-08	6.83E-08
16	50-00-0	Formaldehyde	4.87E-07	2.11E-07	3.63E-07	3.65E-07	1.70E-07	1.91E-07	2.70E-07	2.74E-07	2.82E-07	2.48E-07	2.47E-07
18	71-43-2	Benzene	1.42E-08	6.89E-09	1.19E-08	1.08E-08	5.84E-09	6.38E-09	7.31E-09	7.66E-09	7.64E-09	6.62E-09	7.27E-09
		Total	*1.33E-06*	*4.98E-07*	*8.40E-07*	*7.37E-07*	*3.47E-07*	*3.86E-07*	*5.44E-07*	*5.42E-07*	*5.69E-07*	*5.32E-07*	*6.48E-07*

			Scenario 1A - Incremental Carcinogenic Risk										
No	**CAS # / ID**	**Compound Name**	Receptor 2	Receptor 3	Receptor 4	Receptor 5	Receptor 6	Receptor 7	Receptor 8	Receptor 9	Receptor 10	Receptor 11	Receptor 12
5	7440-38-2	Arsenic	1.31E-07	5.15E-08	1.15E-07	8.88E-08	3.59E-08	4.10E-08	6.45E-08	6.29E-08	6.70E-08	6.26E-08	6.37E-08
8	7440-43-9	Cadmium	2.69E-08	1.03E-08	1.81E-08	2.34E-08	9.16E-09	1.07E-08	1.86E-08	1.88E-08	1.94E-08	1.68E-08	1.56E-08
9	18540-29-9	Chromium (vi)	3.79E-07	1.17E-07	2.06E-07	1.34E-07	5.24E-08	5.76E-08	9.10E-08	8.04E-08	9.39E-08	1.06E-07	1.55E-07
10	7440-02-0	Nickel	3.66E-08	1.21E-08	2.06E-08	1.94E-08	7.72E-09	8.78E-09	1.43E-08	1.36E-08	1.49E-08	1.47E-08	1.72E-08
13		BaP Equivalents	1.17E-07	3.52E-08	3.29E-08	3.08E-08	2.38E-08	2.52E-08	3.02E-08	3.23E-08	3.30E-08	3.17E-08	7.38E-08
15	75-07-0	Acetaldehyde	1.37E-07	5.33E-08	7.25E-08	6.54E-08	4.16E-08	4.45E-08	4.83E-08	5.28E-08	5.17E-08	4.52E-08	6.83E-08
16	50-00-0	Formaldehyde	4.87E-07	2.11E-07	3.63E-07	3.65E-07	1.70E-07	1.91E-07	2.70E-07	2.74E-07	2.82E-07	2.48E-07	2.47E-07
18	71-43-2	Benzene	1.42E-08	6.89E-09	1.19E-08	1.08E-08	5.84E-09	6.38E-09	7.31E-09	7.66E-09	7.64E-09	6.62E-09	7.27E-09
		Total	*1.33E-06*	*4.98E-07*	*8.40E-07*	*7.37E-07*	*3.47E-07*	*3.86E-07*	*5.44E-07*	*5.42E-07*	*5.69E-07*	*5.32E-07*	*6.48E-07*

			Scenario 2 - Incremental Carcinogenic Risk										
No	**CAS # / ID**	**Compound Name**	Receptor 2	Receptor 3	Receptor 4	Receptor 5	Receptor 6	Receptor 7	Receptor 8	Receptor 9	Receptor 10	Receptor 11	Receptor 12
5	7440-38-2	Arsenic	1.40E-07	5.58E-08	1.29E-07	9.91E-08	3.93E-08	4.48E-08	6.96E-08	6.80E-08	7.23E-08	6.74E-08	6.86E-08
8	7440-43-9	Cadmium	2.92E-08	1.13E-08	2.01E-08	2.61E-08	1.01E-08	1.18E-08	2.06E-08	2.08E-08	2.14E-08	1.85E-08	1.73E-08
9	18540-29-9	Chromium (vi)	3.76E-07	1.18E-07	2.19E-07	1.35E-07	5.20E-08	5.69E-08	8.81E-08	7.81E-08	9.11E-08	1.03E-07	1.51E-07
10	7440-02-0	Nickel	3.75E-08	1.26E-08	2.22E-08	2.07E-08	8.16E-09	9.28E-09	1.50E-08	1.44E-08	1.56E-08	1.53E-08	1.78E-08
13		BaP Equivalents	1.45E-07	5.36E-08	6.79E-08	5.08E-08	4.10E-08	4.31E-08	3.77E-08	4.20E-08	4.08E-08	3.76E-08	8.29E-08
15	75-07-0	Acetaldehyde	1.39E-07	5.44E-08	7.35E-08	6.20E-08	4.10E-08	4.36E-08	4.54E-08	5.00E-08	4.87E-08	4.27E-08	6.79E-08
16	50-00-0	Formaldehyde	5.16E-07	2.21E-07	3.80E-07	3.88E-07	1.84E-07	2.07E-07	2.83E-07	2.89E-07	2.95E-07	2.59E-07	2.66E-07
18	71-43-2	Benzene	3.01E-08	1.51E-08	2.63E-08	2.07E-08	1.44E-08	1.54E-08	1.20E-08	1.35E-08	1.26E-08	1.06E-08	1.42E-08
		Total	*1.41E-06*	*5.42E-07*	*9.38E-07*	*8.03E-07*	*3.90E-07*	*4.32E-07*	*5.72E-07*	*5.75E-07*	*5.98E-07*	*5.54E-07*	*6.86E-07*

			Scenario 3 - Incremental Carcinogenic Risk										
No	**CAS # / ID**	**Compound Name**	Receptor 2	Receptor 3	Receptor 4	Receptor 5	Receptor 6	Receptor 7	Receptor 8	Receptor 9	Receptor 10	Receptor 11	Receptor 12
5	7440-38-2	Arsenic	1.33E-07	5.83E-08	1.05E-07	1.01E-07	3.97E-08	4.55E-08	7.17E-08	6.89E-08	7.41E-08	7.05E-08	7.29E-08
8	7440-43-9	Cadmium	2.88E-08	1.18E-08	2.10E-08	2.85E-08	1.06E-08	1.23E-08	2.15E-08	2.12E-08	2.23E-08	1.98E-08	1.90E-08
9	18540-29-9	Chromium (vi)	3.68E-07	1.20E-07	1.66E-07	1.25E-07	5.07E-08	5.56E-08	8.75E-08	7.75E-08	9.04E-08	1.02E-07	1.50E-07
10	7440-02-0	Nickel	3.69E-08	1.29E-08	1.98E-08	2.13E-08	8.29E-09	9.44E-09	1.54E-08	1.46E-08	1.59E-08	1.59E-08	1.86E-08
13		BaP Equivalents	1.48E-07	5.29E-08	6.17E-08	4.31E-08	3.47E-08	3.70E-08	3.69E-08	4.08E-08	4.03E-08	3.70E-08	8.51E-08
15	75-07-0	Acetaldehyde	1.45E-07	5.57E-08	7.19E-08	5.91E-08	3.80E-08	4.08E-08	4.59E-08	5.01E-08	4.94E-08	4.35E-08	7.18E-08
16	50-00-0	Formaldehyde	5.05E-07	2.27E-07	3.74E-07	3.81E-07	1.73E-07	1.95E-07	2.69E-07	2.71E-07	2.80E-07	2.52E-07	2.73E-07
18	71-43-2	Benzene	3.28E-08	1.47E-08	2.37E-08	1.75E-08	1.12E-08	1.24E-08	1.22E-08	1.33E-08	1.30E-08	1.09E-08	1.64E-08
		Total	*1.40E-06*	*5.54E-07*	*8.42E-07*	*7.76E-07*	*3.66E-07*	*4.08E-07*	*5.61E-07*	*5.57E-07*	*5.86E-07*	*5.51E-07*	*7.06E-07*

			Scenario 4 - Incremental Carcinogenic Risk										
No	**CAS # / ID**	**Compound Name**	Receptor 2	Receptor 3	Receptor 4	Receptor 5	Receptor 6	Receptor 7	Receptor 8	Receptor 9	Receptor 10	Receptor 11	Receptor 12
5	7440-38-2	Arsenic	1.33E-07	5.83E-08	1.05E-07	1.01E-07	3.97E-08	4.55E-08	7.18E-08	6.90E-08	7.41E-08	7.05E-08	7.28E-08
8	7440-43-9	Cadmium	2.88E-08	1.18E-08	2.10E-08	2.85E-08	1.06E-08	1.23E-08	2.15E-08	2.12E-08	2.23E-08	1.98E-08	1.90E-08
9	18540-29-9	Chromium (vi)	3.68E-07	1.20E-07	1.66E-07	1.25E-07	5.07E-08	5.56E-08	8.75E-08	7.75E-08	9.04E-08	1.02E-07	1.50E-07
10	7440-02-0	Nickel	3.69E-08	1.29E-08	1.98E-08	2.13E-08	8.29E-09	9.44E-09	1.54E-08	1.46E-08	1.59E-08	1.59E-08	1.86E-08
13		BaP Equivalents	1.50E-07	5.37E-08	6.31E-08	4.50E-08	3.54E-08	3.79E-08	3.84E-08	4.22E-08	4.18E-08	3.84E-08	8.63E-08
15	75-07-0	Acetaldehyde	1.45E-07	5.57E-08	7.18E-08	5.91E-08	3.79E-08	4.07E-08	4.59E-08	5.00E-08	4.94E-08	4.35E-08	7.17E-08
16	50-00-0	Formaldehyde	4.99E-07	2.25E-07	3.69E-07	3.74E-07	1.71E-07	1.92E-07	2.65E-07	2.67E-07	2.75E-07	2.47E-07	2.69E-07
18	71-43-2	Benzene	3.28E-08	1.47E-08	2.37E-08	1.75E-08	1.12E-08	1.24E-08	1.22E-08	1.33E-08	1.30E-08	1.09E-08	1.64E-08
		Total	*1.39E-06*	*5.52E-07*	*8.39E-07*	*7.72E-07*	*3.64E-07*	*4.06E-07*	*5.58E-07*	*5.54E-07*	*5.82E-07*	*5.48E-07*	*7.03E-07*

TABLE A.12: PERCENTAGE CONTRIBUTIONS

			Scenario 1 - Acute										Scenario 1 - Acute									
			Receptor 2		Receptor 3		Receptor 4		Receptor 5		Receptor 6		Receptor 7		Receptor 8		Receptor 9		Receptor 10		Receptor 11		Receptor 12	
No	**CAS # / ID**	**Compound Name**	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest
1	10102-44-0	Nitrogen Dioxide	42.2%	26.9%	72.5%	80.1%	0.0001%	0.0016%	38.0%	56.4%	59.5%	78.3%	48.9%	58.1%	48.2%	53.4%	50.1%	46.2%	47.8%	53.6%	47.1%	67.0%	72.7%	70.9%
2	630-08-0	Carbon monoxide	1.6%	0.3%	0.5%	0.5%	0.0001%	0.0001%	0.8%	1.0%	1.7%	0.4%	1.3%	0.6%	0.8%	1.3%	1.9%	1.8%	0.8%	0.4%	0.7%	0.6%	0.5%	0.7%
3	7446-09-5	Sulphur dioxide	5.6%	1.3%	3.7%	4.1%	0.000003%	0.0001%	2.9%	2.9%	3.4%	4.4%	3.4%	3.8%	3.3%	4.2%	3.6%	2.8%	3.3%	2.9%	3.2%	4.6%	2.8%	1.5%
4	PM10	Particulate matter < 10 µm	44.0%	66.0%	18.5%	9.8%	99.6%	99.6%	54.8%	35.7%	29.5%	11.6%	40.3%	30.5%	42.1%	35.9%	37.3%	43.6%	42.3%	38.2%	44.9%	22.1%	20.3%	22.7%
5	7440-38-2	Arsenic	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
8	7440-43-9	Cadmium	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
10	7440-02-0	Nickel	0.15%	0.05%	0.19%	0.28%	0.003%	0.004%	0.11%	0.09%	0.21%	0.31%	0.14%	0.24%	0.12%	0.20%	0.12%	0.20%	0.11%	0.11%	0.13%	0.32%	0.18%	0.14%
11	7439-97-6	Mercury	3.5%	1.0%	3.0%	4.2%	0.004%	0.023%	1.3%	0.8%	2.1%	4.0%	1.4%	2.5%	1.2%	2.0%	1.4%	2.1%	1.1%	1.3%	1.4%	4.5%	2.7%	2.5%
12	7664-41-7	Ammonia	0.00%	0.01%	0.09%	0.14%	0.000002%	0.00003%	0.02%	0.00%	0.09%	0.15%	0.17%	0.22%	0.17%	0.27%	0.38%	0.10%	0.17%	0.31%	0.32%	0.15%	0.07%	0.14%
14	67-64-1	Acetone	0.006%	0.009%	0.003%	0.002%	0.001%	0.001%	0.003%	0.004%	0.007%	0.002%	0.010%	0.010%	0.008%	0.004%	0.008%	0.005%	0.008%	0.007%	0.004%	0.003%	0.006%	0.006%
15	75-07-0	Acetaldehyde	0.10%	0.15%	0.05%	0.03%	0.02%	0.02%	0.06%	0.07%	0.11%	0.03%	0.15%	0.15%	0.12%	0.07%	0.13%	0.08%	0.13%	0.11%	0.06%	0.05%	0.10%	0.09%
16	50-00-0	Formaldehyde	2.9%	4.2%	1.5%	0.9%	0.3%	0.4%	2.1%	3.1%	3.4%	0.8%	4.2%	3.9%	4.0%	2.6%	5.0%	3.0%	4.1%	2.9%	2.1%	0.7%	0.6%	1.3%
17	78-93-3	2-Butanone	0.0046%	0.0021%	0.0065%	0.0089%	0.0001%	0.0002%	0.0024%	0.0017%	0.0046%	0.0089%	0.0080%	0.0076%	0.0070%	0.0070%	0.0099%	0.0049%	0.0072%	0.0063%	0.0078%	0.0094%	0.0049%	0.0063%
18	71-43-2	Benzene	0.027%	0.004%	0.007%	0.008%	0.000%	0.000%	0.011%	0.012%	0.025%	0.008%	0.020%	0.012%	0.015%	0.022%	0.031%	0.020%	0.015%	0.009%	0.008%	0.008%	0.006%	0.008%
19	108-88-3	Toluene	0.0027%	0.0040%	0.0013%	0.0007%	0.0004%	0.0004%	0.0012%	0.0014%	0.0027%	0.0008%	0.0034%	0.0031%	0.0028%	0.0019%	0.0039%	0.0028%	0.0029%	0.0036%	0.0020%	0.0014%	0.0029%	0.0021%
20	1330-20-7	Xylenes	0.0019%	0.0028%	0.0008%	0.0004%	0.0002%	0.0002%	0.0006%	0.0006%	0.0018%	0.0006%	0.0023%	0.0021%	0.0018%	0.0011%	0.0025%	0.0019%	0.0019%	0.0027%	0.0014%	0.0012%	0.0026%	0.0018%

			Scenario 1A - Acute										Scenario 1A - Acute									
			Receptor 2		Receptor 3		Receptor 4		Receptor 5		Receptor 6		Receptor 7		Receptor 8		Receptor 9		Receptor 10		Receptor 11		Receptor 12	
No	**CAS # / ID**	**Compound Name**	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest
1	10102-44-0	Nitrogen Dioxide	17.4%	33.5%	46.9%	69.3%	0%	0%	33.3%	37.7%	47.5%	43.5%	41.1%	48.8%	40.6%	43.8%	37.9%	48.7%	40.2%	45.0%	40.6%	49.6%	18.2%	21.8%
2	630-08-0	Carbon monoxide	0.1%	0.1%	0.2%	0.4%	0.0001%	0.002%	0.7%	0.4%	0.9%	1.8%	1.1%	0.7%	0.5%	1.1%	0.3%	0.4%	0.5%	0.8%	0.6%	0.4%	0.3%	0.1%
3	7446-09-5	Sulphur dioxide	0.2%	0.2%	1.6%	3.6%	0.0%	0%	2.5%	1.8%	4.5%	2.4%	2.8%	4.0%	3.3%	3.5%	1.2%	3.5%	3.3%	2.9%	2.8%	3.7%	0.2%	0.2%
4	PM10	Particulate matter < 10 µm	12.9%	6.4%	5.1%	7.2%	97.8%	99.8%	48.0%	44.7%	18.3%	29.0%	33.9%	21.1%	33.2%	29.5%	14.0%	24.6%	33.7%	21.9%	38.8%	22.2%	14.5%	21.3%
5	7440-38-2	Arsenic	3.3%	3.4%	5.5%	6.7%	0.0%	0.0%	4.8%	3.7%	9.2%	4.9%	6.0%	8.5%	6.3%	6.7%	3.7%	6.9%	6.4%	6.5%	5.2%	7.4%	3.3%	3.8%
8	7440-43-9	Cadmium	0.4%	0.3%	0.5%	0.7%	0.1%	0.04%	1.6%	1.6%	1.7%	3.0%	2.9%	2.2%	2.9%	1.9%	0.6%	2.6%	3.0%	2.4%	1.7%	1.2%	1.1%	0.4%
10	7440-02-0	Nickel	17.85%	20.02%	16.28%	4.16%	0.01%	0%	2.85%	3.58%	6.99%	5.41%	3.54%	5.13%	4.19%	4.83%	9.97%	4.40%	3.99%	7.94%	3.35%	6.17%	25.29%	16.10%
11	7439-97-6	Mercury	47.2%	35.3%	22.6%	5.4%	1.9%	0%	3.3%	3.8%	7.0%	5.5%	3.5%	5.0%	4.2%	5.0%	30.9%	4.4%	4.0%	8.4%	3.7%	6.4%	35.7%	35.3%
12	7664-41-7	Ammonia	0.131%	0.095%	0.028%	0.006%	0.005%	0.002%	0.030%	0.040%	0.072%	0.111%	0.156%	0.078%	0.107%	0.065%	0.116%	0.086%	0.113%	0.092%	0.090%	0.071%	0.136%	0.250%
14	67-64-1	Acetone	0.005%	0.004%	0.001%	0.001%	0.001%	0.0005%	0.003%	0.003%	0.004%	0.007%	0.008%	0.006%	0.006%	0.003%	0.004%	0.006%	0.006%	0.005%	0.003%	0.003%	0.004%	0.008%
15	75-07-0	Acetaldehyde	0.07%	0.06%	0.02%	0.02%	0.01%	0.01%	0.05%	0.05%	0.07%	0.11%	0.13%	0.09%	0.10%	0.05%	0.06%	0.09%	0.10%	0.08%	0.05%	0.04%	0.06%	0.12%
16	50-00-0	Formaldehyde	0.2%	0.2%	0.5%	0.8%	0.1%	0.1%	1.8%	1.8%	1.9%	3.4%	3.5%	2.5%	3.2%	2.1%	0.5%	2.8%	3.4%	2.7%	1.8%	1.2%	0.9%	0.3%
17	78-93-3	2-Butanone	0.0152%	0.0272%	0.0086%	0.0034%	0.0003%	0.00000000002%	0.0021%	0.0028%	0.0071%	0.0038%	0.0067%	0.0078%	0.0050%	0.0058%	0.0175%	0.0069%	0.0053%	0.0044%	0.0068%	0.0061%	0.0192%	0.0119%
18	71-43-2	Benzene	0.228%	0.286%	0.851%	1.606%	0.017%	0.000000002%	1.069%	0.807%	1.936%	1.022%	1.307%	1.836%	1.415%	1.507%	0.704%	1.532%	1.450%	1.265%	1.282%	1.664%	0.252%	0.309%
19	108-88-3	Toluene	0.0019%	0.0017%	0.0006%	0.0005%	0.0003%	0.0002%	0.0010%	0.0011%	0.0017%	0.0027%	0.0028%	0.0022%	0.0022%	0.0015%	0.0015%	0.0018%	0.0023%	0.0023%	0.0017%	0.0012%	0.0019%	0.0036%
20	1330-20-7	Xylenes	0.0018%	0.0017%	0.0005%	0.0002%	0.0001%	0.0001%	0.0005%	0.0006%	0.0012%	0.0018%	0.0019%	0.0016%	0.0014%	0.0009%	0.0013%	0.0010%	0.0015%	0.0015%	0.0012%	0.0009%	0.0016%	0.0032%

			Scenario 2 - Acute										Scenario 2 - Acute									
			Receptor 2		Receptor 3		Receptor 4		Receptor 5		Receptor 6		Receptor 7		Receptor 8		Receptor 9		Receptor 10		Receptor 11		Receptor 12	
No	**CAS # / ID**	**Compound Name**	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest
1	10102-44-0	Nitrogen Dioxide	5.6%	30.7%	45.7%	69.2%	0%	0%	27.2%	27.9%	46.0%	53.5%	56.2%	32.0%	29.7%	45.9%	30.6%	43.0%	30.2%	34.9%	34.0%	49.1%	10.9%	49.0%
2	630-08-0	Carbon monoxide	0.1%	0.6%	0.2%	0.3%	0.00079%	0.00001%	0.6%	0.3%	0.9%	0.7%	0.6%	1.3%	0.2%	0.2%	0.3%	1.1%	0.2%	1.1%	0.6%	0.4%	0.3%	0.4%
3	7446-09-5	Sulphur dioxide	0.1%	1.4%	0.8%	1.8%	0%	0%	1.1%	0.9%	2.2%	2.4%	2.3%	1.4%	0.5%	1.2%	0.7%	1.5%	0.5%	1.2%	1.4%	1.8%	0.2%	2.0%
4	PM10	Particulate matter < 10 µm	19.6%	42.8%	5.2%	6.2%	98.2%	99.6%	55.1%	54.0%	18.2%	7.7%	4.6%	38.9%	18.4%	22.0%	15.3%	24.1%	19.4%	35.7%	43.8%	22.3%	17.0%	21.1%
5	7440-38-2	Arsenic	3.8%	6.0%	5.8%	7.5%	0.9%	0.00002%	4.8%	4.0%	10.5%	11.7%	11.0%	7.4%	3.8%	6.2%	4.1%	7.4%	3.7%	5.7%	5.8%	8.0%	3.1%	9.0%
8	7440-43-9	Cadmium	0.3%	1.5%	0.5%	0.8%	0.1%	0.2%	1.7%	1.9%	1.9%	1.1%	1.2%	3.8%	0.6%	1.2%	0.7%	2.0%	0.6%	4.0%	2.1%	1.3%	1.3%	1.0%
10	7440-02-0	Nickel	16.85%	3.29%	16.18%	4.66%	0.41%	0.000009%	2.87%	3.75%	7.78%	9.31%	9.36%	4.30%	10.09%	9.67%	10.03%	8.19%	10.06%	5.58%	3.84%	6.57%	26.46%	3.93%
11	7439-97-6	Mercury	52.7%	10.0%	23.9%	6.5%	0.0%	0.000000004%	3.5%	4.1%	7.8%	9.4%	10.9%	4.3%	35.0%	11.0%	36.5%	8.6%	33.7%	5.9%	4.3%	7.1%	39.2%	9.9%
12	7664-41-7	Ammonia	0.121%	0.146%	0.028%	0.006%	0.004%	0.004%	0.029%	0.040%	0.074%	0.041%	0.037%	0.188%	0.117%	0.073%	0.114%	0.087%	0.115%	0.229%	0.103%	0.077%	0.129%	0.092%
14	67-64-1	Acetone	0.005%	0.005%	0.001%	0.001%	0.001%	0.001%	0.003%	0.003%	0.005%	0.003%	0.002%	0.011%	0.004%	0.003%	0.004%	0.003%	0.004%	0.008%	0.004%	0.003%	0.005%	0.004%
15	75-07-0	Acetaldehyde	0.08%	0.08%	0.02%	0.02%	0.01%	0.01%	0.05%	0.06%	0.08%	0.05%	0.04%	0.17%	0.06%	0.05%	0.06%	0.06%	0.06%	0.12%	0.07%	0.05%	0.07%	0.07%
16	50-00-0	Formaldehyde	0.2%	1.7%	0.5%	0.9%	0.2%	0.2%	2.0%	2.1%	2.3%	1.5%	1.3%	4.6%	0.5%	1.2%	0.6%	2.3%	0.5%	4.2%	2.3%	1.4%	1.1%	1.1%
17	78-93-3	2-Butanone	0.0245%	0.0053%	0.0112%	0.0053%	0.0001%	0.0000001%	0.0031%	0.0043%	0.0106%	0.0113%	0.0108%	0.0112%	0.0240%	0.0066%	0.0235%	0.0065%	0.0236%	0.0057%	0.0090%	0.0079%	0.0238%	0.0213%
18	71-43-2	Benzene	0.481%	1.798%	1.061%	2.001%	0.020%	0.000%	1.134%	0.964%	2.257%	2.512%	2.414%	1.598%	0.862%	1.190%	0.999%	1.532%	0.853%	1.312%	1.506%	1.900%	0.323%	2.263%
19	108-88-3	Toluene	0.0022%	0.0025%	0.0007%	0.0006%	0.0004%	0.0004%	0.0012%	0.0013%	0.0022%	0.0013%	0.0010%	0.0040%	0.0018%	0.0015%	0.0017%	0.0018%	0.0018%	0.0043%	0.0021%	0.0014%	0.0022%	0.0020%
20	1330-20-7	Xylenes	0.0019%	0.0020%	0.0005%	0.0002%	0.0001%	0.0001%	0.0005%	0.0006%	0.0014%	0.0007%	0.0006%	0.0026%	0.0016%	0.0011%	0.0015%	0.0011%	0.0016%	0.0031%	0.0014%	0.0009%	0.0018%	0.0016%

TABLE A.12: PERCENTAGE CONTRIBUTIONS

			Scenario 3 - Acute												Scenario 3 - Acute									
			Receptor 2		Receptor 3		Receptor 4		Receptor 5		Receptor 6		Receptor 7		Receptor 8		Receptor 9		Receptor 10		Receptor 11		Receptor 12	
No	**CAS # / ID**	**Compound Name**	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest
1	10102-44-0	Nitrogen Dioxide	27.0%	28.1%	8.4%	56.5%	0%	0%	49.1%	47.6%	46.3%	54.5%	54.4%	26.8%	30.5%	40.3%	31.8%	45.7%	29.4%	32.9%	32.3%	27.8%	18.0%	42.3%
2	630-08-0	Carbon monoxide	0.3%	0.1%	0.0%	0.3%	0.00008%	0.0001%	0.7%	0.8%	0.9%	0.7%	0.5%	0.3%	0.2%	1.1%	0.3%	0.9%	0.2%	0.5%	0.2%	0.7%	0.3%	0.4%
3	7446-09-5	Sulphur dioxide	0.7%	0.7%	0.3%	1.7%	0%	0%	3.3%	1.5%	2.3%	2.6%	2.5%	0.8%	0.9%	1.7%	0.9%	1.7%	0.8%	1.4%	0.6%	0.7%	1.0%	2.5%
4	PM10	Particulate matter < 10 µm	10.8%	7.1%	25.3%	16.0%	90.3%	99.2%	6.7%	29.9%	18.3%	6.8%	4.6%	20.6%	18.1%	31.6%	14.9%	21.1%	18.1%	42.3%	27.6%	50.9%	14.0%	19.6%
5	7440-38-2	Arsenic	2.9%	3.1%	1.6%	7.1%	0.0%	0.01047%	14.3%	6.2%	10.7%	12.1%	11.4%	3.7%	3.8%	7.4%	4.1%	7.8%	3.6%	5.8%	2.6%	3.0%	2.9%	11.4%
8	7440-43-9	Cadmium	0.5%	0.3%	0.2%	1.2%	0.1%	0.3%	1.1%	3.2%	1.9%	1.1%	1.1%	0.8%	0.6%	2.3%	0.7%	1.7%	0.5%	3.9%	0.5%	2.1%	1.2%	0.8%
10	7440-02-0	Nickel	15.59%	17.36%	7.83%	5.12%	0.02%	0.005%	9.01%	2.96%	7.55%	9.09%	9.28%	7.09%	8.41%	5.36%	8.60%	8.56%	8.32%	3.48%	6.08%	5.68%	24.56%	6.66%
11	7439-97-6	Mercury	41.3%	42.5%	55.4%	8.8%	9.2%	0.00002%	11.1%	2.6%	7.5%	9.0%	12.2%	38.1%	36.0%	5.6%	37.0%	9.0%	37.5%	3.7%	28.9%	6.2%	36.4%	12.8%
12	7664-41-7	Ammonia	0.078%	0.081%	0.083%	0.038%	0.009%	0.011%	0.050%	0.028%	0.070%	0.039%	0.036%	0.072%	0.104%	0.069%	0.105%	0.067%	0.097%	0.376%	0.080%	0.101%	0.117%	0.046%
14	67-64-1	Acetone	0.003%	0.004%	0.003%	0.003%	0.001%	0.001%	0.003%	0.005%	0.005%	0.003%	0.002%	0.004%	0.004%	0.004%	0.004%	0.003%	0.003%	0.010%	0.003%	0.004%	0.004%	0.003%
15	75-07-0	Acetaldehyde	0.05%	0.06%	0.05%	0.05%	0.03%	0.03%	0.05%	0.07%	0.08%	0.05%	0.04%	0.05%	0.06%	0.07%	0.06%	0.04%	0.05%	0.17%	0.05%	0.07%	0.07%	0.04%
16	50-00-0	Formaldehyde	0.4%	0.2%	0.3%	1.4%	0.2%	0.5%	1.2%	3.5%	2.2%	1.5%	1.2%	0.8%	0.5%	2.6%	0.6%	1.9%	0.5%	4.0%	0.4%	2.3%	1.1%	0.9%
17	78-93-3	2-Butanone	0.0189%	0.0384%	0.0243%	0.0077%	0.0007%	0.0001%	0.0108%	0.0029%	0.0102%	0.0110%	0.0108%	0.0128%	0.0215%	0.0075%	0.0217%	0.0059%	0.0202%	0.0073%	0.0179%	0.0030%	0.0215%	0.0145%
18	71-43-2	Benzene	0.347%	0.356%	0.543%	1.752%	0.149%	0.028%	3.393%	1.505%	2.258%	2.535%	2.493%	0.916%	0.862%	1.767%	0.957%	1.573%	0.836%	1.452%	0.632%	0.505%	0.269%	2.504%
19	108-88-3	Toluene	0.0013%	0.0018%	0.0015%	0.0013%	0.0008%	0.0009%	0.0012%	0.0015%	0.0021%	0.0013%	0.0009%	0.0013%	0.0016%	0.0018%	0.0016%	0.0014%	0.0015%	0.0050%	0.0017%	0.0021%	0.0021%	0.0012%
20	1330-20-7	Xylenes	0.0011%	0.0016%	0.0012%	0.0006%	0.0003%	0.0003%	0.0008%	0.0006%	0.0014%	0.0007%	0.0006%	0.0010%	0.0014%	0.0010%	0.0014%	0.0008%	0.0013%	0.0038%	0.0015%	0.0014%	0.0017%	0.0009%

			Scenario 4 - Acute												Scenario 4 - Acute									
			Receptor 2		Receptor 3		Receptor 4		Receptor 5		Receptor 6		Receptor 7		Receptor 8		Receptor 9		Receptor 10		Receptor 11		Receptor 12	
No	**CAS # / ID**	**Compound Name**	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest	Max	9th Highest
1	10102-44-0	Nitrogen Dioxide	27.1%	32.7%	8.6%	56.0%	0%	0%	34.7%	36.1%	45.9%	55.0%	54.2%	30.2%	31.2%	40.0%	32.7%	45.7%	30.2%	46.3%	32.8%	47.0%	17.6%	42.7%
2	630-08-0	Carbon monoxide	0.4%	1.5%	0.1%	1.3%	0.00009%	0.0001%	2.3%	0.6%	1.8%	0.7%	1.6%	2.0%	0.5%	2.1%	0.5%	1.1%	0.4%	1.2%	0.7%	0.5%	1.0%	0.5%
3	7446-09-5	Sulphur dioxide	0.7%	0.4%	0.3%	1.7%	0%	0%	1.3%	1.1%	2.3%	2.6%	2.5%	1.4%	0.9%	1.7%	0.9%	1.7%	0.8%	1.7%	0.6%	1.9%	1.0%	2.5%
4	PM10	Particulate matter < 10 µm	10.8%	20.7%	25.2%	15.8%	90.3%	99.1%	42.9%	40.4%	18.1%	6.8%	4.5%	38.3%	17.8%	31.3%	14.6%	21.0%	17.8%	16.3%	27.2%	21.1%	14.0%	19.4%
5	7440-38-2	Arsenic	2.9%	1.6%	1.6%	7.0%	0.04%	0.03%	5.6%	4.7%	10.6%	11.9%	11.2%	6.3%	3.8%	7.3%	4.0%	7.8%	3.6%	7.7%	2.5%	8.7%	2.9%	11.3%
8	7440-43-9	Cadmium	0.5%	1.1%	0.2%	1.2%	0.1%	0.3%	2.0%	1.9%	1.9%	1.1%	1.1%	3.9%	0.6%	2.3%	0.7%	1.7%	0.5%	2.8%	0.4%	0.9%	1.2%	0.8%
10	7440-02-0	Nickel	15.56%	5.16%	7.81%	5.08%	0.02%	0.012%	3.33%	5.72%	7.48%	8.97%	9.10%	5.39%	8.29%	5.30%	8.45%	8.53%	8.20%	9.28%	5.99%	8.30%	24.48%	6.60%
11	7439-97-6	Mercury	41.2%	34.8%	55.2%	8.7%	9.2%	0.05%	4.0%	6.3%	7.4%	8.9%	12.0%	6.0%	35.5%	5.6%	36.4%	8.9%	36.9%	9.9%	28.5%	8.7%	36.3%	12.7%
12	7664-41-7	Ammonia	0.078%	0.093%	0.083%	0.038%	0.009%	0.01%	0.032%	0.035%	0.069%	0.038%	0.035%	0.176%	0.103%	0.068%	0.103%	0.067%	0.096%	0.086%	0.079%	0.081%	0.117%	0.045%
14	67-64-1	Acetone	0.003%	0.004%	0.003%	0.003%	0.001%	0.001%	0.004%	0.003%	0.005%	0.003%	0.002%	0.011%	0.004%	0.004%	0.004%	0.003%	0.003%	0.006%	0.003%	0.003%	0.004%	0.003%
15	75-07-0	Acetaldehyde	0.05%	0.07%	0.05%	0.05%	0.03%	0.03%	0.06%	0.05%	0.08%	0.05%	0.04%	0.17%	0.05%	0.07%	0.06%	0.04%	0.05%	0.09%	0.05%	0.05%	0.07%	0.04%
16	50-00-0	Formaldehyde	0.4%	1.3%	0.3%	1.4%	0.2%	0.5%	2.4%	2.1%	2.2%	1.5%	1.2%	4.8%	0.5%	2.5%	0.6%	1.9%	0.5%	3.0%	0.4%	1.0%	1.1%	0.9%
17	78-93-3	2-Butanone	0.0189%	0.0169%	0.0243%	0.0076%	0.0007%	0.0002%	0.0035%	0.0071%	0.0101%	0.0109%	0.0105%	0.0072%	0.0212%	0.0074%	0.0213%	0.0059%	0.0199%	0.0056%	0.0176%	0.0090%	0.0214%	0.0144%
18	71-43-2	Benzene	0.347%	0.601%	0.541%	1.736%	0.149%	0.043%	1.290%	1.012%	2.238%	2.502%	2.445%	1.394%	0.850%	1.746%	0.941%	1.568%	0.824%	1.570%	0.623%	1.782%	0.268%	2.482%
19	108-88-3	Toluene	0.0013%	0.0019%	0.0015%	0.0013%	0.0008%	0.0009%	0.0013%	0.0012%	0.0021%	0.0012%	0.0009%	0.0039%	0.0016%	0.0018%	0.0016%	0.0014%	0.0015%	0.0024%	0.0017%	0.0014%	0.0021%	0.0012%
20	1330-20-7	Xylenes	0.0011%	0.0014%	0.0012%	0.0006%	0.0003%	0.0003%	0.0006%	0.0005%	0.0013%	0.0007%	0.0006%	0.0025%	0.0014%	0.0010%	0.0013%	0.0008%	0.0013%	0.0015%	0.0015%	0.0011%	0.0017%	0.0009%

TABLE A.12: PERCENTAGE CONTRIBUTIONS

			Scenario 1 - Chronic										
No	**CAS # / ID**	**Compound Name**	Receptor 2	Receptor 3	Receptor 4	Receptor 5	Receptor 6	Receptor 7	Receptor 8	Receptor 9	Receptor 10	Receptor 11	Receptor 12
1	10102-44-0	Nitrogen Dioxide	56.36%	53.38%	57.07%	66.03%	51.57%	52.73%	58.68%	56.89%	58.19%	60.73%	61.09%
3	7446-09-5	Sulphur dioxide	1.86%	1.91%	2.00%	2.13%	2.48%	2.53%	2.71%	2.73%	2.71%	2.56%	1.92%
5	7440-38-2	Arsenic	0.22%	0.23%	0.32%	0.19%	0.22%	0.23%	0.23%	0.23%	0.23%	0.22%	0.20%
6	7782-49-2	Selenium	0.00%	0.00%	0.01%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%	0.003%
7	7439-96-5	Manganese	2.06%	2.25%	3.29%	2.27%	2.58%	2.63%	2.74%	2.78%	2.75%	2.59%	2.07%
8	7440-43-9	Cadmium	7.67%	7.82%	8.48%	8.47%	9.57%	9.81%	11.03%	11.30%	11.06%	10.03%	8.01%
9	18540-29-9	Chromium (vi)	0.24%	0.20%	0.22%	0.11%	0.12%	0.12%	0.12%	0.11%	0.12%	0.14%	0.18%
10	7440-02-0	Nickel	2.75%	2.41%	2.54%	1.85%	2.12%	2.12%	2.23%	2.15%	2.23%	2.31%	2.33%
11	7439-97-6	Mercury	6.78%	9.30%	5.80%	3.70%	7.64%	6.92%	3.24%	3.58%	3.29%	3.15%	4.33%
12	7664-41-7	Ammonia	5.03%	3.84%	2.29%	1.86%	3.29%	3.17%	2.85%	3.09%	3.01%	3.10%	4.42%
14	67-64-1	Acetone	0.02%	0.02%	0.02%	0.01%	0.02%	0.02%	0.01%	0.01%	0.01%	0.01%	0.02%
15	75-07-0	Acetaldehyde	7.85%	8.09%	6.80%	4.74%	8.68%	8.17%	5.71%	6.34%	5.89%	5.42%	7.03%
16	50-00-0	Formaldehyde	8.99%	10.35%	10.98%	8.52%	11.49%	11.35%	10.31%	10.61%	10.36%	9.59%	8.22%
17	78-93-3	2-Butanone	0.02%	0.02%	0.01%	0.01%	0.02%	0.02%	0.01%	0.01%	0.01%	0.01%	0.02%
18	71-43-2	Benzene	0.10%	0.13%	0.14%	0.10%	0.15%	0.15%	0.11%	0.11%	0.11%	0.10%	0.09%
19	108-88-3	Toluene	0.04%	0.04%	0.03%	0.02%	0.04%	0.04%	0.02%	0.03%	0.02%	0.02%	0.04%
20	1330-20-7	Xylenes	0.005%	0.004%	0.003%	0.002%	0.004%	0.004%	0.003%	0.003%	0.003%	0.003%	0.005%

			Scenario 1A - Chronic										
No	**CAS # / ID**	**Compound Name**	Receptor 2	Receptor 3	Receptor 4	Receptor 5	Receptor 6	Receptor 7	Receptor 8	Receptor 9	Receptor 10	Receptor 11	Receptor 12
1	10102-44-0	Nitrogen Dioxide	43.66%	38.22%	45.35%	56.61%	38.64%	40.41%	51.02%	48.83%	50.50%	53.06%	51.29%
3	7446-09-5	Sulphur dioxide	1.44%	1.37%	1.59%	1.83%	1.86%	1.94%	2.36%	2.35%	2.35%	2.23%	1.61%
5	7440-38-2	Arsenic	0.17%	0.17%	0.26%	0.17%	0.17%	0.17%	0.20%	0.19%	0.20%	0.20%	0.17%
6	7782-49-2	Selenium	0.003%	0.003%	0.004%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%
7	7439-96-5	Manganese	1.59%	1.61%	2.61%	1.95%	1.94%	2.02%	2.38%	2.39%	2.39%	2.26%	1.74%
8	7440-43-9	Cadmium	5.95%	5.60%	6.74%	7.26%	7.17%	7.52%	9.59%	9.70%	9.60%	8.76%	6.73%
9	18540-29-9	Chromium (vi)	0.19%	0.14%	0.17%	0.09%	0.09%	0.09%	0.11%	0.09%	0.10%	0.12%	0.15%
10	7440-02-0	Nickel	2.13%	1.73%	2.02%	1.58%	1.59%	1.63%	1.94%	1.85%	1.93%	2.02%	1.96%
11	7439-97-6	Mercury	26.28%	33.29%	23.04%	15.85%	28.61%	26.53%	14.08%	15.38%	14.28%	13.75%	18.19%
12	7664-41-7	Ammonia	3.90%	2.75%	1.82%	1.59%	2.46%	2.43%	2.48%	2.65%	2.61%	2.71%	3.71%
14	67-64-1	Acetone	0.02%	0.02%	0.01%	0.01%	0.02%	0.01%	0.01%	0.01%	0.01%	0.01%	0.02%
15	75-07-0	Acetaldehyde	6.08%	5.79%	5.40%	4.06%	6.51%	6.27%	4.97%	5.44%	5.11%	4.73%	5.91%
16	50-00-0	Formaldehyde	6.96%	7.41%	8.72%	7.31%	8.61%	8.70%	8.96%	9.11%	8.99%	8.37%	6.90%
17	78-93-3	2-Butanone	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
18	71-43-2	Benzene	1.57%	1.87%	2.22%	1.67%	2.29%	2.25%	1.88%	1.97%	1.89%	1.73%	1.57%
19	108-88-3	Toluene	0.03%	0.03%	0.03%	0.02%	0.03%	0.03%	0.02%	0.02%	0.02%	0.02%	0.03%
20	1330-20-7	Xylenes	0.004%	0.003%	0.002%	0.002%	0.003%	0.003%	0.002%	0.002%	0.002%	0.002%	0.004%

			Scenario 2 - Chronic										
No	**CAS # / ID**	**Compound Name**	Receptor 2	Receptor 3	Receptor 4	Receptor 5	Receptor 6	Receptor 7	Receptor 8	Receptor 9	Receptor 10	Receptor 11	Receptor 12
1	10102-44-0	Nitrogen Dioxide	41.40%	34.43%	40.91%	52.62%	34.12%	35.86%	48.04%	45.14%	47.46%	50.79%	48.61%
3	7446-09-5	Sulphur dioxide	1.22%	1.05%	1.16%	1.34%	1.26%	1.32%	1.71%	1.66%	1.70%	1.67%	1.33%
5	7440-38-2	Arsenic	0.17%	0.16%	0.27%	0.18%	0.17%	0.17%	0.21%	0.20%	0.21%	0.20%	0.17%
6	7782-49-2	Selenium	0.003%	0.002%	0.004%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%
7	7439-96-5	Manganese	1.64%	1.64%	2.74%	2.13%	1.96%	2.06%	2.57%	2.56%	2.57%	2.43%	1.85%
8	7440-43-9	Cadmium	5.90%	5.54%	6.92%	7.80%	7.17%	7.59%	10.29%	10.38%	10.29%	9.36%	7.04%
9	18540-29-9	Chromium (vi)	0.17%	0.13%	0.17%	0.09%	0.08%	0.08%	0.10%	0.09%	0.10%	0.12%	0.14%
10	7440-02-0	Nickel	1.99%	1.62%	2.01%	1.63%	1.52%	1.57%	1.97%	1.89%	1.97%	2.04%	1.91%
11	7439-97-6	Mercury	28.14%	36.66%	25.91%	18.20%	31.87%	29.71%	15.75%	17.51%	16.00%	15.01%	19.68%
12	7664-41-7	Ammonia	3.88%	2.72%	1.85%	1.68%	2.46%	2.44%	2.64%	2.83%	2.78%	2.85%	3.78%
14	67-64-1	Acetone	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
15	75-07-0	Acetaldehyde	5.63%	5.32%	5.06%	3.71%	5.80%	5.60%	4.54%	5.00%	4.68%	4.31%	5.53%
16	50-00-0	Formaldehyde	6.74%	6.99%	8.43%	7.49%	8.43%	8.59%	9.13%	9.32%	9.15%	8.47%	7.00%
17	78-93-3	2-Butanone	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
18	71-43-2	Benzene	3.04%	3.68%	4.52%	3.09%	5.08%	4.94%	3.01%	3.37%	3.03%	2.69%	2.89%
19	108-88-3	Toluene	0.04%	0.04%	0.04%	0.02%	0.04%	0.04%	0.03%	0.03%	0.03%	0.03%	0.04%
20	1330-20-7	Xylenes	0.004%	0.003%	0.002%	0.002%	0.003%	0.003%	0.002%	0.003%	0.003%	0.002%	0.004%

TABLE A.12: PERCENTAGE CONTRIBUTIONS

			Scenario 3 - Chronic										
No	**CAS # / ID**	**Compound Name**	Receptor 2	Receptor 3	Receptor 4	Receptor 5	Receptor 6	Receptor 7	Receptor 8	Receptor 9	Receptor 10	Receptor 11	Receptor 12
1	10102-44-0	Nitrogen Dioxide	36.11%	34.08%	41.53%	52.93%	35.75%	36.35%	46.98%	44.05%	46.18%	49.63%	44.82%
3	7446-09-5	Sulphur dioxide	1.01%	1.02%	1.20%	1.42%	1.30%	1.32%	1.65%	1.60%	1.63%	1.63%	1.25%
5	7440-38-2	Arsenic	0.14%	0.16%	0.21%	0.18%	0.17%	0.17%	0.20%	0.20%	0.20%	0.20%	0.16%
6	7782-49-2	Selenium	0.002%	0.002%	0.003%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%
7	7439-96-5	Manganese	1.32%	1.64%	2.30%	2.19%	2.02%	2.05%	2.50%	2.48%	2.48%	2.38%	1.76%
8	7440-43-9	Cadmium	4.89%	5.48%	7.06%	8.33%	7.50%	7.67%	10.08%	10.05%	9.99%	9.27%	6.75%
9	18540-29-9	Chromium (vi)	0.14%	0.13%	0.13%	0.08%	0.08%	0.08%	0.09%	0.08%	0.09%	0.11%	0.12%
10	7440-02-0	Nickel	1.65%	1.58%	1.75%	1.64%	1.55%	1.55%	1.90%	1.81%	1.88%	1.96%	1.74%
11	7439-97-6	Mercury	38.19%	37.84%	27.05%	18.32%	31.77%	31.56%	18.79%	20.84%	19.44%	17.90%	25.71%
12	7664-41-7	Ammonia	3.26%	2.59%	1.81%	1.65%	2.48%	2.38%	2.47%	2.67%	2.59%	2.64%	3.31%
14	67-64-1	Acetone	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
15	75-07-0	Acetaldehyde	4.92%	5.18%	4.82%	3.46%	5.40%	5.09%	4.30%	4.74%	4.43%	4.07%	5.11%
16	50-00-0	Formaldehyde	5.54%	6.81%	8.10%	7.19%	7.94%	7.86%	8.14%	8.28%	8.12%	7.60%	6.27%
17	78-93-3	2-Butanone	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
18	71-43-2	Benzene	2.78%	3.42%	3.97%	2.56%	3.97%	3.87%	2.86%	3.15%	2.91%	2.56%	2.92%
19	108-88-3	Toluene	0.03%	0.04%	0.04%	0.02%	0.03%	0.03%	0.02%	0.03%	0.02%	0.02%	0.04%
20	1330-20-7	Xylenes	0.003%	0.003%	0.002%	0.002%	0.003%	0.003%	0.002%	0.002%	0.002%	0.002%	0.004%

			Scenario 4 - Chronic										
No	**CAS # / ID**	**Compound Name**	Receptor 2	Receptor 3	Receptor 4	Receptor 5	Receptor 6	Receptor 7	Receptor 8	Receptor 9	Receptor 10	Receptor 11	Receptor 12
1	10102-44-0	Nitrogen Dioxide	36.24%	34.38%	41.79%	53.32%	36.03%	36.63%	47.25%	44.33%	46.45%	49.89%	45.13%
3	7446-09-5	Sulphur dioxide	1.01%	1.02%	1.20%	1.42%	1.31%	1.32%	1.66%	1.61%	1.64%	1.63%	1.26%
5	7440-38-2	Arsenic	0.14%	0.16%	0.21%	0.18%	0.17%	0.17%	0.20%	0.20%	0.20%	0.20%	0.16%
6	7782-49-2	Selenium	0.002%	0.002%	0.003%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%
7	7439-96-5	Manganese	1.32%	1.65%	2.31%	2.19%	2.03%	2.06%	2.51%	2.49%	2.49%	2.39%	1.77%
8	7440-43-9	Cadmium	4.92%	5.50%	7.08%	8.32%	7.53%	7.70%	10.12%	10.10%	10.04%	9.30%	6.78%
9	18540-29-9	Chromium (vi)	0.14%	0.13%	0.13%	0.08%	0.08%	0.08%	0.09%	0.08%	0.09%	0.11%	0.12%
10	7440-02-0	Nickel	1.66%	1.59%	1.75%	1.64%	1.56%	1.56%	1.91%	1.82%	1.89%	1.96%	1.75%
11	7439-97-6	Mercury	38.37%	37.90%	27.07%	18.29%	31.85%	31.64%	18.83%	20.89%	19.48%	17.94%	25.78%
12	7664-41-7	Ammonia	2.87%	2.23%	1.59%	1.46%	2.11%	2.02%	2.17%	2.31%	2.28%	2.36%	2.92%
14	67-64-1	Acetone	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
15	75-07-0	Acetaldehyde	4.95%	5.19%	4.83%	3.46%	5.42%	5.11%	4.31%	4.76%	4.45%	4.09%	5.13%
16	50-00-0	Formaldehyde	5.50%	6.76%	8.01%	7.06%	7.86%	7.77%	8.03%	8.19%	8.01%	7.49%	6.20%
17	78-93-3	2-Butanone	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
18	71-43-2	Benzene	2.80%	3.43%	3.98%	2.55%	3.98%	3.89%	2.87%	3.17%	2.92%	2.57%	2.93%
19	108-88-3	Toluene	0.03%	0.04%	0.04%	0.02%	0.03%	0.03%	0.02%	0.03%	0.02%	0.02%	0.04%
20	1330-20-7	Xylenes	0.003%	0.003%	0.002%	0.002%	0.003%	0.003%	0.002%	0.002%	0.002%	0.002%	0.004%

TABLE A.12: PERCENTAGE CONTRIBUTIONS

			Scenario 1 - Incremental Carcinogenic Risk										
No	**CAS # / ID**	**Compound Name**	Receptor 2	Receptor 3	Receptor 4	Receptor 5	Receptor 6	Receptor 7	Receptor 8	Receptor 9	Receptor 10	Receptor 11	Receptor 12
5	7440-38-2	Arsenic	9.85%	10.35%	13.70%	12.05%	10.34%	10.64%	11.85%	11.60%	11.78%	11.77%	9.82%
8	7440-43-9	Cadmium	2.02%	2.07%	2.15%	3.17%	2.64%	2.77%	3.43%	3.47%	3.41%	3.15%	2.40%
9	18540-29-9	Chromium (vi)	28.52%	23.52%	24.55%	18.16%	15.11%	14.93%	16.72%	14.83%	16.50%	19.94%	23.91%
10	7440-02-0	Nickel	2.75%	2.43%	2.45%	2.63%	2.23%	2.28%	2.63%	2.51%	2.61%	2.76%	2.66%
13		BaP Equivalents	8.78%	7.07%	3.92%	4.18%	6.86%	6.54%	5.55%	5.96%	5.80%	5.97%	11.39%
15	75-07-0	Acetaldehyde	10.34%	10.72%	8.63%	8.88%	11.99%	11.55%	8.87%	9.74%	9.08%	8.51%	10.54%
16	50-00-0	Formaldehyde	36.67%	42.46%	43.18%	49.46%	49.14%	49.64%	49.61%	50.48%	49.48%	46.65%	38.17%
18	71-43-2	Benzene	1.07%	1.38%	1.42%	1.46%	1.68%	1.66%	1.34%	1.41%	1.34%	1.24%	1.12%

			Scenario 1A - Incremental Carcinogenic Risk										
No	**CAS # / ID**	**Compound Name**	Receptor 2	Receptor 3	Receptor 4	Receptor 5	Receptor 6	Receptor 7	Receptor 8	Receptor 9	Receptor 10	Receptor 11	Receptor 12
5	7440-38-2	Arsenic	9.85%	10.35%	13.70%	12.05%	10.34%	10.64%	11.85%	11.60%	11.78%	11.77%	9.82%
8	7440-43-9	Cadmium	2.02%	2.07%	2.15%	3.17%	2.64%	2.77%	3.43%	3.47%	3.41%	3.15%	2.40%
9	18540-29-9	Chromium (vi)	28.52%	23.52%	24.55%	18.16%	15.11%	14.93%	16.72%	14.83%	16.50%	19.94%	23.91%
10	7440-02-0	Nickel	2.75%	2.43%	2.45%	2.63%	2.23%	2.28%	2.63%	2.51%	2.61%	2.76%	2.66%
13		BaP Equivalents	8.78%	7.07%	3.92%	4.18%	6.86%	6.54%	5.55%	5.96%	5.80%	5.97%	11.39%
15	75-07-0	Acetaldehyde	10.34%	10.72%	8.63%	8.88%	11.99%	11.55%	8.87%	9.74%	9.08%	8.51%	10.54%
16	50-00-0	Formaldehyde	36.67%	42.46%	43.18%	49.46%	49.14%	49.64%	49.61%	50.48%	49.48%	46.65%	38.17%
18	71-43-2	Benzene	1.07%	1.38%	1.42%	1.46%	1.68%	1.66%	1.34%	1.41%	1.34%	1.24%	1.12%

			Scenario 2- Incremental Carcinogenic Risk										
No	**CAS # / ID**	**Compound Name**	Receptor 2	Receptor 3	Receptor 4	Receptor 5	Receptor 6	Receptor 7	Receptor 8	Receptor 9	Receptor 10	Receptor 11	Receptor 12
5	7440-38-2	Arsenic	9.89%	10.29%	13.74%	12.34%	10.06%	10.38%	12.18%	11.81%	12.10%	12.17%	10.00%
8	7440-43-9	Cadmium	2.07%	2.09%	2.15%	3.25%	2.60%	2.74%	3.60%	3.61%	3.58%	3.34%	2.52%
9	18540-29-9	Chromium (vi)	26.62%	21.71%	23.36%	16.80%	13.32%	13.17%	15.42%	13.58%	15.23%	18.53%	22.04%
10	7440-02-0	Nickel	2.65%	2.32%	2.37%	2.58%	2.09%	2.15%	2.63%	2.50%	2.61%	2.77%	2.60%
13		BaP Equivalents	10.23%	9.89%	7.25%	6.33%	10.51%	9.98%	6.59%	7.31%	6.83%	6.78%	12.09%
15	75-07-0	Acetaldehyde	9.86%	10.04%	7.84%	7.73%	10.50%	10.10%	7.94%	8.69%	8.15%	7.70%	9.90%
16	50-00-0	Formaldehyde	36.55%	40.88%	40.49%	48.39%	47.24%	47.93%	49.52%	50.17%	49.38%	46.80%	38.78%
18	71-43-2	Benzene	2.13%	2.78%	2.80%	2.58%	3.68%	3.56%	2.11%	2.35%	2.11%	1.92%	2.07%

TABLE A.12: PERCENTAGE CONTRIBUTIONS

			Scenario 3 - Incremental Carcinogenic Risk										
No	**CAS # / ID**	**Compound Name**	Receptor 2	Receptor 3	Receptor 4	Receptor 5	Receptor 6	Receptor 7	Receptor 8	Receptor 9	Receptor 10	Receptor 11	Receptor 12
5	7440-38-2	Arsenic	9.54%	10.53%	12.42%	13.06%	10.85%	11.15%	12.79%	12.37%	12.66%	12.79%	10.32%
8	7440-43-9	Cadmium	2.06%	2.13%	2.50%	3.67%	2.88%	3.01%	3.84%	3.81%	3.80%	3.59%	2.68%
9	18540-29-9	Chromium (vi)	26.32%	21.74%	19.71%	16.05%	13.84%	13.63%	15.61%	13.90%	15.44%	18.51%	21.18%
10	7440-02-0	Nickel	2.64%	2.34%	2.35%	2.75%	2.26%	2.31%	2.75%	2.61%	2.72%	2.88%	2.63%
13		BaP Equivalents	10.58%	9.56%	7.32%	5.55%	9.48%	9.08%	6.58%	7.31%	6.89%	6.71%	12.04%
15	75-07-0	Acetaldehyde	10.38%	10.06%	8.53%	7.62%	10.37%	9.99%	8.18%	8.99%	8.44%	7.89%	10.16%
16	50-00-0	Formaldehyde	36.14%	40.98%	44.36%	49.04%	47.28%	47.79%	48.06%	48.61%	47.84%	45.64%	38.66%
18	71-43-2	Benzene	2.35%	2.66%	2.81%	2.25%	3.05%	3.04%	2.18%	2.39%	2.21%	1.99%	2.32%

			Scenario 4 - Incremental Carcinogenic Risk										
No	**CAS # / ID**	**Compound Name**	Receptor 2	Receptor 3	Receptor 4	Receptor 5	Receptor 6	Receptor 7	Receptor 8	Receptor 9	Receptor 10	Receptor 11	Receptor 12
5	7440-38-2	Arsenic	9.57%	10.56%	12.47%	13.15%	10.90%	11.20%	12.87%	12.44%	12.73%	12.87%	10.36%
8	7440-43-9	Cadmium	2.07%	2.14%	2.51%	3.69%	2.90%	3.03%	3.86%	3.83%	3.82%	3.61%	2.70%
9	18540-29-9	Chromium (vi)	26.40%	21.80%	19.79%	16.15%	13.90%	13.70%	15.70%	13.97%	15.53%	18.62%	21.28%
10	7440-02-0	Nickel	2.65%	2.35%	2.36%	2.77%	2.27%	2.33%	2.76%	2.63%	2.74%	2.90%	2.65%
13		BaP Equivalents	10.74%	9.73%	7.52%	5.84%	9.73%	9.34%	6.88%	7.61%	7.18%	7.00%	12.27%
15	75-07-0	Acetaldehyde	10.40%	10.09%	8.56%	7.67%	10.41%	10.04%	8.23%	9.03%	8.48%	7.94%	10.20%
16	50-00-0	Formaldehyde	35.82%	40.67%	43.96%	48.48%	46.82%	47.31%	47.50%	48.09%	47.29%	45.06%	38.21%
18	71-43-2	Benzene	2.35%	2.67%	2.82%	2.26%	3.06%	3.06%	2.19%	2.40%	2.23%	2.00%	2.33%

Appendix B

Post Processing of Modelling Files

APPENDIX B: POST PROCESSING OF MODELLING FILES

The air dispersion modelling for this health risk screening assessment was conducted by Air Assessments (2014) using the CALPUFF model. The results of the air dispersion modelling were provided to ENVIRON as a number of CALPUFF output files for five scenarios as defined by Alcoa for the Pinjarra Refinery. The five scenarios are summarised in Table B1.

Table B1: Scenarios

Scenario	Alumina Production Rate	Emissions	Cogeneration Plant Operation	Health Protective Guidelines
1	4.2 Mtpa	forecast	full load	previous
1A	4.2 Mtpa	forecast	full load	current
2	4.2 Mtpa	nominal (2008-2013 Average)	full load	current
3	5.0 Mtpa	predicted	full load	current
4	5.0 Mtpa	predicted	part load	current

It should be noted that Scenarios 1 and 1A are based on the same set of emission estimates, but using the health protective guidelines applied for the previous screening assessment (ENVIRON, 2008) and the most current health protective guidelines respectively.

ENVIRON read the CALPUFF files provided by Air Assessments and produced individual files that contained the predicted GLCs for each hour of the year for each model grid point for each source. The CALPUFF files were derived using a unit emission rate of 1.0 g/s for each individual source, except in the case of the RSA and the bauxite stockpile which were derived using actual PM_{10} emission rate estimates.

The predicted GLCs for each compound were then calculated by:

- Scaling the predicted GLCs derived using a unit emission rate by the actual emission rate for each individual source and compound (refer to Tables A.1 – A.9 in Appendix A);
- Summing the scaled concentrations from each source for each hour and grid point; and
- Writing the sum of the predicted GLCs for each compound for each hour and for each grid point throughout the modelled year to a separate file for further analysis.

Variations to the above approach were required for determining the predicted GLCs of NO_2, to account for the oxidation of NO present in NO_x emissions, and also for determining the predicted GLCs of selected metals present in fugitive PM_{10} emissions from the RSA and bauxite stockpile.

To derive the NO_2 GLCs, the initial NO_2/NO_X ratio was set for each refinery source based on information provided by Alcoa, presented in Table B2.

Table B2: Initial NO_2/NO_x Ratio

Calciner	Boiler	RTO	Cogeneration Plant
0.12	0.025	0.025	0.13

For each hour, the predicted GLCs of NO and NO_2 were calculated separately based on the contribution from each source and the initial NO_2/NO_X ratio. When all emission sources for the hour had been process, the predicted NO concentration at each grid point was used in conjunction with the ozone limiting method (OLM) to calculate the amount of NO_2 that would be formed from the NO in the presence of ozone (O_3) as follows:

$$NO_{2photo} = \text{minimum } (NO, O_3)$$

NO_{2photo} = NO_2 concentration (ppb) formed by the oxidation of NO by ozone
O_3 = ambient ozone concentration for that hour (ppb).

The ambient ozone concentrations were varied for each hour of the day and based on ambient monitoring data collected at Wagerup as presented in CSIRO (2005) and presented in Table B3.

Table B3: Ozone Concentration (ppb) for Each Hour of the Day

Hour	Ozone	Hour	Ozone	Hour	Ozone	Hour	Ozone
1	19.7	7	19.0	13	28.1	19	22.0
2	19.5	8	20.8	14	28.0	20	21.0
3	19.0	9	22.5	15	27.8	21	19.8
4	18.5	10	24.5	16	27.0	22	20.0
5	18.2	11	26.0	17	25.0	23	20.0
6	18.1	12	27.0	18	23.2	24	19.9

The total NO_2 concentration was then calculated as the sum of the primary NO_2 concentration (i.e. the GLC associated with the percentage of NO_x emitted as NO_2) and the secondary NO_2 (i.e. NO_{2photo}) for each hour and each grid point and written to the output file.

To derive the GLC for selected metals present in fugitive PM_{10} emissions from the RSA and bauxite stockpile the PM_{10} concentrations for each hour and grid point were modelled separately for the RDA and bauxite stockpiles. The concentrations of metals in the PM_{10} was then calculated based on the metal concentrations derived during the Pinjarra RSA particulate study (Ecowise, 2007). The multiplication factors determined in that study are presented in Table B4.

Table B4: Metal Multiplying Factor							
Source	**Arsenic**	**Selenium**	**Manganese**	**Cadmium**	**Chromium VI**	**Nickel**	**Mercury**
RSA	1.29E-05	5.80E-06	1.70E-05	2.10E-07	9.00E-07	5.60E-06	7.00E-08
Bauxite	1.00E-06	5.00E-07	6.01E-06	8.00E-08	- [1]	2.41E-06	8.99E-08

Notes:
[1] The factor for chromium VI bauxite content is equal to zero, based on testing completed since the Ecowise (2007) study (*Pers comm*., Patrick Coffey, 7 May 2008).

The predicted metals GLCs from the fugitive sources were added to the predicted metal GLCs from the Refinery point sources and written to the output file for each hour and each grid point.

The files that contained the predicted concentrations for each individual compound for each hour of the year and for each grid point were then analysed to produce the following statistics for each grid point:

- Maximum 1-hour average GLC;
- 9th highest 1-hour average GLC; and
- Annual average GLC.

For pollutants with an acute health protective guideline that does not refer to a 1-hour averaging period, but rather a 6-hour, 8-hour or 24 hour averaging period, the hour-by-hour GLC file for the pollutant was post processed to provide a rolling 6-hour, 8-hour, or 24-hour average concentration for each hour at each receptor location.

The health risk screening assessment used the predicted GLC statistics to calculate the individual hazard quotients and the total hazard index for the acute non-carcinogenic exposures based on the peak emission rate estimates. The predicted annual average GLCs were used to calculate the chronic non-carcinogenic and carcinogenic exposures based on the average emission rate estimates.